Draft

Kaua‘i Island Utility Cooperative Habitat Conservation Plan

Island of Kaua‘i, Hawai‘i

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Kaua‘i Island Utility Cooperative
Your Touchstone Energy® Cooperative

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ES.1 Introduction and Background

The Kaua'i Island Utility Cooperative (KIUC) is seeking incidental take authorization from the U.S. Fish and Wildlife Service (USFWS) and the Hawai'i Department of Land and Natural Resources (DNLR), Division of Forestry and Wildlife (DOFAW) for the continued operation and maintenance of existing and new KIUC infrastructure. KIUC's application requests coverage for a period of 50 years. The authorization is needed because some of this infrastructure is known to result in incidental take of the state and federally listed species shown in Table ES-1 and referred to as *covered species*. The KIUC activities potentially resulting in take are referred to as *covered activities* and include the continued operation and maintenance of KIUC's existing and future powerlines and lights, and implementation of the conservation measures.

Table ES-1. Covered Species

English Name	Hawaiian Name	Scientific Name	Status[a] (Federal/State)
Newell's shearwater	ʻaʻo	*Puffinus auricularis newelli*	T/T
Hawaiian petrel	ʻuaʻu	*Pterodroma sandwichensis*	E/E
Band-rumped storm-petrel[b]	ʻakēʻakē	*Oceanodroma castro*	E/E
Hawaiian stilt	aeʻo	*Himantopus mexicanus knudseni*	E/E
Hawaiian duck	koloa maoli	*Anas wyvilliana*	E/E
Hawaiian coot	ʻalae keʻokeʻo	*Fulica alai*	E/E
Hawaiian common gallinule	ʻalae ʻula	*Gallinula galeata sandvicensis*	E/E
Hawaiian goose	nēnē	*Branta sandvicensis*	T/E
Green sea turtle[c]	honu	*Chelonia mydas*	T/T

[a] Status:
E = Listed as endangered under the federal ESA or HRS Chapter 195D.
T = Listed as threatened under the federal ESA or HRS Chapter 195D.
[b] Hawaiʻi distinct population segment.
[c] Central North Pacific distinct population segment.

KIUC is seeking an incidental take permit (ITP) from USFWS under Section 10(a)(1)(B) of the federal Endangered Species Act (ESA), and an incidental take license (ITL) from DOFAW under Sections 195D-4 and 195D-21 of the Hawaiʻi Revised Statutes (HRS). This KIUC Habitat Conservation Plan (HCP) supports the issuance of these permits.

KIUC is a public utility cooperative responsible for the production, purchase, transmission, distribution, and sale of electricity on the Island of Kauaʻi (Kauaʻi). To ensure reliable electrical service to Kauaʻi, KIUC owns and operates a variety of electrical utility installations including fossil-fuel-fired, hydroelectric, and solar generating facilities, 17 substations and switchyards, and approximately 1,487 circuit miles (2,393 kilometers [km]) of transmission and distribution lines. KIUC also purchases power from several independent power producers and transmits power that it obtains from these sources through its electrical transmission system.

In May 2011, the USFWS approved KIUC's Short-Term Seabird Habitat Conservation Plan (Short-Term HCP) for a period of 5 years to help develop the knowledge base for a longer permit duration. The KIUC Short-Term HCP covered three seabird species: Newell's shearwater (‘a‘o), Hawaiian petrel (‘ua‘u), and band-rumped storm petrel (‘akē‘akē). After KIUC's Short-Term HCP expired in 2016, KIUC agreed with USFWS and DOFAW to continue implementing the Short-Term HCP conservation measures and reporting until a longer-term HCP could be fully developed. During the Short-Term HCP term, KIUC initiated development of this HCP, adding six species for which the covered activities would potentially result in take, as listed in Table ES-1. This HCP describes potential effects on the nine listed species from KIUC's covered activities over a 50-year permit term. The HCP also describes a conservation strategy to avoid, minimize, and mitigate the effects from those activities during that timeframe and provide a net conservation benefit to each species.

ES.2 Plan Area and Permit Area

The *Plan Area* is the area in which all covered activities and conservation measures will occur. Because KIUC operates an island-wide system exclusively on Kaua‘i and is proposing conservation measures in remote areas of the island, the KIUC HCP Plan Area covers the full geographic extent of Kaua‘i (see Figure ES-1). The *Permit Area* is the specific locations of all covered activities and conservation measures (i.e., the geographic area where the federal ITP and State ITL apply); these locations are described in Chapter 2, *Covered Activities*, and in Chapter 4, *Conservation Strategy*.

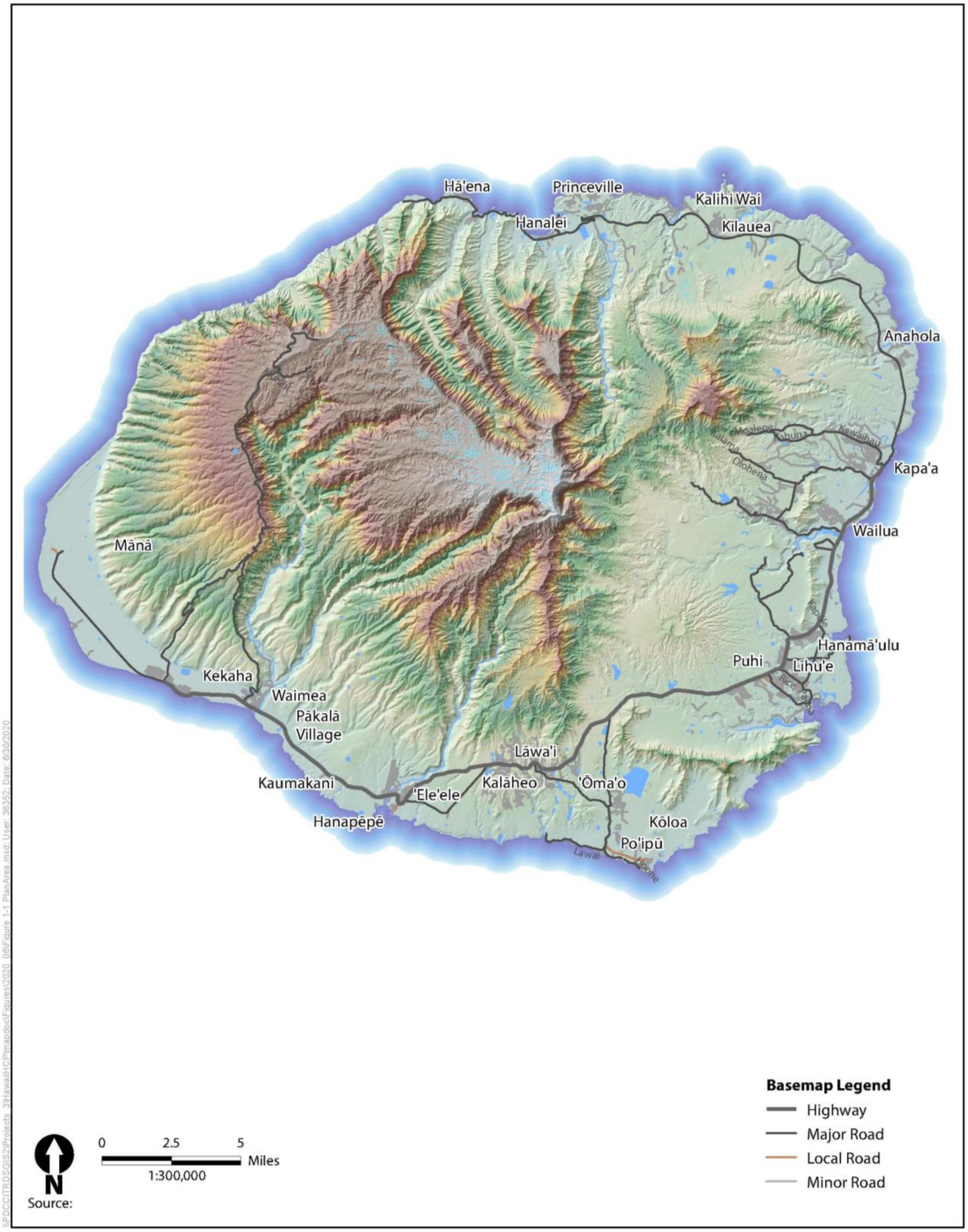

Figure ES-1. KIUC HCP Plan Area

ES.3 Covered Activities

This HCP and its permits are proposed to cover and provide incidental take authorization for KIUC activities that potentially result in take of the covered species. Covered activities must be "under the control" of the permit holder and occur within the permit term to receive coverage. Covered activities in the KIUC HCP are grouped into three broad categories: (1) powerline operations, (2) lighting operations, and (3) implementation of the HCP conservation strategy. The covered activities are listed below; detailed descriptions of the covered activities and their selection process are provided in Chapter 2, *Covered Activities*.

- Powerline operation, retrofit and use of night lighting for repairs. This includes:
  - 171 miles (275 km) of existing transmission wires
  - 816 miles (1,313 km) of existing distribution wires
  - 70 miles (113 km) of existing communication wires
  - Up to 348 miles (560 km) of new powerlines
- Lighting operations: facility, streetlights, and nighttime lighting. This includes:
  - Facility lights at the Port Allen Generating Station and Kapaia Power Generating Station
  - 4,100 existing streetlights
  - Up to 1,754 new streetlights
  - Up to 85 hours of emergency nighttime lighting for restoration of power
- Implementation of the HCP conservation strategy, including construction and maintenance of predator exclusion fences, predator control within and outside the exclusion fences, social attraction to attract covered seabirds to new nesting colony sites, and invasive plant species control.

ES.4 Environmental Setting

Kauaʻi has a land area of approximately 550 square miles (sq mi) (1,425 square kilometers [sq km]). Roughly circular in shape, its most striking physiographic features are a high central plateau of over 5,000 feet (ft) (1,524 meters [m]) at the summits of Mt. Waiʻaleʻale (5,148 ft [1,569 m]) and Mt. Kawaikini (5,243 ft [1,598 m]). The central plateau is characterized by steep cliffs and deeply incised valleys along the northern Nā Pali Coast, the 3,600-ft-deep (1,097 m) Waimea Canyon, the broad Līhuʻe Basin on the southeastern quadrant of the island, and extensive coastal plains. Kauaʻi supports breeding populations of the covered species, as described below.

ES.4.1 Covered Seabirds

The KIUC HCP covered seabirds are Newell's shearwater (ʻaʻo), Hawaiian petrel (ʻuaʻu), and the Hawaiʻi distinct population segment (DPS) of the band-rumped storm-petrel (hereafter band-rumped storm-petrel) (ʻakēʻakē). Kauaʻi supports 90 percent of the total Newell's shearwater (ʻaʻo) population (Pyle and Pyle 2009; Ainley et al. 2020) and 33 percent of the total Hawaiian petrel (ʻuaʻu) population (Raine pers. comm.). No band-rumped storm-petrel (ʻakēʻakē) nests have been located on Kauaʻi; however, based on auditory survey data, breeding likely occurs at several locations on Kauaʻi, primarily in the steep cliff areas of the Nā Pali Coast (Raine et al. 2017a).

The covered seabirds spend most of their time at sea and come to land only to breed (Ainley et al. 2014; Simons 1985; Spear et al. 2007). During the breeding season (generally March through December), they nest in burrows beneath ferns and tree roots in dense forest and on steep slopes and cliffs. Adult Newell's shearwaters (ʻaʻo) and Hawaiian petrels (ʻuaʻu) forage over the sea at night and fly to and from their burrows at night or at sunset or sunrise, to forage and feed their chicks (Raine et al. 2017b). Band-rumped storm-petrels (ʻakēʻakē) have been observed feeding during the day, but likely also feed at night (Harris 1969; Kauaʻi Endangered Seabird Recovery Project 2019).

For species with naturally low reproductive rates that rely on high adult survivorship, introduced threats that increase mortality rates, such as powerline collisions and invasive predators, have resulted in significant population declines. The covered seabirds share these characteristics of low reproductive rates and high adult survivorship, making their populations particularly vulnerable to introduced threats. All three of the covered seabird species have declined over the last few decades (Raine et al. 2017).

Covered seabirds on Kauaʻi are subject to the following threats (Slotterback 2002; State of Hawaiʻi Division of Forestry and Wildlife 2005).

- Depredation at breeding sites by introduced predators such as pigs (*Sus scrofia*), rats (*Rattus rattus*), feral cats (*Felis silvestris*), barn owls (*Tyto alba*), and feral honeybees (Raine et al. 2020).
- Loss and degradation of breeding habitat caused by introduced ungulates such as pigs and goats (*Capra hircus*) and introduced plants.
- Collisions with powerlines, buildings, and towers.
- Artificial lighting from various sources (e.g., streetlights, resorts), which attracts and causes "fallout" of seabirds and increases their chance of colliding with artificial structures.
- Pollution (e.g., mercury, plastic ingestion, oil spills).
- Factors affecting seabird prey availability in the ocean such as ocean acidification, overharvesting by the fishing industry as well as bycatch, and changing ocean conditions due to climate change.
- Extreme weather events such as storms and flooding (exacerbated with climate change).

The daily movement patterns of the covered seabirds between breeding and foraging habitats and their relatively low maneuverability make them particularly susceptible to colliding with artificial structures, predominantly utility lines (Travers et al. 2019, 2020a). Their nocturnal movements, in addition to the phototropic tendencies of fledglings (i.e., tendency to be attracted to light), make them susceptible to fallout from artificial lighting (Telfer et al. 1987).

ES.4.2 Covered Waterbirds

The KIUC HCP covered waterbirds are the Hawaiian stilt (aeʻo), Hawaiian duck (koloa maoli), Hawaiian coot (ʻalae keʻokeʻo), Hawaiian common gallinule (ʻalae ʻula), and the Hawaiian goose (nēnē). The covered waterbirds are endemic to Hawaiʻi.

Except for the Hawaiian goose (nēnē), the covered waterbird species are associated only with wetlands and open water habitat in Kauaʻi. Hawaiian geese (nēnē) use a wide variety of habitats, including highly altered landscapes such as pastures, agricultural fields, and golf courses (U.S. Fish and Wildlife Service 2004).

Long-term census data indicate that the statewide population of the covered waterbirds is stable or increasing (Paxton et al. 2022). The most consequential threat to the covered waterbird species has been the loss of wetland habitat. Environmental contaminants such as fuel spills, water pollution, and pesticides continue to degrade habitats that support covered waterbirds, and these species are also threatened by diseases such as avian botulism. Collisions with vehicles and structures (e.g., powerlines) are also a threat to the covered waterbirds. For example, when taking off and landing, the long, low flight path of the Hawaiian goose (nēnē) makes it vulnerable to collisions with stationary structures and moving objects such as vehicles and aircraft (Banko et al. 2020; State of Hawaiʻi Division of Forestry and Wildlife 2015). The most significant threat facing the Hawaiian duck's (koloa maoli) continued existence is hybridization with feral mallards; as a result, it is now among the rarest of the world's birds (Engilis et al. 2020).

ES.4.3 Green Sea Turtle

The Hawaiian population of the green sea turtle (honu) is a threatened population segment of this species identified as the Central North Pacific Distinct Population Segment (CNPDPS) (81 *Federal Register* 20057). The CNPDPS of the green sea turtle (honu) (hereafter green sea turtle) is also protected by Chapter 195D of the HRS and Section 13-124 of Hawaiʻi Administrative Rules. The range of the green sea turtle (honu) includes the Hawaiian Archipelago and Johnston Atoll.

Green sea turtles (honu) spend most of their lives in open coastline and protected bays and lagoons (Seminoff et al. 2015). On shore, green sea turtles (honu) rely on beaches characterized by intact dune structures, native vegetation, lack of artificial lighting, and normal beach temperatures for nesting (Limpus 1971; Salmon et al. 1992; Ackerman 1997; Witherington 1997; Lorne and Salmon 2007). In 2015, Parker and Balazs documented 20 nesting sites[1] around Kauaʻi. Although nesting density is low (generally zero to two nests per year), observations of nesting have increased over the past 5 years (State of Hawaiʻi Division of Aquatic Resources 2020).

The decline of green sea turtle (honu) is primarily attributed to development and public use of beaches, vessel strikes, attraction to artificial lights, bycatch in fishing gear, pollution, interactions with recreational and commercial vessels, beach driving, and major storm events. The species is also threated by the effects of climate change, including habitat loss and warming sea and air temperatures, including increased sand temperatures (Schroeder and Mosier 2000).

ES.5 Conservation Strategy

The KIUC HCP conservation strategy includes measures to avoid, minimize, and mitigate the impact of the taking on covered species from covered activities and to provide a net benefit to each species. The conservation strategy relies on (1) implementing tools and techniques to minimize effects on covered species from the covered activities, and (2) managing designated areas on the landscape for the benefit of covered species.

[1] Nesting data reported from Kauaʻi are speculative due to the lack of systematic surveys. Estimates may also be skewed toward high-use beaches and beaches that regularly have resting seals (as this is how green sea turtle [honu] nests have been opportunistically found).

ES.5.1 Conservation Framework

The conservation strategy is based on a set of biological goals and objectives for each covered species, shown in Table ES-2. Biological goals and objectives state the intentions of the HCP. The measurable biological objectives also become the threshold by which the success of the HCP will be judged. The conservation strategy consists of six conservation measures for meeting the biological goals and objectives, described in Section 1.4.2, *Conservation Measures.*

Table ES-2. Biological Goals and Objectives

Newell's Shearwater (ʻaʻo) (*Puffinus auricularis newelli*)
Goal 1. Provide for the survival of the Kauaʻi metapopulation of Newell's shearwater (ʻaʻo) and contribute to the species' recovery by minimizing and fully offsetting the impacts of KIUC's taking of this species over the term of the HCP to an extent that is likely to result in numbers of breeding pairs, demography and age structure, population growth rate, and spatial distribution that is representative of a viable metapopulation on Kauaʻi.
Objective 1.1. Substantially reduce the extent and effect of collisions of adult/subadult Newell's shearwaters (ʻaʻo) with KIUC powerlines island-wide, as measured against the pre-HCP strike estimate (Travers et al. 2020b), in accordance with the location, extent, and schedule outlined in the HCP.
Objective 1.2. Minimize the adverse effects of artificial light attraction on Newell's shearwater (ʻaʻo) fledglings from all existing and future KIUC streetlights and existing covered facilities by continuing to implement practicable conservation measures throughout the permit term.
Objective 1.3. Increase the number of Newell's shearwater (ʻaʻo) breeding pairs and new chicks produced annually throughout the duration of the permit by managing and enhancing suitable Newell's shearwater (ʻaʻo) breeding habitat and breeding colonies across 10 conservation sites and reducing the abundance and distribution of key seabird predators in northwestern Kauaʻi. The success of this objective will be measured by the following metrics within all of the 10 conservation sites combined: • Metric 1. Maintain an annual minimum of 1,264 breeding pairs as determined by call rates and burrow monitoring. • Metric 2. Reach a target of 2,371 breeding pairs by year 25 of the permit term and 4,313 breeding pairs by the end of the permit term. • Metric 3. Growth rate for breeding pairs annually of at least 1.0% as measured by a 5-year rolling average. • Metric 4. Maintain a 5-year rolling average 87.2% reproductive success rate. • Metric 5. Eradicate terrestrial predators within predator exclusion fencing. • Metric 6. Produce at least one breeding pair within each of the four social attraction sites by year 10 of the permit term • Metric 7. Ensure that invasive plant and animal species do not preclude meeting the objective metrics above.
Hawaiian Petrel (ʻuaʻu) (*Pterodroma sandwichensis*)
Goal 2. Provide for the survival of the Kauaʻi metapopulation of Hawaiian petrel (ʻuaʻu) and contribute to the species' recovery by minimizing and fully offsetting the impacts of KIUC's taking on this species over the term of the HCP to an extent that is likely to result in numbers of breeding pairs, demography and age structure, population growth rate, demography, and spatial distribution that is representative of a viable metapopulation on Kauaʻi.
Objective 2.1. Substantially reduce the extent and effect of collisions of adult/subadult Hawaiian petrels (ʻuaʻu) with KIUC powerlines island-wide, as measured against the pre-HCP estimate (Travers et al. 2020b) in accordance with the location, extent, and schedule outlined in the HCP.

Objective 2.2. Minimize the adverse effects of artificial light attraction on Hawaiian petrel (ʻuaʻu) fledglings from all existing and future KIUC streetlights and existing covered facilities by continuing to implement practicable conservation measures throughout the permit term.

Objective 2.3. Increase the number of Hawaiian petrel (ʻuaʻu) breeding pairs and new chicks produced annually throughout the duration of the permit by managing and enhancing suitable Hawaiian petrel (ʻuaʻu) breeding habitat and breeding colonies across 10 conservation sites and reducing the abundance and distribution of key seabird predators in northwestern Kauaʻi. The success of this objective will be measured by the following metrics within all of the 10 conservation sites combined:

- Metric 1. Maintain an annual minimum of 2,257 breeding pairs as determined by call rates and burrow monitoring.
- Metric 2. Reach a target of 2,926 breeding pairs by year 25 of the permit term and 3,751 breeding pairs by the end of the permit term.
- Metric 3. Growth rate for breeding pairs annually of at least 1.0% as measured by a 5-year rolling average.
- Metric 4. Maintain a 5-year rolling average 78.7% reproductive success rate.
- Metric 5. Ensure that invasive plant and animal species do not preclude meeting the objective metrics above.

Band-Rumped Storm-Petrel (ʻakēʻakē) (*Oceanodroma castro*)

Goal 3. Contribute to the recovery of the band-rumped storm-petrel (ʻakēʻakē) by reducing threats associated with existing and future KIUC streetlights, existing covered facility lights, and introduced predators on Kauaʻi.

Objective 3.1. Minimize artificial light attraction on band-rumped storm-petrel (ʻakēʻakē) fledglings from all existing and future KIUC streetlights and existing covered facilities by continuing to implement practicable conservation measures throughout the permit term.

Objective 3.2. Facilitate the rescue, rehabilitation, and release of band-rumped storm-petrel (ʻakēʻakē) fledglings through funding of the Save Our Shearwaters Program or other certified rehabilitation facility to offset light attraction by KIUC streetlights.

Objective 3.3. Implement predator control, including barn owl control, within the conservation sites to reduce threats to band-rumped storm-petrel (ʻakēʻakē) in areas near the conservation sites (e.g., Nā Pali Coast).

Covered Waterbirds: Hawaiian Coot (ʻalae keʻokeʻo) (*Fulica alai*), Hawaiian Gallinule (ʻalae ʻula) (*Gallinula galeata sandvicensis*), Hawaiian Stilt (aeʻo) (*Himantopus mexicanus knudseni*), Hawaiian Goose (nēnē) (*Branta sandvicensis*), and Hawaiian Duck (koloa maoli) (*Anas wyvilliana*)

Goal 4. Contribute to the recovery of covered waterbird species by reducing threats associated with KIUC powerlines on Kauaʻi.

Objective 4.1. Reduce covered waterbird collisions with KIUC powerlines in Hanalei and Mānā (Kawaiʻele Waterbird Sanctuary), in accordance with the location, extent, and schedule outlined in the HCP, and relative to measured collisions in 2021.

Objective 4.2. Facilitate the rescue, rehabilitation, and release of grounded covered waterbirds through funding of the Save Our Shearwaters Program or other certified rehabilitation facility to offset collisions with KIUC powerlines.

Green Sea Turtle (honu) (*Chelonia mydas*) (Central North Pacific Distinct Population Segment)

Goal 5. Contribute to the recovery of the species by increasing the ability for green sea turtles (honu) to successfully transit Kauaʻi beaches.

Objective 5.1. Locate and temporarily shield green sea turtle (honu) nests at all locations that are visually affected by KIUC streetlights on an annual basis.

Objective 5.2. For the duration of the permit permanently minimize light effects to the extent practicable from existing and future KIUC streetlights onto beaches with suitable green sea turtle (honu) nesting habitat by implementing practicable minimization techniques that will further reduce or eliminate these light effects.

ES.5.2 Conservation Measures

KIUC will implement or fund six conservation measures that, collectively, are expected to meet the biological goals and objectives summarized above. Below is a short summary of each conservation measure. Further details of each measure can be found in Chapter 4, Section 4.4, *Conservation Measures*.

ES.5.2.1 Conservation Measure 1. Implement Powerline Collision Minimization Projects

Minimization actions under this conservation measure include reconfiguration of powerlines (i.e., changing the profile from vertical to horizontal and reducing the number of layers), static wire removal, and installation of bird flight diverters to substantially reduce powerline collisions. Bird flight diverters are regularly spaced reflective or light-emitting diode (LED) devices that make powerlines more visible to birds, reducing the number of collisions.

KIUC began early implementation of powerline collision minimization projects in 2020, and by the end of 2023 (year 1 of HCP implementation) all practicable minimization projects will be complete on existing powerlines. Minimization will be implemented along a total of 188.1 miles (302.7 km) of existing powerlines by the end of 2023, with many of those miles having both static wire removal and bird flight diverter installation. This will result in static wire removal and bird flight diverters being installed throughout most of KIUC's powerline system, with an expected 65 percent reduction in powerline strikes for covered seabirds and 90 percent reduction in powerline strikes for covered waterbirds compared with 2018 conditions. Figures ES-2 and ES-3 show the location of each bird flight diverter and static wire minimization project identified in Appendix 4B, *KIUC Minimization Projects*. When constructing new transmission and distribution lines during the permit term, KIUC will avoid high-collision zones in the Plan Area to the maximum extent practicable and will design powerlines to minimize strike risk in addition to installing bird flight diverters.

This conservation measure applies to covered seabirds and covered waterbirds. This conservation measure is intended to support Objectives 1.1, 2.1, and 4.1 shown in Table ES-2.

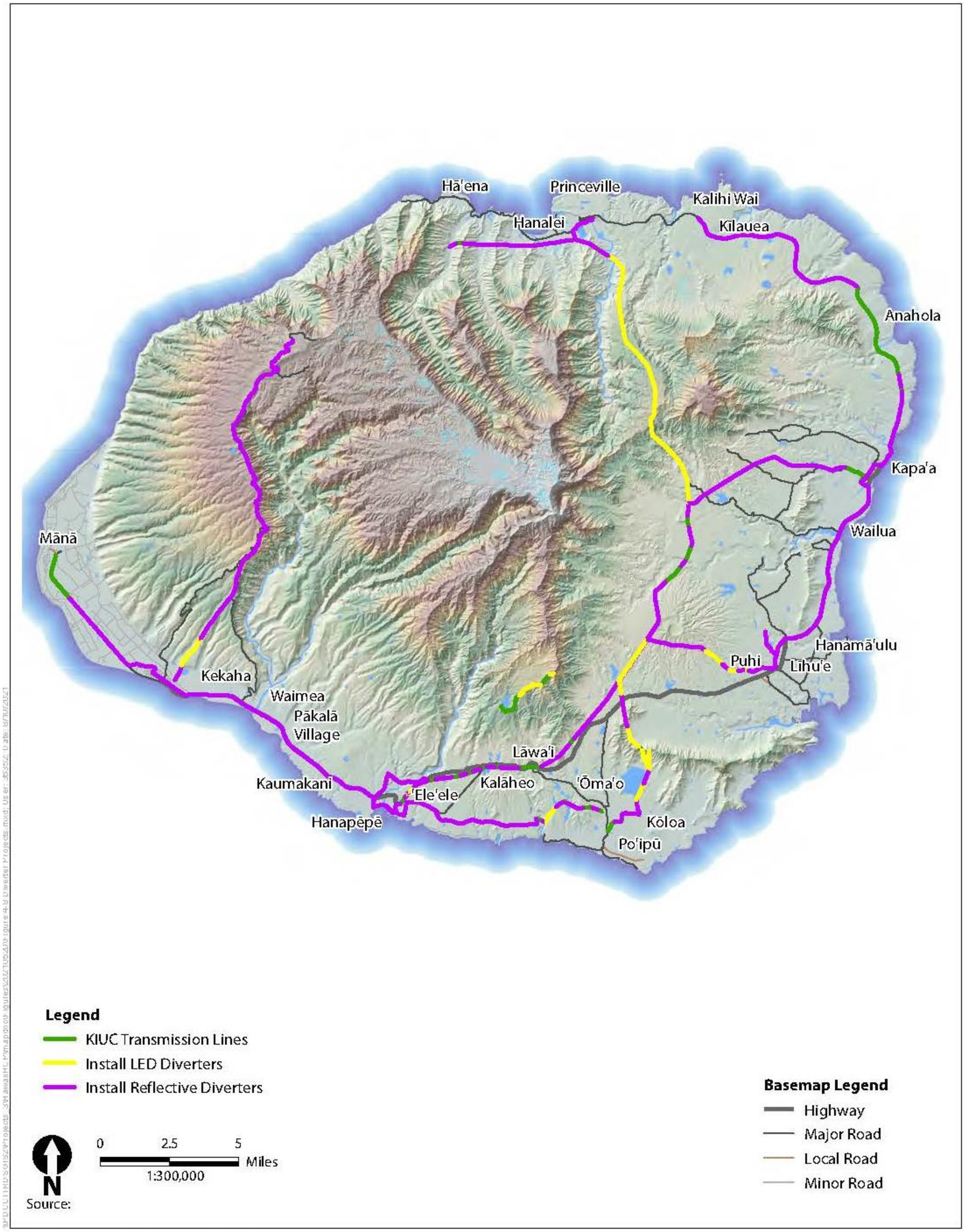

Figure ES-2. KIUC Bird Flight Diverter Minimization Project Locations

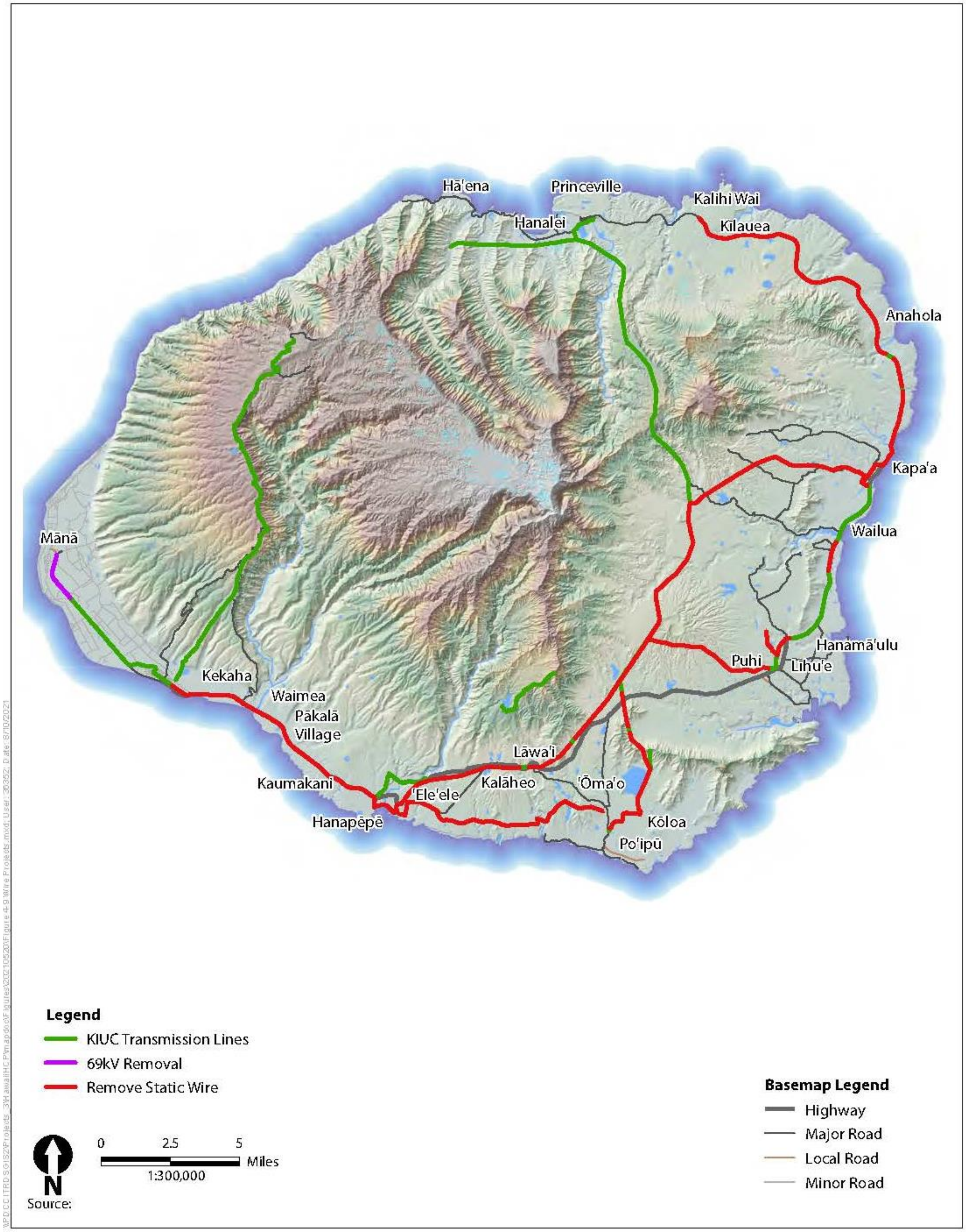

Figure ES-3. KIUC Wire Minimization Project Locations

ES.5.2.2 Conservation Measure 2. Implement Measures to Minimize Light Attraction

Minimization actions under this conservation measure include light attraction through the installation of full-cutoff shield fixtures and use of white bulbs, and dimming exterior night lighting during the fledgling fallout season. In 2017, all existing KIUC streetlights were retrofitted with full-cutoff shields to minimize light attraction, and all KIUC streetlights were converted from high-pressure sodium bulbs to more energy-efficient 3000-kilowatt LED bulbs. In 2019, KIUC replaced all green light bulbs in streetlights with white light bulbs to further reduce light attraction. Light from all new streetlights during the permit term will be similarly minimized. In addition, a predator removal program will be implemented to minimize depredation of light-attracted grounded seabirds.

This conservation measure only applies to the covered seabird species because they are the only covered species group affected by light attraction away from coastal locations. This conservation measure is intended to support Objective 1.2 shown in Table ES-2.

ES.5.2.3 Conservation Measure 3. Provide Funding for the Save our Shearwaters Program

KIUC began funding and largely implementing the Save our Shearwaters (SOS) Program with DOFAW in 2003. Under the HCP, KIUC will fund the SOS Program to a consistent level of $300,000 dollars per year (in 2021 dollars)[2] to rescue, rehabilitate, and release all covered seabirds and waterbirds found within the SOS Program's operational area on Kauaʻi, regardless of the source of injury. KIUC will also employ a public outreach and education program, in coordination with the SOS Program, to inform and educate the public about the risks of powerline strikes and light attraction to the covered species on Kauaʻi.

This conservation measure applies to covered seabirds (particularly band-rumped storm-petrel [ʻakēʻakē]) and covered waterbirds. This conservation measure is intended to support Objectives 3.2 and 4.2 shown in Table ES-2.

ES.5.2.4 Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites

This conservation measure is intended to support Objectives 1.3, 2.3, and 3.3 shown in Table ES-2. KIUC will manage and enhance 10 conservation sites for the KIUC HCP (Figure ES-4). Nine of these sites have been selected, and the final location of the tenth site is still under evaluation. The final site is identified temporarily as "Conservation Site 10" and will occur in the area shown as a dashed purple line on Figure ES-4 in the northwest corner of Kauaʻi. KIUC will select and commit to a specific location for Conservation Site 10 no later than the end of 2023 and before permit issuance. Details regarding the site selection process are provided in Appendix 4A, *Conservation Site Selection.*

[2] KIUC funding will increase annually to keep pace with inflation.

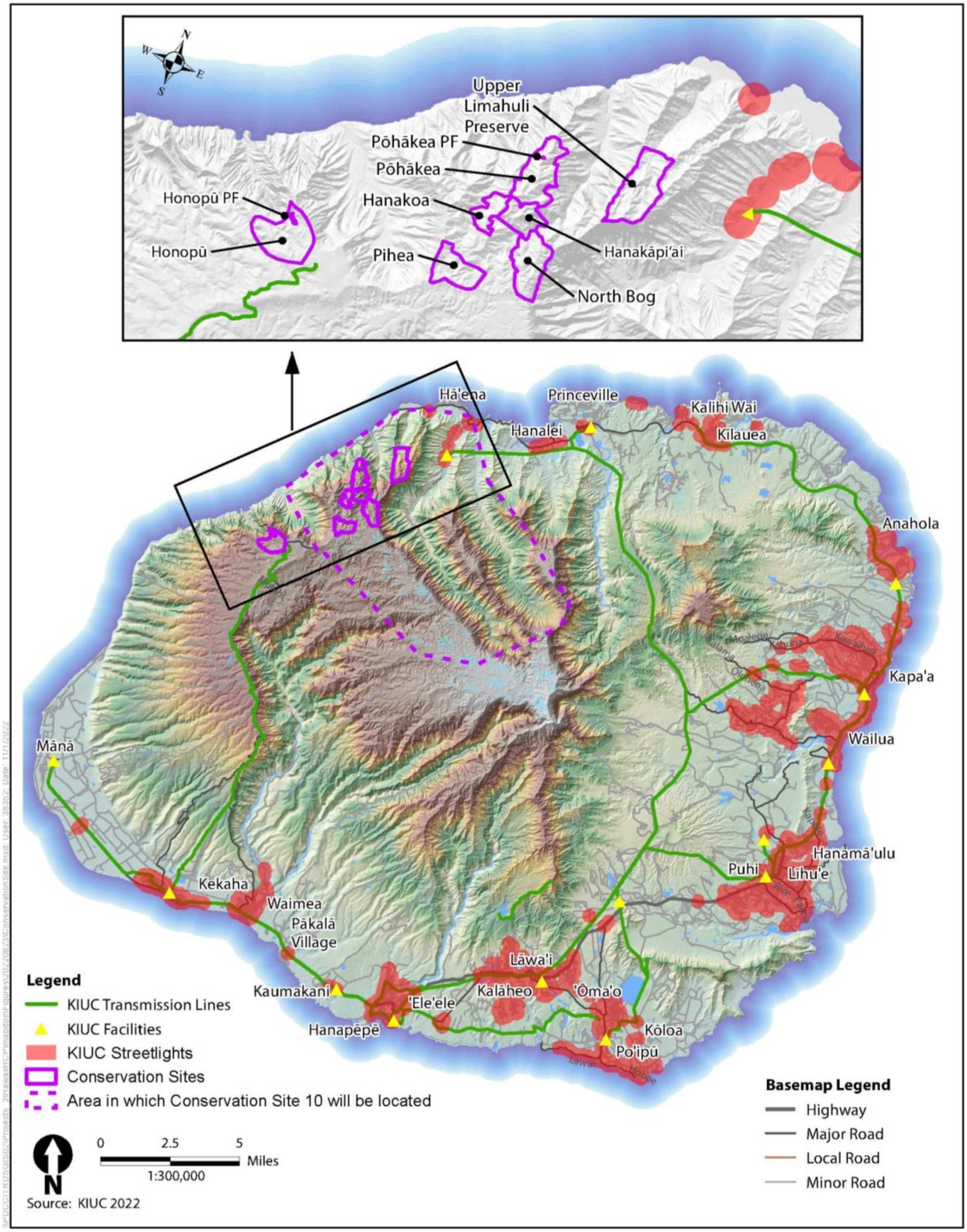

Figure ES-4. Conservation Sites

Designated conservation sites for the Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) will continue to be managed as follows.

- Predator control measures will be implemented at all conservation sites and will be used to establish predator-free breeding habitat or substantially reduce predation, which is critical to successfully restore productive seabird colonies (Buxton et al. 2014; Jones and Kress 2012; Young et al. 2018; Raine et al. 2020). Barn owl and feral bee control will also be implemented where signs of these species are identified. Terrestrial predator control methods may include traps, bait stations, snares, hunting, and other control methods.
- Predator exclusion fencing will be maintained that are impenetrable to most introduced terrestrial predators including feral cats, rats, pigs, and goats. KIUC will establish these fences at four locations: Pōhākea PF and Honopū PF[3], Upper Limahuli Preserve, and Conservation Site 10. The remaining conservation sites occur within existing ungulate exclusion fence that was constructed and is maintained by other entities, and additional fencing will not be required at these locations.
- Social attraction techniques will be used to expand existing colonies and establish new colonies at conservation sites within otherwise suitable breeding habitat. Social attraction methods will include removal of unsuitable vegetation and replanting with native species, installation of artificial burrows, and broadcasting calls in the restored habitat during peak breeding season (April through mid-September). Social attraction will be implemented at Upper Limahuli Preserve, Pōhākea PF, Honopū PF, and Conservation Site 10.
- Invasive plant control will be implemented within the Upper Limahuli Preserve and Upper Mānoa Valley conservation sites. Invasive plant species control at the other conservation sites will occur on an as-needed basis, when species are documented during monitoring and determined to be spreading or otherwise problematic.

ES.5.2.5 Conservation Measure 5. Implement a Green Sea Turtle Nest Detection and Temporary Shielding Program

This conservation measure is intended to support Objective 5.1 shown in Table ES-2. A nest detection and shielding program will be implemented to minimize and offset the effects of light attraction on green sea turtles (honu) from KIUC streetlights. Nest shielding will initially be installed on seven beaches identified by KIUC and USFWS as having suitable green sea turtle (honu) nesting habitat and KIUC streetlights that have been documented as being visible from that habitat. The nest shielding will be installed when active green sea turtle (honu) nests are detected via drone surveys or volunteer monitors. Light-proof fencing will be erected around the nest after approximately 45 days of incubation to minimize the potential for vandalism. After the green sea turtle (honu) hatchlings have emerged and entered the ocean, the fence will be removed and evidence of hatching will be reported to USFWS, DOFAW, and the State of Hawaiʻi Division of Aquatic Resources (DAR) within 24 hours. Unhatched eggs, deceased hatchlings, or samples of either will be sent to the National Oceanic and Atmospheric Administration by a permitted biologist for DNA analysis. Annual monitoring will occur on all beaches on Kauaʻi to allow for continual updates to the nest shielding program by identifying additional beaches that may require shielding as well as removing locations where environmental conditions change and light attractant risks are removed. All staff and

[3] DOFAW are currently constructing these fences, KIUC will be responsible for management and maintenance during the permit term.

volunteers will be required to complete an annual training provided by USFWS, DOFAW, DAR or trainers approved by USFWS, DOFAW, and DAR, that will allow them to recognize green sea turtle (honu) tracks, signs of nesting, and hatchling activity, as well as the proper techniques for installing a temporary light shield. These measures will be implemented over the 50-year permit term unless KIUC is able to demonstrate to USFWS, DOFAW, and DAR that permanent modification of existing and future streetlights fully avoids take of green sea turtles (honu) (see Conservation Measure 6).

ES.5.2.6 Conservation Measure 6. Identify and Implement Practicable Streetlight Minimization Techniques for Green Sea Turtle

This conservation measure is intended to support Objective 5.2 shown in Table ES-2. Measures implemented to minimize the impact of streetlights on the covered seabirds (Conservation Measure 2) do not reduce streetlight visibility to green sea turtle (honu) hatchlings. As of 2020, KIUC and USFWS identified 29 streetlights that are visible from suitable green sea turtle (honu) nesting habitat within the Plan Area. Additional modifications are needed to reduce light attraction of green sea turtle (honu) hatchlings at these locations without compromising public health or safety. KIUC will work with the County and State to determine the range of available practicable minimization measures and their timeline for implementation. Light minimization techniques may include additional shielding or change in wattage. If no practicable minimization measures can be agreed upon, KIUC would not be required to implement this conservation measure further, and instead would continue to implement the temporary shielding required under Conservation Measure 5 throughout the life of the permit term. If new locations are identified as beaches and the surrounding vicinity changes over time or new streetlights are installed that could cast light onto suitable green sea turtle (honu) habitat, the same light minimization techniques agreed upon for the existing 29 streetlights will be implemented for any additional streetlights identified throughout the permit term.

ES.6 Effects on Covered Species

Effects on the covered species have been evaluated using a systematic, scientific analysis of the estimated adverse, beneficial, and net effects as a result of the HCP covered activities and their effects pathways. Effects are summarized below by species group: covered seabirds, covered waterbirds, and green sea turtle (honu).

ES.6.1 Effects on Covered Seabirds

KIUC activities result in four sources of take of covered seabirds: collisions with powerlines, light attraction from streetlights, facility lights and nighttime lighting, and predator trapping at the conservation sites. The covered seabirds collide with powerlines, static wires, and fiber optic cables owned and operated by KIUC along their flight paths between the ocean feeding areas and montane breeding habitats (Travers et al. 2020a). KIUC operates streetlights, external lights at its covered facilities, and night lighting for emergency restoration of power; artificial lighting often attracts the covered seabirds (primarily fledglings), and after flying around the lights, the seabirds can tire or inadvertently hit a structure and may become grounded, an event referred to as fallout (Imber 1975; Telfer et al. 1985). The conservation strategy may also result in a minimal amount of take of covered seabirds as individual birds may be inadvertently caught in leg hold or other traps placed for invasive predator control. The following sections summarize methods and results for estimating the level of take from each covered activity, the effects of take on the covered seabirds, the beneficial effects of the conservation strategy, and the net effects considering both the adverse effects of take and the beneficial effects of the conservation strategy.

ES.6.1.1 Take Analysis: Methods

To quantify take of Newell’s shearwater (‘a‘o) and Hawaiian petrel (‘ua‘u) from powerlines, KIUC used acoustic monitors that recorded bird collisions at key locations and applied a Bayesian model as described in Appendix 5D, *Bayesian Acoustic Strike Model*. While acoustic monitoring provides data on the number of birds colliding with lines, these data cannot provide information on the species colliding with the powerlines or the proportion of those collisions that result in injuries or mortality (Travers et al. 2021). Travers et al. (2021) therefore used observations of seabird powerline collisions to estimate the proportion of collisions by species and the post-collision outcomes. KIUC reduced annual take estimates based on projected results of powerline minimization measures, and estimated take from planned new powerlines by extrapolating from calculations for existing powerlines. KIUC also calculated changing annual collisions over time as a function of changing abundance and powerline strike minimization (see Appendix 5E, *Population Dynamics Model for Newell’s shearwater (‘a‘o) on Kaua‘i*, and Appendix 5F, *Population Dynamics Model for Hawaiian petrel (‘ua‘u) on Kaua‘i*, for a detailed description of this step). There have been no direct observations of band-rumped storm-petrel (‘akē‘akē) colliding with powerlines (Travers et al. 2021), and a reliable collision estimate could not be determined, although if they were hitting the lines in large numbers they would have probably been observed because other small species that are somewhat difficult to detect such as bats that have struck powerlines have been documented (Raine pers. comm). Instead, a small amount of take was estimated for this species independent of the calculations described herein.

To calculate take of Newell’s shearwater (‘a‘o) and Hawaiian petrel (‘ua‘u) from streetlights, KIUC assigned fallout documented by the SOS Program to streetlights based on the proportional contribution of those lights to the lightscape of Kaua‘i. The proportional assessment was developed using remotely sensed radiance (brightness) data collected by a sensor on the Suomi National Polar-Orbiting Partnership Satellite (Cao et al. 2020). The process used to estimate fledgling fallout due to streetlights is described in Appendix 5C, *Light Attraction Modeling*. For the covered facilities, take was estimated using the average number of downed birds located at each facility as documented in KIUC monitoring logs (Kaua‘i Island Utility Cooperative 2019) and the SOS database. KIUC assumes that all fallout from covered activities results in mortality of each covered species, except when SOS rescues are successful. The population dynamics model assumes 100 percent of fallout results in mortality.

Impacts on band-rumped storm-petrel (‘akē‘akē) from light attraction are difficult to estimate because it is a very small and cryptic seabird that is difficult to find once grounded. KIUC set a total take limit 40 of band-rumped storm-petrel (‘akē‘akē) over the 50-year permit term.

To estimate the number of covered seabirds anticipated to be taken as a result of trapping predators at conservation sites, KIUC estimated annual rates of injuries and mortalities based on trapping data from 2015 through 2022 for six of KIUC’s longest running conservation sites and extrapolated based on assumed trapping efforts during the 50-year permit term.

To estimate indirect take of eggs and chicks as a result of powerline collisions, KIUC assumed every breeding adult injury or mortality resulted in the loss of an egg or chick that breeding season. KIUC assumed 20 percent of powerline collisions consisted of breeding adults, and 100 percent of mortality or injury from predator trapping consisted of breeding adults.

ES.6.1.2 Take Analysis: Results

Table ES-3 provides the requested take amount by unit of take for Newell's shearwater (ʻaʻo), Hawaiian petrel (ʻuaʻu), and band-rumped storm-petrel (ʻakēʻakē), respectively. KIUC requests all forms of take (injury, mortality, indirect take of eggs and chicks) associated with the requested take by unit of take. That is, the requested take is quantified by unit of take, and take will be measured during implementation by unit of take, but the estimated resulting breakdown of injuries, mortalities, and indirect take cannot be measured during implementation. Chapter 5, *Effects*, provides the estimated breakdown for each species in terms of injury, mortality, and indirect take of eggs and chicks that was incorporated into the population dynamics model. The following sections summarize effects on each of the covered seabirds.

Table ES-3. Covered Seabirds, Requested Take and Estimated Amount by Form of Take

	Type of Take	Unit of Take	Requested Take by Unit of Take (50 years)	Percent of Total Take for the Species
Newell's shearwater (ʻaʻo)	Existing and new powerlines	Powerline strikes	35,236	88%
	Existing streetlights	Fallout	3,345	8%
	New streetlights	Fallout	1,025	3%
	Facilities	Fallout	260	1%
	Conservation program	Individuals caught in traps	177	<1%
	Total		**40,043**	**100%**
Hawaiian petrel (ʻuaʻu)	Existing and new powerlines	Powerline strikes[f]	21,196	97%
	Existing streetlights	Fallout	200	1%
	New streetlights	Fallout	60	<1%
	Facilities	Fallout	5	<1%
	Conservation Program	Individuals caught in traps	315	1%
	Total		**21,776**	**100%**
Band-rumped storm-petrel (ʻakēʻakē),	Existing and new powerlines	Powerline strikes	22	21%
	Existing streetlights	Fallout	35	34%
	New streetlights	Fallout	46	45%
	Facilities	Fallout	0	0%
	Conservation Program	Individuals caught in traps	0	0%
	Total		**103**	**100%**

ES.6.1.3 Effects Assessment

To assess effects on Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu), KIUC used a custom population dynamics model for the Kauaʻi metapopulation.[4] Appendix 5E, *Population Dynamics Model for Newell's Shearwater (ʻaʻo) on Kauaʻi* describes the model and results for Newell's shearwater (ʻaʻo). Appendix 5F, *Population Dynamics Model for Hawaiian Petrel (ʻuaʻu) on Kauaʻi* describes the model and results for Hawaiian petrel (ʻuaʻu). The modeling framework allows each subpopulation to have its own set of vital rate values and therefore different trends in abundance through time. The vital rates for each subpopulation were also modeled to change through time as management efforts continue to be implemented and increase their benefits to the species, corresponding to the timeline of these measures described in Chapter 4, *Conservation Strategy*. Island-based estimates of abundance for each subpopulation were used to initialize population trajectories, which were then projected forward in time through the 50-year permit term. The model compared four scenarios outlined in Table ES-4.

Table ES-4. Explanation of Population Dynamics Model Scenarios Used for Effects Analysis

Scenario	Take from KIUC Activities	KIUC HCP Powerline Minimization	KIUC HCP Conservation Strategy	Purpose
No-Take	No	Yes (100% strike reduction)	No	A hypothetical scenario in which the take proposed for authorization under the HCP does *not* occur. This scenario isolates factors that are *not* related to the proposed take, so that impacts of the proposed take during the permit term can be clearly evaluated.
Unminimized Take	Yes	No	No	A scenario in which powerline minimization measures attributed to this HCP do not occur. This scenario isolates the beneficial effects of KIUC's minimization measures by comparing outcomes with unminimized take versus the proposed take.
Proposed Take	Yes	Yes	No	A scenario in which the proposed, minimized take occurs, but with no additional measures to offset impacts. The purposes of this scenario are to compare against the no take, unminimized take, and HCP scenarios for analyzing effects of the proposed take, the minimization, and the compensatory mitigation, respectively.
HCP	Yes	Yes	Yes	This is the scenario proposed in the HCP, including the minimized take and the compensatory mitigation of the conservation strategy. The HCP scenario is compared against the other scenarios to evaluate the adverse, beneficial, and net effects of implementing the HCP.

[4] A metapopulation is a group of populations that periodically interbreed. Newell's shearwater (ʻaʻo) populations on Kauaʻi are recognized as a distinct metapopulation (Vorsino 2016).

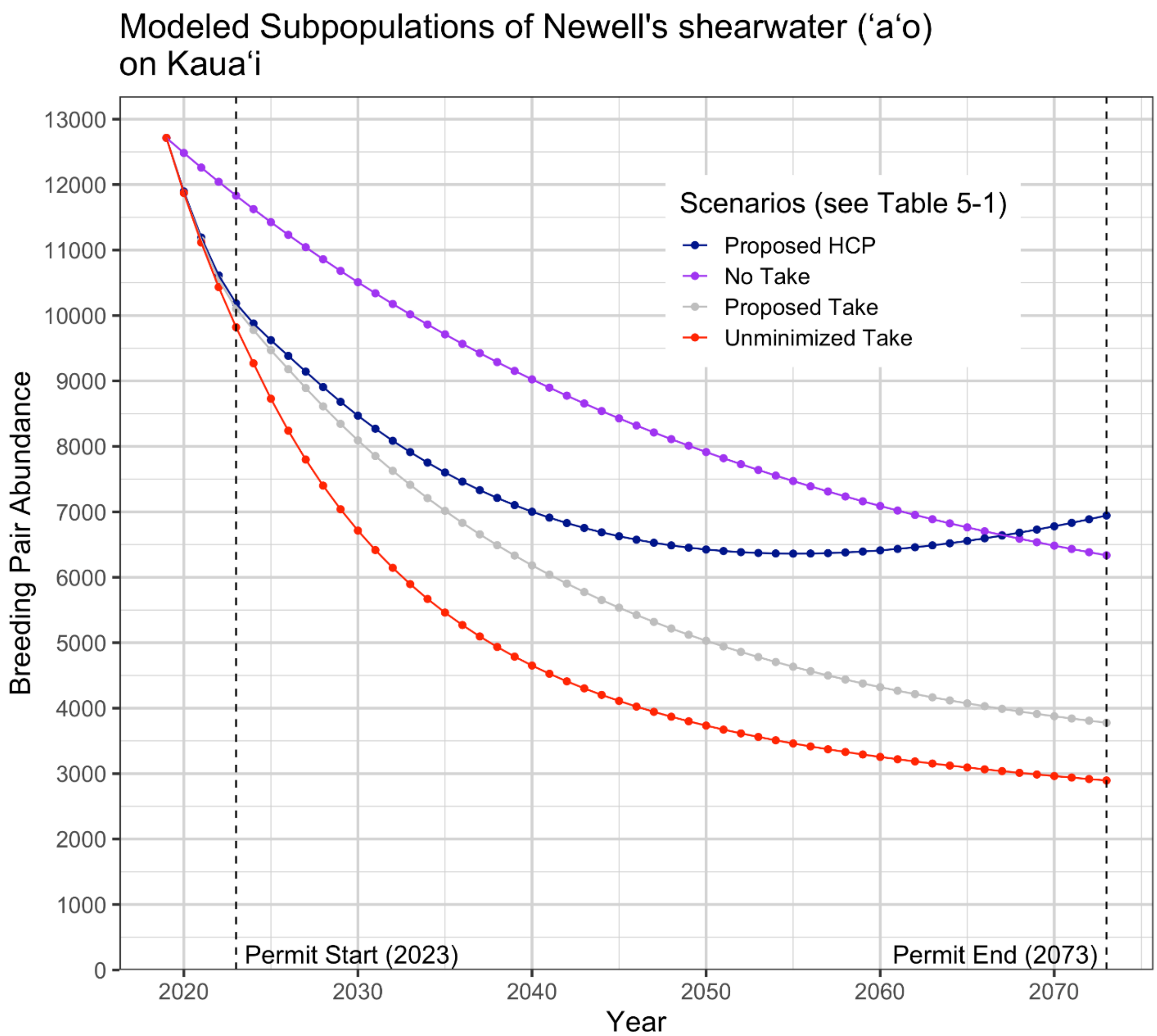

Figure ES-5. Newell's Shearwater (ʻaʻo) Population Dynamics Model: Island-wide Outcomes for All Scenarios[5]

[5] See Table ES-4 for a description of each scenario evaluated to assess effects of the take and the conservation strategy. See Appendix 5E, *Population Dynamics Model for Newell's Shearwater (ʻaʻo) on Kauaʻi* for details on the model structure and assumptions*.*

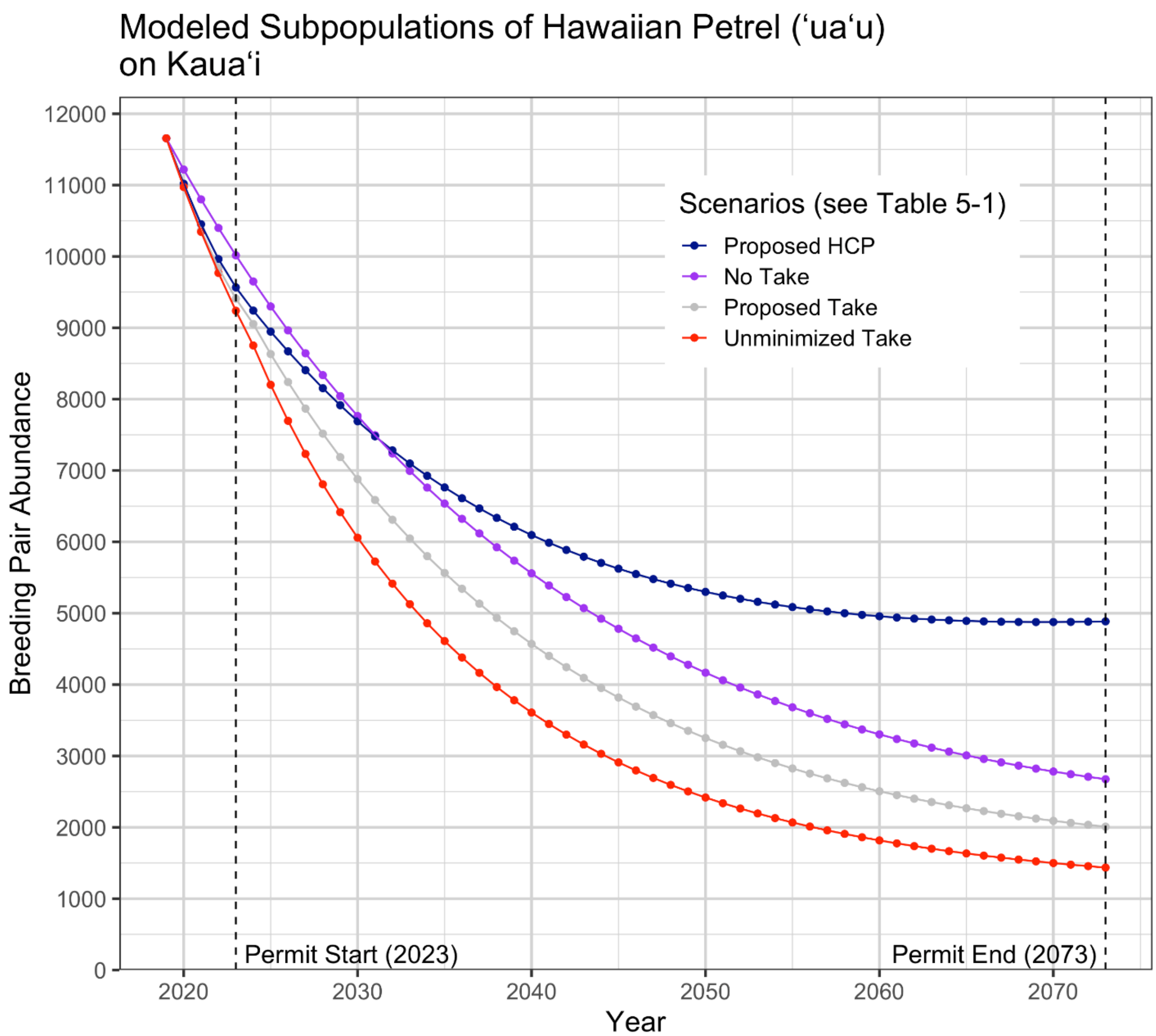

Figure ES-6. Population Dynamics Model Results for Hawaiian Petrel (ʻuaʻu) Island-wide for All Four Scenarios

Impact of the Taking

To evaluate the impacts of the taking on Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu), the hypothetical no-take scenario was compared with the proposed take scenario. The results are shown by comparing the purple line with the grey line in Figures ES-5 and ES-6.

As shown with the purple line on both figures, in the hypothetical absence of take related to KIUC operations during the permit term and without the proposed conservation measures,[6] the Kauaʻi metapopulation would continue to decline. This assessment shows that the effects of predation and

[6] Since KIUC powerlines are already in operation and their removal would be infeasible, this no-take scenario is hypothetical and used only as a basis for evaluating the impact of the proposed taking that would occur under this HCP on the species.

other threats to the species are substantial even without the adverse effects of KIUC's covered activities.

As shown by the grey line on both figures, even with minimization, the continued loss of Newell's shearwaters (ʻaʻo) and Hawaiian petrel (ʻuaʻu) as a result of KIUC covered activities could have an appreciable negative effect on the Kauaʻi metapopulations of these species in the absence of mitigation measures to offset these effects.

The worldwide population size of the band-rumped storm-petrel (ʻakēʻakē) is uncertain, but is most likely around 150,000 birds (Appendix 3A, *Species Accounts*). The Hawaiʻi DPS of the band-rumped storm-petrel (ʻakēʻakē) represents a small, remnant population of possibly 400–500 birds or an estimated 221 breeding pairs (U.S. Fish and Wildlife Service 2020). The loss of 108 band-rumped storm-petrels (ʻakēʻakē) over the 50-year permit term (an average of approximately 2 birds per year), is not likely to have an appreciable effect on the survival and recovery of the Hawaiʻi DPS of band-rumped storm-petrel (ʻakēʻakē).

Beneficial and Net Effects

To evaluate the beneficial effects of powerline minimization on Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu), KIUC compared the unminimized take scenarios with the minimized take scenarios. As shown by comparing the red and grey lines on Figures ES-5 and ES-6, the proposed minimization measures result in substantially reduced levels of metapopulation decline for both species. In the absence of these conservation measures to offset impacts, however, the metapopulations continue to decline for both species.

To evaluate the beneficial effects of the conservation strategy (minimization and mitigation) on Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu), KIUC compared the unminimized take scenarios with the HCP scenario. As shown by comparing the red and dark blue lines on Figures ES-5 and ES-6, the metapopulation sizes at the end of the 50-year permit term are substantially greater for both species under the HCP scenario than under the unminimized take scenario, demonstrating the beneficial effects of the conservation strategy.

To evaluate net effects of the HCP on Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu), considering both adverse effects of the take and beneficial effects of the conservation strategy, KIUC compared the HCP scenario with the hypothetical no-take scenario. For both species, the HCP results in net beneficial effects on the species in that metapopulation numbers are greater and population trends are more positive under the HCP scenario than under the hypothetical no-take scenario. For Newell's shearwater (ʻaʻo), the net benefit in metapopulation numbers is not realized until approximately 2067, but a shift toward positive population growth begins at approximately 2055 and there is a strong upward trend by the end of the permit term. For Hawaiian petrel (ʻuaʻu), the net benefit in metapopulation numbers occurs as early as year 15 of the permit term, and the population trends stabilize by the end of the permit term.

The SOS Program (funded mostly by KIUC) is expected to minimize and partially offset effects of powerline strikes for band-rumped storm-petrel (ʻakēʻakē). Based on SOS data from 2009 through 2019, an estimated 20 band-rumped storm-petrels (ʻakēʻakē) will be rescued and released over the 50-year permit term, minimizing, and partially offsetting the 44 mortalities from KIUC covered activities conservatively estimated for this species over the permit term. Although no band-rumped storm-petrels (ʻakēʻakē) have been observed at the conservation sites to date, the species is likely to benefit from predator control at the Honopū conservation site because of its proximity to the Nā Pali

Coast where most band-rumped storm-petrel (ʻakēʻakē) are thought to occur on Kauaʻi. Barn owl control at all conservation sites is likely to benefit band-rumped storm-petrel (ʻakēʻakē) by reducing predation at their breeding sites from these wide-ranging predators. KIUC expects funding of the SOS Program, in addition to the conservation measures for the other two covered seabird species, are sufficient to offset the impact of the taking on band-rumped storm-petrel (ʻakēʻakē). Considering both the take associated with KIUC activities and the effects of SOS recoveries and regional predator control, the KIUC HCP will have a net benefit to band-rumped storm-petrels (ʻakēʻakē) on Kauaʻi.

ES.6.2 Effects on Covered Waterbirds

The covered waterbirds are susceptible to powerline strikes but not susceptible to light attraction, so the analysis focuses only on estimating the effects of powerline strikes. The effects analysis for covered waterbirds is based on an assessment provided as Appendix 5B, *Rapid Waterbird Powerline Collision Assessment*. A combination of acoustic data of recorded strikes and observations of waterbird behavior around powerlines were used to estimate powerline collisions for three of the covered waterbirds: Hawaiian stilt (aeʻo), Hawaiian duck (koloa maoli), and Hawaiian goose (nēnē). Observational and acoustic data were not available for Hawaiian common gallinule (ʻalae ʻula) or Hawaiian coot (ʻalae keʻokeʻo), so strike estimates were not developed for these species. Rather, analysis of grounded bird detections was used to estimate the number of powerline mortalities (not strikes) for these two species. The resulting take estimates for the 50-year permit term are provided in Table ES-5. KIUC requests take of the covered waterbirds associated with 74 percent of all KIUC powerline collisions along powerline spans in Mānā (spans 1–113) and Hanalei (spans 462–478 and 1297–1328) during the permit term.

Rescue and recovery efforts through the SOS Program will minimize and offset the number of covered waterbird mortalities from powerline strikes. In addition, the SOS Program is expected to fully offset mortalities through the rescue, recovery, and release of waterbirds back into the wild that are affected by factors unrelated to KIUC's covered activities (e.g., botulism). Rescuing, treating, and releasing covered waterbirds in this situation contributes to the species recovery by increasing their survival and reproduction. The final column in Table ES-5 provides the projected 50-year total of recoveries based on the annual average number of individuals of each covered waterbird species recovered or released from the SOS Program from 2012 through 2019, which is when SOS consistently collected data on waterbirds. As shown in Table ES-5, the number of recoveries exceeds the number of mortalities for all the covered waterbird species. As these species are stable or increasing on Kauaʻi despite ongoing loss resulting from powerline collisions, the proposed take is not expected to adversely affect the survival or recovery of the species on Kauaʻi and the SOS recoveries are expected to provide a net benefit for the covered waterbird species.

Table ES-5. Summary of Estimated Effects on Covered Waterbirds from Powerline Strikes

Covered Species	50-Year Injury[a]	50-Year Powerline Mortality[a]	50-Year Projected SOS Rehabilitation[a]
Hawaiian stilt (aeʻo)	28	65	69
Hawaiian duck (koloa maoli)	94	219	763
Hawaiian coot (ʻalae keʻokeʻo)	17	42	219
Hawaiian common gallinule (ʻalae ʻula)	67	167	175
Hawaiian goose (nēnē)[f]	215	502	1,106

[a] See footnotes in Table 5-7 for explanations as to how these numbers were calculated.

ES.6.3 Effects on Green Sea Turtle

Adverse effects of lights on green sea turtle (honu) hatchlings are well documented throughout the species' range, where hatchlings become disoriented by lights when heading back to sea from nests on the beach and die from dehydration, predation, or vehicle collisions. Green sea turtles (honu) have been documented to be vulnerable to these effects from KIUC streetlights in close proximity to suitable green sea turtle (honu) nesting habitat.

KIUC conducted a field evaluation in 2020 to assess the extent to which KIUC streetlights might affect green sea turtles (honu), and to evaluate where additional minimization measures are needed. Seven beaches were determined to have streetlights that were visible from potentially suitable green sea turtle (honu) nesting habitat at the time of the evaluation.

Based on a low average annual nesting density of green sea turtles (honu) at all Kauaʻi beaches and presumed efficacy of the minimization measures described in Section 1.4.2, *Conservation Measures*, KIUC assumes that with the monitoring and minimization measures, most or all take resulting from KIUC streetlights will be avoided. Despite this, KIUC requests take authorization of 50 green sea turtle (honu) nests over the 50-year permit term, which is equivalent to an average of one nest every year. Take of any hatchlings in a nest of any type (disorientation, injury, or mortality) will count as take of that nest. This requested take accounts for the possibility of green sea turtle (honu) nests going undetected by monitors and not being temporarily shielded from a KIUC streetlight. Alternatively, temporary shielding may be ineffective at some nest sites due to incorrect placement or vandalism, in which case hatchlings may be affected by KIUC streetlights.

The estimated number of female green sea turtles (honu) that nest in the Plan Area is only 0.39 percent of the total breeding females estimated for the entire CNPDPS of green sea turtle (honu) (Seminoff et al. 2015). Of 20 nesting sites documented on Kauaʻi, all but two were described as having intermittent or indeterminate use (Parker and Balazs 2015). The loss of up to 50 nests over a 50-year period resulting from KIUC streetlights, where most or all of the take is expected to consist of small fraction of the hatchlings in each nest, is not expected to adversely affect the population or appreciably reduce the likelihood of the species' survival and recovery in the wild.

The green sea turtle (honu) monitoring and minimization measures will not only minimize take resulting from KIUC streetlights (possibly to zero) but is also expected to minimize take resulting from other proximate light sources. On six of the seven beaches identified[7] in KIUC's 2020 streetlight assessment, most of the light is from sources other than KIUC streetlights, including residential buildings, commercial buildings (e.g., restaurants, resorts, shopping centers), and beach infrastructure (e.g., restrooms, parking lot lighting, walking path lighting). As described in Chapter 4, *Conservation Strategy*, KIUC's nest shielding program will shield any nests that have even the smallest potential to be affected by KIUC streetlights. This will result in the shielding of green sea turtle (honu) nests affected by non-KIUC light sources. As such, the take of hatchlings in up to 50 nests over 50 years is expected to be fully offset through the reduction of take from non-KIUC light sources. The nest shielding program is also expected to provide a net conservation benefit to green sea turtle (honu) because over the 50-year permit term KIUC will be shielding more nests than would be affected by their own streetlights.

[7] At the Kekaha Shoreline, the primary light source is KIUC streetlights. Surrounding lights in the vicinity are sparse and therefore contribute little to the beach lightscape.

ES.7 Monitoring and Adaptive Management

Chapter 6, *Monitoring and Adaptive Management Program*, of the KIUC HCP describes the monitoring and adaptive management program. The purposes of this program are to do the following.

- Ensure that KIUC remains in compliance with the HCP, the federal ITP, and the State ITL.
- Ensure take of the covered species does not exceed the maximum limits set by the federal ITP and State ITL.
- Evaluate the effectiveness of the conservation measures (Chapter 4, *Conservation Strategy*) on an ongoing basis and identify when adaptive management must be applied to improve their effectiveness.

For compliance monitoring KIUC has included in Chapter 6, *Monitoring and Adaptive Management Program*, a compliance schedule and adaptive management triggers and responses for all relevant compliance monitoring actions (see Table 6-2 in Chapter 6). Compliance monitoring and adaptive management will allow KIUC to document that all the requirements of the HCP are being met and will allow USFWS and DOFAW[8] to determine, using the success metrics in Table 6-2, whether the HCP is on track both in terms of scope and schedule.

The take monitoring under the KIUC HCP compares the actual take that occurs during implementation to ensure KIUC does not exceed the 50-year take limit authorized by the federal ITP and State ITL. Table 6-2 describes triggers for adaptive management responses if take levels are higher than expected based on 5-year rolling averages of take during HCP implementation.

Chapter 6, *Monitoring and Adaptive Management Program*, of the KIUC HCP also includes monitoring and adaptive management triggers and responses to ensure the effectiveness of the HCP's conservation measures. DOFAW and USFWS will be participate in adaptive management decisions, although KIUC will have discretion over day-to-day adjustments to the conservation strategy that do not rise to the level of adaptive management as detailed in Chapter 6. Table 6-3 of the HCP includes the monitoring strategies, metrics of success, adaptive management triggers, and adaptive management responses for all the HCP's conservation measures.

ES.8 Plan Implementation

Chapter 7, *Plan Implementation*, of the KIUC HCP describes how KIUC will implement the HCP. The chapter describes the following topics.

- Implementation responsibilities of KIUC, USFWS, and DOFAW (Section 7.2, *Implementation Responsibilities*).
- Regulatory assurances requested for this HCP under the federal ESA and HRS (Section 7.3, *Regulatory Assurances*);
- Estimated costs of HCP implementation (Section 7.4, *Costs of KIUC HCP Implementation*) and funding assurances (Section 7.5, *Funding Assurances*).

[8] And DAR, when green sea turtle (honu) is involved.

- The process to revise or amend the HCP during implementation (Section 7.6, *Revisions and Amendments*).
- Requirements for annual reporting to USFWS and DOFAW (Section 7.7, *Annual Reporting*).

ES.8.1 Implementation Responsibilities

KIUC is responsible for implementing the conservation and other implementation actions described in the HCP. USFWS and DOFAW will have the responsibility during HCP implementation for reviewing and verifying reports submitted by KIUC for completeness and compliance; determining whether KIUC is making progress towards achieving the biological goals and objectives and implementing all applicable requirements of the HCP; making recommendations to KIUC regarding adaptive management changes according to the adaptive management process described in Chapter 6, *Monitoring and Adaptive Management Program*; coordinating with KIUC as necessary to stay informed about HCP implementation; and providing technical advice to KIUC, as necessary or requested. Additionally, DOFAW will be responsible for providing HCP Annual Reports to the Endangered Species Recovery Committee (ESRC) for their review and recommendations for adaptive management, considering recommendations from the ESRC regarding adaptive management or other changes to the HCP to improve its effectiveness, and coordinating with USFWS and KIUC regarding these recommendations.

ES.8.2 Regulatory Assurances

No Surprises assurances are provided by the federal ESA through the "No Surprises" rule (50 Code of Federal Regulations [CFR] Section 17.22.32). This rule provides assurances to ITP holders that USFWS will not require the commitment of additional land, water, or financial compensation; or additional restrictions on the use of land, water, or other natural resources beyond the level otherwise agreed to in the HCP without the consent of the permittee. The HRS provides for regulatory "incentives" in Section 195D-23 that are similar to the regulatory assurances provided by the federal ESA. The State cannot, in order to protect a threatened or endangered species, "impose additional requirements or conditions, or modify any existing requirements or conditions to mitigate or compensate for changes in the conditions or circumstances of any species or ecosystem, natural community, or habitat covered by the [HCP]." Allowable exceptions are described in Chapter 7, Section 7.3, *Regulatory Assurances.*

Consistent with the No Surprises regulations, the KIUC HCP identifies and analyzes reasonably foreseeable changed circumstances that could affect a species or geographic area during its term (50 CFR Section 17.3). Changed circumstances addressed in the HCP include effects of severe weather, natural hazards, and climate change, new invasive species, disease outbreaks in the covered species, vandalism, and population declines due to issues at sea. Should one or more of the changed circumstances described in the HCP occur, KIUC is required to implement the measures specified in Section 7.3.3, *Changed Circumstances Addressed by this HCP*, to respond to the changes. KIUC is not required to implement remedial actions for any unforeseen circumstances, which are also defined in the same section.

ES.8.3 Costs and Funding

The cost to implement the KIUC HCP is summarized in Table ES-6.

Table ES-6. Summary of Estimated Costs to Implement KIUC HCP

Cost categories	50-year total HCP cost (2023–2073)[a]	Percentage of 50-year total HCP cost
Plan Administration	$20,665,000	7.8%
Powerline Collision Minimization	$23,006,640	8.7%
Save Our Shearwaters Program	$15,000,000	5.7%
Manage and Enhance Conservation Sites	$80,607,204	30.4%
Green Sea Turtle Nest Detection and Temporary Shielding Program	$5,205,000	2.0%
Infrastructure Monitoring and Minimization Program	$26,995,544	10.2%
Seabird Colony Monitoring Program	$47,649,648	18.0%
State Compliance Monitoring	$2,500,000	0.9%
Changed Circumstances	$28,646,679	10.8%
Adaptive Management	$12,868,745	4.9%
Contingency	$1,749,762	0.6%
Total	**$264,894,222**	**100.0%**

[a] Costs are expressed in 2021 dollars.

KIUC has the financial capacity and commits to fully fund all costs of the KIUC HCP summarized in Table ES-6. To ensure funding for adaptive management and for remedial measures should they be needed to address changed circumstances, KIUC will secure a letter of credit in an amount sufficient to fund a reasonable proportion of expected adaptive management or remedial actions in any one year, as described in Section 7.5, *Funding Assurances*. Costs for implementation of the KIUC HCP are part of KIUC's operational costs, which will be passed on to all KIUC ratepayers. KIUC's costs for implementation of the KIUC HCP are anticipated to be fully covered by its revenues received, electricity rates charged, and debt financing.

KIUC has demonstrated its ability to fund HCP implementation since 2011. Since 2016, KIUC has continued to implement many of the same conservation measures in the Short-Term HCP that are now part of this HCP. In addition, KIUC has implemented many powerline collision minimization projects during both the Short-Term HCP and afterwards, as early implementation actions for this HCP. This track record of funding many of the same conservation actions since 2016 provides assurances to USFWS and DOFAW that KIUC will be able to fully fund HCP implementation.

ES.8.4 Revisions and Amendments

There are two types of changes that may be made to the HCP: minor modifications or major amendments. Minor modifications are changes to the HCP provided for under the operating conservation program, including adaptive management changes and responses to changed circumstances. Minor modifications also include revisions that do not increase the levels of authorized incidental take or do not materially modify the scope or nature of effects on the covered species from activities or actions covered by the ITP and State ITL. USFWS and DOFAW will confirm receipt of any modification request and will notify KIUC acknowledging the minor modification or determining if such modification request constitutes a major amendment.

Major amendments are changes in the HCP that may affect the impact analysis or conservation strategy. Amendments to the HCP and either the ITP or State ITL follow the same formal application and review process as the original HCP and permits, including National Environmental Policy Act/ Hawai'i Environmental Protection Act[9] review, *Federal Register* notices, an internal Section 7 consultation by USFWS, and approval by the ESRC and the Board of Land and Natural Resources.

[9] HRS Chapter 343.

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Chapter 1
Introduction and Background

1.1 Overview and Background

1.1.1 Applicant: Kauaʻi Island Utility Cooperative

The Kauaʻi Island Utility Cooperative (KIUC) is a not-for-profit, tax-exempt cooperative association governed by a publicly-elected nine-member Board of Directors.[1] As a public utility responsible for the production, purchase, transmission, distribution, and sale of electricity on the Island of Kauaʻi (Kauaʻi), KIUC is regulated by the State of Hawaiʻi (state) Public Utility Commission, and is required by law to provide and ensure the availability of electrical service on the island of Kauaʻi. KIUC is entirely owned by its members, which total approximately 34,000 ratepayers.

To ensure reliable electrical service to Kauaʻi, KIUC owns and operates a variety of electrical utility installations. These installations include fossil-fuel-fired, hydroelectric, and solar generating facilities, 17 substations and switchyards, and approximately 1,487 circuit miles of transmission and distribution lines. KIUC also purchases power from several independent power producers and transmits power that it obtains from these sources through its electrical transmission system.

1.1.2 Need for the KIUC Habitat Conservation Plan

KIUC's electrical transmission and distribution system is largely above ground and consists of wires supported by poles or towers that extend from 25 to more than 100 feet above ground. Three species of seabirds listed under the federal Endangered Species Act (federal ESA) are known to collide with these powerlines. Such collisions often result in injury or mortality of the affected birds. In addition to powerline collisions, lights at KIUC facilities and KIUC streetlights[2] are known to attract and/or disorient listed seabirds, particularly fledglings making their first flights to sea. Birds that become disoriented by these lights can exhaust themselves by flying around the lighted areas before eventually landing on the ground (commonly referred to as *fallout*). Due to their physiology, these birds have difficulty regaining flight, so without intervention, they either succumb to starvation or dehydration, or are killed by invasive predators or vehicles.

The take of species (See Chapter 10, *Glossary of Terms*) protected by the federal ESA and its state law equivalent, the Hawaiʻi Revised Statutes (HRS) Chapter 195D, incidental to otherwise lawful activities, is prohibited unless authorized via an incidental take permit (federal ITP) issued by the U.S. Fish and Wildlife Service (USFWS) and an incidental take license (state ITL) issued by the State of Hawaiʻi Department of Land and Natural Resources (DLNR), Division of Forestry and Wildlife (DOFAW) (hereafter DOFAW), respectively. These permits are referred to collectively as the *take authorizations*. Applications for a federal ITP and state ITL are supported by a habitat conservation plan (HCP) that describes, among other things, the anticipated effects of the proposed taking on listed species; how those effects on the affected species will be avoided, minimized, and mitigated; and how the HCP will be funded.

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[1] KIUC was formed as a cooperative pursuant to the provisions of Chapter 421C of the Hawaiʻi Revised Statutes.

In May 2011, USFWS approved KIUC's *Short-Term Seabird Habitat Conservation Plan* (Short-Term HCP) for a period of 5 years. The Short-Term HCP addresses the following federal and state-listed seabirds which are known to be adversely affected by KIUC facilities.

- Newell's shearwater (ʻaʻo) (*Puffinus auricularis newelli*)
- Hawaiian petrel (ʻuaʻu) (*Pterodroma sandwichensis*)
- Hawaiʻi distinct population segment of the band-rumped storm-petrel (hereafter band-rumped storm-petrel) (ʻakēʻakē) (*Oceanodroma castro*)

Before the Short-Term HCP was prepared, relatively little was known about the distribution, population, and behaviors of the three listed seabirds on Kauaʻi, or the extent of the effects of KIUC's facilities and operations on these species. Thus, a central purpose of the Short-Term HCP was to have KIUC, in concert with multiple conservation partners, implement a suite of specific monitoring and research projects, and use the resulting new information to inform the development and implementation of a subsequent HCP that would have a longer permit duration.

At the time the take authorization for the Short-Term HCP was issued to KIUC in 2011, USFWS expected that KIUC would receive longer-term take coverage under the *Kauaʻi Seabird Habitat Conservation Plan* (KSHCP; Section 1.2.1, *Kauaʻi Seabird Habitat Conservation Plan*). However, by 2015, monitoring data suggested that KIUC's annual take would exceed the capacity of the KSHCP, prompting a decision by DOFAW that KIUC needed to prepare a separate long-term HCP covering only KIUC's facilities and operations that result in take of the three listed seabirds.

1.2 Relationship to Other Habitat Conservation Plans on Kauaʻi

1.2.1 Kauaʻi Seabird Habitat Conservation Plan

DOFAW and USFWS approved the KSHCP in 2020 and issued federal ITPs and state ITLs to the qualifying applicant. The KSHCP covers the effects of artificial nighttime lighting on the Newell's shearwater (ʻaʻo), Hawaiian petrel (ʻuaʻu), band-rumped storm-petrel (ʻakēʻakē), and the Central North Pacific distinct population segment of the green sea turtle (hereafter green sea turtle) (honu) (*Chelonia mydas*). Take of listed species due to light attraction on Kauaʻi is an island-wide issue that adversely affects the above covered species and is collectively caused by many different entities (hotels and resorts, businesses, and government agencies). The duration of the KSHCP permits is 30 years and the geographic scope of the HCP is the entire island of Kauaʻi.

The structure of the KSHCP enables multiple parties on Kauaʻi to each hold their own federal ITP and state ITL for light attraction effects on the covered species at their particular facility under the coordinated framework of the KSHCP. This framework takes advantage of economies of scale and enables a pooling of funding resources to collectively implement mitigation activities to achieve the conservation goals of the KSHCP. The inclusion of eight entities[3] in the KSHCP involved the development of Participant Inclusion Plans that were approved by DOFAW and USFWS.

The KSHCP overlaps with the KIUC HCP in geographic scope and in coverage of the same three seabird species. Each of these plans addresses anticipated take of seabirds and sea turtles resulting from light attraction and includes conservation/mitigation measures to offset those impacts. The plans will be implemented separately.

1.2.2 Kaua‘i Lagoons Habitat Conservation Plan

Kaua‘i Lagoons LLC received approval from USFWS and DOFAW for the Kaua‘i Lagoons HCP in 2012. This HCP covers short-term construction and long-term resort and golf course operations at the approximately 600-acre Kaua‘i Lagoons Resort[4] in Līhu‘e. The Kaua‘i Lagoons HCP covers activities including new facility construction, general property operation and maintenance (including facility lighting), and public access and usage (e.g., driving, biking). The associated state ITL and federal ITP provide take authorization for Newell’s shearwater (‘a‘o), Hawaiian petrel (‘ua‘u), band-rumped storm-petrel (‘akē‘akē), Hawaiian stilt (ae‘o) (*Himantopus mexicanus knudseni*), Hawaiian coot (‘alae ke‘oke‘o) (*Fulica alai*), Hawaiian common gallinule (‘alae ‘ula) (*Gallinula galeata sandvicensis*), Hawaiian duck (koloa maoli) (*Anas wyvilliana*), and Hawaiian goose (nēnē) (*Branta sandvicensis*). The duration of the Kaua‘i Lagoons HCP is 30 years and the geographic scope is restricted to the resort property.

Although the Kaua‘i Lagoons HCP and the KIUC HCP provide take coverage for the same seabird and waterbird species and include light attraction of listed seabirds as a covered activity, there is no overlap in the location of KIUC streetlights and Kaua‘i Lagoon lights.

1.3 Scope of the KIUC HCP

1.3.1 Plan Area and Permit Area

The *Plan Area* is the area in which all covered activities and conservation measures will occur. Because KIUC operates an island-wide system exclusively on Kaua‘i and is proposing conservation measures in remote areas of the island, the KIUC HCP Plan Area covers the full geographic extent of Kaua‘i (see Figure 1-1). The *Permit Area* is the specific locations of all covered activities and conservation measures (i.e., the geographic area where the ITP applies); these locations are described in Chapter 2, *Covered Activities*, and in Chapter 4, *Conservation Strategy*.

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[3] These entities include NCL (Bahamas Ltd.), The Princeville Resort Kaua‘i, Kaua‘i Marriott Resort, Kaua‘i Coffee Company, LLC, Sheraton Kaua‘i Resort (Starwood Resorts), County of Kaua‘i, Hawai‘i Department of Transportation, and Alexander & Baldwin, Inc. The permit issued to Alexander and Baldwin, Inc. also covers their 11 subsidiaries and affiliates including A & B Properties Hawaii, LLC, Alexander & Baldwin, LLC, McBryde Sugar Company, LLC, McBryde Resources, Inc., Kukui‘ula Village, LLC, Kukui‘ula Development Company (Hawaii), LLC, KDC, LLC, ABP Waipouli, LLC, ABP LR1 LLC, ABP LR2 LLC, and ABP LR3 LLC.

[4] In 2015, the name of Kaua‘i Lagoons Resort was changed to Hōkūala Resort. In 2019–2020, the Hōkūala Community Association requested a minor amendment to change the name of the Kaua‘i Lagoons Habitat Conservation Plan to Hōkūala Habitat Conservation Plan. The minor amendment is pending further consideration by USFWS.

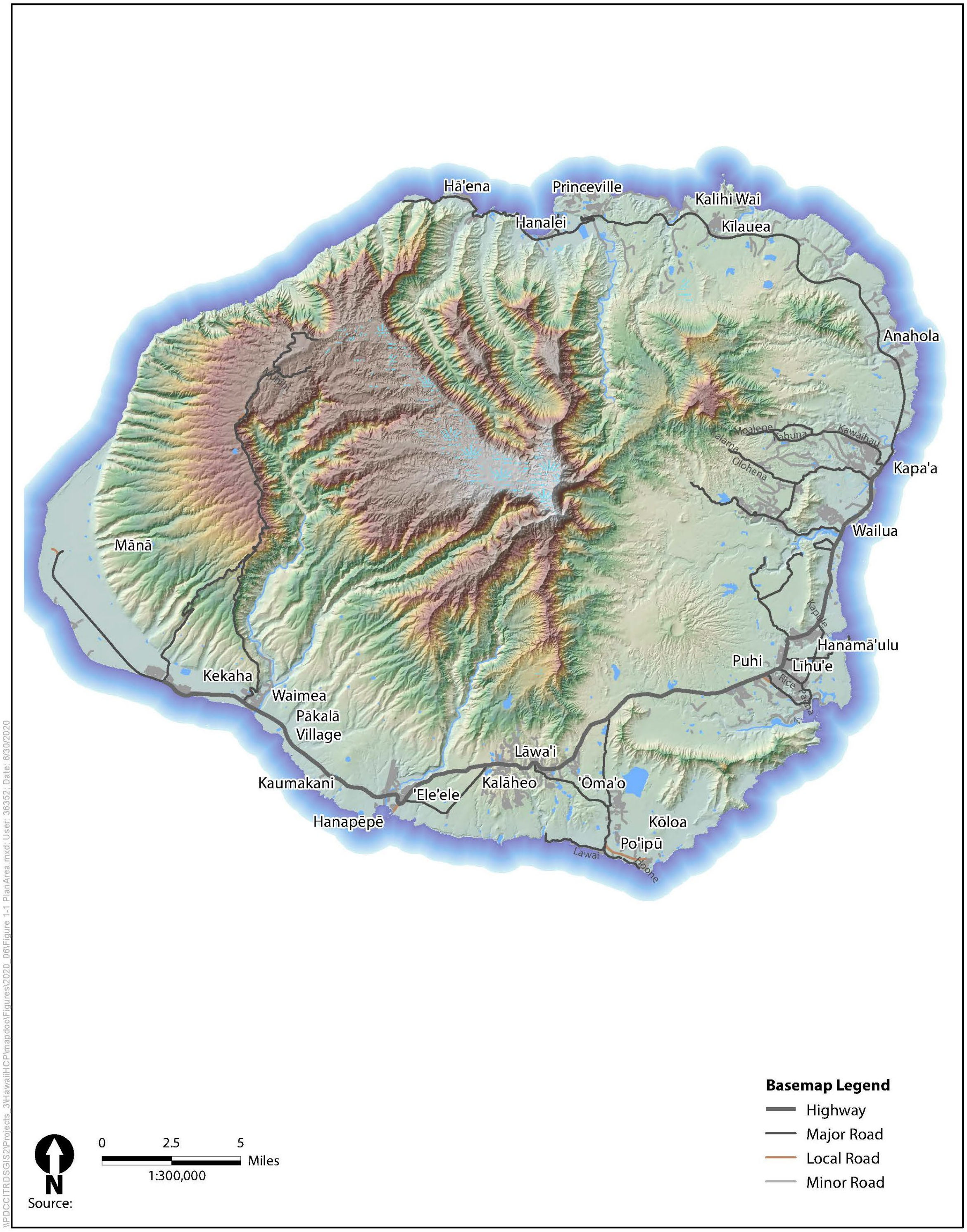

Figure 1-1. KIUC HCP Plan Area

1.3.2 Covered Species

Nine species are covered in this HCP and are referred to as *covered species* (Table 1-1). The covered species were selected based on their listing status and potential for the covered activities to result in take as defined by the federal ESA and state HRS Chapter 195D. Appendix 1A, *Evaluation of Special-Status Species Considered for Coverage*, describes the evaluation process and rationale by which KIUC selected the covered species.

Table 1-1. Covered Species

English Name	Hawaiian Name	Scientific Name	Status[a] (Federal/State)
Newell's shearwater	ʻaʻo	*Puffinus auricularis newelli*	T/T
Hawaiian petrel	ʻuaʻu	*Pterodroma sandwichensis*	E/E
Band-rumped storm-petrel[b]	ʻakēʻakē	*Oceanodroma castro*	E/E
Hawaiian stilt	aeʻo	*Himantopus mexicanus knudseni*	E/E
Hawaiian duck	koloa maoli	*Anas wyvilliana*	E/E
Hawaiian coot	ʻalae keʻokeʻo	*Fulica alai*	E/E
Hawaiian common gallinule	ʻalae ʻula	*Gallinula galeata sandvicensis*	E/E
Hawaiian goose	nēnē	*Branta sandvicensis*	T/E
Green sea turtle[c]	honu	*Chelonia mydas*	T/T

[a] Status:
E = Listed as endangered under the federal ESA or HRS Chapter 195D.
T = Listed as threatened under the federal ESA or HRS Chapter 195D.
[b] Hawaiʻi distinct population segment.
[c] Central North Pacific Region distinct population segment.

1.3.3 Covered Activities

Covered activities are those projects or ongoing activities that have the potential to take the covered species and for which KIUC is requesting take authorization. Covered activities include the continued operation and maintenance of many of KIUC's facilities; the construction, operation, and maintenance of certain future KIUC facilities; and implementation of the conservation measures described in this HCP. Covered activities are described in detail in Chapter 2, *Covered Activities*.

1.3.4 Permit Term

The *permit term* represents the period over which KIUC is authorized to incidentally take the covered species in conjunction with implementing the HCP. All conservation actions outlined in the HCP must also be completed within the permit term to offset the impacts of the covered activities on the covered species. KIUC is requesting take authorization from USFWS and DOFAW for 50 years. Accordingly, all assessments made in this HCP are based on a 50-year permit term.

This permit term was determined by KIUC as a reasonable timeframe to justify the significant investment in preparing and implementing this HCP. This period provides sufficient regulatory assurances to justify this investment and provides KIUC with the certainty it needs to continue to provide cost-effective electricity to its members on Kauaʻi. This permit term also provides enough time in which to implement the conservation strategy and conduct long-term biological monitoring to determine its effectiveness in offsetting the impacts of the taking of the covered species caused by covered activities. As discussed in Chapter 7, *Plan Implementation*, prior to the expiration of the KIUC HCP and the take authorizations, KIUC may apply to renew or extend the federal ITP, and the state ITL in accordance with applicable laws existing at that time.

1.4 Regulatory Context

1.4.1 Federal Endangered Species Act

The federal ESA provides for the conservation of endangered or threatened species and the ecosystems on which they depend. Section 9 of the federal ESA prohibits the take of endangered or threatened wildlife species without a special exemption. Under the federal ESA, the term *take* means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect listed species or to attempt to engage in any such conduct (16 United States Code [U.S.C.] 1532; 50 Code of Federal Regulations [CFR] 17.3). *Harm* includes significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns including, but not limited to, breeding, feeding, or sheltering (50 CFR 17.3). *Harass* is defined as intentional or negligent acts or omissions that create the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt essential behavioral patterns including, but not limited to, breeding, feeding, or sheltering (50 CFR 17.3).

1.4.1.1 Federal Section 7 Process

Section 7 of the federal ESA requires all federal agencies to ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of a listed species or result in the destruction or adverse modification of critical habitat. To that end, proposed federal actions that may affect listed species or critical habitat trigger formal consultation with USFWS, unless a may affect, not likely to adversely affect determination is warranted. The proposed issuance of a federal ITP for this HCP is a federal action that triggers a formal ESA Section 7 consultation. Consultation begins when the federal agency submits a written request for initiation to USFWS, along with a biological assessment (BA) of its proposed action and when USFWS accepts that BA as complete. If USFWS concurs with the finding in the BA that the action is not likely to adversely affect a listed species or critical habitat, the action may be conducted without further review under the federal ESA. If not, formal consultation is conducted. The outcome of formal consultation is USFWS issuance of a biological opinion (BiOp) describing how the proposed federal agency action is likely to affect the listed species and its critical habitat, and whether the action complies with the federal ESA Section 7 mandate to avoid jeopardy and destruction/adverse modification of critical habitat. For this HCP, USFWS will consult internally (with itself) to comply with Section 7 of the federal ESA.

If the BiOp concludes the proposed federal action is likely to jeopardize the continued existence of a listed species or adversely modify its critical habitat, the BiOp will include “reasonable and prudent alternatives” to avoid those outcomes. If the BiOp concludes that the proposed federal action would take a listed species but would not jeopardize its continued existence or destroy or adversely modify critical habitat, the BiOp will include an incidental take statement exempting anticipated take. *Incidental take* “refers to takings that result from, but are not the purpose of, carrying out an otherwise lawful activity” (50 CFR 402.02). The incidental take statement accompanying the BiOp specifies the form, the amount or extent of anticipated take and reasonable and prudent measures and terms and conditions to minimize the impacts of the taking on the listed species and to specify monitoring and reporting requirements.

1.4.1.2 Federal Section 10 Process

Section 10(a) of the federal ESA establishes a process for non-federal entities to obtain authorization to incidentally take ESA-listed species. Private landowners, corporations, state agencies, local agencies, and other non-federal entities must obtain a Section 10(a)(1)(B) federal ITP for take of federally listed fish and wildlife species "that is incidental to, but not the purpose of, otherwise lawful activities." Submission of a conservation plan, generally referred to as an HCP, is required for all ESA Section 10 federal ITP applications. A detailed description of the HCP process is presented in the *Habitat Conservation Planning and Incidental Take Permit Processing Handbook* (HCP Handbook) (U.S. Fish and Wildlife Service and National Marine Fisheries Service 2016).

1.4.2 Hawai'i Revised Statutes, Chapter 195D

HRS Chapter 195D is the state's legislation corresponding to the federal ESA. Chapter 195D formally declares the state's policy to proactively ensure that the survival of indigenous aquatic life, wildlife, and plants and their habitat are perpetuated, and provides that any species listed as endangered or threatened pursuant to the federal ESA is automatically deemed to be an endangered or threatened species by the state. Section 195D-3 expressly prohibits, except as permitted by rules adopted by DOFAW, any person to take, possess, transport, transplant, export, process, sell, offer for sale, or ship any species that DOFAW has determined to need conservation (see also HRS Section 195D-4(e)). Under the HRS, *take* is defined similarly to the federal ESA as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect endangered or threatened species of aquatic life or wildlife, or to cut, collect, uproot, destroy, injure, or possess endangered or threatened species of aquatic life or land plants, or to attempt to engage in any such conduct.

HRS Section 195D-4(g) establishes a process for permitting incidental take. After consultation with the Endangered Species Recovery Committee (ESRC), the Board of Land and Natural Resources (BLNR) may issue a take authorization in the form of a temporary license as part of an HCP to allow take otherwise prohibited if the take is incidental to, and not the purpose of, carrying out an otherwise lawful activity. The role of the ESRC (Section 195D-25) is to provide guidance to DOFAW and BLNR on matters relating to endangered, threatened, proposed, and candidate species. The ESRC is comprised of biological experts, representatives of relevant federal and state agencies (e.g., USFWS, U.S. Geological Survey, DOFAW), and other appropriate governmental and non-governmental members. The ESRC reviews all HCP permit applications and makes recommendations to BLNR on whether they should be approved, amended, or rejected. The ESRC also reviews all existing HCPs and state ITLs annually to ensure compliance and makes recommendations for any necessary changes to existing HCPs.

1.5 Habitat Conservation Plan Process

The process for obtaining federal and state incidental take authorization has three phases: (1) the HCP development phase; (2) the permit application processing phase; and (3) if a permit is issued, the post-issuance/implementation phase.

1.5.1 HCP Development Phase

During the HCP development phase, the applicant prepares an HCP that includes a description of covered activities, covered species, the conservation program that will be implemented to avoid, minimize, and mitigate the impacts of anticipated taking of listed species, and funding assurances for implementation of the HCP. Based on the USFWS and National Marine Fisheries Service (2016) HCP Handbook, an HCP submitted in support of a federal ITP application must include the following information.

- A complete description of the activity(ies) for which take will be authorized.
- A determination of the type and potential amount of take of the covered species caused by covered activities, and specification of the impacts on the covered species likely to result from such taking.
- Steps and measures that the applicant will implement to avoid, minimize, and mitigate such impacts, to the maximum extent possible.
- Assurances that adequate funding will be made available to implement the avoidance, minimization, and mitigation measures proposed under the HCP.
- Procedures and funding to deal with changed circumstances.
- Alternative actions to such taking that were considered, and the reasons why such alternatives are not being utilized.
- A discussion of the biological goals and objectives of the HCP.
- A monitoring plan.
- An adaptive management plan.

Pursuant to HRS Section 195D-21(a), HCPs submitted in support of a state ITL must provide the following information.

- The geographic area encompassed by the HCP.
- The ecosystems, natural communities, or habitat types within the Plan Area that are the focus of the HCP.
- The endangered, threatened, proposed, and candidate species known or reasonably expected to occur in the ecosystems, natural communities, or habitat types in the Plan Area.
- The activities contemplated to be undertaken with sufficient detail to allow DOFAW to evaluate the impact of the activities on the ecosystems, natural communities, or habitat types within the Plan Area.
- The measures to be undertaken to protect, maintain, restore, or enhance those ecosystems, natural communities, or habitat types within the Plan Area.
- A schedule for implementation of the proposed measures and actions contained in the HCP.
- An adequate funding source to ensure that the proposed measures and actions contained in the HCP are undertaken in accordance with the schedule.

The HCP development phase concludes, and USFWS's permit processing phase begins when the applicant submits a complete permit application package to USFWS. HRS Section 195D-4(i) directs

DOFAW to work cooperatively with federal agencies to concurrently process federal ITP and state ITL permit applications pursuant to the federal ESA on a consolidated basis to the extent feasible to minimize procedural burdens upon the applicant.

1.5.2 Permit Processing Phase

Once an applicant submits a draft HCP and a complete federal ITP application, USFWS publishes a Notice of Availability of the draft HCP document (and the draft National Environmental Policy Act [NEPA] document that accompanies the draft HCP) in the *Federal Register* for a 30-day minimum public comment period on the potential issuance of a federal ITP based on the HCP. After a complete application has been received, USFWS initiates the internal ESA Section 7 consultation process addressing the effects of the HCP and the federal ITP action on listed species and critical habitat (Section 1.4.1.1, *Federal Section 7 Process*). The culmination of the consultation process is USFWS's issuance of a BiOp. The public comment period and consultation process are important feedback mechanisms during HCP development and can inform other measures the Secretary of the Interior may require as being necessary or appropriate for purposes of the plan pursuant to the authority for such measures under ESA Section 10(a)(2)(A)(iv).

When the BiOp is completed, USFWS prepares the required federal ESA findings under Section 10 and decides whether it will issue the federal ITP. These findings analyze whether the HCP meets each component of the Section 10 permit issuance criteria. The statutory and regulatory federal ITP issuance criteria for each covered species are listed below.

- The taking will be incidental to an otherwise lawful activity.
- 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 HCP will be provided.
- The HCP includes provisions to address any changed or unforeseen circumstances.
- The taking will not appreciably reduce the likelihood of survival and recovery of the listed species in the wild.
- The applicant will ensure that other measures required by USFWS as being necessary or appropriate will be met.
- USFWS has received assurances that the applicant will implement the HCP.

The State of Hawai'i's BLNR approval process for an HCP and issuance of the state ITL occurs in parallel with the federal process. DLNR reviews the HCP for consistency with state regulations on the take of listed species and the Office of Environmental Quality Control publishes a Notice of Availability of the draft HCP in its bulletin *The Environmental Notice* for a 60-day minimum public comment period.[5] During this time, the ESRC meets to review and provide comments on the draft HCP, conducts a site visit, reviews any revisions to the draft HCP resulting from public comment and USFWS consultation (DOFAW would also hold a public meeting on Kaua'i), and provides a recommendation to approve or deny the HCP/ITL application to BLNR. BLNR then decides to approve or deny the HCP/ITL application; if the HCP is approved, DOFAW issues the state ITL.

[5] At DLNR's discretion, the state public comment period can be initiated as soon as the public draft HCP is complete, prior to the federal comment period.

1.5.3 Implementation Phase

If the federal ITP and state ITL are issued, the applicant (now a permittee) will implement the HCP as described in the final HCP, the federal ITP, and state ITL. The applicant will prepare regular monitoring reports and will coordinate with USFWS as specified in the HCP and federal ITP. USFWS will monitor and review the permittee's compliance with the HCP and federal ITP, including the progress towards achieving the HCP's biological goals and objectives, over the entire permit term. In addition, the ESRC will review the HCP and state ITL on an annual basis to ensure compliance with all agreed upon activities and make recommendations for any necessary changes on the basis of available monitoring reports and scientific and other reliable data.

1.5.4 National Environmental Policy Act

NEPA requires federal agencies to analyze the environmental impacts of their discretionary decisions and ensure that environmental information is available to agency officials before decisions are made and before actions are taken. NEPA also ensures public scrutiny during project planning and decision-making. Depending on the scope and potential effects of the HCP, the federal agency usually prepares one of three environmental documents: (1) a categorical exclusion; (2) an environmental assessment; or (3) an environmental impact statement (EIS). The NEPA process helps federal agencies make informed decisions with respect to the environmental consequences of their actions and ensures that measures to protect, restore, and enhance the environment are included, as necessary, as a component of their actions.

Although the federal ESA and NEPA requirements overlap considerably, the scope of NEPA goes beyond that of the federal ESA by considering impacts of a federal action not only on fish and wildlife resources but also on other resources such as water quality, air quality, and cultural resources.

1.5.5 Migratory Bird Treaty Act

The Migratory Bird Treaty Act of 1918, as amended (MBTA), implements various treaties and conventions between the United States and Canada, Japan, Mexico, and the former Soviet Union for the protection of migratory birds. Under the MBTA, taking, killing, or possessing migratory birds is unlawful, as is taking of any parts, nests, or eggs of such birds (16 U.S.C. 703). Take is defined more narrowly under the MBTA than under the federal ESA and includes only the death or injury of individuals of a migratory bird species or their eggs. The MBTA defines migratory birds broadly; all covered birds in this HCP are considered migratory birds under the MBTA.

USFWS provides guidance regarding take of federally listed migratory birds (U.S. Fish and Wildlife Service and National Marine Fisheries Service 2016:Appendix 5). According to these guidelines, an incidental take permit can function as a Special Purpose Permit under the MBTA (50 CFR 21.27) for the take of all ESA-listed migratory birds that are covered by the HCP in the amount and/or number and subject to the terms and conditions specified in the HCP. Any such take would not be in violation of the MBTA (16 U.S.C. 703-12).

All the covered bird species identified in Table 1-1 are protected by the MBTA and listed under the federal ESA. Accordingly, once issued, the federal ITP will automatically function as a Special

Purpose Permit under the MBTA, as specified under 50 CFR 21.27, for these species for a 3-year term subject to renewal by KIUC.

Other migratory birds not covered by the HCP and that may be affected by the covered activities are discussed in the NEPA document for this HCP.

1.5.6 Hawaiʻi State Environmental Review Law

The State of Hawaiʻi Office of Environmental Quality Control facilitates the state's environmental review process pursuant to HRS Chapter 343 and its implementing regulations (Hawaiʻi Administrative Rules 11-200), also commonly known as the Hawaiʻi Environmental Protection Act. The office announces the availability of environmental assessments and EISs for public review and comment, as well as summaries of proposed actions and details of upcoming EIS public scoping meetings in its semi-monthly publication, *The Environmental Notice*. The office is responsible for environmental oversight and review and assists throughout the environmental review process.

1.5.7 National and State Historic Preservation Acts

The National Historic Preservation Act (NHPA) of 1966 (16 U.S.C. 470) established a comprehensive program to preserve the historical and cultural foundations of the nation as a living part of community life. Prior to implementing an *undertaking* (e.g., issuing a federal permit), Section 106 of the NHPA requires federal agencies to assess and determine whether the undertaking has the potential to affect historic properties that are on the National Register of Historic Places (National Register) or that are eligible for listing on the National Register, and to afford the Advisory Council on Historic Preservation and the State Historic Preservation Officer (SHPO) a reasonable opportunity to comment on any undertaking that may adversely affect such properties. NHPA Section 101(d)(6)(A) allows properties of traditional religious and cultural importance to a tribe or Native Hawaiian organization to be determined eligible for inclusion on the National Register if they meet the listing criteria. The Section 106 process normally involves step-by-step procedures that are described in detail in the implementing regulations (36 CFR 800) and summarized below.

- Establish if the proposed federal action constitutes an undertaking as defined in the NHPA.
- Delineate the Area of Potential Effect.
- Identify and evaluate historic properties in consultation with the SHPO and interested parties.
- Assess the effects of the undertaking on properties that are eligible for inclusion on the National Register.
- Where effects are present, consult with the SHPO, other agencies, and interested parties to develop an agreement that addresses the treatment of historic properties and notify the Advisory Council on Historic Preservation accordingly.
- Finally, proceed with the project according to the conditions of the agreement.

HRS Chapter 6E establishes a comprehensive program of historic preservation to promote the use and conservation of historic properties for the education, inspiration, pleasure, and enrichment of state citizens. HRS Section 6E-8 requires that before any agency or officer of the state or its political subdivisions commences any project that may affect an historic property, aviation artifact, or a burial site, the agency or officer must advise DOFAW and allow the department an opportunity for review of the effect of the proposed project and obtain its written concurrence before commencing. KIUC must comply with the requirements of this law and its regulations as it implements the avoidance, minimization, and mitigation measures that are part of the KIUC HCP.

1.6 Organization of the KIUC HCP

The KIUC HCP consists of the following sections.

- Chapter 1, *Introduction and Background*, provides an overview of KIUC as the applicant, the purpose and need for the KIUC HCP, and the regulatory framework within which the KIUC HCP is being prepared.
- Chapter 2, *Covered Activities*, describes KIUC's existing and future activities that are covered by the KIUC HCP.
- Chapter 3, *Environmental Setting*, describes the existing conditions of the Plan Area relevant to the HCP.
- Chapter 4, *Conservation Strategy*, summarizes the conservation strategy and describes the specific conservation actions to be implemented to fully offset the impacts of the taking of covered species by covered activities, and to contribute to the recovery of the covered species.
- Chapter 5, *Effects*, presents the impacts of the covered activities on each of the covered species.
- Chapter 6, *Monitoring and Adaptive Management*, discusses the monitoring requirements and adaptive management procedures associated with implementation of conservation actions and reserve management.
- Chapter 7, *Plan Implementation*, discusses how the HCP is to be implemented and funded over time, including timeframes and success criteria.
- Chapter 8, *Alternatives to Take*, presents the required analysis of alternatives considered that would reduce take of the covered species but were rejected by KIUC and why they were rejected.
- Chapter 9, *References*, lists the documents and sources cited and relied upon in preparing this HCP.
- Chapter 10, *Glossary of Terms*, provides definitions for technical terms used in the HCP.
- Chapter 11, *List of Contributors*, provides a list of individuals that contributed to the HCP.
- Appendix 1A, *Evaluation of Special-Status Species for Coverage in the KIUC HCP*, lists the special-status species that were considered for coverage under this HCP, their legal status, their coverage under the HCP (covered or noncovered status), and the rationale for coverage. Attachments to this appendix provide additional detail on Hawaiian hoary bat (‘ōpe‘ape‘a) (*Lasiurus cinereus semotus*) and listed plant species, including avoidance and minimization measures that must be implemented during the 50-year HCP permit term.
- Appendix 3A, *Species Accounts*, presents detailed ecological accounts of all covered species, including modeling results of habitat distribution, that were developed for selected species.

- Appendix 4A, *Conservation Site Selection Process*, presents the methods and results for habitat suitability analyses and population distribution modeling that were conducted to inform the conservation site selection process.
- Appendix 4B, *KIUC Minimization Projects*, presents a spreadsheet of all KIUC's completed and planned powerline flight diverters and static wire removal projects.
- Appendix 4C, *Invasive Plant Species Control Methods*, present the invasive plant species control methods that are currently employed (and will continue to be employed during HCP implementation) within the conservation sites
- Appendix 5A, *Variables Influencing Powerline Strike*, presents the methods and results for estimating take of the covered seabird species caused by light attraction due to KIUC streetlights and lights at KIUC facilities on Kaua‘i.
- Appendix 5B, *Rapid Waterbird Powerline Collision Assessment*, describes each of the variable influencing powerline strikes, with an emphasis on the covered seabirds.
- Appendix 5C, *Light Attraction Modeling*, presents the methods and results for estimating take of the covered seabird species caused by light attraction due to KIUC streetlights and lights at KIUC facilities on Kaua‘i.
- Appendix 5D, *Bayesian Acoustic Strike Model*, outlines the methods and results for estimating pre-HCP annual collisions with existing powerlines
- Appendix 5E, *Population Dynamics Model for Newell's Shearwater (‘a‘o) on Kaua‘i*, presents the methods and results for the effect of KIUC's minimization and conservation actions on the Kaua‘i metapopulations of Newell's shearwater (‘a‘o).
- Appendix 5F, *Population Dynamics Model for Hawaiian Petrel (‘ua‘u) on Kaua‘i*, presents the methods and results for the effect of KIUC's minimization and conservation actions on the Kaua‘i metapopulations of Hawaiian petrel (‘ua‘u).
- Appendix 6A, *KIUC Monitoring Protocols and Procedures for Protected Seabirds*, described the monitoring protocols and procedures that will be employed to locate and rescue grounded seabirds at KIUC covered facilities and at construction sites with night lighting.
- Appendix 7A, *Cost Model,* describes the cost model used to estimate HCP costs described in Chapter 7.

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Chapter 2
Covered Activities

This chapter describes existing and future activities for which KIUC is seeking take coverage under the HCP; these activities are collectively referred to as *covered activities*. The scope of covered activities was determined using a systematic process involving the application of screening criteria. Under the HCP, a covered activity must meet all of the following criteria. These criteria are based on the requirements in the Habitat Conservation Planning and Incidental Take Permit Processing Handbook (U.S. Fish and Wildlife Service and National Marine Fisheries Service 2016).

- **Control or Authority:** The covered activity must be under the direct control of KIUC as a project or activity it implements directly, implements through contracts or leases, or controls through a regulatory framework (e.g., under a federal or state permit or other authorization).
- **Location:** The covered activity must occur within the geographic area of the KIUC HCP Plan Area (see Section 1.3.1, *Plan Area and Permit Area*).
- **Timing:** The covered activity must occur during the proposed permit term (50 years; see Section 1.3.4, *Permit Term*).
- **Impact:** The covered activity must have a reasonable likelihood of causing incidental take of one or more covered species (see Section 1.3.2, *Covered Species*).
- **Project Definition:** The location, footprint, frequency, and types of impacts resulting from the activity can be defined well enough such that direct and indirect impacts to covered species can be evaluated and conservation measures can be developed.

The covered activities that meet all these criteria are described in three broad categories: (1) powerline operations and retrofit, (2) lighting operations, and (3) implementation of the HCP conservation strategy. These categories are described in the following subsections as they relate to operation and retrofit of existing and future KIUC infrastructure. KIUC is seeking take coverage under federal and state permits for all covered activities described in this chapter.

The final section of this chapter lists KIUC infrastructure operations and retrofit activities not covered by the HCP because it was determined they do not meet one or more of the criteria listed above.

The covered activities described in this chapter are intended to be as inclusive as possible of KIUC activities currently occurring or expected to occur in the Permit Area and that have a reasonable likelihood of causing incidental take of the covered species. Any activities identified in the future that, in either or both U.S. Fish and Wildlife Service's (USFWS) or State of Hawai‘i Department of Land and Natural Resources, Division of Forestry and Wildlife's (DOFAW) view may not clearly fall within the scope of covered activities described in this chapter will be evaluated on a case-by-case basis, by USFWS and DOFAW to determine whether take is covered under their respective permits, or whether a new permit or permit amendment is required. Factors the agencies will consider in this assessment include, but are not limited to, the following.

- The activity is under the direct control or authority of KIUC.
- The activity does not increase the probability that the biological goals and objectives of the HCP (Chapter 4, *Conservation Strategy*) cannot be met.

- The activity does not change the types of impacts evaluated in Chapter 5, *Effects Analysis*, including, without limitation, the take estimate of any covered species.
- Adequate take coverage under the federal and state permits remains available for the covered activities originally described in the KIUC HCP.
- The activity is otherwise legal, does not require an HCP amendment under then applicable law, and does not require additional regulatory compliance including, without limitation, supplemental National Environmental Policy Act/Hawaiʻi Environmental Policy Act analysis.

If USFWS or DOFAW determines that a specific project or activity is reasonably certain to cause take of the of the covered species and is under KIUC's control but it is not included within the descriptions in this chapter, then KIUC will not receive coverage under their respective permits, and KIUC may, at its discretion, apply for an amendment to either the federal incidental take permit or state incidental take license, or both, in accordance with processes set out in then-applicable law.

2.1 Powerline Operation, Retrofit and Use of Night Lighting for Repairs

2.1.1 Powerline Operation

KIUC owns and operates overhead electric powerlines on Kauaʻi (Figure 2-1). The wire sizes and pole heights vary widely for each type of line depending on site-specific physical circumstances present along the powerline corridor (e.g., topography). Moreover, line configuration may switch from one type to another (and often back again) within distances of as little as a few hundred feet (ft) depending on site-specific conditions. This changeability makes it impossible to map the differences on a system-wide scale. All KIUC wires on Kauaʻi are considered operational when the wires are in place (i.e., when they are in the bird's flight path) but they do not need to be electrified. The types of KIUC wires with the potential to cause take of the covered species fall into one of the following three categories: (1) transmission, (2) distribution, and (3) communication (Figure 2-2a). KIUC is seeking permit coverage for all existing and future KIUC wires falling into one of these three categories and all existing and future KIUC supporting structures holding these wires. Supporting structures for the purposes of this HCP include only poles, towers, lattice structures, and H-frames[1] (hereafter referred to as support structures).

- **Transmission Wires**. KIUC owns and operates 171 circuit-miles[2] (mi) (275 kilometers [km]) of transmission lines. Transmission wires are typically raised between 59 ft (18 meters [m]) and 79 feet (24 m) above the ground, with the tallest lines more than 100 ft (34 m) above the ground (Figures 2-2a and 2-2b). There are roughly 1,330 KIUC-owned support structures that support the transmission wires. The transmission circuits are protected from lightning strikes by a wire mounted above the conductor wire, known as an overhead shield wire (OHSW), static wire, or earth wire. The OHSW, if present, is typically the highest wire and, because it is a smaller and

[1] Poles and towers are columns or posts that are differentiated based on the type of material: poles are wood, and towers are steel. Lattice structures and H-frame structures are also currently part of the grid system and can both be made of either wood or steel (Kauaʻi Island Utility Cooperative 2020).

[2] A circuit-mile is defined as 1 mile of either a set of alternating current three-phase conductors in an overhead or underground alternating current circuit, or one pole of a direct current circuit.

lighter wire, it sags less than the conductor wires. A fiber-optic communication cable may be present in place of the OHSW. There are approximately 16.4 mi (141 km) of static wires and 15 mi (24 km) of fiber-optic communication wires.

A single transmission circuit is comprised of three conductor wires (three phases) that can be on one or both sides of the pole and can switch back and forth. These wires are nearly always bare aluminum; often two circuits are mounted on a single pole. This configuration is common on the west side of Kauaʻi. However, on the east and north sides of Kauaʻi, transmission lines often include double circuits with six wires on alternate sides of the pole (Travers et al. 2019). Transmission wires can be arranged in three different types of arrays.

- ○ Vertical arrays, where the conductor wires are immediately above one another on the pole (Figure 2-2a).
- ○ Triangular arrays, where conductor cables are mounted on either side of the pole.
- ○ Horizontal arrays, where the lines are mounted on horizontal crossarms or post-type insulators, which is rare for transmission wires but more common for distribution wires.

- **Distribution Wires**. KIUC owns and operates 816 circuit-mi (1,408 km) of distribution lines. Distribution wires built on the same pole as transmission wires are always mounted underneath the transmission wires (termed an *under-build*; Figure 2-2a). Where transmission wires are not present, distribution wires are mounted on support structures that are 40 to 50 ft (12 to 15 m) tall (Figure 2-2a), often with under-build service circuits mounted below the distribution wires. There are roughly 25,000 KIUC-owned support structures that support distribution, and some of these support structures also support transmission wires above the distribution wires. Distribution circuits can range from two to four wires (i.e., one to three conductors and a neutral wire), depending on the requirements in the area. Distribution wires can be placed closer together than transmission wires because they carry a lower voltage. As with transmission lines, the distribution wires are arranged in a variety of ways and a variety of heights depending upon each pole's site-specific circumstances; it is common for distribution wires to be vertically spaced on alternating sides of the pole (Travers et al. 2019). Moreover, distribution circuits frequently change from one configuration to another over a short distance. In some instances, distribution wires owned by other public agencies or private entities are located on the same pole with KIUC distribution wires. Distribution wires less than 35 feet in height are not covered by this HCP because they are below the height where collisions with covered seabirds are likely to occur (see Section 2.4, *Activities Not Covered*).
- **Communication Wires**. KIUC owns and operates approximately 70 circuit-mi (112 km) of communication lines. KIUC's communication wires are typically only present where transmission lines are also present but are not present in all transmission line locations. The communication wire, if present, is typically mounted below the transmission and distribution wires and is therefore typically the nearest wire to the ground (Figures 2-2a and 2-2b). Because the communication wire consists of fragile fiber-optic cable, it is protected by a black plastic buffer tube. The buffer tubes may be different diameters depending on the length of the wire. In some cases, the communication wire serves as the static wire at the top of the line, as described above under *Transmission Wires*.

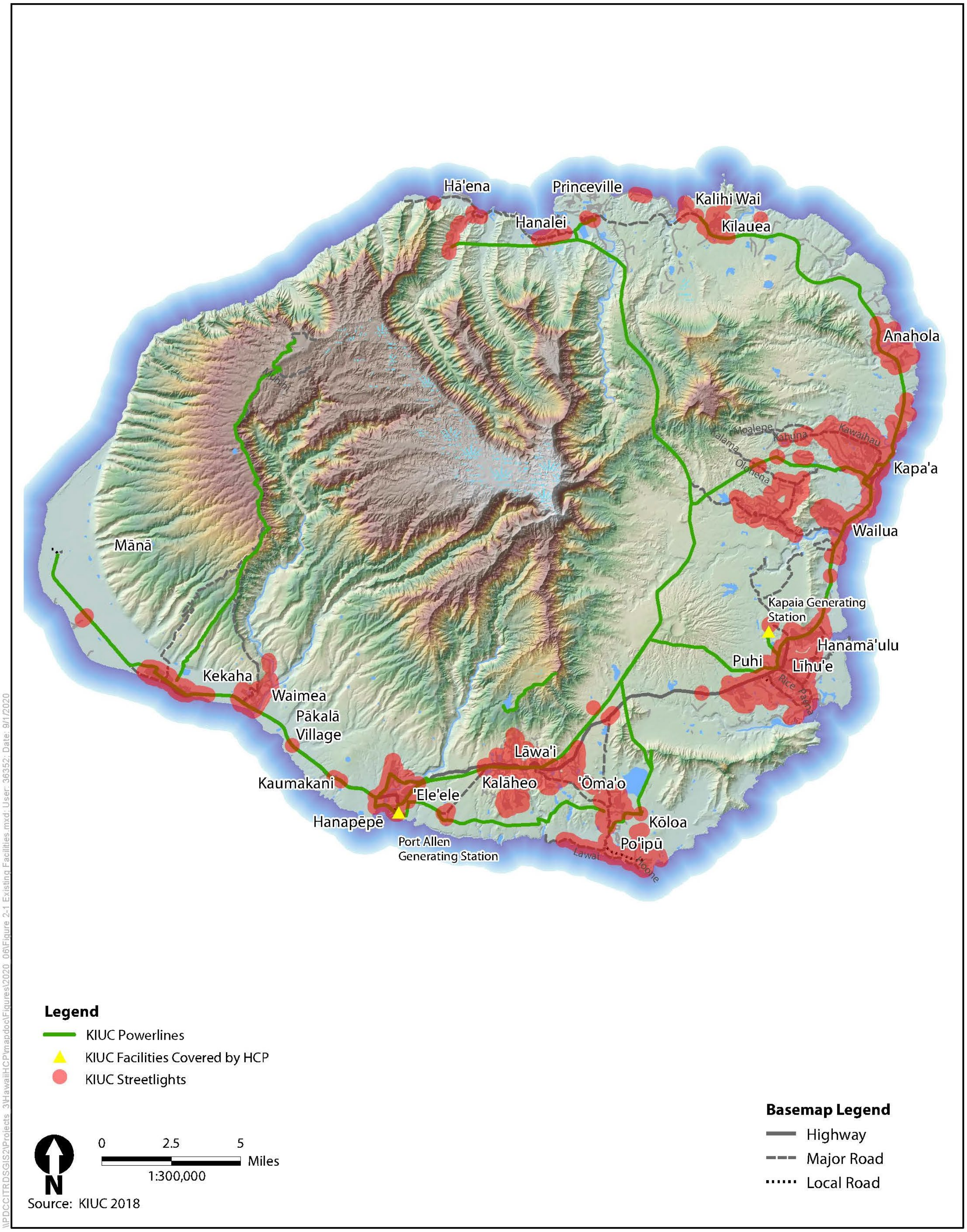

Figure 2-1. Covered Activities: Existing Facilities

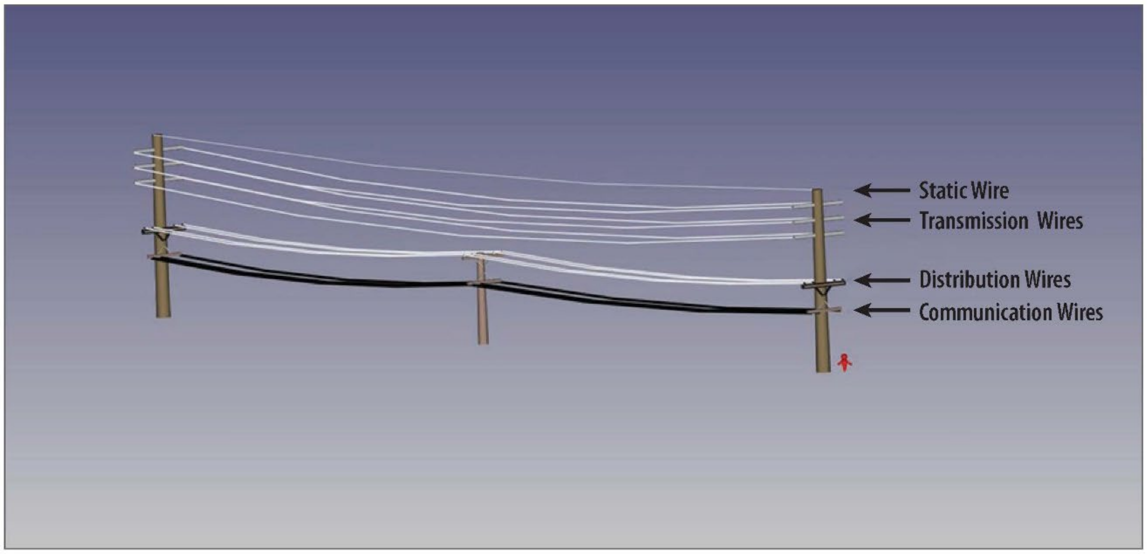

FIGURE 2-2a. Types of wires covered in the KIUC HCP, shown in a vertical array.

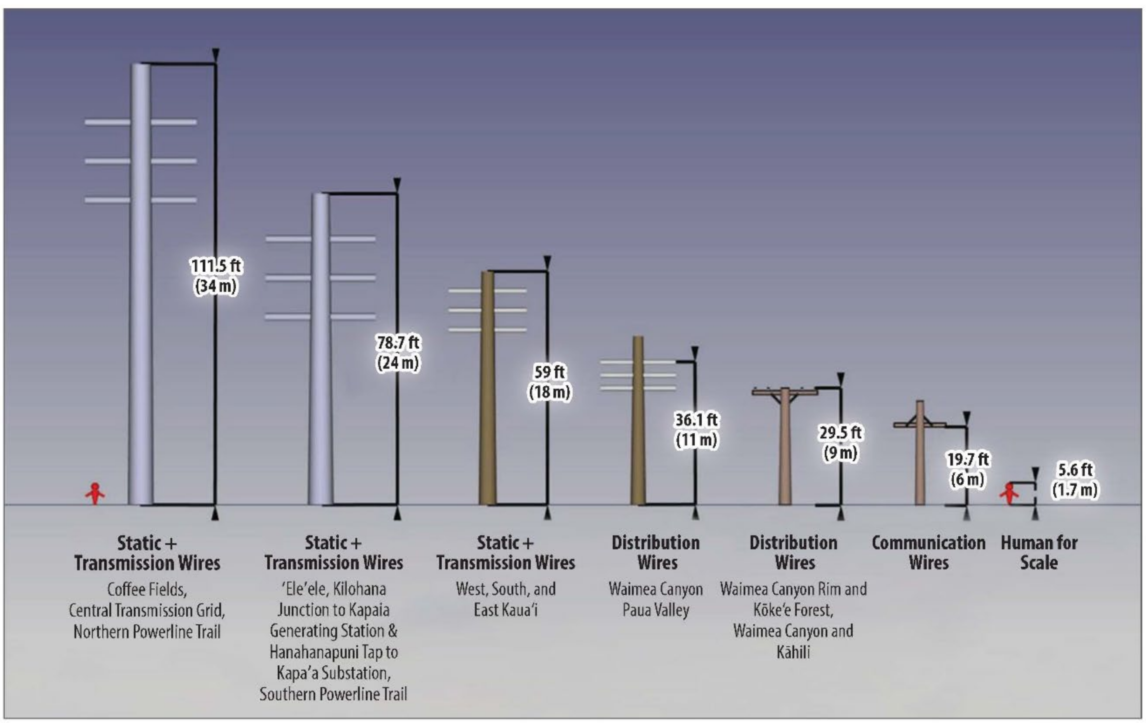

FIGURE 2-2b. Typical wire heights of KIUC transmission, distribution, and communication lines based on general location.

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Source: Travers et al. 2019

Figure 2-2. Typical Wire Types and Heights of KIUC Powerlines

2.1.2 Powerline Retrofits: Additional Powerlines and Changes in Wire Numbers and Configuration

KIUC periodically modifies transmission lines or distribution lines in response to changes in electricity demand. In other cases, KIUC may modify powerline systems in response to changing land uses that might interfere with safe and reliable power delivery. In either instance, powerline retrofits are covered activities if these modifications change wire height, add new powerlines, or expose wires, as described below.

2.1.2.1 Increasing Wire Height

KIUC increases wire height primarily to meet minimum clearance standards. For example, reconductoring, which replaces a smaller conductor with a heavier-duty one, is occasionally necessary to accommodate increasing electrical loads on the lines. To maintain a proper offset distance between the wires, the height of a heavier-duty line must sometimes be increased.

Retrofit of wires with increased heights is a covered activity in this HCP. KIUC estimates that over the 50-year permit term, 16 percent of their total transmission wire length (i.e., 27.2 mi [43.8 km]) will require wire height increases (an average of 0.54 mile [0.9 km] per year for 50 years).

2.1.2.2 Adding New Powerlines

KIUC adds new powerlines into its electric system to increase capacity, especially to carry additional electrical load during times of peak usage. New powerlines can provide redundancy in the system that reduce or prevent power outages for customers. New powerlines are expected in response to growing demand for power due to population growth. In addition, KIUC expects to install new powerlines to connect new power sources (e.g., new renewable generation stations) to the electric grid. KIUC expects to install new powerlines in three circumstances, each of which is summarized below.

1. Adding wires to existing circuits (i.e., on existing poles or towers and on existing support structures).
2. Adding new powerlines to new poles or towers in existing rights-of-way (i.e., adjacent to existing powerline circuits).
3. Adding new powerlines to new poles or towers in new rights-of-way (i.e., where powerlines did not exist before).

KIUC frequently adds new wires to their existing circuits to accommodate growth in demand and to increase redundancy in the system. In some cases, KIUC can offset the effects of the additional wires by changing the vertical arrangement to a horizontal (i.e., one-level) arrangement.

When there is no additional capacity or space available on existing poles or towers, KIUC must construct new powerline corridors with new poles or towers. To save costs, improve efficiency of operations, and minimize visual impacts KIUC strives to place these new powerlines in an existing right-of-way adjacent to existing power poles or towers. However, there are many cases where this is not feasible owing to narrow rights-of-way or land use constraints that do not allow a wider corridor. In these instances, KIUC would build a new powerline (with new poles or towers) in a new right-of-way.

In all these cases, KIUC does not control where new demands for electrical service will arise. KIUC is a secondary developer of new powerlines that is asked to provide electricity based on the request of a primary developer of the new power demand (e.g., a new residential development, a new commercial development, or a new power generation source). In all cases the primary developer will address cultural resource issues associated with project construction, including the location of new powerline poles or towers, through the Hawaiʻi Revised Statutes 6E regarding historic preservation, where appropriate. Construction of new powerlines is not a covered activity under this HCP until the wires are in place (they do not need to be electrified), because construction activities are not expected to result in take of covered species (Section 2.4, *Activities Not Covered*). KIUC is requesting take coverage for the operation of new wires and support structures in locations that are currently unknown. KIUC estimates that over the 50-year permit term, a maximum of 34 percent of its powerlines (348 mi [560 km]) will require new wires (an average of 7 mi [11.3 km] per year for 50 years). Of these 348 mi (560 km) of new wires, a maximum of 17 percent will be in high-collision-risk zones (in comparison to 48 percent in low-collision-risk zones) and most of the new powerlines will be distribution lines.

2.1.2.3 Exposing Wires

Vegetation management is performed near powerlines to maintain adequate clearance. Vegetation management is a covered activity only when and where it exposes wires that were previously shielded by vegetation.

2.1.3 Operation of New or Extended Powerlines

As described above, KIUC expects to add new or extend existing powerlines to accommodate growth and to integrate renewable resources across Kauaʻi. KIUC will also need to expand the system of distribution lines to service new homes and businesses that are developed outside of the existing network of distribution lines. These expansions are expected to require extending existing distribution lines or building new transmission lines.

Operation of new or extended powerlines (for transmission and distribution) is a covered activity in this HCP. Because new or extended powerlines will require new wires and support structures, the 20 percent limit for the addition of new wires and support structures across KIUC's electric system included under Section 2.1.2.2, *Adding New Powerlines*, also encompasses the operation of new wires associated with new powerlines. Construction of new powerlines is not a covered activity until the wires are in place (they do not need to be electrified) because construction activities are not expected to result in take of covered species (Section 2.4, *Activities Not Covered*).

2.1.4 Night Lighting for Restoration of Power

When equipment failure or powerline damage occurs, KIUC must restore power to its customers as quickly as possible.[3] In this context, KIUC may need to repair existing powerlines or construct new powerlines and support structures (in cases where the damage is too extensive to utilize the existing infrastructure). If the power outage occurs at night, lighting may be necessary to illuminate the work area. While repair work at night due to outages is rare, KIUC is requesting take coverage for all

[3] This does not include catastrophic events like Hurricane ʻIniki that threaten human life and property.

repairs that may require night lighting during the seabird fallout season (September 15 to December 15) over the 50-year permit term.

Restoration of power takes on average 1 hour to complete and night lighting is operated for half of that time. The first half-hour is typically used to troubleshoot and setup, and the last half-hour is used to perform the repair using lights. Based on records of past outages, KIUC estimated an average of 170 hours of nighttime outages occur on an annual basis during the covered seabird fallout season (September 15 to December 15). Therefore, KIUC assumes half of those hours (i.e., 85 hours) require night lighting on an annual basis.

2.2 Lighting Operation

2.2.1 Facility Lights

2.2.1.1 Existing Facilities

Operation of facility lights at the Port Allen Generating Station and the Kapaia Power Generating Station (Figure 2-1) is a covered activity in the KIUC HCP. Both facilities maintain night lighting for operations, visibility of personnel, and safety.

The Port Allen Generating Station is located at Port Allen east of Hanapēpē. Facility lighting at the Port Allen Generating Station includes 29 KIUC-owned lights mounted on poles and placed throughout the facility and eight lights mounted on building walls. In September 2019, the existing 150-watt high pressure sodium (HPS) streetlights were retrofitted with 41- and 90-watt white light-emitting diode (LED) bulbs, allowing output to be dimmed while still maintaining visibility for staff. In addition, the eight wall-mounted lights were retrofitted with shielded wall-mounted white LED box lighting.

The Kapaia Power Generating Station is located approximately 1 mile northwest of the town of Līhuʻe. Lighting consists of KIUC-owned streetlights and building lights placed throughout the facility in the parking lot and outdoor work areas. The streetlights consist of 150-watt HPS bulbs placed close to one another and relatively close to the ground. Each bulb is housed in a shield that completely covers the bulb except for the downward-facing glass. The design reflects all the light downward so that there is no upward lateral light transmission. The building lights use the same design concept but use a lower-wattage bulb.

Despite the light attraction minimization efforts at the Port Allen Generating Station and the Kapaia Power Generating Station, any KIUC infrastructure that produces light at night when the covered seabirds are fledging has the potential to cause fallout, resulting in incidental take. As such, the entire surface of the Port Allen Generating Station and Kapaia Power Generating Station, or approximately 9 acres and 14 acres, respectively, are covered under the HCP because seabird fallout may occur anywhere within the stations.

2.2.1.2 Night Lighting for Repair of Facilities

As described in Section 2.1.4, *Night Lighting for Restoration of Power*, night lighting may be necessary to facilitate repair of KIUC infrastructure. Night lighting for repair at all[4] KIUC facilities is a covered activity in the KIUC HCP. KIUC is requesting take coverage for all events that would require night lighting during the seabird fallout season (September 15 to December 15). The 50 hours of annual night lighting described under Section 2.1.4, *Night Lighting for Restoration of Powers*, also includes night lighting that would be required for repairs at covered facilities.

2.2.2 Streetlights

2.2.2.1 Existing Streetlights

KIUC owns and operates approximately 4,100 streetlights under agreements with the state, County of Kauaʻi, and private entities, which includes those located at KIUC facilities as identified in Section 2.2.1.1, *Existing Facilities* (Figure 2-1). Most of these lights are on poles and towers that also carry electric lines, but some of the lights are stand-alone fixtures on their own stanchions. All lights are switched on and off at sunset and sunrise automatically by photosensitive switches installed in individual lights. As of 2017, all KIUC streetlights were converted from HPS to more energy-efficient 3000-kilowatt LED bulbs (Kauaʻi Island Utility Cooperative 2017), and of these approximately 75 percent are 41-watt bulbs and approximately 25 percent are 90-watt bulbs. All KIUC-operated streetlights have full cutoff shielded fixtures.[5]

Operation of existing KIUC streetlights is a covered activity in the KIUC HCP because they contribute to the lightscape on Kauaʻi. For a streetlight to be considered operational under this HCP, the light must be on. Despite efforts to minimize the reflectance of KIUC streetlights, they may still result in covered seabird fledgling fallout and green sea turtle (honu) (*Chelonia mydas*) disorientation, resulting in incidental take (although in the case of green sea turtle [honu] only coastal streetlights visible from suitable beach habitat would have the potential to affect this species).

2.2.2.2 New Streetlights

KIUC expects to operate up to 1,754 new shielded streetlights along Kauaʻi's roadways over the 50-year permit term (an average of 35 new streetlights per year). Based on growth projections on Kauaʻi, the number of new streetlights is not expected to exceed 50 per year. As with all the existing streetlights on Kauaʻi, any new streetlights will also be equipped with full-cutoff shields.

Operation of future streetlights is a covered activity under the HCP for the same reason as described for existing streetlights (Section 2.2.2.1, *Existing Streetlights*). Construction of new streetlights is not a covered activity because installation of the streetlights is not expected to result in take of any covered species given that the light is not operational during construction. KIUC has no authority over the siting of new streetlights because they are the secondary developer asked to provide electricity and install streetlights based upon the request of a primary developer. The primary

[4] This includes all existing and new KIUC facilities, even those that apart from nighttime lighting events are not covered by this HCP (i.e., solar and hydroelectric facilities).

[5] *Full cutoff shielded fixtures* are designed to direct the light downward and outward, rather than upward toward the sky.

developer will address cultural resource issues for the covered activities through the Hawai'i Revised Statutes 6E (historic preservation) process, where appropriate.

2.3 Implementation of the Conservation Strategy

Activities related to implementation of the HCP conservation strategy at the conservation sites may result in short-term impacts on the covered species. The conservation measures implemented at the conservation sites include construction and maintenance of predator exclusion fences, predator control within and outside of the predator exclusion fences, social attraction to attract covered seabirds to new nesting colony sites within the fenced areas, and selective invasive plant species control. These activities are further described in Chapter 4, Section 4.5, *Conservation Measures*, and are expected to have a net benefit to the covered seabird species (see Chapter 5, *Effects Analysis*).

2.4 Activities Not Covered

The KIUC HCP is designed to cover all activities for which KIUC envisions the need for incidental take coverage over the permit term. The following activities were determined by KIUC to not require coverage in this HCP. If coverage of any of these activities becomes necessary in the future, KIUC may apply for an amendment to this HCP, as described in Chapter 7, *Plan Implementation*.

- **Construction of KIUC Infrastructure.** Construction of all KIUC infrastructure is not a covered activity in the KIUC HCP, including but not limited to construction of buildings, streetlights, facilities, powerlines, and LED diverters. Construction of KIUC infrastructure is not a covered activity because ground-disturbing activities would not result in take of the covered species. The only exception is that powerlines are covered once the wires are strung between the supporting structures, even if construction is not complete and the wires are not electrified.
- **Routine Wire Retrofit and Repair.** KIUC must regularly service and repair all wires, either for preventative retrofit or in response to equipment failure. Routine retrofit of wires and supporting structures is not a covered activity unless the retrofit will increase wire height, add new wires, or expose wires to increased collision risk (i.e., through vegetation maintenance) (see Section 2.1.2, *Powerline Retrofit*, for details). These routine retrofit activities are not covered activities because they are not reasonably certain to result in take of the covered species.
- **Routine Support Structure Retrofit and Replacement**. KIUC must regularly service and repair all supporting structures, either for preventative retrofit or in response to damage. Preventative retrofit does not include any conservation measures included in Chapter 4, *Conservation Strategy*, of this HCP. Routine retrofit of support structures (e.g., power poles) is not a covered activity under this HCP. Replacement of support structures is also not covered in this HCP if the replacement support structure is located along an existing powerline. In addition, increasing pole height is not a covered activity under this HCP. These routine retrofit activities are not covered activities because they are not reasonably certain to result in take of the covered species.
- **Operation and Retrofit of Other Infrastructure within the Port Allen Generating Station and the Kapaia Power Generating Station.** Operation and retrofit of all KIUC infrastructure within the Port Allen Generating Station or Kapaia Power Generating Station, other than

powerlines and facility lights, are not covered activities in the KIUC HCP because they are not reasonably certain to result in take of the covered species. This includes operation and retrofit of KIUC infrastructure such as buildings, parking lots, fuel storage tanks, water treatment facilities, and gas turbines.

- **Operation and Retrofit of Service Wires.** Service wires are always mounted below distribution wires, where both are present. In cases where service wires are the only electric wires on a pole, they are typically mounted on poles and towers that are less than 35 ft (10.7 m) tall. In both cases, due to their lower height, they are not reasonably certain to result in take of the covered species. As such, operation and retrofit of service wires is not a covered activity in the KIUC HCP.
- **Distribution Wires at Low Heights or Owned by Others**. Distribution wires can be installed at a variety of heights depending upon each pole's site-specific circumstances. Distribution wires less than 35 feet (10.7 m) above ground are not covered under this HCP because they are not likely to result in take of the covered species. In addition, KIUC does not own all distribution wires in the Plan Area. Distribution wires (at any height) located on the same pole as KIUC infrastructure but owned by other entities are not covered by this HCP.
- **Operation and Retrofit of Existing Solar Facilities and Hydroelectric Facilities.** KIUC maintains two solar facilities and two hydroelectric facilities. None of these facilities operate nighttime security lighting. Lights at these facilities are only used in the rare case of nighttime repair work, which is a covered activity (see Section 2.2.1.2, *Night Lighting for Repair of Facilities*). The equipment and structures at these solar and hydroelectric facilities are therefore not reasonably certain to result in take of the covered species. The operation of powerlines connecting these generating facilities to the grid is a covered activity, as described in Section 2.1.1, *Powerline Operation*.
- **Operation and Retrofit of Existing Substations and Switchyards.** KIUC maintains electric substations and switchyards throughout its electric transmission system. Similar to solar and hydroelectric facilities, substations and switchyards do not operate nighttime security lighting and are only lit during nighttime repairs (which is a covered activity). The operation or retrofit of substations and switchyards is not a covered activity because there are no streetlights or exterior building lights that could result in take of the covered species due to light attraction.
- **Decommissioning Infrastructure.** Decommissioning typically involves removing all above-ground structures, lights, and/or electrical infrastructure including, but not limited to, control structures, enclosures, transformers, voltage regulators, A-frames, H-frames, and their respective footings, along with all onsite interconnections with the island-wide grid. This activity is not reasonably certain to result in take of the covered species, and in fact may result in beneficial effects on the covered species where powerlines or lights are removed. Therefore, decommissioning of infrastructure is not a covered activity in the KIUC HCP.

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Chapter 3
Environmental Setting

This chapter provides an overview of the existing environment on the Island of Kauaʻi (Kauaʻi) with a focus on factors relevant to effects of KIUC activities on the covered species and the conservation needs of those species on Kauaʻi. More information on the existing environment that could be affected by implementing the KIUC HCP may be found in the environmental impact statement (EIS) prepared pursuant to the National Environmental Policy Act and State of Hawaiʻi Revised Statutes Chapter 343 Hawaiʻi Environmental Protection Act.

Chapter 3, *Environmental Setting*, is divided into three sections.

- Section 3.1, *Affected Physical Environment*, summarizes the relevant physical environment, including physiography, geology, soils, hydrology, climate, and air quality.
- Section 3.2, *Land Use*, summarizes relevant existing and planned land use patterns on the island.
- Section 3.3, *Existing Biological Environment*, summarizes relevant aspects of the existing biological environment on Kauaʻi, including vegetation and the ecology, distribution, range, abundance, and current threats to each of the covered species.

3.1 Affected Physical Environment

3.1.1 Physiography, Geology, and Soils

3.1.1.1 Physiography

Kauaʻi has a land area of approximately 550 square miles (sq mi) (1,425 square kilometers [sq km]). Roughly circular in shape, its most striking physiographic features are a high central plateau of over 5,000 feet (ft) (1,524 meters [m]) at the summits of Mt. Waiʻaleʻale (5,148 ft [1,569 m]) and Mt. Kawaikini (5,243 ft [1,598 m]). The central plateau is characterized by steep cliffs and deeply incised valleys along the northern Nā Pali Coast, the 3,600-ft-deep (1,097 m) Waimea Canyon, the broad Līhuʻe Basin on the southeastern quadrant of the island, and extensive coastal plains. These features can be seen on the topographic relief map (Figure 3-1) and the slope map (Figure 3-2) of the island.

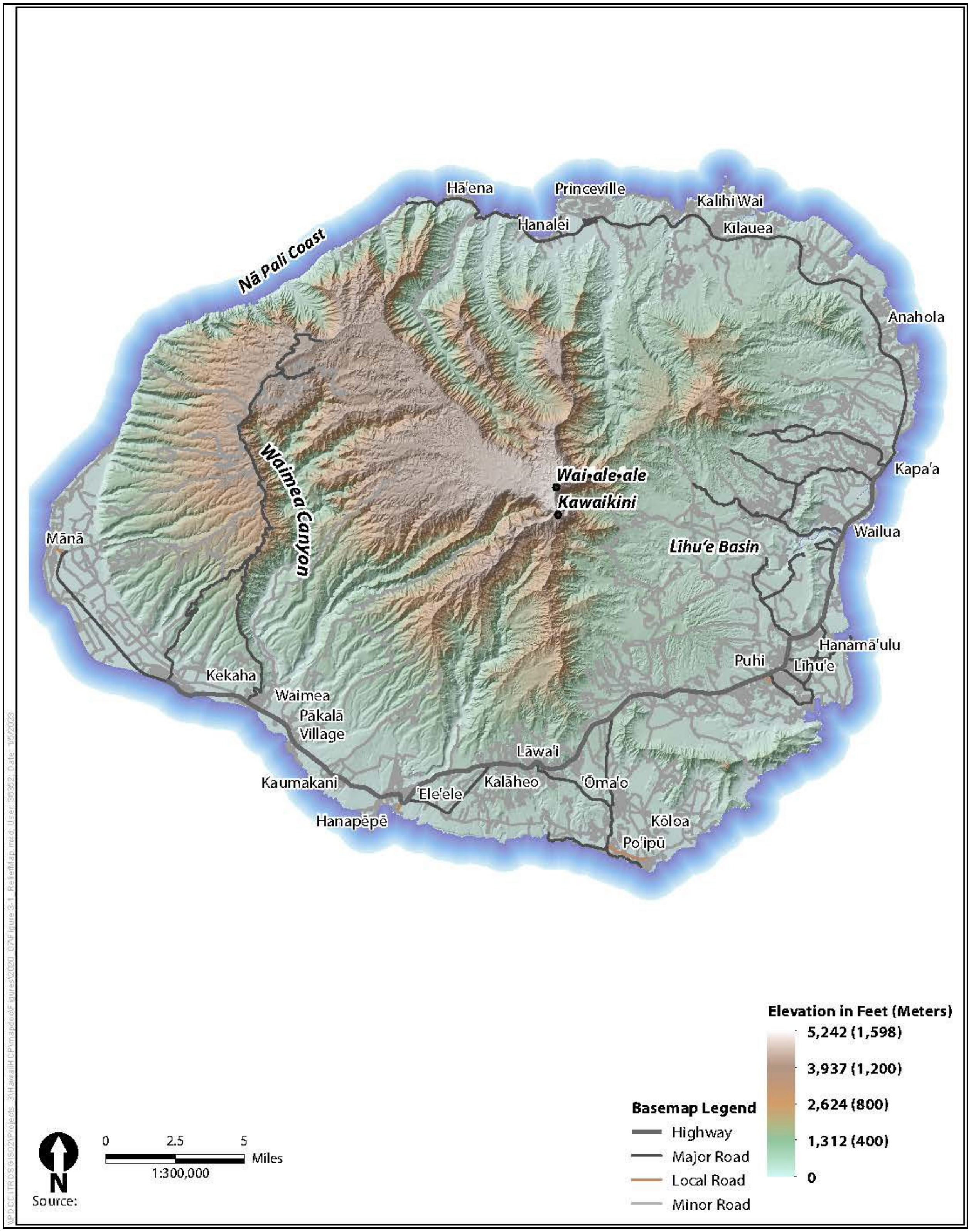

Figure 3-1. Topographic Relief of Kauaʻi

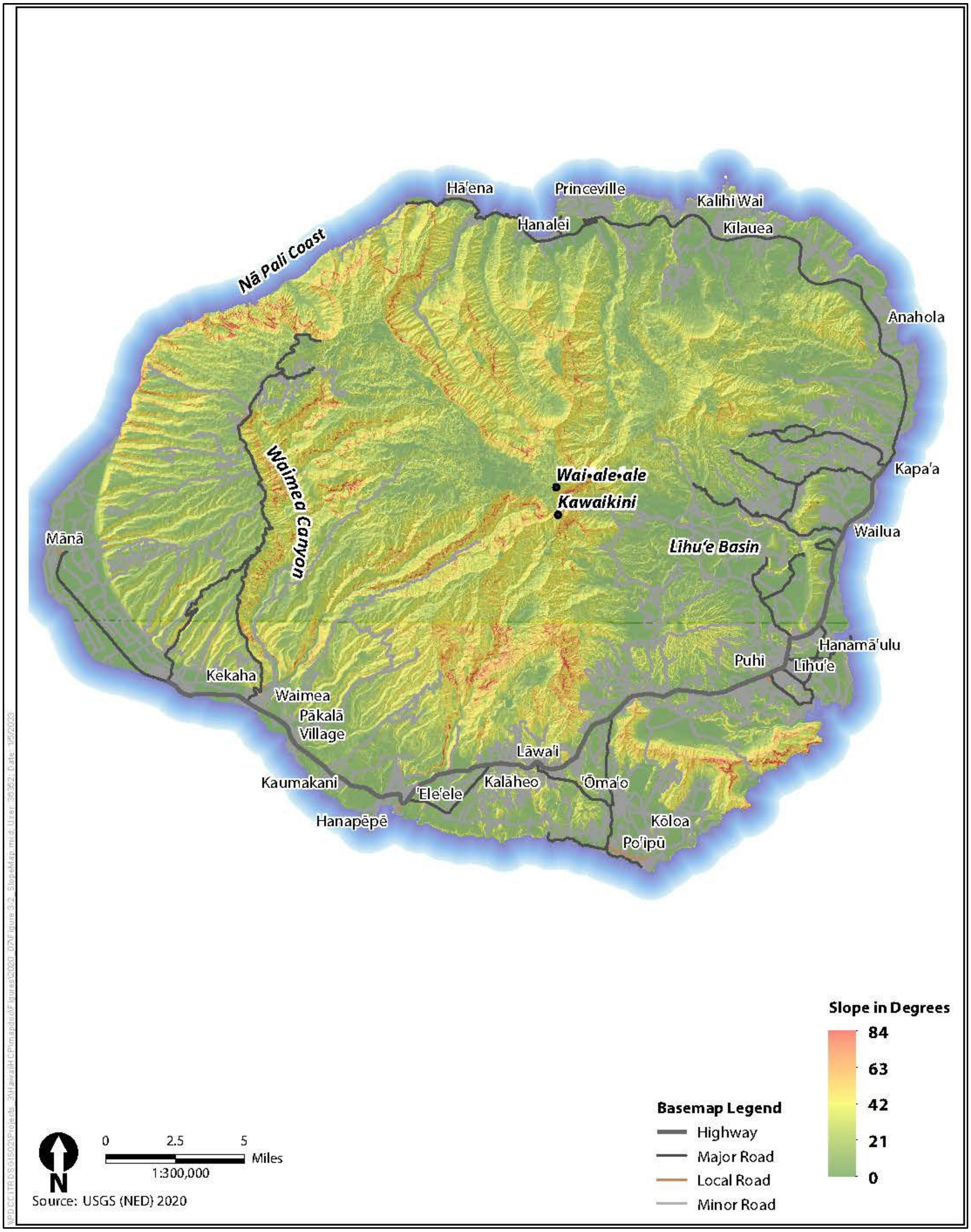

Figure 3-2. Slope Map of Kauaʻi

3.1.1.2 Geology

Kauaʻi, like the other Hawaiian Islands, was formed by magma that emerged from a hotspot beneath the Earth's crust that remained stationary as the plates on the Earth's crust moved over it (Stearns and MacDonald 1960). The main mass of Kauaʻi is believed to be about 3 to 5 million years old, although there were a few small eruptions on Kauaʻi as late as about 500,000 years ago (Juvik 1998). As this magma moved towards the surface, it erupted as lava, pouring out over the ocean floor. Over time, the eruptions formed a typical Hawaiian shield volcano. Deep erosion and weathering of the flows resulted in the topographically and geologically complex landscape present today (Juvik 1998).

3.1.1.3 Soils

As one of the oldest and most geologically complex Hawaiian Islands, Kauaʻi has a relatively high diversity of soil types. The lowland areas have predominantly deep, nearly level to steep, well-drained soils that have a fine-textured or moderately fine-textured subsoil. The western half of the island also has well-drained soils over basalt bedrock. The more rugged areas in central and northwestern portions have relatively shallow, rocky soils (U.S. Department of Agriculture 1973). Seabirds play an important role in soil nutrient recycling in Hawaiʻi, depositing guano that provides an important source of nutrients to the volcanic soils from the marine environment (Rowe et al. 2017).

3.1.2 Hydrology

Figure 3-3 depicts the perennial rivers and streams on Kauaʻi. Like all of the Hawaiian Islands, Kauaʻi's streams respond rapidly to storm rainfall because drainage basins are small and the distance of overland flow is short (Juvik 1998). Most streams on Kauaʻi radiate out from the Waiʻaleʻale-Kawaikini massif[1] in all directions, cutting through intrusive dikes that retard the groundwater movement toward the ocean from high rainfall areas in the interior. In the process, streams tend to receive large influxes of groundwater throughout their length. Thus, unlike most Hawaiian streams, many of the streams on Kauaʻi gain flow as they descend.

Figure 3-4 depicts the distribution of wetlands and open water (i.e., lakes, reservoirs, and other impoundments) on Kauaʻi based on regional data from the National Wetland Inventory (U.S. Fish and Wildlife Service 2020a). Numerous estuarine and freshwater emergent wetlands skirt the lowlands of the island, along with human-made reservoirs and scattered ponds, all of which provide habitat for most of the covered waterbirds (U.S. Fish and Wildlife Service 2011). Freshwater wetlands are also present in the higher elevation, forested areas. Alakaʻi swamp (Figure 3-4) is a montane wet forest located on a high plateau and containing alpine bogs that support federally listed plant species, but the covered species do not occur in these wetlands (75 *Federal Register* 18959).

[1] A block of the earth's crust bounded by faults and shifted to form peaks of a mountain range.

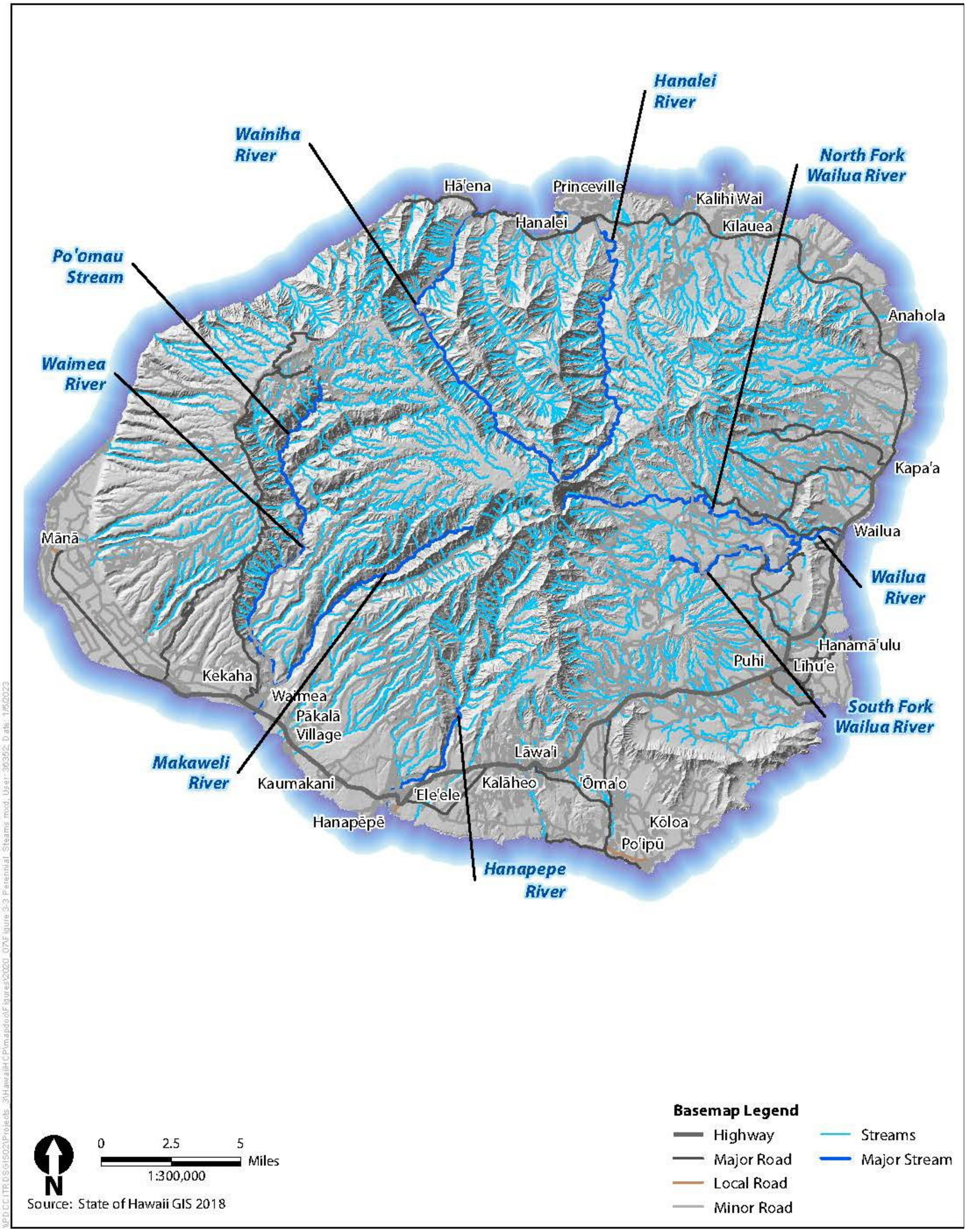

Figure 3-3. Perennial Rivers and Streams of Kauaʻi

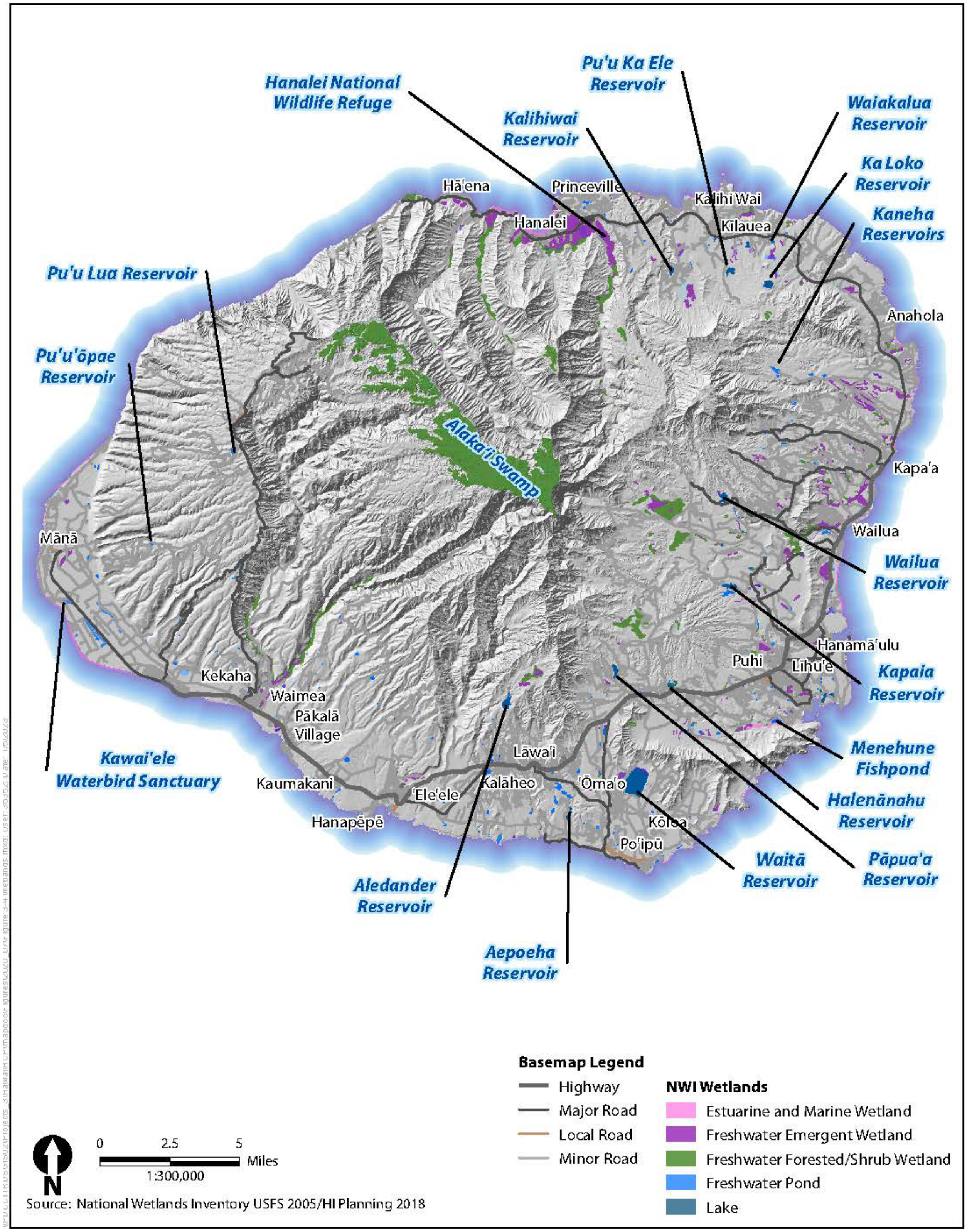

Figure 3-4. Wetlands and Open Waters of Kaua'i

3.1.3 Climate and Weather

3.1.3.1 Wind

The northeast trade winds are the most important determinant of Kaua'i's climate. They represent the outflow of air from the high-pressure region known as the Pacific Anticyclone, whose typical location is well north and east of Hawai'i (Western Regional Climate Center 2018). The trade wind zone moves north and south seasonally and reaches its northernmost position in the summer. Consequently, the trade winds are strongest and most persistent from May through September, when the trade winds are prevalent 80 to 95 percent of the time. From October through April, the heart of the trade winds are south of Hawai'i, and trade wind frequency decreases to about 50 percent (as a monthly average). On a few exposed headlands and in the mountains that catch and concentrate the full force of the trade winds, winds above 40 miles per hour (mph) (64.4 kilometers per hour [kph]) may occur several days each month of the year. In nearly all other locations, however, such winds are infrequent, and then only as the result of a major storm, the passage of a cold front, or an unusual local situation (Western Regional Climate Center 2018).

The land and sea circulations (due to convection air movements) are on a far smaller scale than the circulations of the trade winds or major storm systems, with the exchange of air often being confined to a few square miles. Circulations of this kind are most common on the southern and western coast in locations that are to the leeward with reference to the trade winds and topographically sheltered from them. Land and sea air circulation exhibit a diurnal rhythm. From the late morning until the early evening air moves inland on a sea breeze; sometimes these sea breezes are brisk. During the night and until shortly after sunrise, the air drifts back from land to sea; this movement is usually quite gentle.

3.1.3.2 Rainfall

Kaua'i lies in the path of the persistent northeast trade winds that gather substantial moisture as they pass over the Pacific Ocean. Rainfall along the eastern side of the island is induced by the topographic relief of the mountains as the air is forced to rise over Mt. Wai'ale'ale. At Mt. Wai'ale'ale, on Kaua'i, the annual average rainfall reaches the extraordinary total of 486 inches (in) (1,234.4 centimeters [cm])—over 40 ft (12.2 m). This is the highest recorded annual average in the world (Western Regional Climate Center 2018). As the air descends on the western side of the island, rainfall diminishes drastically towards the town of Kekaha. This results in one of the largest and steepest rainfall gradients on Earth (Ferrier et al. 2013; Juvik 1998) (see Figure 3-5). Average annual rainfall at Waimea on Kaua'i's southwestern shore is less than 30 in (76.2 cm); 20 mi (32.2 km) away at the summit of Mt. Wai'ale'ale, it is more than 400 in (1,016 cm).

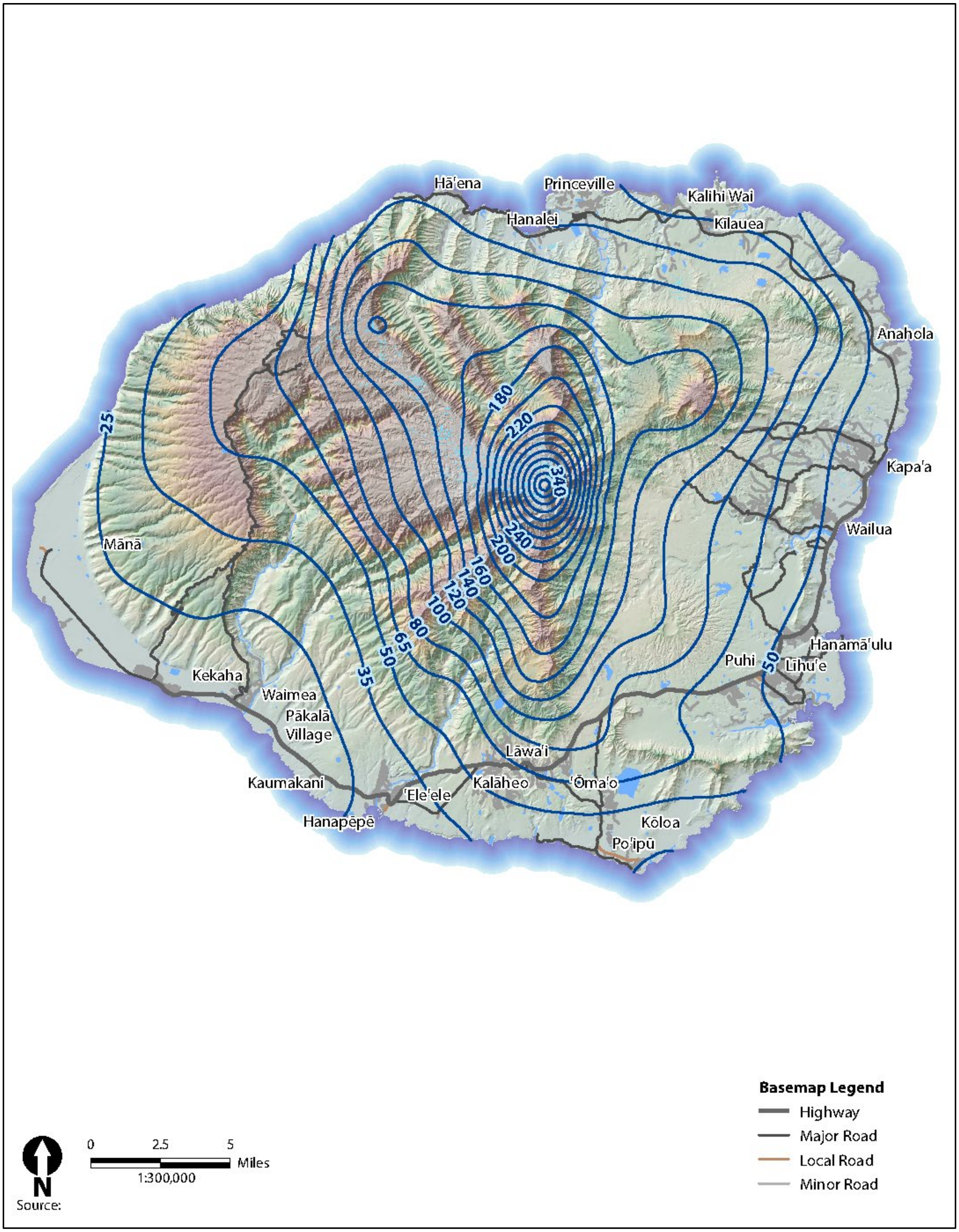

Figure 3-5. Average Annual Rainfall on Kauaʻi, in Inches

Extreme rainfall intensities can occur, with the most intense rainfall events not associated with hurricanes. To take the most extreme instance on record, during the storm of April 13 to April 15, 2018, an automated rain gage near Hanalei on the North Shore recorded 53.57 in (136.1 cm) in 48 hours, including 49.69 in (126.2 cm) during a 24-hour period.

While rainfall can be extremely heavy, very light showers are frequent in most localities. On the windward coast, for example, it is common to have up to ten brief showers in a single day, each producing less than 0.01 in (0.025 cm) of rain. This seeming contradiction is explained by the fact that the usual run of trade-wind weather yields many light showers in the lowlands. Mountain slopes and crests within the cloud belt receive water in the form of fog drip or cloud mists as well as direct rainfall (Western Regional Climate Center 2018).

3.1.3.3 Air Temperature

Kaua'i, like the other Hawaiian Islands, has one of the most stable climates on Earth. Isolated from large landmasses, Hawai'i has a very low annual temperature range (Giambelluca et al. 2008). This muted annual cycle of air temperature is due to the small season-to-season changes in solar radiation and the ocean's moderating influence. Differences in temperature from place to place are mainly due to elevation, with a fairly constant temperature decrease of 3.6 degrees Fahrenheit (°F) (2 degrees Celsius [°C]) per 1,000 ft (304.8 m) from sea level to about 4,100 ft (1,249.7 m) and 2.2°F (1.2°C) per 1,000 ft (304.8 m) above 4,100 ft (1,249.7 m). Small differences in temperature occur between cloudier, wetter, windward locations and sunny, dry, leeward locations at similar elevations (Juvik 1998). Diurnal temperature ranges are smallest in the lowlands, with daytime temperatures commonly in the 70s to 80s (°F) and nighttime temperatures in the 60s to 70s. Mean annual temperatures range between about 72°F (22°C) and 75°F (24°C) near sea level.

Outside the dry, leeward areas, temperatures of 90°F (32°C) and above are uncommon. In the leeward areas, temperatures in the low 90s may be reached on several days during the year, but temperatures higher than these are uncommon.[2] The warmest days are usually during what is known as *Kona weather*, when the trade winds, which come from cooler latitudes, fail and air stagnates over the heated islands (Western Regional Climate Center 2018).

3.1.3.4 Hurricanes, Tropical Storms, and Waterspouts

Major storm systems periodically affect all of the Hawaiian Islands including Kaua'i. There are four classes of disturbances that produce major storms. Sometimes a cold front sweeps across the islands, bringing with it locally heavy showers and gusty winds. A storm eddy, or low-pressure system, can move past the islands bringing widespread heavy rains often accompanied by strong winds. These low-pressure systems are known as *Kona storms*.[3] A separate and third class of disturbance are those instances of severe weather attributable to low-pressure systems in the upper atmosphere that are not associated with the foregoing cold fronts or Kona storms (Western Regional

[2] The highest temperature on record is from Līhu'e, which reported 99°F (37°C) on December 23, 2010 (https://www.plantmaps.com/hawaii-record-high-and-low-temperature-map.php).

[3] The term *Kona storm* was originally applied to the slow-moving subtropical cyclones that occasionally enter the Hawaiian area. Increasingly, this term is now applied by the local public to any widespread rainstorm accompanied by winds from a direction other than that of the trade winds.

Climate Center 2018). The fourth class of disturbance is the true tropical storm or hurricane.[4] These are rare, but can pass close enough to the islands to yield heavy rains, high winds, and large waves (Western Regional Climate Center 2018). The official hurricane season in Hawaiʻi is from June 1 through November 1. The number of hurricanes and tropical storms in the central Pacific per year over the last 20 years (1999–2018) has varied from 1 in multiple years to 14 in 2015 with an average of 3.4 per year. Such storms typically bring heavy rains and are sometimes accompanied by strong winds. However, the highest rainfall intensities have not been associated with hurricanes.

Hurricanes and tropical storms have struck Kauaʻi on a number of occasions over the past 50 years. Table 3-1 summarizes the important characteristics of hurricanes that have affected Kauaʻi since 1950. Hurricanes are infrequent, but have had a great effect on Kauaʻi, especially its utility infrastructure. Most recently, on September 11, 1992, Hurricane ʻIniki struck Kauaʻi with sustained winds of 130 mph (209 kph) and caused nearly $2 billion in property and infrastructure damage. Kauaʻi also received the brunt of Hurricane ʻIwa, which struck on November 23, 1982, and produced an estimated $234 million in damage. Tropical storms that do not make landfall in Hawaiʻi can still cause considerable infrastructure damage mostly due to winds and high surf (National Oceanic and Atmospheric Administration n.d.).

Table 3-1. Major Hurricanes Affecting Kauaʻi: 1950 to 2018

		Maximum recorded winds ashore (mph)		
Name	Date	Sustained	Peak gusts	Category
Hiki	Aug. 15–17, 1950	68	UNK	1
Nina	Dec. 1–2, 1957	UNK	92	1
Dot	Aug. 6, 1959	81	103	2
ʻIwa	Nov. 23, 1982	65	117	3
ʻIniki	Sept. 11, 1992	92	143	4

Source: State of Hawaiʻi Department of Business, Economic Development, and Tourism 2019:Table 5.53.
Note: Category is based on the Saffir-Simpson Hurricane Scale:
Category 1: wind speed of 74–95 mph (119–153 kph), minimal damage.
Category 2: wind speed of 96–110 mph (154.5–177 kph), moderate damage.
Category 3: wind speed of 111–130 mph (178.6–209 kph), extensive damage.
Category 4: wind speed of 131–155 mph (210.8–249.4 kph), extreme damage.

Hurricanes ʻIniki and ʻIwa both resulted in significant changes in vegetation on the Kauaʻi, especially in the more remote areas of the interior. Hurricane-force winds denuded large areas of densely forested valley walls. Harrington et al. (1997) studied hurricane ʻIniki's effect on forest structure in Puʻu Ka Pele Forest Reserve, Nā Pali Kona Forest Reserve, and Kōkeʻe State Park and found that major overstory species, namely koa (*Acacia koa*) and ʻōhiʻa (*Metrosiderous polymorpha*), were damaged less than the subcanopy species ʻaʻaliʻi kūmakani (*Dodonaea viscosa*) and guava (*Psidium guajava*). Further, the invasive species guava had much higher survival than the native kūmakani. Forest structure and productivity had recovered to a great degree within 2 years after landfall of the hurricane (Harrington et al. 1997).

[4] A *hurricane* is an intense tropical weather system with well-defined circulation and maximum sustained winds of 74 mph (64 knots) or higher. A *tropical storm* is an organized system of strong thunderstorms with a defined circulation and maximum sustained winds of 39 to 73 mph (62.8 to 117.5 kph).

3.1.3.5 Global Climate Change

Global climate change is occurring because of high concentrations of greenhouse gases in the Earth's atmosphere (National Research Council 2010; Intergovernmental Panel on Climate Change 2014). *Climate* is defined as the average weather over many years, and climate change refers to a statistically significant change in the state of the climate or its variability that persists for an extended period, typically for decades or longer (Intergovernmental Panel on Climate Change 2014). Recent assessments demonstrate the Earth is undergoing changes in climate beyond natural variation (National Research Council 2010; Intergovernmental Panel on Climate Change 2014; Melillo et al. 2014). Evidence of long-term changes in climate over the 20th century includes the following.

- An increase of 1.53°F (0.85°C) in the Earth's global average surface temperature
- An increase of 6.7 in (17 cm) in the global average sea level
- A decrease in arctic sea-ice cover at a rate of approximately 4.1 percent per decade since 1979, with faster decreases of 7.4 percent per decade in summer
- Decreases in the extent and volume of mountain glaciers and snow cover
- A shift to higher altitudes and latitudes of cold-dependent habitats
- Longer growing seasons
- More frequent weather extremes, such as droughts, floods, severe storms, and heat waves

To better understand anticipated increases in temperature, climate models are frequently used. Projections of future climate are developed at many scales, from Global Climate Models to Regional Climate Models, including Regional Climate Models based on Global Climate Model data that have been statistically downscaled to particular regions (Wang et al. 2018), including Hawaiʻi. Future greenhouse gas emissions scenarios are used in climate model projections of possible future climate conditions.

Based on regional climate models that include Hawaiʻi, the size and intensity of large-scale storms in the state are expected to increase in coming years. These changes may already be occurring; recent data shows that the proportion of Category 4 and 5 hurricanes have increased at a rate of 25–30 percent of overall recorded hurricane activity, per °C increase in global warming (Holland and Bruyere 2014). A global warming of 2.7°F (1.5°C) is expected to shift the range of many marine species to higher latitudes, reducing the productivity of fisheries and aquaculture (Intergovernmental Panel on Climate Change 2018:B.4.3). Ocean warming from climate change is expected to increase the thermal stratification in the upper ocean, reducing the upwelling of nutrients and decreasing productivity (Fabry et al. 2008). Squid, a primary food source for Newell's shearwater (ʻaʻo) (*Puffinus auricularis newelli*), Hawaiian petrel (ʻuaʻu) (*Pterodroma sandwichensis*), and many other seabird species are predicted to undergo shifts in their range and size as a result of warmer ocean temperatures. Individual squid would require more food per unit body size, require more oxygen due to faster metabolism, have a reduced capacity to cope without food, and reduced pH could affect ability for squid to uptake oxygen (Pelc and Jackson 2008). Additional threats to the covered species related to climate change are described in Appendix 3A, *Species Accounts*.

3.2 Land Use

Kauaʻi's built environment consists of small, mostly rural communities along the coast margins and plains separated by expanses of open space and agricultural lands. Steep topography across much of Kauaʻi (see Figures 3-1 and 3-2) severely limits development in the interior of the island. There are no incorporated cities on Kauaʻi. The County of Kauaʻi is the one local government agency responsible for all land use planning on the island. Figure 3-6 shows land designations consistent with the Kauaʻi Future Land Use Map in the *Kauaʻi Kākou: Kauaʻi County General Plan* (General Plan) (County of Kauaʻi 2018). The General Plan was designed to avoid urban sprawl by focusing future development, uses, and density within and around existing towns, and preserving agricultural land and open space between towns (County of Kauaʻi 2018). The land use map accommodates projected housing needs within and adjacent to existing developed areas and discourages residential and resort development in new areas not directly adjacent to existing communities. Most of the growth is steered to the Līhuʻe and South Kauaʻi areas. Additional growth is allocated to the Waimea-Kekaha, Hanapēpē-ʻEleʻele, East Kauaʻi, and North Shore areas based on historic and natural increase trends.

A majority of the island is designated as *natural* in the Future Land Use Map—these areas have either limited development potential or are not suitable for development due to topography, hazards vulnerability, sensitive resources, and other constraints. Lands designated as natural generally overlap with the areas that have been identified as existing or potential habitat for the covered species as described in Section 3.3, *Existing Biological Environment*.

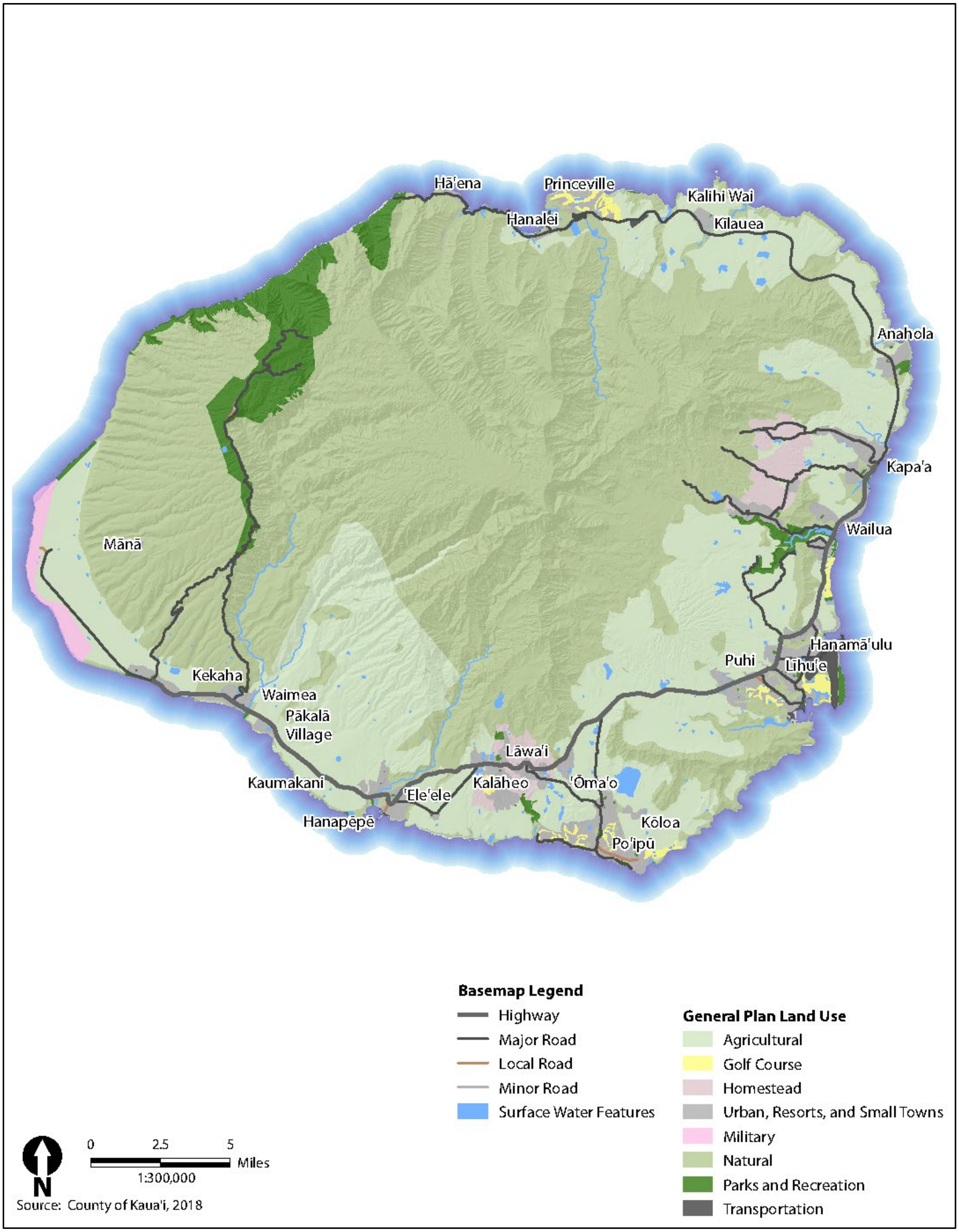

Figure 3-6. Land Use Designations on Kaua'i

3.3 Existing Biological Environment

3.3.1 Vegetation

As the oldest of the main Hawaiian Islands, Kauaʻi has relatively high levels of floristic diversity and endemism. Over time, the topography and habitats have become more fragmented, with deeper valleys and other local topographic features creating greater fragmentation of habitats and thus greater isolation and opportunities for speciation. The age of Kauaʻi (3 to 5 million years) has also provided more time for the development of floral biodiversity than on other Hawaiian Islands (Sakai et al. 2002).

Figure 3-7 depicts existing land cover types throughout Kauaʻi as distinct native and alien (i.e., invasive) vegetation types mapped by the U.S. Geological Survey Gap Analysis Program (GAP) and Carbon Assessment of Hawaiʻi (CAH) (U.S. Geological Survey 2011, 2017). Terrestrial and wetland vegetation types in the CAH dataset were compared in a crosswalk to the GAP dataset. The majority of the two datasets are identical, but the CAH dataset further divides native and alien vegetation types into moisture categories (i.e., wet, mesic, or dry). To minimize the mapping units, the CAH moisture designations were grouped into corresponding vegetation macrogroups consistent with the GAP dataset. For example, the CAH vegetation types mapped as closed koa-ʻōhiʻa wet forest and closed koa-ʻōhiʻa mesic forest were merged with the GAP vegetation type mapped as closed koa-ʻōhiʻa forest. Following are general descriptions of the existing land cover types.

Native terrestrial vegetation is primarily found in the central portion of the island and consists of montane rainforest dominated by ʻōhiʻa and/or koa trees. The dominant tree species is more often ʻōhiʻa but a distinct type of forest in which tall koa trees emerge above the ʻōhiʻa canopy also exists in areas with deep soils above an elevation of 3,000–4,000 ft (914–1,219 m). These forests are multilayered with smaller trees in the subcanopy including kāwaʻu (*Ilex anomala*), ʻalani (*Melicope* spp.), kōlea (*Myrsine* spp.), and olmea (*Perrottetia sandwicensis*). Epiphytic mosses, liverworts, ferns and silver-leaved lily paʻiniu (*Astelia* spp.) are abundant on trunks and branches of large trees. In pristine areas, native ferns are abundant ground cover with scattered shrubs like kanawao (*Broussaisia arguta*) and pūkiawe (*Styphelia tameiameiae*). Lowland rainforest is typically dominated by ʻōhiʻa with an understory of native trees including kōpiko (*Psychotria* spp.) and hame (*Antidesma platyphyllum*) (Cuddihy and Stone 1990).

Native wet cliff vegetation occurs primarily in the system of valleys running outward from the wet summit plateau region above the montane rainforests in the northern and central portions of the island. This land cover type is often dominated by the native uluhe fern (*Dicranopteris* spp.). The dry cliff vegetation on Kauaʻi occurs on steep-sided interior canyons and northern seacliffs and supports endemics like the ʻālula (*Brighamia insignis*). Uluhe-dominated shrublands typically occur in patches throughout the island on mountain slopes (Cuddihy and Stone 1990).

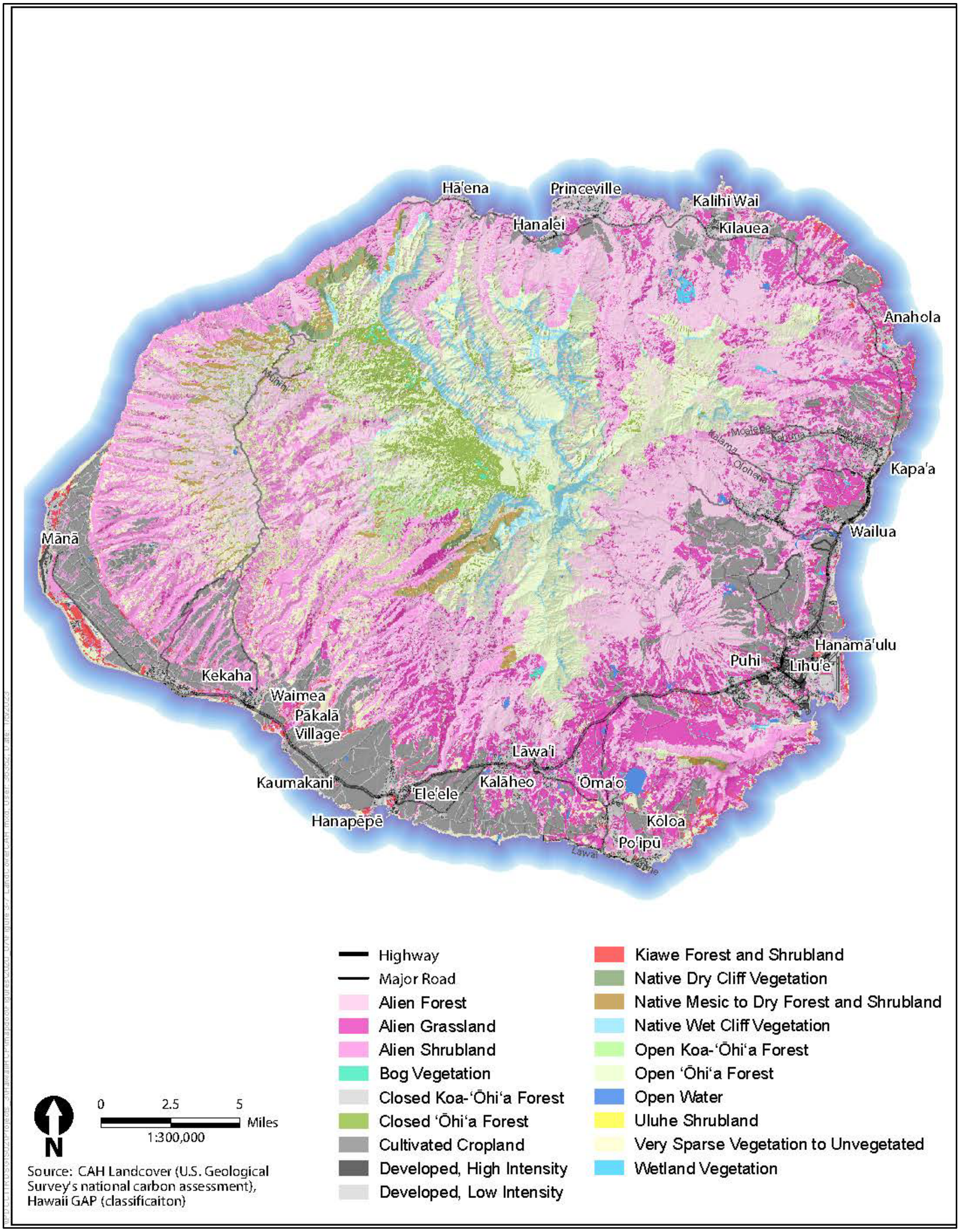

Figure 3-7. Land Cover Types of Kauaʻi

Another type of montane wet land cover is bogs, which are found in very wet, poorly drained places near mountain summits on Kauaʻi. Bogs are characterized by sedges and grasses (*Oreobolus furcatus*, *Carex* spp., *Rhynchospora* spp., *Dicanthelium* spp.) and stunted woody plants including naʻenaʻe (*Dubautia* spp.). Wahiawa Bog (Kanaele Swamp) is one of the island's known bog communities, characterized by shallow, poorly drained acidic peat soils and endemic plant species (Cuddihy and Stone 1990). Numerous estuarine and freshwater emergent wetlands skirt the lowlands throughout the island, along with human-made reservoirs and scattered ponds. Freshwater wetlands are also present in the higher-elevation, forested areas in the central region. Freshwater emergent wetlands typically consist of hydrophytic species including sedges (*Cyperus* spp.), rushes (*Mariscus* spp.), and bulrushes (*Schoenoplectella* spp.) both native and introduced to Kauaʻi (U.S. Fish and Wildlife Service 2011).

Mesic to dry forest and shrubland communities differ from wet montane forests in the relative scarcity of tree ferns (*Cibotium* spp.) and epiphytes, the abundance of shrubs such as pūkiawe in the understory, and a different complement of native ferns in the ground cover. For most of these forests the dominant trees are either ʻōhiʻa or koa, or a mixture of these two species. In a very few sites, mānele *(Sapindus saponaria)* is a co-dominant species in the ʻōhiʻa and koa mixed canopy. Mesic to dry forests have a very restricted distribution on Kauaʻi.

Vegetation known to be introduced to Kauaʻi include kiawe forest/shrubland in addition to alien grasslands, shrublands, and forests. Kiawe (*Prosopis pallida*) is a common invasive tree species known throughout the Hawaiian Islands and along the coastal zone of Kauaʻi. Alien shrublands and forests are characterized by introduced species such as jumbay (*Leucaena leucocephala*), fire tree (*Morella faya*), silk oak (*Grevillea robusta*), New Zealand laurel (*Corynocarpus laevigatus*), albizia (*Falcataria moluccana*), koa haole (*Leucaena leucocephala*) and banana poka (*Passiflora mollisima*) and occur throughout most of the island. Many invasive grasslands are also known from the eastern side of Kauaʻi and consist of a mix of invasive species including but not limited to molasses grass (*Melinis minutiflora*) and bushy beardgrass (*Andropogon glomeratus* var. *pumilus*) (Edmonds et al. 2016; Nagendra 2017; Natural Area Reserves System 2011; National Tropical Botanical Garden 2008).

Native vegetation on Kauaʻi has undergone extreme alterations because of past and present land use (primarily agriculture/cultivated croplands) and the intentional and inadvertent introduction of invasive plants and animals (Benning et al. 2002). Top crop items such as coffee, corn, taro, and fruit trees are grown on the island and over 3,000 acres (1,214 hectares) have been converted to pasture (County of Kauaʻi 2012). Remote island ecosystems such as the Hawaiian Islands have especially low biotic resistance to invasion because island species have evolved in isolation and often have little resistance to competitors, herbivores, and pathogens that have found their way to the island from continental regions (Weller et al. 2011). Browsing, digging, and trampling by introduced ungulates (i.e., pigs, goats, cattle, sheep, and deer) have resulted in the spread of invasive plants because many of the invasive plants can colonize newly disturbed areas more quickly and effectively than Hawaiʻi's native plants. Introduced ungulates are especially devastating for native island species that evolved in their absence (Milchunas and Noy-Meir 2002). Introduced rodents (rats and mice) feed on the fruits, seeds, and new growth of many endemic plants. Furthermore, even with ungulate exclusion and native seed augmentation, regeneration continues to be strongly limited by invasive grasses. Forced out by invasive plants, many endemic plants are now extinct, which now number more than 4,600 species. Many of the remaining endemic species are now listed as threatened or endangered. As a result, native forests are now limited to Kauaʻi's upper-elevation, moist, and wet regions.

The mountainous region of northwest Kauaʻi, where KIUC is managing and monitoring the covered seabirds supports semi-intact, native wet forest dominated by ʻōhiʻa and ʻōlapa (*Cheirodendron fauriei*) with openings in the forest dominated by uluhe. Other native trees common to mesic forests are scattered throughout such as hōʻawa (*Pittosporum glabrum*), pāpala kēpau (*Pisonia* sp.), hala pēpē (*Chrysodracon aurea*), and lama (*Diospyros sandwicensis*) (Edmonds et al. 2016; Nagendra 2017; Natural Area Reserves System 2011; National Tropical Botanical Garden 2008).

Despite the remoteness of these established conservation sites, invasive species are also present. They include, but are not limited to, the autograph tree (*Clusia rosea*), octopus tree (*Schefflera actinophylla*), broad-leaved paperbark (*Melaleuca quinquenervia*), Australian tree fern (*Cyathea cooperi*), Himalayan ginger (*Hedychium gardnerianum*), lantana (*Lantana camara*), molasses grass, and bushy beardgrass (Edmonds et al. 2016; Nagendra 2017; Natural Area Reserves System 2011; National Tropical Botanical Garden 2008). These invasive species are believed to be spreading when left unchecked (National Tropical Botanical Garden 2008). The National Tropical Botanical Garden, which owns and manages the Upper Limahuli Preserve, actively works to control invasive species within the Upper Limahuli Preserve with funding from KIUC and others.

3.3.2 Covered Species

Detailed information on the status, life history, distribution, population trends, and habitat use of each of the covered species is included in the species accounts provided in Appendix 3A, *Species Accounts*. The sections below summarize basic biological information to provide context for the next two chapters of the HCP (Chapter 4, *Conservation Strategy*, and Chapter 5, *Effects*). For covered seabirds, status and seasonal and local movement patterns are summarized below because they relate to species impacts resulting from the covered activities (powerline strikes and light attraction). The reproductive biology and threats to covered seabirds are also summarized below because they are relevant to the impact analysis and conservation strategy. Relevant factors summarized for covered waterbirds include threats and conservation needs, status, habitat affinities, and movement patterns. Relevant factors summarized for green sea turtle (honu) include range, life history, and current known threats.

3.3.2.1 Covered Seabirds

The seabirds covered in the KIUC HCP include Newell's shearwater (ʻaʻo), Hawaiian petrel (ʻuaʻu), and the Hawaiʻi distinct population segment (DPS) of the band-rumped storm-petrel (ʻakēʻakē) (*Oceanodroma castro*) (hereafter band-rumped storm-petrel). Newell's shearwater (ʻaʻo) is state- and federally listed as threatened: breeding is only known on Kauaʻi, Maui, and Hawaiʻi, but song meter recordings made in 2016 and 2017 indicate that a small number of Newell's shearwaters (ʻaʻo) regularly prospect on Oʻahu (Young et al. 2019). The Hawaiian petrel (ʻuaʻu) is state- and federally listed as endangered: once abundant and widely distributed across Hawaiʻi, the majority of the breeding population is now found on Kauaʻi, Maui and Lānaʻi, with smaller populations on Hawaiʻi. Hawaiian petrel (ʻuaʻu) is nearly extirpated on Oʻahu and Molokaʻi (Pyle and Pyle 2017). The band-rumped storm-petrel (ʻakēʻakē) is also state- and federally listed as endangered: their current distribution is poorly known (Raine et al. 2017a), but potential breeding sites have been recorded on Hawaiʻi (Banko et al. 1991; Galase et al. 2016), Maui (Banko et al. 1991), Kahoʻolawe (Hawaiʻi Heritage Program 1992), Lehua Islet (VanderWerf et al. 2007), and Kauaʻi (Raine et al. 2017a; Wood et al. 2002). No band-rumped storm-petrel (ʻakēʻakē) nests have been located on

Kauaʻi, but based on auditory survey data, breeding likely occurs at several locations on Kauaʻi, primarily in the steep cliff areas of the Nā Pali Coast (Raine et al. 2017a).

The covered seabirds are pelagic, spending most of their time at sea and coming to land only to breed (Ainley et al. 2014; Simons 1985; Spear et al. 2007). During the non-breeding season they travel well away from Hawaiʻi in the tropical Pacific. Newell's shearwaters (ʻaʻo) are absent from waters within 125 mi (201 km) of the Hawaiian Islands in the non-breeding season (winter and autumn) (King and Gould 1967; Spear et al. 1995). Some band-rumped storm-petrels (ʻakēʻakē) remain near their breeding island during the non-breeding season, while others make long-distance movements as far as over 990 mi (1,593 km) south of Hawaiʻi to the Phoenix Islands and Japan (Slotterback 2002; Mitchell et al. 2005).

During the breeding season (March through December, with slight variability in the breeding window by species), the seabirds return to land, where they nest in burrows beneath ferns and tree roots in dense forest and on steep slopes and cliffs. Adult Newell's shearwaters (ʻaʻo) only fly to and from their burrows at night. Breeding adults fly from the ocean to their breeding site after sunset and leave their burrows and fly from the breeding site to the ocean in the early morning before sunrise. Newell's shearwaters (ʻaʻo) travel between the sea and nests generally nightly to forage and feed their chicks (Ainley et al. 2020). Hawaiian petrels (ʻuaʻu) transit over land to and from the breeding sites mostly in darkness, though some begin to fly ashore just at sunset (Ainley et al. 1997). Unlike Newell's shearwaters (ʻaʻo), Hawaiian petrels (ʻuaʻu) have highly variable flight schedules, with arrivals and departures occurring from sunset to sunrise (Raine et al. 2017b). Band-rumped storm-petrels (ʻakēʻakē) have been observed feeding during the day, but likely also feed at night (Harris 1969; Kauaʻi Endangered Seabird Recovery Project 2019).

Newell's shearwaters (ʻaʻo) remain at sea for the first few years of life, and subadults are thought to start visiting their breeding sites at 2–3 years of age and start breeding at approximately 6 years of age (Ainley et al. 2001; Griesemer and Holmes 2011; Raine et al. 2020). In late March/early April through late April, adults arrive at inland breeding sites to check on their burrows and maintain them. In late April and possibly through mid-May, breeding adults forage at sea to build up reserves (Raine and Banfield 2015; Raine and McFarland 2013), during which time females are gone for 25 to 30 days while males visit the burrows occasionally (Ainley et al. 2020). In early June through July, each breeding pair lays a single egg and parents take turns incubating the egg and going out to sea to feed. Peak overland passage rates for Newell's shearwaters (ʻaʻo) coincide with the late incubation (July) and chick-rearing stages (August) (Travers et al. 2013). In late July through early October, both parents go to sea during the day with one returning each night to feed the chick. Provisioning by both adults continues through September with individual adults being at sea for periods of 1 to 3 nights (Ainley et al. 2014; Raine and McFarland 2013). From late September through mid-November the fledgling flies from its burrow to the sea, with a peak in October.

Hawaiian petrels (ʻuaʻu) on Kauaʻi arrive at their colonies mid- to late March and engage in a period of burrow maintenance or building and socialization. In mid-April, they return to the ocean for approximately 1 month to forage and build up reserves. Upon returning to the colonies in May, each pair lays a single egg and alternates incubating for approximately 55 days. Chicks typically hatch in July, at which point both parents fly to the ocean to forage and return to feed the nestling. Petrel offspring require up to 5 months of care from both parents to fledge. Both adult male and female Hawaiian petrels (ʻuaʻu) attend to nest duties equally (Simons and Hodges 1998). Fledging typically occurs in late October through mid-December, peaking in November.

Band-rumped storm-petrels (ʻakēʻakē) on Kauaʻi return to nest sites in late May, complete egg laying by mid-June, and fledge in October (Raine et al. 2016a). Incubation averages 42 days and young fledge 70–78 days after hatching (Harris 1969). Fledglings leave the nest between mid-September and late November, with peak fledging occurring in October (Raine et al. 2016a). Based on acoustic data, adults likely leave the nesting grounds in October.

For species with naturally low reproductive rates that rely on high adult survivorship, introduced threats that increase mortality rates, such as powerline collisions and invasive predators, can result in significant population declines. The covered seabirds share these characteristics of low reproductive rates and high adult survivorship, making their populations particularly vulnerable to introduced threats. Newell's shearwaters (ʻaʻo) breed at a late age (6 years to first breeding) and have low fecundity (only one chick per pair each breeding year), and high adult survival (Warham 1990, 1996; Ainley et al. 2001; Griesemer and Holmes 2011; Raine et al. 2020). No specific data exist on the longevity for Newell's shearwater (ʻaʻo) but based on what has been observed among other shearwaters it is reasonable to assume that they can reach a maximum age of 30 years or more (Ainley et al. 2001). Similarly, Hawaiian petrels (ʻuaʻu) have a long lifespan (up to 35 years), do not reproduce until 6 years of age, and lay only one egg per year (Simons and Hodges 1998). They also tend to have high adult survival (Ainley et al. 2001; Griesemer and Holmes 2011; Raine et al. 2020). Band-rumped storm-petrel (ʻakēʻakē) reach sexual maturity between 3 and 7 years of age (Harrison 1990), have only one chick per year, and likely live for 15 to 20 years (State of Hawaiʻi Division of Forestry and Wildlife 2005).

Kauaʻi supports 90 percent of the total Newell's shearwater (ʻaʻo) population (Pyle and Pyle 2009; Ainley et al. 2020) and 33 percent of the total Hawaiian petrel (ʻuaʻu) population (Raine pers. comm.). Archipelago Research and Conservation (ARC) developed a theoretical population estimate for each species based on the most current data available, which estimated a minimum Newell's shearwater (ʻaʻo) population on Kauaʻi of approximately 34,546 individuals and a minimum Hawaiian petrel (ʻuaʻu) population of approximately 25,277 individuals. There is insufficient data available to estimate the band-rumped storm-petrel (ʻakēʻakē) population on Kauaʻi.

At conservation sites which have been actively managed and acoustically monitored, there have been statistically significant increases in call rates between the first year of monitoring (either 2014 or 2015, depending on the site) and 2021. The rates of increase in Newell's shearwater (ʻaʻo) call rates range between 8.23 percent at Hanakoa and 18.29 percent at North Bog and Hawaiian petrel (ʻuaʻu) range between 8.76 percent at Hanakoa to 26.48 percent at North Bog (Archipelago Research and Conservation 2022).

Covered seabirds on Kauaʻi are subject to the following threats (Slotterback 2002; State of Hawaiʻi Division of Forestry and Wildlife 2005).

- Depredation at breeding sites by introduced predators such as pigs (*Sus scrofia*), rats (*Rattus rattus*), feral cats (*Felis silvestris*), barn owls (*Tyto alba*), and feral honeybees (Order: Hymenoptera) (Raine et al. 2020).
- Loss and degradation of breeding habitat caused by introduced ungulates such as pigs and goats (*Capra hircus*) and introduced plants.
- Artificial lighting from various sources (e.g., streetlights, resorts), which attracts and causes "fallout" of seabirds and increases their chance of colliding with artificial structures.
- Collisions with powerlines, buildings, towers, and wind turbines.

- Pollution (e.g., mercury, plastic ingestion, oil spills).
- Factors affecting seabird prey availability in the ocean such as overharvesting by the fishing industry, as well as bycatch.
- Climate change, potentially affecting both terrestrial and ocean conditions.

The daily movement patterns of the covered seabirds between breeding and foraging habitats and their relatively low maneuverability make them particularly susceptible to colliding with artificial structures, predominantly utility lines (Travers et al. 2019, 2020). Their nocturnal movements, in addition to the phototropic tendencies of fledglings (i.e., tendency to be attracted to light), make them susceptible to fallout from artificial lighting (Telfer et al. 1987). In addition to human-caused factors, stochastic events such as storms are likely to influence population numbers (Vorsino 2016). Both local and regional storms, depending on their severity and type, can result in significant habitat degradation and loss due to high winds, landslides, and flooding, as well as loss of burrows, chicks, and eggs. In 2021, a Hawaiian petrel ('ua'u) chick was rescued from a flooded burrow in the Hono O Nā Pali Natural Area Reserve (Archipelago Research and Conservation 2022). Habitat loss and conversion historically has had a major negative effect on the covered seabird species as civilization has expanded into natural areas along with its accompanying pets, farm animals, vehicles, and other infrastructure (Raine et al. 2016b, 2016c, 2016d).

Compared to Newell's shearwater ('a'o), fewer Hawaiian petrels ('ua'u) are found grounded and turned in to Save Our Shearwaters (SOS) during the fledging season, likely related to a lower level of attraction to artificial light. On average, 9.6 Hawaiian petrels ('ua'u) (compared to 179 Newell's shearwater ['a'o]) were received by the SOS program annually between 2014 and 2018 (Anderson 2015, 2016, 2017, 2018, 2019).

3.3.2.2 Covered Waterbirds

Waterbirds covered in the KIUC HCP are the Hawaiian stilt (ae'o) (*Himantopus mexicanus knudseni*), Hawaiian duck (koloa maoli) (*Anas wyvilliana*), Hawaiian coot ('alae ke'oke'o) (*Fulica alai*), Hawaiian common gallinule ('alae 'ula) (*Gallinula galeata sandvicensis*), and the Hawaiian goose (nēnē) (*Branta sandvicensis*). The covered waterbirds are endemic to Hawai'i and are state- and federally listed as endangered, except for Hawaiian goose (nēnē), which was federally downlisted to threatened in January 2020 (84 *Federal Register* 69918).

Except for the Hawaiian goose (nēnē), the covered waterbird species are associated only with wetlands and open water habitat in Kaua'i (Figures 3-3 and 3-4). Hawaiian geese (nēnē) use a wide variety of habitats including coastal dune vegetation and grasslands, sparsely vegetated lava flows, shrublands, and woodlands in areas that typically have less than 90 in (228.6 cm) of annual rainfall (U.S. Fish and Wildlife Service 2004). The Hawaiian goose (nēnē) also inhabits highly altered landscapes such as pastures, agricultural fields, and golf courses (U.S. Fish and Wildlife Service 2004).

All the covered waterbird species are non-migratory, but movements within Kaua'i and between islands vary by species. Interisland movement is an important strategy for Hawaiian stilts (ae'o) to exploit food resources, and individuals on Kaua'i move seasonally to Ni'ihau in response to water level changes in Ni'ihau's ephemeral lakes (VanderWerf 2012). Breeding habitat differs from foraging habitat for Hawaiian stilts (ae'o), and individuals move between the two habitats daily. Some seasonal, altitudinal, and interisland movements occur for Hawaiian ducks (koloa maoli), although the timing and mechanics are not well understood (Engilis and Pratt 1993). Hawaiian coots

(ʻalae keʻokeʻo) travel long distances, including between islands, in response to rainfall and food source depletion and many move to Niʻihau when suitable temporary ponds are available. It is unknown whether Hawaiian common gallinules (ʻalae ʻula) are capable of interisland movement. Historically, Hawaiian goose (nēnē) flocks have moved between high-elevation feeding habitats and lowland nesting areas and although they are capable of interisland flight, their wings are reduced in size when compared to closely related species.

Long-term census data indicate that the statewide population of the covered waterbirds are stable or increasing, within global population trends being heavily influenced by Kauaʻi population trends (Paxton et al. 2022). Over the last two decades the Hawaiian stilt (aeʻo) population has averaged 1,500 individuals (U.S. Fish and Wildlife Service 2020b). The Hawaiian duck (koloa maoli) population is estimated to be about 2,200 individuals, with 2,000 true (non-hybrid) Hawaiian ducks (koloa maoli) on Kauaʻi and Niʻihau, and 200 on the Island of Hawaiʻi (Engilis et al. 2020). The State's biannual surveys typically do not include remote wetlands and streams (Engilis et al. 2002), where an estimated 50 to 80 percent of Hawaiian ducks (koloa maoli) are believed to reside on Kauaʻi (Schwartz and Schwartz 1953). The Hawaiian coot (ʻalae keʻokeʻo) population is currently estimated to be between 1,248 and 2,577 individuals. The current population of the Hawaiian common gallinule (ʻalae ʻula) is small but relatively stable, with a minimal 5-year average of 927 (678 to 1,235) individuals. The 2020 statewide population of Hawaiian geese (nēnē) totaled 3,865 individuals (Nēnē Recovery Action Group 2022) (in comparison to the 2,855 individuals reported in 2016 (Nēnē Recovery Action Group 2017), and the fewer than 300 individuals at the time of listing in 1967 (U.S. Fish and Wildlife Service 2004).

The most consequential threat to the covered waterbird species has been the loss of wetland habitat. In the last 110 years, approximately 31 percent of coastal plain wetlands have been lost (U.S. Fish and Wildlife Service 2011). Many remaining wetland areas have been invaded by invasive plant species, altering the plant communities, and rendering the habitat unsuitable for some native species such as stilts. Predation by invasive animals such as feral cats and rats continues to negatively affect the covered waterbird species on Kauaʻi (U.S. Fish and Wildlife Service 2011). Environmental contaminants such as fuel spills, water pollution, and pesticides continues to degrade habitats that support covered waterbirds. Collisions with vehicles and structures (e.g., powerlines) are also a threat to the covered waterbirds. For example, when taking off and landing, the long, low flight path of Hawaiian geese (nēnē) makes them vulnerable to collisions with stationary structures and moving objects such as vehicles and aircraft (Banko et al. 2020; State of Hawaiʻi Division of Forestry and Wildlife 2015). The most significant threat facing the Hawaiian duck's (koloa maoli) continued existence is hybridization with feral mallards; as a result, it is now among the rarest of the world's birds (Engilis et al. 2020).

Disease is also a significant cause of mortality for the covered waterbird species in Hawaiʻi. The most prevalent avian disease that continues to endanger Hawaiian waterbirds is avian botulism. The disease can reappear annually in wetland habitats with stagnant water. The deadly effect, which includes flaccid paralysis and eventual leg paralysis, is caused by a toxin produced by the anaerobic bacteria known as *Clostridium botulinum* (type C). Avian botulism has been documented in the following locations: ʻŌhiʻapilo Pond on Molokaʻi, Hanalei National Wildlife Refuge on Kauaʻi, ʻŌpaeʻula Pond and ʻAimakapā Pond on Hawaiʻi, Keālia Pond National Wildlife Refuge and Kanahā Pond Wildlife Sanctuary on Maui, and at the lake on Laysan Island. Two emerging avian diseases also pose significant threats to the covered waterbirds: West Nile virus and avian influenza H5N1 or "bird flu". Both diseases have yet to be identified in the covered waterbird populations in Hawaiʻi (U.S. Fish and Wildlife Service 2011).

3.3.2.3 Green Sea Turtle

Green sea turtle (honu) (*Chelonia mydas*) was listed under the federal Endangered Species Act on July 28, 1978 (43 *Federal Register* 32800). On February 16, 2012, both the U.S. Fish and Wildlife Service and National Marine Fisheries Service (referred to herein as the Services) received a petition to identify the Hawaiian green sea turtle (honu) population as a DPS and delist it. After conducting a status review, the Services determined on April 6, 2016, that the Hawaiian population of the green sea turtle (honu) met the definition of threatened and identified it as the Central North Pacific Distinct Population Segment (CNPDPS) (81 *Federal Register* 20057). The CNPDPS of the green sea turtle (honu) (hereafter green sea turtle) is also protected by Chapter 195D of the Hawaiʻi Revised Statutes and Section 13-124 of Hawaiʻi Administrative Rules.

The range of the green sea turtle (honu) includes the Hawaiian Archipelago and Johnston Atoll. The Hawaiian Archipelago represents the most geographically isolated chain of islands globally and this DPS's distribution reflects that isolation. From 1965 to 2013, 17,536 individuals of green sea turtle (honu) have been tagged, an effort that has involved all post-pelagic size classes from juveniles to adults. With only three exceptions, the 7,360 recaptures of these tagged turtles have been made within the Hawaiian Archipelago. The outliers involved one recovery each in Japan, the Marshall Islands, and the Philippines (Seminoff et al. 2015).

Most green sea turtles (honu) spend most of their lives in open coastline and protected bays and lagoons (Seminoff et al. 2015). While in these areas, green sea turtles (honu) rely on marine algae and seagrass as their primary food, although some populations also forage heavily on invertebrates at different parts of their life cycle. On shore, green sea turtles (honu) rely on beaches characterized by intact dune structures, native vegetation, lack of artificial lighting, and normal beach temperatures for nesting (Limpus 1971; Salmon et al. 1992; Ackerman 1997; Witherington 1997; Lorne and Salmon 2007). In Kauaʻi, green sea turtle (honu) monitoring data collected from 2010 to 2012 were used to calculate an estimated nesting abundance of 16 females (Seminoff et al. 2015). In 2015, Parker and Balazs documented 20 nesting sites[5] around Kauaʻi. Average annual nesting density of green sea turtles (honu) at all Kauaʻi sites is very low, ranging from less than one (i.e., one nest every several years) to one to two nests per year between 2015 and 2020 (State of Hawaiʻi Division of Aquatic Resources 2020). Although nesting density is low, observations of nesting have increased over the past 5 years (State of Hawaiʻi Division of Aquatic Resources 2020).

The primary causes of the decline of green sea turtle (honu) are attributed to a variety of anthropogenic threats; development and public use of beaches, vessel strikes, attraction to artificial lights, bycatch in fishing gear, pollution, interactions with recreational and commercial vessels, beach driving, and major storm events all negatively affect green sea turtles (honu). Three of the most common reasons for sea turtle injury and mortality in Hawaiʻi are entanglement in fishing lines, interactions with fishing hooks, and interaction with marine debris (usually entanglement in nets). Coastal development and construction, vehicular and pedestrian traffic, beach pollution, tourism, and other human-related activities are increasing threats to the basking and nesting population in the main Hawaiian Islands and negatively affect hatchling and nesting turtles on Hawaiʻi's beaches.

[5] Nesting data reported from Kauaʻi are speculative due to the lack of systematic surveys. Estimates may also be skewed toward high-use beaches and beaches that regularly have resting seals (as this is how green sea turtle [honu] nests have been opportunistically found).

Threats resulting from climate change, including habitat loss and effects from warming sea and air temperatures, are characterized as high and the extent to which green sea turtles (honu) can adapt to these changes in nesting beach location and quality is unknown. Climate change will likely also cause higher sand temperatures, leading to increased feminization of surviving hatchings (i.e., changes in sex ratio), which in turn can lead to lower fecundity rates and ultimately population declines (Blechschmidt et al. 2020). Some beaches will also experience lethal incubation temperatures that will result in complete losses of hatchling cohorts (Glen and Mrosovsky 2004; Fuentes et al. 2010, 2011, Blechschmidt et al. 2020). Changes in sea temperatures will also likely alter seagrass, macroalgae, and invertebrate populations in coastal habitats in many regions (Scavia et al. 2002). Coastal areas denuded of vegetation or with construction can also affect thermal regimes on beaches; thus, they can affect incubation rates and increase the probability of biased sex ratios in hatchling sea turtles. Because of potential tidal inundation associated with lack of vegetation, nests laid in these areas are at a higher risk than those on more pristine beaches (Schroeder and Mosier 2000).

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Chapter 4
Conservation Strategy

4.1 Introduction

The KIUC HCP conservation strategy is the program that KIUC will implement over the permit term to contribute to the recovery of the covered species and fully offset the impacts of the taking of the covered activities on each covered species. The conservation strategy is designed to meet or exceed the regulatory requirements of the federal Endangered Species Act (federal ESA) and Hawai‘i Revised Statutes (HRS) Chapter 195D, as well as to streamline compliance with the National Environmental Policy Act, Hawai‘i Environmental Policy Act, and other applicable environmental regulations (see discussion in Chapter 1, *Introduction and Background*). Based on the biological needs of the covered species, the conservation strategy also minimizes the effects of the covered activities on the covered species. The conservation strategy provides mitigation and conservation for the effects of KIUC's covered activities on the covered species that remain, after minimization. See Chapter 5, *Effects*, for a full description of the effects of KIUC's covered activities on each of the covered species.

4.1.1 Overview

The conservation strategy is composed of two primary components that are closely linked—the biological goals and objectives and a set of conservation measures. The biological goals and objectives, described in Section 4.3, *Biological Goals and Objectives,* reflect the expected ecological outcomes of full implementation of the KIUC HCP. The biological goals set out the broad principles KIUC used to guide the development of the conservation strategy. The biological objectives describe the specific conservation commitments. Objectives are measurable and quantitative; they clearly state a desired result and will collectively achieve the biological goals. Biological goals and objectives are the foundation of the conservation strategy and are intended to provide the following functions.

- Describe the desired biological outcomes of the conservation strategy and how those outcomes will provide for the conservation of covered species and their habitats.
- Provide quantitative commitments and timeframes for achieving the desired outcomes.
- Serve as benchmarks by which to measure progress in achieving those outcomes across multiple temporal and spatial scales.
- Provide metrics for the monitoring program that will evaluate the effectiveness of the conservation measures and, if necessary, provide a basis to adjust the conservation measures to achieve the desired outcomes.

To achieve the biological goals and objectives, KIUC commits to implementing the conservation measures, described in Section 4.4, *Conservation Measures*. The conservation measures are the actions KIUC will implement to meet the biological goals and objectives.

4.2 Methods and Approach

The conservation strategy was developed through extensive discussions and collaboration with the U.S. Fish and Wildlife Service (USFWS) and State of Hawai'i Department of Land and Natural Resources (DLNR), Division of Forestry and Wildlife (DOFAW), during and after implementation of KIUC's *Short-Term Seabird Habitat Conservation Plan* (Short-Term HCP; Kaua'i Island Utility Cooperative 2011). It incorporates engineering and biological information regarding the cost, feasibility, and biological effectiveness of various minimization and conservation measures, drawing on techniques and information KIUC has developed through the Short-Term HCP for seabirds.

The conservation strategy is based on the best scientific data available as listed in Section 4.2.3, *Information Sources*, and was designed to be quantitative and measurable (Noss 1987).

4.2.1 Regulatory Background on Biological Goals and Objectives and Conservation Measures

HCPs are required to include biological goals and objectives for the covered species, either individually or in groups (U.S. Fish and Wildlife Service and National Marine Fisheries Service 2016). HRS Chapter 195D does not require biological goals and objectives in HCPs.

Biological goals are broad, guiding principles based on the biological needs of the covered species, and should broadly describe the desired future conditions for covered species in the Plan Area in succinct statements (U.S. Fish and Wildlife Service and National Marine Fisheries Service 2016:9-8). Each biological goal steps down to one or more biological objectives that define how to achieve the goal in measurable terms. As such, biological objectives are expressed as specific desired conditions that are measurable and quantitative when practicable and provide the foundation for evaluating effectiveness of the conservation strategy.

Biological goals and objectives should be developed based on existing conservation information relevant to the covered species. Biological goals and objectives should also be developed to remain attainable given the projected effects of climate change in the Plan Area during the permit term (U.S. Fish and Wildlife Service and National Marine Fisheries Service 2016:9-5).

Biological objectives are met through one or more *conservation measures*. Conservation measures can include actions that do any of the following to meet the goals and objectives of the HCP.

- Avoid effects on the covered species, or on other non-covered species (called *avoidance measures*)
- Reduce or minimize effects on the covered species (called *minimization measures*)
- Offset effects on the covered species that remain after minimization (called *mitigation*)

In sum, the entire conservation strategy (i.e., all conservation measures together) are intended to meet the regulatory standards under both the federal ESA[1] and HRS Chapter 195D[2] to do the following.

- Minimize and mitigate the impacts of the take to the maximum extent practicable (federal ESA and HRS Chapter 195D)

[1] 50 Code of Federal Regulations Section 17.22(b)(2)(i).

[2] Hawai'i Revised Statute Sections 195D-4(g) and 195D-21(c)(1) and (2).

- Not appreciably reduce the likelihood of survival and recovery of the covered species in the wild (federal ESA)
- Increase the likelihood that the covered species will survive and recover (HRS Chapter 195D)
- Result in an overall net gain in the recovery of the covered species (HRS Chapter 195D)

4.2.2 Process of Developing the Biological Goals and Objectives and Conservation Measures

The biological goals and objectives were developed first for the covered seabirds to address the complexities associated with the high level of effects (see Chapter 5, *Effects*) that has degraded the status of the species (Appendix 3A, *Species Accounts*). The seabird biological goals and objectives focus first on minimizing KIUC's impact from powerline strikes and light attraction from KIUC streetlights. Second, the biological goals and objectives for covered seabirds focus on mitigating to the maximum extent practicable the remaining unavoidable effects and contributing to species recovery.

The biological goals and objectives for the covered waterbirds are very similar to the goals and objectives for the covered seabirds. For example, the covered waterbird biological goals and objectives also focus on minimizing and mitigating the effects of powerline strikes. However, the covered waterbird strategy focuses on minimization efforts at specific locations with the highest probability of waterbird strikes rather than throughout the Plan Area.

The biological goals and objectives for green sea turtle (honu) focus on minimizing the effects of streetlights at active nests in order to minimize hatchling disorientation.

As with any biological system, there is some uncertainty regarding the effectiveness of the conservation measures. To address this uncertainty, the adaptive management program is a critical component of the KIUC HCP. Adaptive management will allow KIUC to adjust the conservation measures based on the monitoring results so that they are more likely to meet the biological goals and objectives of the HCP. See Chapter 6, *Monitoring and Adaptive Management Program*, for the KIUC HCP's prescriptive adaptive management strategy.

4.2.3 Information Sources

The conservation strategy was developed by KIUC in close collaboration with USFWS, DOFAW, and other local conservation partners such as Archipelago Research and Conservation (ARC) (species experts formerly with the Kaua'i Endangered Seabird Recovery Project). It is based on the biological needs of the covered species and the need to meet the regulatory standards described at the beginning of this chapter and in Chapter 1, *Introduction and Background*. The biological needs of the covered species are summarized in the species accounts in Appendix 3A, *Species Accounts*. In addition, several key sources of literature were used to inform the conservation strategy.

- *Hawaiian Dark-Rumped Petrel and the Newell's Manx Shearwater Recovery Plan* (U.S. Fish and Wildlife Service 1983)
- *Hawaiian Dark-rumped Petrel and Newell's Manx Shearwater Recovery Plan: Newell's Townsend's Shearwater Recovery Criteria* (U.S. Fish and Wildlife Service 2019)
- *Draft Recovery Plan for the Nene or Hawaiian Goose* (U.S. Fish and Wildlife Service 2004)

- *Recovery Plan for Hawaiian Waterbirds*, Second Revision (U.S. Fish and Wildlife Service 2011)
- *Regional Seabird Conservation Plan* (U.S. Fish and Wildlife Service 2005)
- *Hawaii's Comprehensive Wildlife Conservation Strategy* (Mitchell et al. 2005)
- *Hawai'i's State Wildlife Action Plan* (State of Hawai'i Department of Land and Natural Resources 2015)
- *Newell's Shearwater and Hawaiian Petrel Recovery: A Five-Year Action Plan* (Holmes et al. 2015)
- *Newell's Shearwater Landscape Strategy* (U.S. Fish and Wildlife Service 2017a)
- Newell's Shearwater Landscape Strategy Appendix II, *Modelling Methods and Results used to Inform the Newell's Shearwater Landscape Strategy* (U.S. Fish and Wildlife Service 2017b)
- *Short-Term Seabird Habitat Conservation Plan* (Kaua'i Island Utility Cooperative 2011)
- *Kaua'i Seabird Habitat Conservation Plan* (State of Hawai'i Division of Forestry and Wildlife 2020)
- *Final Environmental Assessment for Newell's Shearwater Management Actions* (U.S. Fish and Wildlife Service 2016)
- *Managing the Effects of Introduced Predators on Hawaiian Endangered Seabirds* (Raine et al. 2020a)
- *Underline Monitoring Project Review Draft—Bayesian Acoustic Strike Model* (Travers et al. 2020a)
- *Assessing the Reliability of Existing Newell's Shearwater* Puffinus newelli *and Hawaiian Petrel* Pterodroma sandwichensis *Population Estimates Using Contemporary Tracking Data* (Raine et al. 2021a)
- *Post-release Survival of Fallout Newell's Shearwater Fledglings from a Rescue and Rehabilitation Program on Kaua'i, Hawai'i* (Raine et al. 2020b)
- *2017 Annual Radar Monitoring Report* (Raine et al. 2017a)
- *2020 Annual Radar Monitoring Report* (Raine and Rossiter 2020)
- *Underline Monitoring Project-Power Line Minimization Briefing Document* (Travers et al. 2019a)
- *Underline Monitoring Project Power Line Minimization Briefing Document Supplement 2* (Travers and Raine 2020a)
- *Underline Monitoring Project Annual Reports* for field seasons 2012 through 2019 (Travers et al. 2012, 2013, 2014, 2015, 2016, 2017a, 2018, 2019b, and 2020b)
- *Using Automated Acoustic Monitoring Devices to Estimate Population Size of Endangered Seabird Colonies on Kaua'i* (Raine et al. 2019a)
- *KIUC Long-Term HCP Conservation Strategy for the Newell's Shearwater and Hawaiian Petrel to Address Power Line Strikes* (U.S. Fish and Wildlife Service and State of Hawai'i Division of Forestry and Wildlife 2018)
- *Declining Population Trends of Hawaiian Petrel and Newell's Shearwater on the Island of Kaua'i, Hawaii, USA* (Raine et al. 2017b)
- *Post-collision impacts, crippling bias, and environmental bias in a study of Newell's Shearwater and Hawaiian Petrel powerline collisions* (Travers et al. 2021)

- *Endangered Seabird Management Site Ranking Matrix* (Raine et al. 2020c)
- *2020 KIUC Fence Prioritization Evaluation* (Young 2020)

New analysis associated with this HCP included extensive computer modeling of the predicted effects of the covered activities on the covered species and the expected conservation benefits of the conservation measures. These models, which are included as appendices to Chapter 5, *Effects*, informed many of the quantitative population targets and types and amount of mitigation necessary to fully offset KIUC's impacts and result in a net benefit to each of the covered species.

4.2.4 Relationship to KIUC Short-Term HCP

The biological goals and objectives and conservation measures for covered seabirds are based on a long history (over 10 years) of implementing and refining the same or similar measures based on monitoring and data collected during and following KIUC's implementation of the Short-Term HCP (Kaua'i Island Utility Cooperative 2011). KIUC's Short-Term HCP was approved in May 2011 and was implemented over 5 years, until 2016. As described in Chapter 1, *Introduction and Background*, before the Short-Term HCP was prepared, relatively little was known about the distribution, population, and behaviors of the three listed seabirds on Kaua'i. In addition, little was known about the extent of the effects of KIUC's facilities and operations on these species. Thus, an important goal of the Short-Term HCP was to have KIUC work with conservation partners to implement a suite of specific monitoring and research projects to address this scientific uncertainty.

After the Short-Term HCP expired in 2016, KIUC continued to implement the same conservation measures and conduct extensive monitoring and research on the listed seabirds. KIUC reported the results of this work to USFWS and DOFAW annually in order to improve techniques and share best practices. This monitoring and research continue today, focused on the effectiveness of conservation measures for the covered seabirds and the nature of impacts of KIUC's facilities on the covered seabirds. More details on the ongoing monitoring program that will be incorporated into the monitoring program for this HCP can be found in Chapter 6, *Monitoring and Adaptive Management Program*. The biological goals and objectives and conservation measures for this HCP built on the extensive, long-term monitoring and research program that KIUC began before 2011.

4.3 Biological Goals and Objectives

The biological goals and objectives for the KIUC HCP describe what the conservation strategy is intended to achieve. The biological goals and objectives are organized by species group: seabirds, waterbirds, and turtles. Each covered seabird species is listed individually to address differences in metapopulation size, colony location, and data availability. The covered waterbirds are grouped under one goal because the actions to minimize and mitigate KIUC's effects are the same for all five species and because each species' population is generally thought to be either stable or increasing.

The biological goals and objectives are summarized in Table 4-1. Each biological objective will be met through one or more conservation measures listed in Table 4-1. Detailed descriptions of the conservation measures are found in Section 4.4, *Conservation Measures*.

In addition, this section includes a detailed description of the rationale for each biological objective, which follows each objective.

Table 4-1. Biological Goals and Objectives and Applicable Conservation Measures

Biological Goals and Objectives	Applicable Conservation Measures (see Section 4.4 for full descriptions of conservation measures)
Newell's Shearwater (ʻaʻo) (*Puffinus auricularis newelli*)	
Goal 1. Provide for the survival of the Kauaʻi metapopulation of Newell's shearwater (ʻaʻo) and contribute to the species' recovery by minimizing and fully offsetting the impacts of KIUC's taking of this species over the term of the HCP to an extent that is likely to result in numbers of breeding pairs, demography and age structure, population growth rate, and spatial distribution that is representative of a viable metapopulation on Kauaʻi.	
Objective 1.1. Substantially reduce the extent and effect of collisions of adult/subadult Newell's shearwaters (ʻaʻo) with KIUC powerlines island-wide, as measured against the pre-HCP strike estimate (Appendix 5D), in accordance with the location, extent, and schedule outlined in the HCP.	**Conservation Measure 1.** Implement Powerline Collision Minimization Projects
Objective 1.2. Minimize the adverse effects of artificial light attraction on Newell's shearwater (ʻaʻo) fledglings from all existing and future KIUC streetlights and existing covered facilities by continuing to implement practicable conservation measures throughout the permit term.	**Conservation Measure 2.** Implement Measures to Minimize Light Attraction, **Conservation Measure 3.** Provide Funding for the Save Our Shearwaters Program
Objective 1.3. Increase the number of Newell's shearwater (ʻaʻo) breeding pairs and new chicks produced annually throughout the duration of the permit by managing and enhancing suitable Newell's shearwater (ʻaʻo) breeding habitat and breeding colonies across 10 conservation sites and reducing the abundance and distribution of key seabird predators in northwestern Kauaʻi. The success of this objective will be measured by the following metrics within all of the 10 conservation sites combined: **Metric 1**. Maintain an annual minimum of 1,264 breeding pairs as determined by call rates and burrow monitoring. **Metric 2.** Reach a target of 2,371 breeding pairs by year 25 of the permit term and 4,313 breeding pairs by the end of the permit term. **Metric 3.** Growth rate for breeding pairs annually of at least 1% as measured by a 5-year rolling average. **Metric 4.** Maintain a 5-year rolling average 87.2% reproductive success rate. **Metric 5.**Eradicate terrestrial predators within predator exclusion fencing. **Metric 6.** Produce at least one breeding pair within each of the four social attraction sites by Year 10 of the permit term **Metric 7.** Ensure that invasive plant and animal species do not preclude meeting the objective metrics above.	**Conservation Measure 4.** Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites

Biological Goals and Objectives	Applicable Conservation Measures (see Section 4.4 for full descriptions of conservation measures)
Hawaiian Petrel (ʻuaʻu) (*Pterodroma sandwichensis*)	
Goal 2. Provide for the survival of the Kauaʻi metapopulation of Hawaiian petrel (ʻuaʻu) and contribute to the species' recovery by minimizing and fully offsetting the impacts of KIUC's taking on this species over the term of the HCP to an extent that is likely to result in numbers of breeding pairs, demography and age structure, population growth rate, demography, and spatial distribution that is representative of a viable metapopulation on Kauaʻi.	
Objective 2.1. Substantially reduce the extent and effect of collisions of adult/subadult Hawaiian petrels (ʻuaʻu) with KIUC powerlines island-wide, as measured against the pre-HCP estimate (Appendix 5D) in accordance with the location, extent, and schedule outlined in the HCP.	**Conservation Measure 1.** Implement Powerline Collision Minimization Projects
Objective 2.2. Minimize the adverse effects of artificial light attraction on Hawaiian petrel (ʻuaʻu) fledglings from all existing and future KIUC streetlights and existing covered facilities by continuing to implement practicable conservation measures throughout the permit term.	**Conservation Measure 2.** Implement Measures to Minimize Light Attraction, **Conservation Measure 3.** Provide Funding for the Save Our Shearwaters Program
Objective 2.3. Increase the number of Hawaiian petrel (ʻuaʻu) breeding pairs and new chicks produced annually throughout the duration of the permit by managing and enhancing suitable Hawaiian petrel (ʻuaʻu) breeding habitat and breeding colonies across 10 conservation sites and reducing the abundance and distribution of key seabird predators in northwestern Kauaʻi. The success of this objective will be measured by the following metrics within all of the 10 conservation sites combined: **Metric 1.** Maintain an annual minimum of 2,257 breeding pairs as determined by call rates and burrow monitoring. **Metric 2.** Reach a target of 2,926 breeding pairs by year 25 of the permit term and 3,751 breeding pairs by the end of the permit term. **Metric 3**. Growth rate for breeding pairs annually of at least 1.0% as measured by a 5-year rolling average. **Metric 4.** Maintain a 5-year rolling average 78.7% reproductive success rate. **Metric 5**. Ensure that invasive plant and animal species do not preclude meeting the objective metrics above.	**Conservation Measure 4.** Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites

Biological Goals and Objectives	Applicable Conservation Measures (see Section 4.4 for full descriptions of conservation measures)
Band-Rumped Storm-Petrel (ʻakēʻakē) (*Oceanodroma castro*)	
Goal 3. Contribute to the recovery of the band-rumped storm-petrel (ʻakēʻakē) by reducing threats associated with existing and future KIUC streetlights, existing covered facility lights, and introduced predators on Kauaʻi.	
Objective 3.1. Minimize artificial light attraction on band-rumped storm-petrel (ʻakēʻakē) fledglings from all existing and future KIUC streetlights and existing covered facilities by continuing to implement practicable conservation measures throughout the permit term.	**Conservation Measure 2.** Implement Measures to Minimize Light Attraction
Objective 3.2. Facilitate the rescue, rehabilitation, and release of band-rumped storm-petrel (ʻakēʻakē) fledglings through funding of the Save Our Shearwaters Program or other certified rehabilitation facility to offset light attraction by KIUC streetlights.	**Conservation Measure 3.** Provide Funding for the Save Our Shearwaters Program
Objective 3.3. Implement predator control, including barn owl control, within the conservation sites to reduce threats to band-rumped storm-petrel (ʻakēʻakē) in areas near the conservation sites (e.g., Nā Pali Coast).	**Conservation Measure 4.** Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites
Covered Waterbirds: Hawaiian Coot (ʻalae keʻokeʻo) (*Fulica alai*), Hawaiian Gallinule (ʻalae ʻula) (*Gallinula galeata sandvicensis*), Hawaiian Stilt (aeʻo) (*Himantopus mexicanus knudseni*), Hawaiian Goose (nēnē) (*Branta sandvicensis*), and Hawaiian Duck (koloa maoli) (*Anas wyvilliana*)	
Goal 4. Contribute to the recovery of covered waterbird species by reducing threats associated with KIUC powerlines on Kauaʻi.	
Objective 4.1. Reduce covered waterbird collisions with KIUC powerlines in Hanalei and Mānā (Kawaiʻele Waterbird Sanctuary), in accordance with the location, extent, and schedule outlined in the HCP, and relative to measured collisions in 2021.	**Conservation Measure 1.** Implement Powerline Collision Minimization Projects
Objective 4.2. Facilitate the rescue, rehabilitation, and release of grounded covered waterbirds through funding of the Save Our Shearwaters Program or other certified rehabilitation facility to offset collisions with KIUC powerlines.	**Conservation Measure 3.** Provide Funding for the Save Our Shearwaters Program
Green Sea Turtle (honu) (*Chelonia mydas*) (Central North Pacific Distinct Population Segment)	
Goal 5. Contribute to the recovery of the species by increasing the ability for green sea turtles (honu) to successfully transit Kauaʻi beaches.	
Objective 5.1. Locate and temporarily shield green sea turtle (honu) nests at all locations that are visually affected by KIUC streetlights on an annual basis.	**Conservation Measure 5.** Implement a Green Sea Turtle Nest Detection and Temporary Shielding Program
Objective 5.2. For the duration of the permit permanently minimize light effects to the extent practicable from existing and future KIUC streetlights onto beaches with suitable green sea turtle (honu) nesting habitat by implementing practicable minimization techniques that will further reduce or eliminate these light effects.	**Conservation Measure 6.** Identify and Implement Practicable Streetlight Minimization Techniques for Green Sea Turtle

4.3.1 Newell’s Shearwater (‘a‘o)

Goal 1. Provide for the survival of the Kaua‘i metapopulation of Newell’s shearwater (‘a‘o) and contribute to the species’ recovery by minimizing and fully offsetting KIUC’s impacts on this species over the term of the HCP to an extent that is likely to result in numbers of breeding pairs, demography and age structure, population growth rate, and spatial distribution that is representative of a viable metapopulation on Kaua‘i.

Objective 1.1. Substantially reduce the extent and effect of collisions of adult/subadult covered seabirds with KIUC powerlines island-wide, as measured against the estimated pre-HCP strike estimate (Appendix 5D) in accordance with the location, extent, and schedule outlined in the HCP.

Rationale

Reduction of powerline collisions is key to reducing overall human-caused seabird injury and mortality (Travers et al. 2020a, 2020b, 2021; Travers and Raine 2020a), and hence to retaining the potential for Newell’s shearwater (‘a‘o) recovery. The current rate of seabird powerline collision is affecting the age structure of the population by removing large portions of subadult and adult individuals annually from the population. Because the reproductive strategy of this species evolved to have high adult survivorship with a relatively low number of offspring, increased levels of adult mortality are particularly harmful to this species and its population viability. Left unchecked, low adult survivorship (or conversely high adult mortality) will depress populations to levels where they can become vulnerable to extirpation. A reduction in these collisions will retain more adults and subadults, thereby improving the existing population rate of change, demography and age class structure, and population size, and contribute to population numbers that represent a viable metapopulation for Newell’s shearwater (‘a‘o) by the end of the permit term.

Based on KIUC’s pre-implementation monitoring data showing that strikes are reduced from between 42 percent to over 95 percent depending on the minimization technique (or combination of techniques), KIUC’s powerline minimization projects will reduce seabird powerline collisions by at least 65.3 percent by the end of 2023 (Travers and Raine 2020a).

The comparison point (i.e., baseline) for all future measurements of powerline strike minimization is proposed as estimated strikes calculated by a Bayesian model using powerline strike date collected between 2013 and 2019 (Travers et al. 2020b). To avoid double counting strike reductions from early implementation of the KIUC HCP (counted as 2020–2022) versus KIUC’s Short-Term HCP (counted as 2011–2019), the baseline only includes the effect of minimization actions that were implemented during the 7-year period counted as part of KIUC’s implementation of its Short-Term HCP.[3]

See Section 4.4.1, *Conservation Measure 1. Implement Powerline Collision Minimization Projects*, for details of the conservation measure proposed to achieve this biological objective.

Objective 1.2. Minimize the adverse effects of artificial light attraction on Newell’s shearwater (‘a‘o) fledglings from all existing and future KIUC streetlights and existing covered facilities by continuing to implement practicable conservation measures throughout the permit term.

[3] KIUC did not carry out any minimization projects in 2017, 2018, or 2019.

Rationale

Conservation measures with proven success at reducing covered seabird fledgling light attraction have been implemented for KIUC's existing streetlights (full-cutoff shields for lights), in partnership with the County of Kauaʻi (County) and State of Hawaiʻi (State), and KIUC's covered facility lights. An early study on Kauaʻi showed that the shielding of bright lights reduced fallout of Newell's shearwater (ʻaʻo) by 40 percent (Reed et al. 1985). Recent studies continue to indicate that the reduction of lateral light spillage is beneficial to reducing light-induced fallout of seabirds (Rodríguez et al. 2017a, 2017b). KIUC also began dimming or turning off covered facility lights at the Port Allen Generating Station in 2019, which reduced Newell's shearwater (ʻaʻo) fallout from an average of 5.5 fledglings per year to an average of 1 fledgling per year (Kauaʻi Island Utility Cooperative 2020).

These conservation actions would continue to be implemented for existing and new facility lights, as well as for all new streetlights installed during the permit term. Increased fledgling survival would benefit from recruitment and lead to more future breeding-age individuals in the Kauaʻi metapopulation. Because this species has very low reproductive productivity, increasing recruitment to the breeding-age population, and hence increasing the number of chicks that can be produced by the metapopulation each year, is a key conservation strategy that would contribute to population numbers that represent a viable metapopulation for Newell's shearwater (ʻaʻo) by the end of the permit term.

See Section 4.4.2, *Conservation Measure 2. Implement Measures to Minimize Light Attraction*, and Section 4.4.3, *Conservation Measure 3. Provide Funding for the Save Our Shearwaters Program*, for details of the conservation measures proposed to achieve this biological objective.

Objective 1.3. Increase the number of Newell's shearwater (ʻaʻo) breeding pairs and new chicks produced annually throughout the duration of the permit by managing and enhancing suitable Newell's shearwater (ʻaʻo) breeding habitat and breeding colonies across 10 conservation sites and reducing the abundance and distribution of key seabird predators in northwestern Kauaʻi. The success of this objective will be measured by the following metrics within all of the 10 conservation sites combined:

a. Maintain an annual minimum of 1,264 Newell's shearwater (ʻaʻo) breeding pairs as determined by call rates and burrow monitoring.

b. Reach a target of 2,371 breeding pairs by year 25 of the permit term and 4,313 Newell's shearwater (ʻaʻo) breeding pairs by the end of the permit term.

c. Growth rate for breeding pairs annually of at least 1 percent as measured by a 5-year rolling average.

d. Maintain a 5-year rolling average 87.2 percent reproductive success rate.

e. Eradicate terrestrial predators within predator exclusion fencing.

f. Produce at least one breeding pair within each of the four social attraction sites by Year 10 of the permit term.

g. Ensure that invasive plant and animal species do not preclude meeting the objective metrics above.

Rationale

Operation of KIUC infrastructure has had substantial effects on the Kauaʻi metapopulation of this species and is one of the primary reasons the metapopulation is at historically low levels. Because at least 90 percent of the breeding population of Newell's shearwater (ʻaʻo) occurs on Kauaʻi, a viable metapopulation in the Plan Area is critical to retaining the potential for species recovery. A viable metapopulation for Newell's shearwater (ʻaʻo) is quantified as 2,500 breeding pairs and a total population size of 10,000 individuals (Nagatani pers. comm.).

The densest colonies of Newell's shearwater (ʻaʻo) in the Plan Area are concentrated in the remote northwestern portion of Kauaʻi (Raine et al. 2020c). This area has been determined by species experts to have the greatest potential to resulting in a viable metapopulation by increasing the number of Newell's shearwater (ʻaʻo) breeding pairs and new chicks produced (see Conservation Measure 4 for the reasons), and therefore this area has been the focus of conservation efforts for the last decade (Raine et al. 2020c). KIUC has secured nine conservation sites and will select a tenth conservation site (which is still being evaluated) in this part of the island (see Section 4.4.4, *Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites*) at which to manage and enhance habitat for existing breeding colonies of Newell's shearwater (ʻaʻo). The nine selected sites total approximately 2,216 acres (896 hectares).[4]

Management actions with proven success at improving the reproductive productivity of Newell's shearwater (ʻaʻo) breeding colonies are ongoing at all the selected conservation sites and would continue and be expanded by the HCP for the duration of the permit term. For example, predator control has been shown to be the most effective tactic to increase the reproductive success rate of Newell's shearwater (ʻaʻo), with estimated increases of 35.8 percent in managed areas (Raine et al. 2020a). Expanding the scale and types of predator control (e.g., installing and/or maintaining predator exclusion fencing at four conservation sites and predator eradication within predator exclusion fences) will further reduce this significant threat and increase the survivorship of chicks produced each year. Social attraction within the fenced conservation sites is also expected to accelerate colony recruitment and colony increases and expansion.

All of the conservation measures that support this objective are designed to result in population increases at the conservation sites. In combination with a substantial reduction in powerline strikes (see Objective 1.1), the HCP's conservation strategy will improve the status of the Newell's shearwater (ʻaʻo) metapopulation by continuing to protect and manage existing colonies within conservation sites. See Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites (Section 4.4, *Conservation Measures*).

Collectively, these measures would result in a viable metapopulation of Newell's shearwater (ʻaʻo) that leads to a viable metapopulation on Kauaʻi, as stated in Goal 1. We cannot measure population viability directly, but important characteristics of the metapopulation can be estimated by evaluating the following components of population dynamics that contribute to viability and that can be measured.

- Numbers of breeding pairs
- Population growth rate

[4] See Appendix 4A, *Conservation Site Selection*, for further details on these conservation sites, their specific characteristics, and how and why they were selected.

- Demography and age structure
- Spatial distribution

Each of these components of a viable metapopulation is explained below.

Numbers of breeding pairs. The word *viable* often refers to a population (or metapopulation) that is not expected to become or has a low likelihood of becoming extinct, or quasi-extinct, during a specified timeframe. In other words, the number of individuals would have a high probability of persistence over the long term. Quasi-extinction can occur when some number of individuals remains alive, but the population itself is no longer viable because it has fallen below a threshold number of individuals below which it cannot recover. This threshold is also known as a minimum viable population size (Schaffer 1981). Extinction or quasi-extinction below a minimum viable population can be associated with a population too small to allow individuals to find mates. In other cases, small populations can result in reductions in fitness (i.e., called inbreeding depression) that reduces reproductive success below levels necessary for population replacement (also known as Allee effects; Courchamp et al. 1999; Schippers et al. 2011). Populations below a minimum viable level are also at much greater risk of adverse stochastic events such as extreme weather events, diseases, novel predators, or demographic shifts such as adversely skewed sex ratios.

No population viability analysis has been conducted for the covered seabirds. However, USFWS (pers. comm.) estimates that for the Kaua'i metapopulation of Newell's shearwater ('a'o), 10,000 individuals (and 2,500 breeding pairs) represents a minimum viable level for the Plan Area. This estimate considers the roles of age structure, catastrophes, random demographic and environmental fluctuations (stochasticity), and inbreeding depression. Populations that are maintained above minimum viable levels ensure a higher likelihood of population persistence. For the covered seabirds, a key metric related to population viability is the number of breeding pairs.

Metric 1 of Objective 1.3 is designed to ensure that the number of breeding pairs in the 10 conservation sites does not fall below the current level of 1,264 Newell's shearwater ('a'o) breeding pairs. Metric 2 of Objective 1.3 is designed to ensure that progress is always being made to expand the subpopulations of all conservation sites to the ultimate target of 4,313 breeding pairs by the end of the permit term, which is well above the minimum viable population target of 2,500 breeding pairs. Metric 2 also includes an interim target of 2,371 breeding pairs by year 25 of the permit term (halfway) to ensure that progress is being met towards the target at the end of the permit term. These values were derived from the population dynamics model, described in Chapter 5, *Effects*, and Appendix 5E, *Population Dynamics Model for Newell's Shearwater ('a'o) on Kaua'i*, presents the methods and results for the effect of KIUC's minimization and conservation actions on the Kaua'i metapopulations of Newell's shearwater ('a'o). Metrics 5 and 7 in Objective 1.3 are qualitative; they are included to help ensure that the population-based metrics are met.

Population growth rate. Declining populations are populations with declining trends in abundance (i.e., with negative rates of population change through time). Populations that are consistently in decline are, by definition, not viable over the long term unless the negative trend in abundance can be stabilized (no longer in decline) or reversed (positive growth) before abundance has been reduced below a minimum viable population size. For a population to be viable, trends in abundance must be increasing, or at least under certain circumstances be stable (i.e., not increasing or decreasing) through time. For example, stable trends in abundance are consistent with a viable population if abundance is at high levels relative to the carrying capacity of the environment. In the case of endangered species, however, abundance levels are often by definition lower than the carrying capacity of the environment, and therefore achieving positive trends in abundance is necessary for population viability.

Metrics 3 and 4 in Objective 1.3, in combination with Metric 2, are designed to ensure that the subpopulations within the 10 conservation sites combined continue to grow annually. Meeting or exceeding the annual minimum population growth rate (Metric 3) and minimum reproductive success rate (Metric 4) will ensure that the 10 conservation sites combined are growing at rates that will ensure a minimum viable population is met or exceeded by the end of the permit term. Metrics 5 and 7 in Objective 1.3 are qualitative; they are included to help ensure that the population-based metrics are met.

Demography and age structure. Age structure reflects the proportions of individuals at different life stages, and this variable is an indicator of population status. Growing populations tend to have larger proportions of individuals in younger age classes, while declining populations tend to have lower proportions of younger individuals (although populations with larger proportions of younger individuals may also reflect low adult survivorship). Although age structure cannot be directly measured, a stable age structure is assumed when the growth rate for breeding pairs is increasing, which indicates that the population is increasing and recruitment is occurring.

Sex ratios are another important demographic factor influencing population viability for species that have long-term pair bonding. Although it is not possible to measure or track sex ratios, a 50:50 sex ratio is assumed if reproduction is occurring. For the KIUC HCP, modeled metapopulation numbers that are increasing would be consistent with demography that indicates viability because an increase in the modeled metapopulation size occurs when the total annual number of fledglings produced is greater than the number of deaths on an island-wide basis.

Metrics 1, 2, 3, and 4 of Objective 1.3 are designed to ensure that the subpopulations in the 10 conservation sites combined are growing in ways to provide an age structure and sex ratio consistent with a viable metapopulation (i.e., no metrics can be included to measure age structure or sex ratio directly).

Spatial distribution. Spatial distribution is often an important component of population viability. For example, the more populations or subpopulations present in a species, all else being equal, the greater the chance that the species can persist in the long term because some stochastic events may operate independently or semi-independently in different populations or subpopulations. Species with more subpopulations have a greater chance of withstanding these events. For example, a species with 10 separate subpopulations might lose two of these subpopulations because of a major hurricane, but the remaining eight subpopulations can persist. A species with only two subpopulations is at much greater risk of losing half or all of the subpopulations in a major hurricane.

Spatial distribution is a component of a viable metapopulation for Newell's shearwater (ʻaʻo) (U.S. Fish and Wildlife Service 2019). One reason KIUC proposes to protect and maintain so many conservation sites (10) is to help increase the spatial distribution of the Kauaʻi metapopulation. Having numerous protected and managed conservation sites, including four with predator-proof fencing, will help ensure that populations persist even in the face of extreme weather and changing climate, for example. The proposed conservation sites represent the best remaining available habitat for this species on Kaua‘i because of their remote location, rugged terrain, and distance from powerlines and lights.

Metric 6 in Objective 1.3 supports the goal of maintaining sufficient spatial distribution because this metric will ensure that all of the social attraction sites are occupied and producing new breeding pairs. All or almost all of the 10 conservation sites need to be occupied in order to meet Metrics 1, 2, 3, and 4 of Objective 1.3, ensuring that the spatial distribution of the species by the end of the permit term is consistent with a viable metapopulation.

In conclusion, metapopulation numbers within the conservation sites that exceed 10,000 individuals (2,500 breeding pairs) that are increasing at the end of the permit term would be consistent with a viable metapopulation on Kaua‘i (U.S. Fish and Wildlife Service pers. comm.).

4.3.2 Hawaiian Petrel (‘ua‘u)

Goal 2. Provide for the survival of the Kaua‘i metapopulation of Hawaiian petrel (‘ua‘u) and contribute to the species’ recovery by minimizing and fully offsetting KIUC’s impacts on this species over the term of the HCP to an extent that is likely to result in a population size, age structure, population growth rate, demography, and distribution that is representative of a viable metapopulation on Kaua‘i.

Objective 2.1. Substantially reduce the extent and effect of collisions of adult/subadult Hawaiian petrels (‘ua‘u) with all KIUC powerlines island-wide, as measured against the 2020 strike estimate (Travers et al. 2020b) in accordance with the location, extent, and schedule outlined in the HCP.

Rationale

Reduction of powerline collisions is key to reducing overall human-caused seabird injury and mortality (Travers et al. 2020a; Travers and Raine 2020a), and hence to retaining the potential for Hawaiian petrel (‘ua‘u) recovery. The current rate of seabird powerline collision is affecting the age structure of the population by removing large portions of subadult and adult individuals annually from the population. Because the reproductive strategy of this species evolved to have high adult survivorship with a relatively low number of offspring, increased levels of adult mortality are particularly harmful to this species and its population viability. Left unchecked, low adult survivorship (or conversely high adult mortality) will depress populations to levels where they can become vulnerable to extirpation. A reduction in these collisions will retain more adults and subadults, thereby improving the existing population rate of change, demography and age class structure, and population size, and move toward numbers that represent a viable metapopulation for Hawaiian petrel (‘ua‘u).

Based on KIUC’s pre-implementation monitoring data showing that strikes are reduced from between 42 percent to over 95 percent depending on the minimization technique (or combination of techniques), the powerline minimization projects in progress by KIUC will reduce seabird powerline collisions by at least 65.3 percent (Travers and Raine 2020a).The comparison point (i.e., baseline) for all future measurements of powerline strike minimization is proposed as estimated strikes in 2020 as calculated by a Bayesian model using powerline strike data collected between 2013 and 2019 (Travers et al. 2020b). To avoid double counting strike reductions resulting from early implementation of the KIUC HCP (counted as 2020–2022) versus KIUC's Short-Term HCP (counted as 2011–2019), the baseline only includes the effect of minimization actions that were implemented during the 7-year period counted as part of KIUC's implementation of its Short-Term HCP.[5]

See Conservation Measure 1. Implement Powerline Collision Minimization Projects (Section 4.4, *Conservation Measures*) for details of the conservation measure proposed to achieve this biological objective.

Objective 2.2. Minimize the adverse effects of artificial light attraction on Hawaiian petrel (ʻuaʻu) fledglings from all existing and future KIUC streetlights and existing covered facilities by continuing to implement practicable conservation measures throughout the permit term.

Rationale

Conservation measures with proven success at reducing covered seabird fledgling light attraction have been implemented for KIUC's existing streetlights (full-cutoff shields for lights), in partnership with the County and State, and KIUC's covered facility lights. An early study on Kauaʻi showed that the shielding of bright lights reduced fallout of Newell's shearwater (ʻaʻo) by 40 percent (Reed et al. 1985). Recent studies continue to indicate that the reduction of lateral light spillage is beneficial to reducing light-induced fallout of seabirds (Rodríguez et al. 2017a, 2017b). KIUC also began dimming or turning off covered facility lights at the Port Allen Generating Station in 2019. Although there has been no change in the documented Hawaiian petrel (ʻuaʻu) fallout at KIUC covered facilities before or after light dimming (only one individual was recorded in 2012), as described in Section 4.3.1, *Newell's shearwater (ʻaʻo*), fallout for Newell's shearwater (ʻaʻo) was reduced from an average of 5.5. fledglings per year to an average of 1 fledgling per year (Kauaʻi Island Utility Cooperative 2020), so it is assumed light dimming also benefits Hawaiian petrel (ʻuaʻu).

These conservation actions would continue to be implemented for existing and new facility lights, as well as for all new streetlights installed during the permit term. Increased fledgling survival would benefit from recruitment and lead to more future breeding-age individuals in the Kauaʻi metapopulation. Because this species has very low reproductive productivity, increasing recruitment to the breeding-age population, and hence increasing the number of chicks that can be produced by the metapopulation each year, is a key conservation strategy that would contribute to population numbers that represent a viable metapopulation for Hawaiian petrel (ʻuaʻu) by the end of the permit term.

See Conservation Measure 2. Implement Measures to Minimize Light Attraction and Conservation Measure 3. Provide Funding for the Save Our Shearwaters Program (Section 4.4, *Conservation Measures*) for details of the conservation measures proposed to achieve this biological objective.

Objective 2.3. Increase the number of Hawaiian petrel (ʻuaʻu) breeding pairs and new chicks produced annually throughout the duration of the permit by managing and enhancing suitable Hawaiian petrel (ʻuaʻu) breeding habitat and breeding colonies across 10 conservation sites and reducing the abundance and distribution of key seabird predators in northwestern Kauaʻi. The

[5] KIUC did not carry out any minimization projects in 2017, 2018, or 2019.

success of this objective will be measured by the following metrics within all of the 10 conservation sites combined:

a. Maintain an annual minimum of 2,257 Hawaiian petrel (ʻuaʻu) breeding pairs

b. Reach a target of 2,926 breeding pairs by year 25 of the permit term and 3,715 breeding pairs by the end of the permit term.

c. Growth rate for breeding pairs annually of at least 1 percent as measured by a 5-year rolling average.

d. Maintain a 5-year rolling average 78.7 percent reproductive success rate.

e. Ensure that invasive plant and animal species do not preclude meeting the objective metrics above.

Rationale

Operation of KIUC infrastructure has had substantial effects on the Kauaʻi metapopulation of this species and is one of the primary reasons the metapopulation is at historically low levels. Because a large share of the breeding individuals of Hawaiian petrel (ʻuaʻu) occur on Kauaʻi, a viable metapopulation in the Plan Area is critical to retaining the potential for species recovery. A viable metapopulation for Hawaiian petrel (ʻuaʻu) is quantified as 2,500 breeding pairs and a total population size of 10,000 individuals.

The densest colonies of Hawaiian petrel (ʻuaʻu) in the Plan Area are concentrated in the remote northwestern portion of Kauaʻi (Raine et al. 2020c). This area has been determined by species experts to have the greatest potential to result in a viable metapopulation by increasing the number of Hawaiian petrel (ʻuaʻu) breeding pairs and new chicks produced (see Conservation Measure 4 for the reasons), and this area has been the focus of conservation efforts for the last decade (Raine et al. 2020c). KIUC has secured nine conservation sites and will select a tenth conservation site (which is still being evaluated) in this part of the island (see Section 4.4.4, *Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites*) at which to manage and enhance habitat for existing breeding colonies of Hawaiian petrel (ʻuaʻu). The nine selected sites total approximately 2,216 acres (896 hectares).[6]

Management actions with proven success at improving the reproductive success of Hawaiian petrel (ʻuaʻu) breeding colonies are ongoing at all the selected conservation sites and would continue and be expanded by the HCP for the duration of the permit term. For example, predator control has been shown to be the most effective tactic to increase the reproductive success rate of Hawaiian petrel (ʻuaʻu) by a mean of 35.8 percent in managed areas (Raine et al. 2020a). Expanding the scale and types of predator control (e.g., installing and/or maintaining predator exclusion fencing at two conservation sites, predator eradication within predator exclusion fences) will further reduce this significant threat and increase the survivorship of chicks produced each year. Social attraction within the fenced conservation sites is also expected to accelerate colony recruitment and colony increases and expansion.

All the conservation measures that support this objective are designed to result in population increases at the conservation sites. In combination with a substantial reduction in powerline

[6] See Appendix 4A, *Conservation Site Selection*, for further details on these conservation sites, their specific characteristics, and how and why they were selected.

strikes (see Objective 1.1), the HCP's conservation strategy will improve the status of the Hawaiian petrel ('ua'u) metapopulation by continuing to protect and manage existing colonies within conservation sites. Collectively, these measures would result in a viable metapopulation of Hawaiian petrel ('ua'u) on Kaua'i, as stated in Goal 2. We cannot measure population viability directly, but this important characteristic of the metapopulation can be estimated by evaluating the following components of population dynamics that that contribute to viability that we can measure.

- Number of breeding pairs
- Population growth rate
- Demography and age structure
- Spatial distribution

These components of a viable metapopulation are explained above for Newell's shearwater ('a'o) under Objective 1.3. The same principles apply to Hawaiian petrel ('ua'u) but are not repeated here. The discussion for Hawaiian petrel ('ua'u) is limited to how each of the five metrics of Objective 2.3 support each of the components of a viable metapopulation.

Metric 1 of Objective 2.3 is designed to ensure that the number of breeding pairs in the 10 conservation sites does not fall below the current level of 2,257 Hawaiian petrel ('ua'u) breeding pairs. Metric 2 of Objective 2.3 is designed to ensure that progress is always being made to expand the subpopulations of all conservation sites to the ultimate target of 3,751 breeding pairs by the end of the permit term, which is well above the minimum viable population target of 2,500 breeding pairs. Metric 2 also includes an interim target of 2,926 breeding pairs by year 25 of the permit term (halfway) to ensure that progress is being met towards the target at the end of the permit term. These values were derived from the population dynamics model, described in Chapter 5, *Effects*, and Appendix 5F, *Population Dynamics Model for Hawaiian Petrel ('ua'u) on Kaua'i*, presents the methods and results for the effect of KIUC's minimization and conservation actions on the Kaua'i metapopulations of Hawaiian petrel ('ua'u). Metric 5 in Objective 2.3 is qualitative; it is included to help ensure that the population-based metrics are met.

Metrics 3 and 4 in Objective 2.3, in combination with Metric 2, are designed to ensure that the subpopulations within the 10 conservation sites combined continue to grow annually. Meeting or exceeding the annual minimum population growth rate (Metric 3) and minimum reproductive success rate (Metric 4) will ensure that the 10 conservation sites combined are growing at rates that will ensure a minimum viable population is met or exceeded by the end of the permit term.

Metrics 1, 2, 3, and 4 of Objective 2.3 are designed to ensure that the subpopulations in the 10 conservation sites combined are growing in ways to provide an age structure and sex ratio consistent with a viable metapopulation (i.e., no metrics can be included to measure age structure or sex ratio directly). All or almost all of the 10 conservation sites need to be occupied in order to meet Metrics 1, 2, 3, and 4 of Objective 2.3, thus ensuring that the spatial distribution of the species by the end of the permit term is consistent with a viable metapopulation.

See Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites (Section 4.4, *Conservation Measures*).

4.3.3 Band-Rumped Storm-Petrel (ʻakēʻakē)

There have been no documented collisions of band-rumped storm-petrel (ʻakēʻakē) with KIUC powerlines, despite extensive annual monitoring efforts since 2011 (Travers et al. 2019b). Band-rumped storm-petrels (ʻakēʻakē) are less common and more difficult to detect and also have a different flight pattern and body type than Newell's shearwaters (ʻaʻo) and Hawaiian petrels (ʻuaʻu). KIUC assumes band-rumped storm-petrels (ʻakēʻakē) are rarely affected by powerline collisions. Biological objectives 1.2 and 2.2 for the other covered seabirds are expected to address the impacts on and conservation needs of band-rumped storm-petrel (ʻakēʻakē) with respect to the very rare occurrence (once every several years) of powerline collisions. Powerline collision minimization projects to reduce powerline collisions for the other two covered seabird species in this HCP are also expected to minimize powerline collisions of band-rumped storm-petrel (ʻakēʻakē).

The biological objectives for this species focus on the primary threats of artificial light attraction and predation from introduced wildlife species.

Goal 3. Contribute to the recovery of the band-rumped storm-petrel (ʻakēʻakē) by reducing threats associated with existing and future KIUC streetlights, existing covered facilities on Kauaʻi, and introduced predators on Kauaʻi.

Objective 3.1. Minimize artificial light attraction on band-rumped storm-petrel (ʻakēʻakē) fledglings from all existing and future KIUC streetlights and existing covered facilities.

Rationale

Conservation measures with proven success at reducing covered seabird fledgling light attraction have been implemented for KIUC's existing streetlights (full-cutoff shields for lights), in partnership with the County and State, and KIUC's covered facility lights. An early study on Kauaʻi showed that the shielding of bright lights reduced fallout of Newell's shearwater (ʻaʻo) by 40 percent (Reed et al. 1985). Recent studies continue to indicate that the reduction of lateral light spillage is beneficial to reducing light-induced fallout of seabirds (Rodríguez et al. 2017a, 2017b). KIUC also began dimming or turning off covered facility lights at the Port Allen Generating Station in 2019. Although there has been no documented band-rumped storm-petrel (ʻakēʻakē) fallout at KIUC covered facilities before or after light dimming, as described in Section 4.3.1, *Newell's shearwater (ʻaʻo*), fallout for Newell's shearwater (ʻaʻo) was reduced from an average of 5.5. fledglings per year to an average of 1 fledgling per year (Kauaʻi Island Utility Cooperative 2020). It is assumed that light dimming also benefits band-rumped storm-petrel (ʻakēʻakē) in similar ways as Newell's shearwater (ʻaʻo). These conservation actions would continue to be implemented for existing and new facility lights, as well as for all new streetlights installed during the permit term.

See Conservation Measure 2. Implement Measures to Minimize Light Attraction (Section 4.4, *Conservation Measures*) for details of the conservation measure proposed to achieve this biological objective.

Objective 3.2. Facilitate the rescue, rehabilitation, and release of band-rumped storm-petrel (ʻakēʻakē) fledglings through funding of the Save Our Shearwaters (SOS) Program or other certified rehabilitation facility to offset light attraction by KIUC streetlights.

Rationale

The SOS Program is an established avian rescue and rehabilitation program on Kauaʻi with proven success in improving the survivorship of grounded seabirds (Raine et al. 2020b). The SOS Program rescues between zero and two band-rumped storm-petrels (ʻakēʻakē) annually (Bache 2020). The SOS Program also has established protocols for collecting and rehabilitating a variety of avian species, including all the covered seabirds. Since 2003, KIUC has been the predominate funder of the SOS Program. KIUC's continued funding of this program at an increased level[7] from previous years is expected to benefit band-rumped storm-petrels (ʻakēʻakē).

See Conservation Measure 3. Provide Funding for the Save Our Shearwaters Program (Section 4.4, *Conservation Measures*) for details of the conservation measures proposed to achieve this biological objective.

Objective 3.3. Implement predator control, including barn owl control, within the conservation sites to reduce threats to band-rumped storm-petrel (ʻakēʻakē) in areas near the conservation sites (e.g., Nā Pali Coast).

Rationale

Management actions with proven success at reducing Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) depredations are ongoing at all the selected conservation sites and would continue and be expanded by the HCP for the duration of the permit term. This includes actions to reduce the abundance of rats, cats, and barn owls within the conservation sites. These predators are a significant constraint for the current abundance and distribution of band-rumped storm-petrel (ʻakēʻakē) based on documented depredations (Raine et al. 2017c). Although there are no documented band-rumped storm-petrel (ʻakēʻakē) colonies within the conservation sites, they are known to occur along the Nā Pali Coast based on call rates detected during auditory surveys (Raine et al. 2017c). Given that rats, cats, and barn owls produce many offspring in a short period of time and are highly mobile, it is assumed that predator control efforts at the conservation sites will benefit band-rumped storm-petrel (ʻakēʻakē) in the greater region.

See Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites (Section 4.4, *Conservation Measures*) for details of the conservation measure proposed to achieve this biological objective.

4.3.4 Covered Waterbirds: Hawaiian Coot (ʻalae keʻokeʻo), Hawaiian Gallinule (ʻalae ʻula), Hawaiian Stilt (aeʻo), Hawaiian Goose (nēnē), and Hawaiian Duck (koloa maoli)

Goal 4. Contribute to the recovery of the covered waterbird species by reducing threats associated with KIUC powerlines on Kauaʻi.

Objective 4.1. Reduce covered waterbirds collisions along KIUC powerlines in Hanalei and Mānā (Kawaiʻele Waterbird Sanctuary) (Figure 4-1) from 2021 levels in accordance with the location, extent, and schedule outlined in the HCP.

[7] Chapter 7, Section 7.4, *Costs of KIUC HCP Implementation*, provides details of KIUC's funding commitment for this program.

Rationale

Powerlines at two locations, Hanalei (spans 462–478 and 1297–1328) and Mānā (spans 1–113), likely have the greatest effect on the covered waterbird species (Travers and Raine 2020b) because the powerlines cross protected habitat with a high abundance of waterbirds (Figure 4-1). Transmission line removal, static wire removal, and installing bird flight diverters (most spans use a combination of multiple techniques) on high-risk line segments for covered waterbirds on Kaua‘i will substantially reduce collisions of covered waterbirds (Raine pers. comm. [a]). In a study of blue cranes (*Grus paradisea*) in South Africa, Shaw et al. (2021) found that line markers (i.e., same as diverters or similar in style and effect) reduced powerline collisions by 92 percent in comparison to control spans. Outcomes for covered waterbirds in the Plan Area are expected to be similar to the results of the Shaw et al. study, which shows that diverters can be highly effective for waterbird species.

See Conservation Measure 1. Implement Powerline Collision Minimization Projects (Section 4.4, *Conservation Measures*) for details of the conservation measure proposed to achieve this biological objective.

Objective 4.2. Facilitate the rescue, rehabilitation, and release of grounded covered waterbirds through funding of the SOS Program or other certified rehabilitation facility to offset collisions with KIUC powerlines.

Rationale

The SOS Program is an established avian rescue and rehabilitation program on Kaua‘i with proven success in improving the survivorship of grounded seabirds (Raine et al. 2020b). The SOS Program also has established protocols for collecting and rehabilitating a variety of waterbird species, including the covered waterbirds. For example, between 2012 and 2019, SOS has rescued and rehabilitated approximately 177 Hawaiian geese (nēnē) and 121 Hawaiian ducks (koloa maoli). KIUC has provided almost all of the funding for this program for over 15 years.

See Conservation Measure 3. Provide Funding for the Save Our Shearwaters Program (Section 4.4, *Conservation Measures*) for details of the conservation measure proposed to achieve this biological objective.

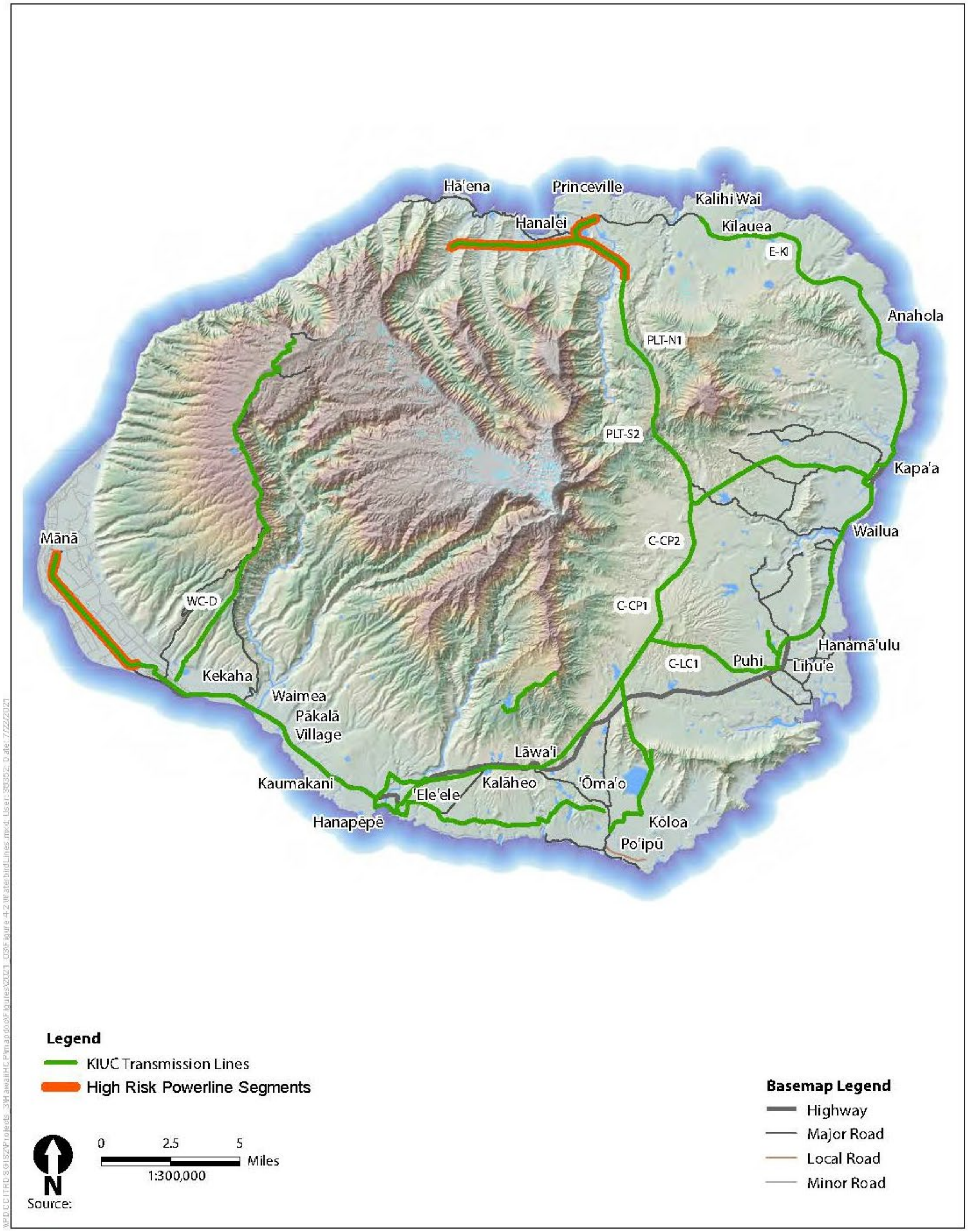


Figure 4-1. High-Risk Powerline Spans for Waterbirds

4.3.5 Central North Pacific Distinct Population Segment of the Green Sea Turtle (honu)

Goal 5. Contribute to the recovery of the species by increasing the ability for green sea turtles (honu) to successfully transit Kauaʻi beaches.

Objective 5.1. Locate and temporarily shield green sea turtle (honu) nests on beaches that are visually affected by KIUC streetlights on an annual basis.

Rationale

Artificial lights shining on green sea turtle (honu) hatchlings as they emerge from nests at night can cause the hatchlings to move toward the lights instead of toward the ocean. There was an incident in September 2020 on Kauaʻi where green sea turtle (honu) hatchlings from a nest on Kekaha Beach crossed a street and moved toward a KIUC streetlight, and some of the hatchlings were crushed by vehicles. There has been no documented disorientation of nesting adults on Kauaʻi; however, monitoring to date on Kauaʻi has not been systematic.

The DLNR Division of Aquatic Resources (DAR) currently monitors nesting sea turtles on Kauaʻi, but this program is informal and lacks consistent funding. This HCP will require systematic surveys to locate and protect green sea turtle (honu) nests and placement of temporary shields at locations at risk of light attraction from streetlights. Green sea turtle (honu) nests can be temporarily shielded from artificial light sources at the nest site, minimizing the risk of disorientation from streetlights.

See Conservation Measure 5. Implement a Green Sea Turtle Nest Detection and Temporary Shielding Program (Section 4.4, *Conservation Measures*) for details of the conservation measure proposed to achieve this biological objective.

Objective 5.2. Permanently minimize light effects to the extent practicable from existing and future KIUC streetlights onto beaches with suitable green sea turtle (honu) nesting habitat by implementing practicable minimization techniques that will reduce or eliminate these light effects.

Rationale

Coastal streetlights have the potential to cause disorientation of hatchling green sea turtles (honu) if they are visible from suitable green sea turtle (honu) nesting habitat. To date, there has only been a single incident of documented disorientation of green sea turtle (honu) hatchlings attributable to KIUC streetlights. KIUC has identified as part of this HCP a total of 29 streetlights that are currently visible from green sea turtle (honu) nesting habitat.[8] Existing coastal streetlights with vegetation or structures currently blocking visible light from the beach could also result in light effects during the 50-year permit term if the physical setting changes, or entirely new streetlights are installed near beaches in the future.

Although KIUC owns and operates the streetlights on Kauaʻi, the County and State determine the location, height, wattage, and shielding, and must approve any modification. KIUC will work with the County and State to identify practicable minimization measures to permanently reduce

[8] KIUC's 2020 streetlight assessment found that the current condition of the beach has limited suitability for nesting green sea turtles (honu). However, to be conservative, six streetlights along Kūhiō Highway in Wailua are included in the total in the event this habitat becomes more suitable due to future weather patterns.

streetlight visibility from green sea turtle (honu) nesting habitat. Permanent minimization measures on streetlights that eliminate or reduce lateral light spillage (e.g., shields) could greatly decrease the potential for disorientation of green sea turtle (honu) hatchlings. Permanent minimization measures are those that would, once installed, remain in place in perpetuity. If an entire streetlight is repaired or replaced, the shield would be repaired or replaced as well at the same time, as needed.

See Conservation Measure 6. Identify and Install Practicable Permanent Light Minimization Techniques for Green Sea Turtle (Section 4.4, *Conservation Measures*) for details of the conservation measure proposed to achieve this biological objective.

4.4 Conservation Measures

This section describes the conservation measures KIUC will implement or fund to meet the biological goals and objectives described in Section 4.3, *Biological Goals and Objectives*. There are six conservation measures in total.

- **Conservation Measure 1**. Implement Powerline Collision Minimization Projects
- **Conservation Measure 2**. Implement Measures to Minimize Light Attraction
- **Conservation Measure 3**. Provide Funding for the Save Our Shearwaters Program
- **Conservation Measure 4**. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites
- **Conservation Measure 5**. Implement a Green Sea Turtle Nest Detection and Temporary Shielding Program
- **Conservation Measure 6**. Identify and Install Practicable Permanent Light Minimization Techniques for Green Sea Turtle

Related management actions that KIUC will implement to achieve the biological goals and objectives are grouped under a single conservation measure. For example, all the actions that KIUC will implement to minimize powerline collisions, which includes powerline reconfiguration, static wire removal, and flight diverters, are described under Conservation Measure 1.

The conservation measures are described with sufficient detail and specificity to allow their implementation. Most of the conservation measures address several biological goals and objectives. As a result of the large scale and long timeframe over which the KIUC HCP will be implemented, the conservation measures are also designed to be flexible and allow adaptive management with increasing knowledge over time. The flexibility provided by the adaptive management program (Chapter 6, *Monitoring and Adaptive Management Program*) is an important component of the conservation strategy.

4.4.1 Conservation Measure 1. Implement Powerline Collision Minimization Projects

This conservation measure describes the actions KIUC will apply to meet the covered seabird and covered waterbird biological goals and objectives for powerline collision minimization. Powerline collision is one of, if not the most, important conservation issue for the Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) on Kauaʻi (Travers et al. 2012, 2013, 2014, 2015, 2016, 2017a, 2018, 2019b, 2021). Seabird mortality from collisions with KIUC powerlines has significantly contributed to the decline of Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) populations and continues to suppress populations of both species (Travers et al. 2013, 2014, 2015, 2016, 2017a, 2018; Raine et al. 2017b). Collisions occur most often with the overhead static wire due its tall height and position above all other wires (Chapter 2, *Covered Activities*, Figure 2-2a), and because the static wire has a smaller diameter than energized conductors and therefore is less visible. Static wires are widespread across KIUC's electric system (Chapter 2, Section 2.1.1, *Powerline Operation*) and are present in nearly all high-collision locations. The other contributing factors for seabird powerline collision risks are the number or wires in a vertical stack, the total wire height, and the position of powerlines along ridgelines and in areas between active colonies and the ocean (i.e., along seabird migration routes). The greater the number of wires in the vertical stack and the higher the wires, the greater the risk of seabird collision. Powerline aboveground height is highest when wires are strung from ridgeline to ridgeline across a drainage or valley. On Kauaʻi many of the powerline spans with the highest seabird collision risk are strung across mountain drainages.

The minimization actions for the covered seabirds under this conservation measure include reconfiguration of powerlines (i.e., changing the profile from vertical to horizontal and reducing the number of layers) (Chapter 2, Section 2.1.2, *Powerline Retrofits: Additional Powerlines and Changes in Wire Numbers and Configuration*), static wire removal[9] to substantially reduce powerline collisions, and installation of bird flight diverters on many powerlines (reconfigured lines or not) to further reduce powerline collisions by making remaining lines far more visible to covered seabirds at night. Bird flight diverters are regularly spaced devices that make powerlines more visible to birds, reducing the number of collisions. KIUC uses two types of flight diverters—reflective diverters and light-emitting diode (LED) diverters. Reflective diverters are made of plastic and have a shiny, reflective surface; LED diverters utilize a blinking LED light. The minimization actions for the covered waterbirds under this conservation measure include 69-kilovolt distribution line removal, static wire removal, and the installation of bird flight diverters (both reflective and LED); no reconfiguration projects are proposed for the covered waterbird species.

4.4.1.1 Background

KIUC completed six minimization projects that are consistent with this conservation measure in 2015 and 2016 during implementation of the Short-Term HCP.

- Installed reflective diverters from the Waimea Bridge to Kaumakani from spans 244 to 254 (approximately 1 mile [mi] [1.6 kilometers {km}])
- Installed reflective diverters from Moloaʻa to Kīlauea from spans 1196 to 1214 (approximately 1.8 mi [2.9 km])

[9] Powerline reconfiguration can include static wire removal but static wire can occur in locations where powerline reconfiguration is not planned.

- Removed static wire from spans 328 to 342 from Waialo Road to Brydeswood
- Removed static wire at span 352 (Fujita Tap) (0.5 mile [0.8 km])
- Removed static wire from spans 328 to 342 (2.2 mi [3.5 km])
- Removed static wire at span 581 (0.3 mi [0.5 km]) (Halewili Positron to Aepo Substation)
- Buried underground spans 2030, and 6000 to 6005 (approximately 0.5 mile [0.8 km]) of distribution wires on Kāhili mountain.[10]

These minimization actions completed for the KIUC Short-Term HCP are similar to what KIUC will implement for this HCP under this conservation measure.

4.4.1.2 Powerline Collision Minimization Projects

Additional Bird Flight Diverter and Static Wire Projects

KIUC will install additional bird flight diverters and remove additional static wire to further reduce covered seabird and covered waterbird collisions. Most of KIUC's minimization projects use both bird flight diverters and static wire removal on the same spans to maximize strike reductions, except in a small number of instances where engineering or legal constraints prohibited the use of one technique. Appendix 4B, *Minimization Projects*, identifies all of the bird flight diverters and static wire projects by span and year. All projects shown in Appendix 4B, *Minimization Projects*, pertain to the covered seabirds except for those at Mānā (spans 1–113) and Hanalei (spans 462–478 and 1297–1328). Figures 4-2 and 4-3 show the location of each bird flight diverter and static wire minimization project identified in Appendix 4B, *Minimization Projects*. In a concerted effort to reduce the severity of the effects of the covered activities on the covered seabird and waterbird species prior to completion of the KIUC HCP, KIUC intends to complete all of the static wire removal and bird flight diverters projects identified in Appendix 4B, *Minimization Projects*, and Figures 4-2 and 4-3 by the end of 2023. These early implementation projects will total approximately 188.1 mi (302.7 km) of KIUC powerlines (Table 4-2).

Based on KIUC's pre-implementation monitoring data showing that strikes are reduced from between 42 percent to over 95 percent depending on the minimization technique (or combination of techniques), KIUC's powerline minimization projects will reduce seabird powerline collisions by at least 65.3 percent (Travers and Raine 2020a). For the covered waterbirds, the estimated percent of strikes avoided through the implementation of minimization techniques is even higher (90 percent) based on other data (Section 4.3.4, *Covered Waterbirds: Hawaiian Coot (ʻalae keʻokeʻo), Hawaiian Gallinule (ʻalae ʻula), Hawaiian Stilt (aeʻo), Hawaiian Goose (nēnē), and Hawaiian Duck (koloa maoli)*, provides more information).

[10] KIUC buried these wires underground because Underline Monitoring Program observation data indicated that these very short powerlines (19.7–26.2 feet [6–8 meters] above ground) had the highest collision rate on the island because the wires were mounted on a steep mountain ridge running directly through colonies of Newell's shearwaters (ʻaʻo) and Hawaiian petrels (ʻuaʻu).

Table 4-2. Amount of Powerline Collision Minimization Activity by Year (2020–2023)

Type of Minimization Activity	Year Complete	Linear Distance (mi)	Linear Distance (km)
Static wire removal	2020	17.0	27.3
Reflective diverters		6.8	10.9
Static wire removal	2021	30.2	48.6
Reflective diverters		37.4	60.2
LED diverters		5.4	8.7
Static wire removal	2022	20.6	33.1
Reflective diverters		41.2	66.3
LED diverters		11.7	18.9
Static wire removal	2023	3.8	6.2
Reflective diverters		12.8	20.6
LED diverters		1.2	1.9
Static wire removal	2020-2023 Totals	71.6	115.2
Reflective diverters		98.2	158
LED diverters		18.3	29.5
Total[1]	**--**	**188.1**	**302.7**

[1] Total mileage of all activities some of which overlap

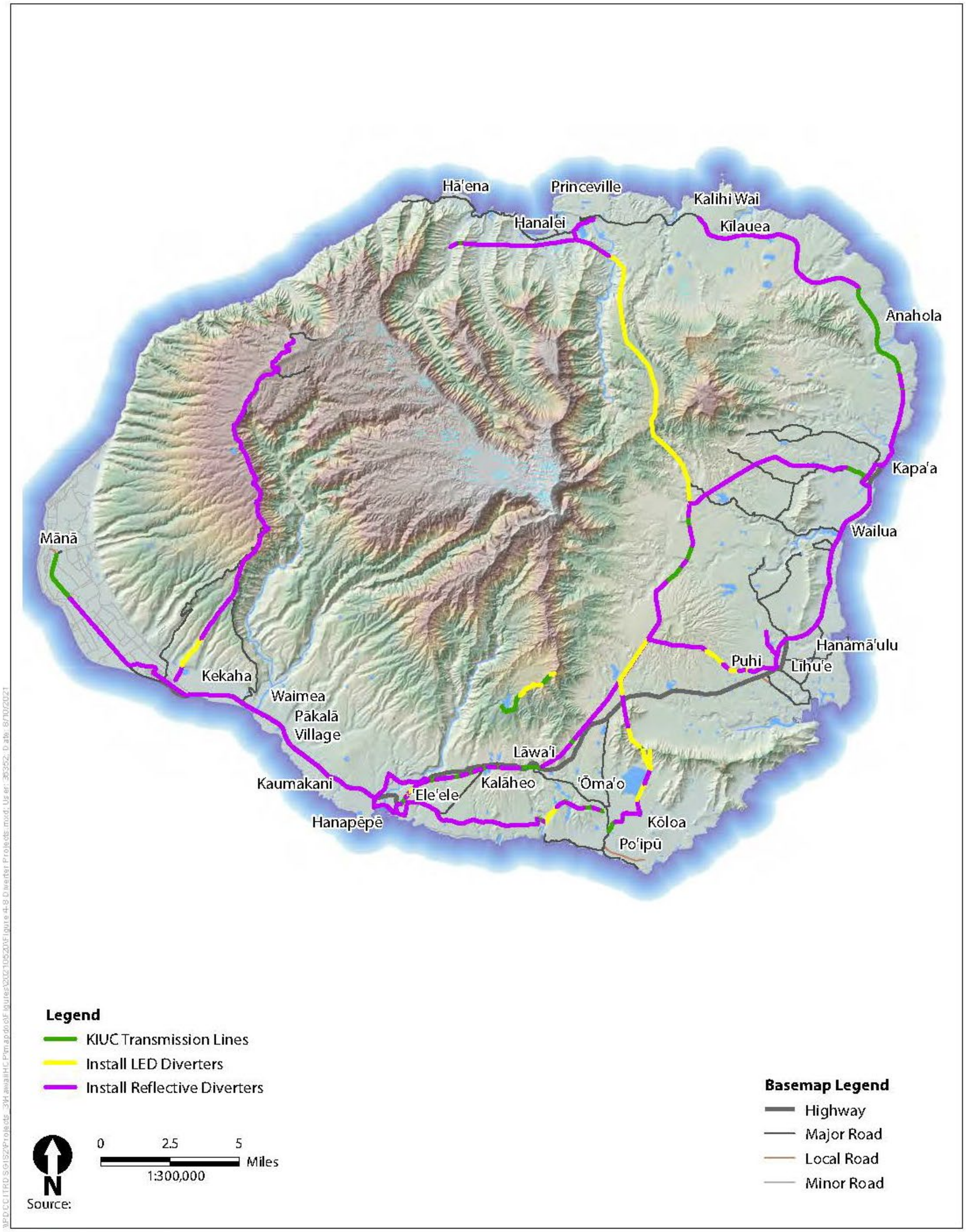


Figure 4-2. KIUC Bird Flight Diverter Minimization Project Locations

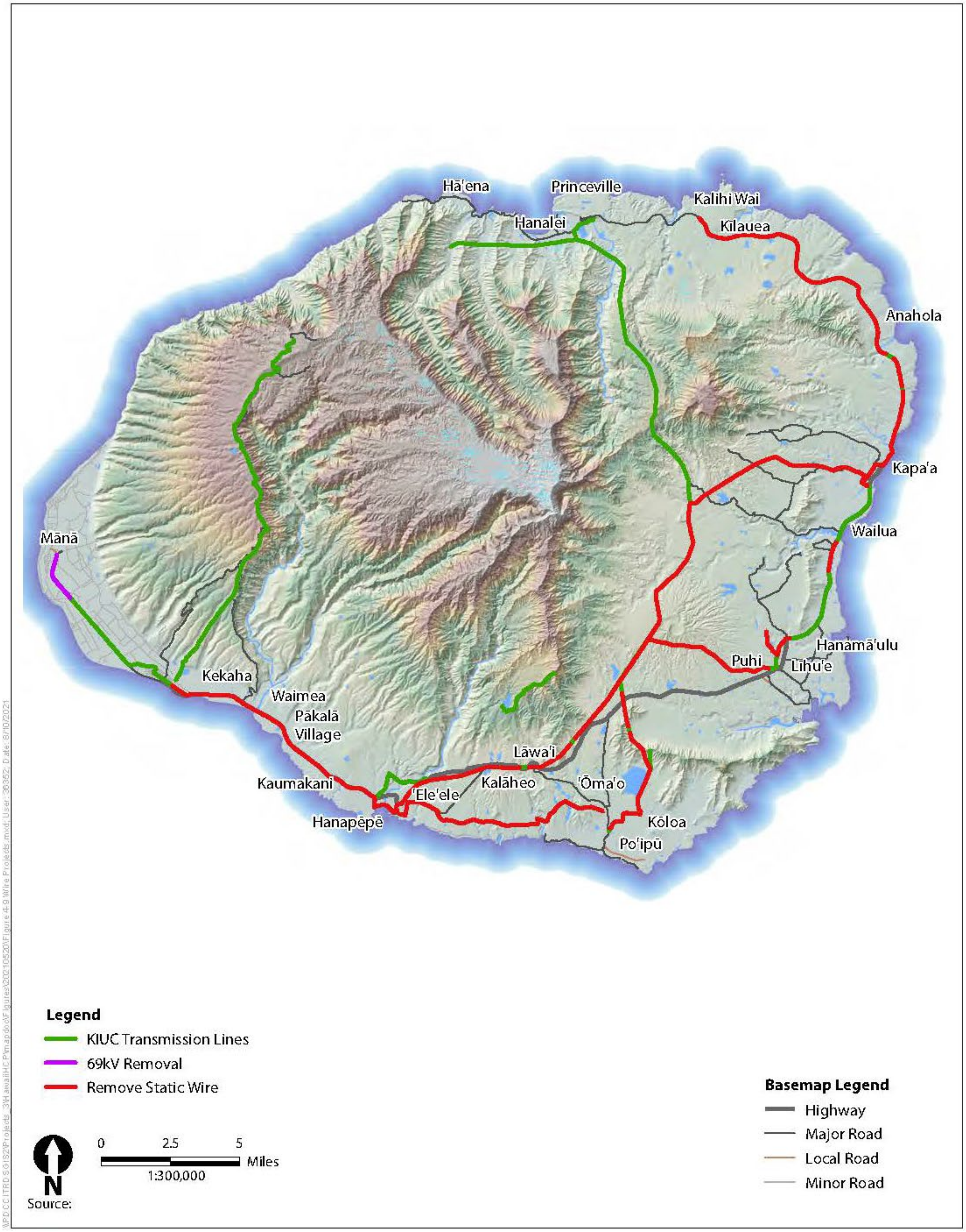


Figure 4-3. KIUC Wire Minimization Project Locations

Powerline Reconfiguration Projects

KIUC implemented three powerline reconfiguration projects in 2020 to reduce covered seabird collisions (Table 4-3, Figure 4-4). The three projects, which total 8.2 mi (13.2 km; 5 percent of the 171 mi [275.2 km] of transmission lines), include static wire removal. In summary, these projects accomplished the following.

- **Reduce maximum wire heights**. As shown in Table 4-3, the maximum height of wires along the project segments was reduced by more than 20 feet (6.1 meters [m]).
- **Reduce the number of vertical wire levels**. The collision risk in these line segments was reduced by reducing the number of vertical *wire levels* (Figure 2-2), which reduces the number of wires a level flying bird could fly at directly. The number of wire levels was reduced in these three projects by 50 percent or more.
- **Reduce the vertical profile.** To reduce the number of wire levels, the wires were positioned in a horizontal profile. This reduces the vertical profile of all wires that covered birds are exposed to in their travel path. The vertical distance of wire arrays was reduced substantially in all three projects.

No additional powerline reconfiguration projects are planned as part of this HCP.

Table 4-3. Powerline Reconfiguration Projects Implemented in 2020

Project ID	Spans	Linear Distance (mi)	Linear Distance (km)	Condition	No. of Wire Levels	Vertical Distance of Array (feet)	Vertical Distance of Array (m)	Highest Wire at Structure (feet AGL [a])	Highest Wire at Structure (m AGL)
C-LC1	702–718	2.6	4.2	Original	9	60.5	18.4	n/a[b]	n/a[b]
				Reconfiguration	3	20	6.1	29	8.8
C-CP1	389–400	2.6	4.2	Original	4	36	11.0	100	30.5
				Reconfiguration	2	11	3.4	75	22.9
C-CP2	401–417	3.0	4.8	Original	4	36	11.0	100	30.5
				Reconfiguration	2	11	3.4	75	22.9

[a] Above ground level
[b] Information not available

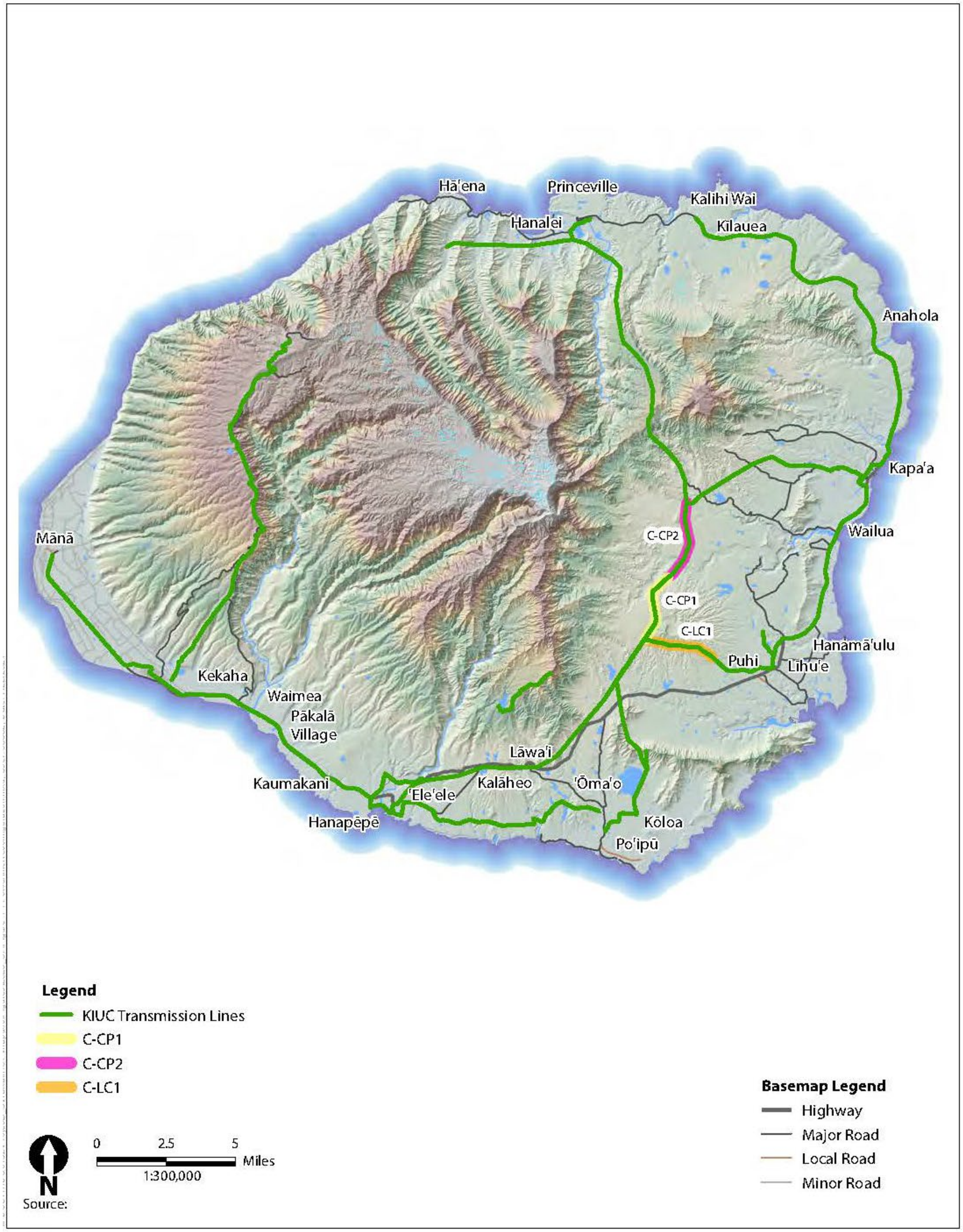


Figure 4-4. KIUC Powerline Reconfiguration Projects Implemented in 2020

4.4.1.3 Future Transmission and Distribution Lines

As described in Chapter 2, *Covered Activities*, KIUC will need to construct new transmission and distribution lines during the 50-year permit term to service new development on Kauaʻi. New transmission and distribution lines are defined as either new powerlines in new locations (including powerline extensions) or powerline retrofits that increase wire height or expose wires, as described in Chapter 2, Section 2.1.2, *Powerline Retrofits: Additional Powerlines and Changes in Wire Numbers and Configuration*. New powerlines will be reviewed with USFWS and DOFAW according to Chapter 2, *Covered Activities*, for compliance with the KIUC HCP and to minimize impacts. All new powerline installations will be planned and implemented with potential covered species impacts in mind. Appropriate minimization will be deployed on new powerlines applying the standards described below and with the goal of achieving the greatest practicable level of reduction to potential strikes in any given location.

KIUC will avoid construction of new transmission and distribution lines in high-collision zones in the Plan Area, to the maximum extent practicable. During the planning process for each new covered transmission or distribution line, existing data, predictive models (Travers et al. 2017b), and/or consultation with a qualified biologist will be used to determine the potential strike rate (strikes per year) per span. Proposed alignments that are modeled to have high strike rates will be avoided unless there is no alternative route.

KIUC will minimize the potential for collisions on all new transmission and distribution lines by applying the following standards for all new transmission and distribution lines.

- **No static wire.** New powerline configurations will not have a static wire.
- **Minimize powerline height.** New distribution lines will be no more than 45 feet (13.7 m) above ground.[11] KIUC commits to maintaining this horizontal design standard (or an equivalent or better standard) for new distribution lines throughout the 50-year term of the HCP consistent with engineering and safety requirements. There is no maximum aboveground height for transmission lines because they are dictated by Public Utilities Commission standards and engineering regulations; however, KIUC will minimize transmission line height when and where practicable.
- **One vertical wire level.** New distribution and transmission lines will be installed in one horizontal plane to the greatest extent practicable consistent with KIUC's 2007 standards already in place for distribution lines.
- **Powerline placement.** To the extent practicable, new powerlines will be located in areas that will reduce and minimize collision risk such as in valleys or along the bottom of slopes (instead of along ridgelines or at the top of slopes). To the extent practicable, long powerline span placement across valleys will also be avoided (i.e., perpendicular to valleys).
- **Bird flight diverters.** All new powerlines will be evaluated to determine if bird flight diverters are a practicable minimization technique. If bird flight diverters are practicable, they will be

[11] KIUC adopted a *Flat Design Standard for New 12.47 kV Electrical Distribution Lines* in 2007 (Kauaʻi Island Utility Cooperative 2007). This design standard requires new distribution circuits to utilize a horizontal arrangement with a single wire layer that is no more than 45 feet (13.7 m) above ground, minimizing the potential for seabirds to collide with new overhead 12.47-kilovolt distribution lines. KIUC will also apply this design standard to all new transmission lines.

installed at the time of construction. Where powerlines are adjacent to or near roads, reflective diverters will be used. Where powerlines are farther from roads, LED diverters will be used.

These new or extended transmission and distribution lines would be connected to the grid using one of the following methods.

- Conductors that descend downward in a single run from the existing transmission or distribution circuit into the new renewable energy project site.
- Conductors placed on an existing powerline alignment with existing and new wires configured such that no wires exceed a height of 45 feet (13.7 m) above ground at the poles.
- Conductors placed co-linear to an existing powerline (i.e., parallel to existing powerlines) and the new wires configured such that they do not exceed a height of 45 feet (13.7 m) above ground at the poles.

Based on the same monitoring data described above for existing powerlines under A*dditional Bird Flight Diverters and Static Wire Projects* (Travers and Raine 2020a), KIUC has estimated that 80 percent[12] of the anticipated seabird powerline collisions and 90 percent of the anticipated waterbird powerline collisions resulting from the installation of new powerlines under unminimized conditions would be avoided with the implementation of minimization techniques. The estimated reduction in powerline collisions for new powerlines assumes that all new spans will lack static wire and include bird flight diverters. These estimated strike reductions are considered conservative because KIUC also has the opportunity to further minimize collisions by siting new powerlines in lower-risk areas, when practicable, and using a horizontal wire configuration.

4.4.2 Conservation Measure 2. Implement Measures to Minimize Light Attraction

This conservation measure describes the actions KIUC will apply to meet the covered seabird biological goals and objectives for light attraction minimization. Bright artificial lights attract and confuse the covered seabird fledglings, causing them to become grounded (Imber 1975; Telfer et al. 1985). If the light-attracted individuals that become grounded are not rescued, they are at risk of succumbing to injury or mortality due to starvation, predation, collisions with cars, or a combination thereof. KIUC's streetlights and covered facility lights are one source of artificial light in the Plan Area that can result in these effects. Under this conservation measure, KIUC will take actions to reduce and minimize this impact, as described below.

4.4.2.1 Streetlights

All KIUC streetlights were retrofitted in 2017 to minimize light attraction and reduce the risk of seabird fledgling fallout while still maintaining lighting necessary for public health and safety of public roads and neighborhoods. KIUC installed full-cutoff shielded fixtures on the approximately 4,150 streetlights it owns and operates. These fixtures effectively direct all light toward the ground

[12] This is based on data collected by Travers and Raine (2020a) for the Infrastructure Monitoring and Minimization Project on existing powerline spans that have a combination of static wire removal and reflective diverters. On average, static wire removal reduces strikes by 50 percent and installation of reflective diverters reduces strikes by an additional 42 percent (92 percent total combined). However, because other factors can affect strike rates, KIUC conservatively assumes unminimized strikes (no HCP) resulting from new powerlines will be reduced a minimum of 80 percent with the minimization techniques presented in this chapter.

and minimize the amount of light directed outward or upward toward the sky. With these full-cutoff shielded fixtures, all KIUC-owned streetlights do not produce light that shines above the 90-degree horizontal plane (Figure 4-5). At the same time, all KIUC streetlights were converted from high-pressure sodium bulbs to more energy-efficient 3000-kilowatt LED bulbs. In 2019, KIUC replaced all green light bulbs in streetlights with white light bulbs to further reduce light attraction.

Figure 4-5. Example of Full-Cutoff Shield Installed by KIUC on a Kauaʻi Streetlight

KIUC has estimated that approximately 1,050 new streetlights (see Chapter 2, Section 2.2.2.2, *New Streetlights*) will be installed during the permit term. All future streetlights will utilize the same light minimization features, installed by KIUC at the time of construction.

4.4.2.2 Covered Facility Lights

KIUC also operates night lighting at two facilities covered by this HCP, the Port Allen Generating Station and the Kapaia Generating Station, called the *covered facilities* (see Chapter 2, Section 2.2.1.1, *Existing Facilities*). KIUC will continue to dim the exterior lighting at Port Allen Generating Station during the fledgling fallout season (September 15 to December 15) to minimize light attraction. At the beginning of the fallout season, all exterior facility lights are dimmed to the lowest extent practicable (i.e., consistent with all applicable laws and regulations and allowing KIUC to conduct its work in a safe manner). KIUC began this practice in 2019 and saw significant reductions in fallout at this covered facility. Between 2016 and 2018 prior to dimming the lights, KIUC recorded between 4 and 10 grounded Newell's shearwaters (ʻaʻo). Following dimming, KIUC recorded no fallout in 2019 and one grounded Newell's shearwater (ʻaʻo) in 2020 (Kauaʻi Island Utility Cooperative 2020, 2021).

Interior building lights at covered facilities will be turned off at night during the fledgling fallout season (September 15 to December 15) to avoid light attraction. If interior building lights must be turned on for any portion of the night, retractable screens or shades will be used to block lights from emitting from the building.

In 2019, KIUC retrofitted all the exterior lights at the Port Allen Generating Station and at the Kapaia Generating Station. At the Port Allen Generating Station, KIUC replaced its existing freestanding[13] exterior facility lights with full-cutoff white LED lights and shielded wall-mounted white LED box lighting. Similarly, at the Kapaia Generating Station, all the 150-watt high-pressure sodium streetlights and building lights were shielded to direct light downward, away from the sky. Any new lights installed within the two covered facilities by KIUC during the permit term will utilize the same minimization features.

4.4.2.3 Night Lighting for Restoration of Power

KIUC may also need to utilize artificial lighting during the seabird fallout season if power outages occur between September 15 and December 15. KIUC will search for grounded birds at work sites operating at night to restore power during these 3 months according to the same protocol used at the covered facilities (Section 4.4.2.2, *Covered Facility Lights*). Due to the emergency nature of this work, minimization of lighting at night for the restoration of power is not possible. If KIUC documents that significant fallout is occurring from night lighting for restoration of power, KIUC will address this issue through the adaptive management program. Chapter 6, Section 6.4.2, *Light Attraction Monitoring and Adaptive Management*, provides more details.

4.4.2.4 Annual Training

KIUC will continue to conduct its ongoing annual seabird training program prior to the start of the seabird fallout period (September 15 to December 15) using the *KIUC Site Monitoring Protocols and Procedures for Protected Seabirds* (Appendix 6A, *Protocols and Procedures*). Training will continue to be provided for staff who conduct or supervise grounded seabird searches at facilities and for staff at nighttime work sites to address power outages with artificial lighting. KIUC will provide the training both in person and online so that staff can review it at any time. The Protocols and Procedures will be updated prior to the first seabird fallout season in Year 1 of HCP implementation. The Protocols and Procedures will continue to be updated on an as-needed basis when adaptive management is implemented.

The annual training will include an overview of the KIUC HCP, the importance of compliance with the HCP and all relevant environmental laws, and a summary of all the relevant avoidance and minimization measures, best management practices, and conservation measures outlined in the HCP. A qualified professional will lead the training on the covered species and provide specific information regarding the species' appearance and their life histories. The trainer will also describe the covered species rescue protocol should a staff member or contractor encounter live or dead covered species consistent with the Protocols and Procedures. KIUC will maintain a log of the names of staff and contractors who attend and complete the annual training.

4.4.2.5 Predator Removal at Covered Facilities

KIUC will remove predators from the covered facilities (Port Allen Generating Station and Kapaia Generating Station) to minimize depredation of grounded covered seabirds and waterbirds. KIUC will trap and remove feral cats and dogs observed at their covered facilities. These animals will be transferred to a suitable animal shelter or sanctuary. KIUC will also trap and remove mice and rats if they are observed within the covered facilities. Daily predator management at the KIUC covered

[13] Stand-alone fixtures on their own stanchions or attached to power poles.

facilities and near the covered facilities on KIUC-owned land will occur throughout the entire permit term. Traps will be placed throughout the facility in locations where target predators have been observed or at ingress points (e.g., gates, roads, along the edges of buildings) and will be checked on a regular basis to remove trapped animals.

4.4.3 Conservation Measure 3. Provide Funding for the Save Our Shearwaters Program

The SOS Program is an avian rescue and rehabilitation program that operates year-round on Kauaʻi. The initial focus of the program was on rescue and rehabilitation of Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu). The program has since been expanded to include all native bird species including all covered seabirds and waterbirds, as well as other, non-covered birds. Under the SOS Program, grounded seabirds, waterbirds, and other birds that are rescued by members of the public or businesses can be turned into SOS Program staff. Injured birds are assessed, rehabilitated if possible, and released back into the wild by trained staff and volunteers and professional veterinary staff. All rehabilitation actions occur at an accredited animal rescue facility with extensive equipment and facilities for any necessary procedure to treat minor injuries or perform major surgery or treatment, including extended stays prior to release back into the wild.

To date, the SOS Program has recovered and released more than 30,500 seabirds since the 1970s (Raine et al. 2020b). Approximately 80 to 85 percent of the covered seabirds and 40 to 70 percent of the covered waterbirds that are handled by the SOS Program are rehabilitated and released back into the wild[14] (Anderson 2018, 2019; Bache 2019), with the expectation that they will successfully reproduce in future nesting seasons. While rehabilitated and released fledglings of covered seabirds do have reduced survivorship compared with wild fledglings, research has shown that a proportion of rehabilitated fledglings have been documented to successfully migrate to their wintering grounds (Raine et al. 2020b). Using satellite tags, Raine et al. (2020b) found that after 21 days, 28.9 percent of SOS-rehabilitated fledglings were still transmitting in comparison with 50 percent of wild fledglings. However, it is assumed that all the rehabilitated seabirds would have died as a result of collision or grounding injuries, starvation, dehydration, predation, vehicle interactions, or other sources of mortality, if not retrieved, treated, and released by the SOS Program. Consequently, operation of the SOS Program plays a significant role in maintaining sustainable populations of the covered species on Kauaʻi.

Beginning in 2003, KIUC began funding and largely implementing the SOS Program with DOFAW oversight and assistance. KIUC has continued to provide the majority of the funding for the SOS Program annually. For this conservation measure, KIUC commits to fund the SOS Program at an increased level of $300,000 annually (in constant 2023 dollars) for the duration of the permit term. As described in Chapter 7, *Plan Implementation*, KIUC funding will increase annually to keep pace with inflation. This funding is anticipated to adequately support the SOS Program (or other adequate program) for the rescue, rehabilitation, and release of covered seabirds and covered waterbirds affected by KIUC's covered activities and that are found by the public and volunteers. Because KIUC has been the primary source of funding for the SOS Program for most of its history, KIUC's continued

[14] The remaining 15 to 20 percent of the covered seabirds and 30 to 60 percent of the covered waterbirds are dead on arrival, their injuries are so severe they must be euthanized, or they succumb to their injuries within 24 hours of admittance.

financial support at this level ($300,000 annually in constant 2023 dollars) will ensure that these benefits to the covered species continue for 50 years.

For the purposes of this HCP, funding the SOS Program is considered both minimization and mitigation for the covered seabirds and mitigation for the covered waterbirds. For the covered seabird species that are grounded due to KIUC covered activities (i.e., KIUC streetlights and facility lights), the SOS Program minimizes the impact of the taking by rescuing, treating, and releasing the seabirds, thereby minimizing the extent of the injury and the amount of mortality. Covered seabirds that are grounded because of light attraction from non-KIUC sources (e.g., lights from shopping malls or other commercial facilities), and then rescued, rehabilitated, and released by the SOS Program contribute to the mitigation in this HCP.[15]

For covered waterbird species injured due to threats unrelated to KIUC powerlines (e.g., botulism, vehicle collisions), funding the SOS Program by the HCP is considered mitigation.

4.4.3.1 Public Outreach and Education

Conservation Measure 3 includes public outreach and education to inform and educate the public about the risks of powerline strikes and light attraction to threatened and endangered species on Kaua'i. The SOS Program has its own public outreach and education program that KIUC will support as part of its financial support of that program. Also, as part of this measure, KIUC will continue to conduct its own public outreach and education in coordination with the SOS Program. These efforts may include, but are not limited to, the following actions.

- Encourage developers of new commercial and residential development on Kaua'i to bury powerlines in the areas to be developed, especially in areas with high risk of collision by the covered species.
- Encourage the County to adopt new zoning regulations that require all new developments on Kaua'i to bury new utility lines.
- Prepare and distribute information on the covered species, the SOS Program, and the HCP in the *Currents* magazine, which is sent via direct mail to all KIUC customers.
- Publicize the SOS Program and the HCP with radio, newspaper, or television announcements, as well as community school programs.
- Develop, assemble, and disseminate a variety of education materials. The SOS Program staff distributes these materials.
  - SOS Program posters
  - SOS Program brochures
  - Seabird activities coloring book
  - Seabird "tattoos"

[15] The exception to this are covered seabirds that fallout due to activities covered by the Kaua'i Seabird Habitat Conservation Plan (State of Hawai'i Division of Forestry and Wildlife 2020) or the Kaua'i Lagoons Habitat Conservation Plan (Kaua'i Lagoons LLC 2012). These two HCPs also provide funding to the SOS Program to minimize the effects of light attraction at their covered facilities. KIUC is not responsible for the rescue, rehabilitation, or release of covered seabirds that fallout due to activities covered by other approved HCPs on Kaua'i.

  - Reusable shopping bags
  - Tee-shirts
- Perform annual seabird public blessings (pule) and release events to promote the cultural connection between the people of Kauaʻi and the covered seabirds.
- Publicize the program at outreach events such as Earth Day, Lighthouse Day, or Agricultural and Environmental Awareness Day.

4.4.4 Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites

This conservation measure describes the actions KIUC will apply to meet the Newell's shearwater (ʻaʻo) Hawaiian petrel (ʻuaʻu), and band-rumped storm petrel (ʻakēʻakē) (related only to predator control) biological goals and objectives. The management and enhancement actions identified under this conservation measure will occur exclusively within designated conservation sites on Kauaʻi throughout the permit term.

4.4.4.1 Conservation Sites

Conservation sites are specific parcels in the Plan Area where KIUC will continue to implement management actions (e.g., predator control, social attraction) to increase the reproductive success of Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) breeding colonies, and to benefit band-rumped storm petrel (ʻakēʻakē) occurring in the region. As part of the early planning process for this HCP, KIUC went through an extensive site selection process to identify and secure suitable conservation sites for the HCP. As part of this selection process, KIUC considered 19 sites throughout the Plan Area and evaluated them against a set of 14 criteria, which fall into the following eight summary categories. A site could be selected and secured only if it met all of these criteria.

- Covered species presence
- High habitat quality
- Low to moderate predator abundance
- Existing management
- Management feasibility
- Accessibility by foot or helicopter
- Landowner willingness
- Low degree of anthropogenic threats (light attraction and powerlines)

This assessment was informed by experts at ARC, Pacific Rim Conservation, and Hallux Ecosystem Restoration LLC, who have been conducting these management actions for many years, including as part of the KIUC Short-Term HCP. Details of the evaluation criteria, site assessment, and the evaluation process are found in Appendix 4A, *Conservation Site Selection Process.*

Based on this assessment, ten conservation sites have been included in the KIUC HCP (Figure 4-6). Nine of these sites have been selected and were judged to meet all the major criteria listed above.[16] Pōhākea PF (i.e., predator fence) and Honopū PF are smaller areas within their respectively named sites; although they are located within a larger conservation area, they are identified as separate conservation sites for the purposes of this HCP.

1. Upper Limahuli Preserve
2. North Bog
3. Pōhākea
4. Pōhākea PF
5. Honopū
6. Honopū PF
7. Pihea
8. Hanakoa
9. Hanakāpiʻai

Most of the nine conservation sites that were selected for the KIUC HCP are the same sites where KIUC has been funding predator control and seabird monitoring (and invasive plant species control) annually since 2011 for the Short-Term HCP and in the interim period between the Short-Term HCP and commencement of this KIUC HCP. This provided KIUC, USFWS, and DOFAW with a large amount of data that was used to determine if management at these sites would continue to benefit the covered seabird species during HCP implementation. Because management had been occurring at these sites for such a long time, it also led to the decision to include these sites as conservation sites for the KIUC HCP rather than replace them with new sites.

Other significant factors for selection of the conservation sites in the KIUC HCP included site adjacency and presence of existing fences. The Upper Limahuli Preserve already has an ungulate fence surrounding the entire boundary. North Bog, Pōhākea, Hanakoa, and Hanakāpiʻai are located in the Hono O Nā Pali Natural Area Reserve (NAR), managed by DOFAW. KIUC added the Hanakoa and Hanakāpiʻai conservation sites in 2021 in large part due to the fact that seabird management was already occurring in the Hono O Nā Pali NAR. In addition, the Hono O Nā Pali NAR contains sections of pig fences that prevent pigs from damaging the covered seabird colonies within these conservation sites. Pihea and Honopū are part of the Nā Pali Coast State Wilderness Park owned by the Division of State Parks. In addition, DOFAW and DOFAW's partners constructed predator exclusion fences to create the Pōhākea PF and Honopū PF conservation sites; this allowed KIUC to begin social attraction in these conservation sites in 2022 prior the permit term.

[16] Many other sites failed the evaluation because of a failure to meet key criteria necessary for management such as landowner willingness, documented presence of the covered species, site access, or a combination of these factors. Appendix 4A, *Conservation Site Selection Process*, provides details.

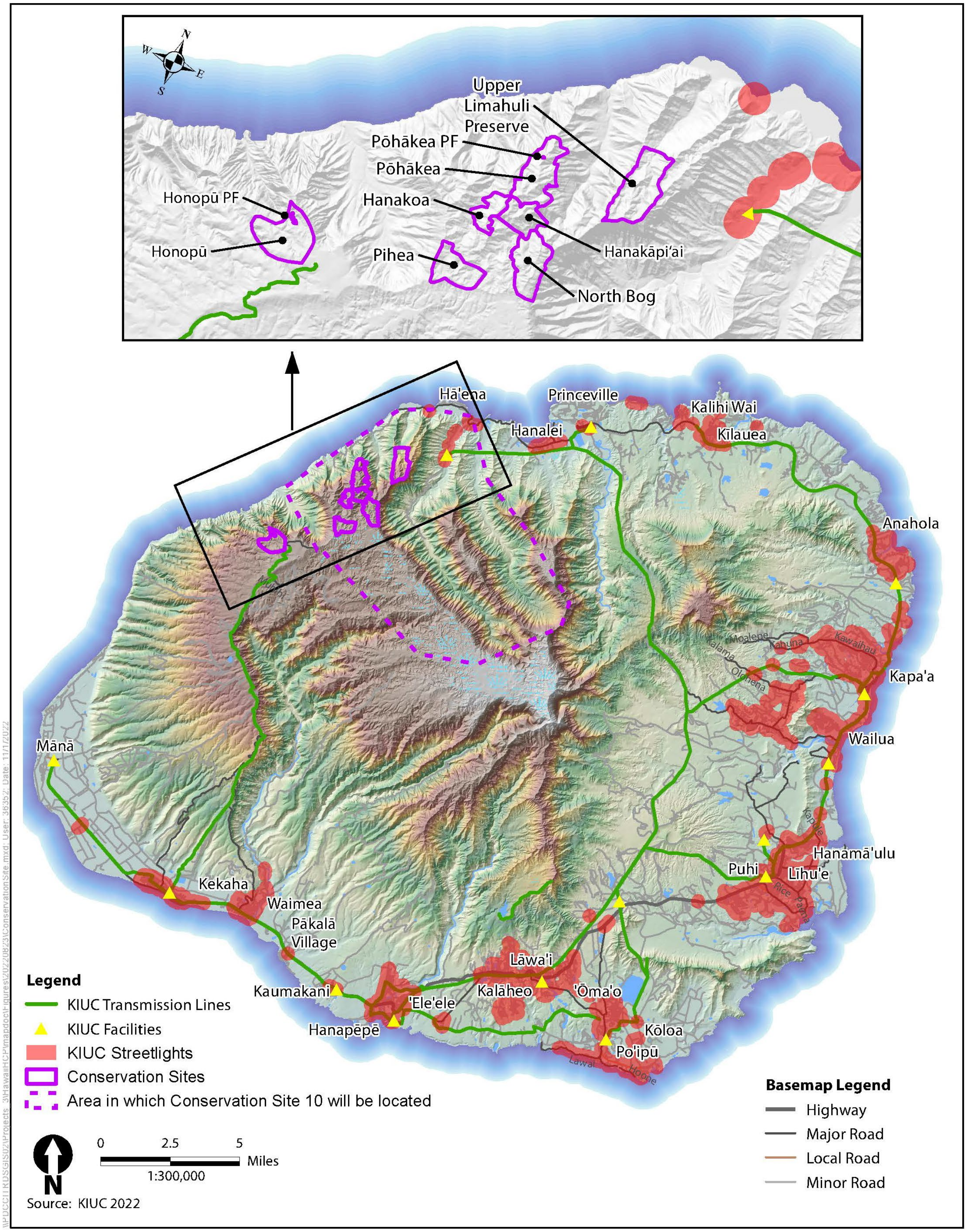


Figure 4-6. Conservation Sites

KIUC will select a tenth conservation site but the final location of this site is still under evaluation. The final site is identified temporarily as “Conservation Site 10” and will occur in the area shown as a dashed purple line on Figure 4-6 in the northwest corner of Kaua‘i. KIUC is currently evaluating four candidate locations for Conservation Site 10 against the selection criteria listed in Appendix 4A, *Conservation Site Selection Process*. Specifically, Conservation Site 10 will be selected based on the presence of Newell’s shearwater (‘a‘o) colonies and the feasibility of establishing a predator exclusion fencing and initiating social attraction. KIUC will select and commit to a specific location for Conservation Site 10 no later than the end of 2023 and before permit issuance.

During the development of this HCP, KIUC was planning to include a tenth conservation site near the Upper Limahuli Preserve called Upper Mānoa Valley. KIUC had included the Upper Mānoa Valley site in many drafts of the HCP and planned on including it in the final HCP. However, in late 2022 this site proved infeasible due to an inability to reach agreement with the landowner. KIUC will select the new site (Conservation Site 10) in coordination with and approval from USFWS and DOFAW. The conservation benefits of Conservation Site 10 identified in this HCP are based on the previously selected site (Upper Mānoa Valley). KIUC will ensure that Conservation Site 10 will provide equal or greater benefit than the Upper Mānoa Valley site it is replacing. KIUC will continue management of the previously selected conservation site until such time as the new site has been selected to replace it, to ensure that there are no gaps in the HCP’s conservation benefits for the covered seabird species.

Five of the 10 sites currently support Newell’s shearwater (‘a‘o) and Hawaiian petrel (‘ua‘u) breeding colonies (Table 4-4). Of the remaining five sites, Honopū primarily supports Newell’s shearwater (‘a‘o) but contains suitable habitat for Hawaiian petrel (‘ua‘u). Conversely, Pihea currently contains very few Newell’s shearwater (‘a‘o) breeding pairs but supports a robust Hawaiian petrel (‘ua‘u) population. The Pōhākea PF and Honopū PF sites are small social attraction sites within predator exclusion fences that contain suitable habitat for the covered seabird species but are currently unoccupied. Lastly, for Conservation Site 10, KIUC will ensure that the selected conservation site encompasses, at a minimum, Newell’s shearwater (‘a‘o) colonies and is suitable habitat for Hawaiian petrel (‘ua‘u). None of the conservation sites support band-rumped storm petrel (‘akē‘akē).

Together, the 10 conservation sites (assuming Conservation Site 10 will have an equal or greater number of Newell’s shearwaters [‘a‘o] than the previously selected site) currently support an estimated colony population of 1,264 to 1,605 Newell’s shearwater (‘a‘o) breeding pairs and an estimated colony population of 2,257 to 3,675 Hawaiian petrel (‘ua‘u) breeding pairs (Table 4-4). A detailed description of each of the nine selected conservation sites is included in Appendix 4A, *Conservation Site Selection Process*.

Table 4-4. Breeding Pairs of Newell’s Shearwater (‘a‘o) and Hawaiian Petrel (‘ua‘u) at the HCP Conservation Sites in 2021, Based on Acoustic Monitoring Data

Conservation Site	Total Site Size (acres/hectares)	Low/High Newell’s Shearwater (‘a‘o) Breeding Pairs[a]	Low/High Hawaiian Petrel (‘ua‘u) Breeding Pairs[a]
Upper Limahuli Preserve	378/153	498/617	112/135
North Bog	348/141	67/80	880/1,261
Pōhākea	363/147	290/464	161/611
Pōhākea PF[b]	0.34/0.14	0	0

Conservation Site	Total Site Size (acres/hectares)	Low/High Newell's Shearwater (ʻaʻo) Breeding Pairs[a]	Low/High Hawaiian Petrel (ʻuaʻu) Breeding Pairs[a]
Honopū	239/97	90/92	0
Honopū PF[b]	3.3/1.3	0	0
Pihea	515/208	0/1	645/815
Hanakoa	186/75	45/74	171/455
Hanakāpīʻai	187/76	76/85	289/398
Conservation Site 10	TBD[c]	198/283[c]	0
Total	**2,216/896**	**1,264/1,605**	**2,257/3,675**

Source: Raine 2022

[a] The breeding pair estimates are informed by acoustic call rate and nesting burrow monitoring studies, which have demonstrated a significant relationship between call rates and estimated densities of active nesting burrows (e.g., Raine et al. 2019a). These acoustic call rates are used in combination with published habitat suitability models (Troy et al. 2014, 2017).

[b] Both of these conservation sites are bound by small predator exclusion fences that will be managed and maintained as social attraction sites by KIUC. Both social attraction areas contain suitable habitat for the covered seabirds.

[c] To be determined once Conservation Site 10 is selected. Assumes Conservation Site 10 will have an equal or greater number of Newell's shearwaters (ʻaʻo) than Upper Mānoa Valley.

Because KIUC or other entities have been managing most of these sites for covered seabird species well before the start of the permit term, the measurable benefits to the covered seabirds will be realized much earlier in the permit term than if site management began after permit issuance. Management actions such as predator exclusion fence construction, predator control, and social attraction take several years to implement fully and several years after that to begin to measurably benefit the covered seabirds, but predator control will benefit the covered seabirds during Year 1 of HCP implementation due to KIUC's long history of predator management within these conservation sites.

4.4.4.2 Management Actions

This conservation measure is the primary means of offsetting the impacts of the taking on Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) and providing a net benefit for each species (see Chapter 5, *Effects*, for modeling that quantifies this benefit). This conservation measure includes four management actions that KIUC will employ within the conservation sites.

- Predator control
- Predator exclusion fencing
- Social attraction
- Invasive plant species control (limited to areas with predator exclusion fencing)

Table 4-5 shows which management actions are planned for each of the 10 conservation sites during the 50-year permit term.

Table 4-5. Management Actions Implemented in Each Conservation Site

Conservation Site	Predator Control	Predator Exclusion Fencing	Social Attraction	Invasive Plant Species Management[a]
Upper Limahuli Preserve	X	X[b]	X	X
North Bog	X	--	--	--
Pōhākea	X	--	--	--
Pōhākea PF	X	X	X	X
Honopū	X	---	--	--
Honopū PF	X	X	X	X
Pihea	X	--	--	--
Hanakoa	X	--	--	--
Hanakāpiʻai	X	--	--	--
Conservation Site 10	X	X[b]	X	X
Total	**10**	**4**	**4**	**4**

[a] Invasive plant species management occurs primarily in the social attraction sites. Invasive plant species management in other areas within the conservation sites is conducted on an as-needed basis.

[b] The predator exclusion fence is located within the larger conservation site

The management actions described in this measure have been applied in the field for most of the sites over the past 10 years, as described in *Interim Management Actions*, allowing extensive field testing and refining of tools, equipment, and techniques. However, new technology or approaches may become available during the permit term to improve the effectiveness or cost-efficiency of these measures. If that is the case, the details of these measures may be modified through adaptive management based on results of monitoring and the best available scientific and technical information, as described in Chapter 6, Section 6.4.4, *Conservation Site Monitoring and Adaptive Management*. Each of these four management actions is described below.

Predator Control

Predator control is the primary management action to establish predator-free breeding habitat or substantially reduce predation, which is critical to successfully restore productive seabird colonies (Buxton et al. 2014; Jones and Kress 2012; Young et al. 2018; Raine et al. 2020a). Given the length of time necessary for birds to reach sexual maturity and successfully start fledging chicks (5–6 years), adult mortality is extremely harmful to the species (Raine et al. 2020a).

Terrestrial Predator Control

Terrestrial predator control has been proven to be very effective at increasing seabird nesting productivity on Kauaʻi. Raine et al. (2020a) found that between 2011 and 2017, Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) reproductive success rates increased by a mean of approximately 36 percent and 48 percent, respectively, following predator control operations within managed breeding sites. Without predator control, Raine et al. (2020a) found that modeled population trajectories within all management sites declined rapidly over a 50-year period, with many colonies approaching extirpation.

Terrestrial predator control methods may include traps, bait stations, snares, hunting, and other control methods. Predator control at all sites will be designed to achieve the conservation benefits in

Chapter 5, *Effects*. Predator control efforts may be timed based on seasonality, rainfall, and the phenology and/or vulnerability to toxicants of endemic species within the fenced area. Traps will also be deployed in other areas where there are high levels of human use such as weatherports, campsites, and other small facilities within the conservation sites. Terrestrial predator control in areas without predator exclusion fencing will focus on high-traffic locations for predators near known breeding colonies.

At four of the conservation sites, predator exclusion fences will be constructed in a portion of the conservation site to eradicate terrestrial predators (cats, rats, mice, pigs, goats) in areas where social attraction will be initiated. Depending on terrestrial predator abundance and the total size of the fenced area, complete terrestrial predator eradication can take anywhere from 3 to 12 months to achieve (Young pers. comm.); individuals must be removed at a rate faster than they can reproduce. Where there are fencing gaps at drainage crossings, traps will be placed 66 feet (20 m) apart to intercept any animals that enter the containment zone. Once terrestrial predators are eradicated within the exclusion fence boundary, as determined by the results of the monitoring program (Chapter 6, *Monitoring and Adaptive Management Program*), this HCP assumes that the habitat within the fenced area will remain free of terrestrial predators except when fences are breached or damaged. In cases of a fence breach or damage immediate terrestrial predator control will occur within the fenced area in order to remove any predators that may have entered the breach and to maintain predator-free habitat. In addition, the fences will have no effect on barn owls (and may even facilitate perching), so barn owl control within the fenced areas will still be necessary for the duration of the 50-year permit term. Some of the conservation sites also have ungulate fences or pig fences that partially or entirely surround the conservation site, as described below.

Upper Limahuli Preserve

- Predator exclusion fence (approximately 12 acres [5 hectares]) around a social attraction site. Predators will be eradicated within the fenced area.
- Entire 378-acre (153-hectare) conservation site protected by ungulate fence. Terrestrial predator control (cats, rodents, barn owls, feral bees) will occur in the entire ungulate fenced area for the duration of the 50-year permit term.

Pōhākea

- Predator exclusion fence (approximately 0.34 acre [0.14 hectare]) around a social attraction site (i.e., Pōhākea PF). Predators will be eradicated within the fenced area.
- Remainder of 363-acre (147-hectare) conservation site is protected by a partial pig fence. Terrestrial predator control (ungulates, cats, rodents, barn owls, feral bees) will occur in all of the conservation site outside the predator exclusion fenced area for the duration of the 50-year permit term.

Honopū

- Predator exclusion fence (approximately 3.3 acres [1.3 hectares]) around a social attraction site (i.e., Honopū PF). Predators will be eradicated within the fenced area.
- Remainder of 239-acre (97-hectare) conservation site is protected by a partial pig fence. Terrestrial predator control (ungulates, cats, rodents, barn owls, feral bees) will occur in all of the conservation site outside the predator exclusion fenced area for the duration of the 50-year permit term.

Pihea

- Partial pig fence at this conservation site.
- Terrestrial predator control (ungulates, cats, rodents, barn owls, feral bees) will occur throughout the entire 515-acre (208-hectare) conservation site for the duration of the 50-year permit term.

Hanakoa

- No fencing on any kind at this conservation site.
- Terrestrial predator control (ungulates, cats, rodents, barn owls, feral bees) will occur throughout the entire 186-acre (75-hectare) conservation site for the duration of the 50-year permit term.

Hanakāpiʻai

- No fencing on any kind at this conservation site.
- Terrestrial predator control (ungulates, cats, rodents, barn owls, feral bees) will occur throughout the entire 187-acre (76-hectare) conservation site for the duration of the 50-year permit term.

Conservation Site 10

- Predator exclusion fence of unknown size around a social attraction site. Predators will be eradicated within the fenced area.
- Remainder of the conservation site will have no fencing. Terrestrial predator control (ungulates, cats, rodents, barn owls, feral bees) will occur in the unfenced conservation site for the duration of the 50-year permit term.

Barn Owl Control

Barn owls are the only introduced owl in the state of Hawaiʻi. Barn owls are known to be significant predators of Newell's shearwater (ʻaʻo), Hawaiian petrel (ʻuaʻu), and band-rumped storm-petrel (ʻakēʻakē) on Kauaʻi (Raine et al. 2017c, 2019b). Barn owls can have multiple clutches in a year and produce large broods (del Hoyo et al. 1999), far outpacing the number of fledglings produced by the covered seabird species annually. In addition, barn owls are difficult to control because they have large home ranges and the capacity to kill large numbers of seabirds in a short period of time (Raine et al. 2019b). In a study by Raine et al. (2019b) where barn owl depredations were recorded between January 2011 and October 2018 across nine study sites, barn owls depredated 379 seabirds, of which 13 were Newell's shearwaters (ʻaʻo) and eight were Hawaiian petrels (ʻuaʻu). These numbers are likely an underestimate of the actual amount of barn owl depredation given that barn owls often transport their prey to other locations before feeding (Raine et al. 2019b).

The Raine et al. (2019b) study also found that barn owl control measures, when implemented in a concentrated and systematic fashion, can significantly decrease seabird depredations. Barn owl control will occur at all of the conservation sites to reduce further predation of the covered seabird species and increase reproductive success. This will be particularly important in areas where social attraction will be performed because playing a recording of a seabird call will not only attract the target seabird but will also attract hunting barn owls.

Barn owl control methods will include targeted trapping and hunting and will occur in areas where barn owls or sign of barn owls (e.g., pellets, feathers) have been observed either incidentally or through the monitoring program (Chapter 6, *Monitoring and Adaptive Management Program*). All field crew members will be trained to identify a barn owl to prevent adverse effects on the only other owl on Kauaʻi, a Hawaiian endemic subspecies of the short-eared owl (pueo) (*Asio flammeus sandwichensis*) that co-occurs with barn owl.[17] Barn owl control will reduce predation of covered seabirds within the conservation sites as well as outside of the conservation sites. Barn owl control is already well established at the conservation sites: Upper Limahuli, North Bog, Pihea, Hanakāpiʻai, Hanakoa, and Pōhākea (Kauaʻi Island Utility Cooperative 2019).

Invasive Bee Control

Feral European honeybees (*Apis mellifera*) have been found to be a conservation issue for endangered seabirds breeding in the Hawaiian Islands (Raine and McFarland. 2015). Feral European honeybees (feral bees) are often defined as descendants of domesticated European honeybees that have escaped managed colonies and establish self-sustaining wild colonies. Feral bees have been responsible for the takeover of active breeding burrows of both Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) at most of the management sites on Kauaʻi, as well as on Lānaʻi, resulting in abandonment of the burrow, and even mortality of adults and chicks due to bee sting (Raine pers. comm. [b]).

Whenever a burrow is found with an active beehive, the feral bees will be vacuumed out using specialized equipment and the honeycomb inside extracted. Every effort will be made to do this soon after the takeover is discovered, to increase the chance that the burrow will not fail, reduce the chances of mortality of visiting adults, and reduce the chance of more burrows being taken over nearby once the beehive splits. Furthermore, feral beehives that are located incidentally during other management and monitoring activities will also be actively removed using the same technique, to protect the birds as well as fieldworkers in the area.

Predator Exclusion Fencing

Predator exclusion fencing for the purposes of this HCP is defined as constructing fences that are impenetrable to most introduced terrestrial predators including feral cats (*Felis catus*), rats (*Rattus* spp.), pigs [*Sus scrofa*], and goats [*Capra hircus*]). Deer (*Odocoileus hemionus*) can jump over these fences but will be managed if they are documented in the conservation sites. Predator exclusion fencing supplements terrestrial predator control, which can be highly effective in and of itself, further reducing predation events. Predator exclusion fencing has proven to be an effective means of multi-species predator control for seabird colonies in Hawaiʻi (Day and MacGibbon 2002; Young et al. 2012, 2013; VanderWerf and Young 2014; Tanentzap and Lloyd 2017). Once a predator exclusion fence is built, all target predators must be eradicated within the fence. After predator eradication, traps will be placed along the boundary of the fence to further limit the potential for predators to reenter the fenced area. Barn owl control would continue within the predator exclusion fenced area.

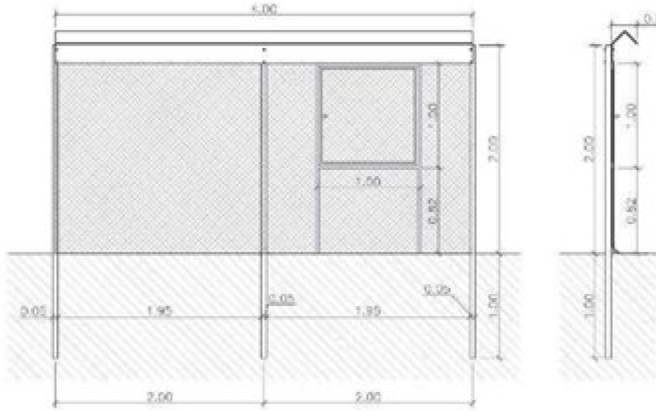
[17] Although barn owl and short-eared owl (pueo) occur in the same habitat, barn owls are nocturnal while short-eared owls (pueo) are diurnal, minimizing the potential for both species to be active at the same time.

There will be four predator exclusion fences included as part of the conservation strategy for the KIUC HCP. Two small predator exclusion fences will be in place before the start of the permit term in the Pōhākea and Honopū conservation sites. KIUC will eradicate all predators and initiate social attraction by no later than the end of Year 1 of the permit term. Both fences were constructed by DOFAW and DOFAW's partners and KIUC will take control of management and maintenance of these fences during the first year of the permit term (2023). KIUC will construct two additional predator exclusion fences within the Upper Limahuli Preserve and Conservation Site 10 conservation sites by 2025.

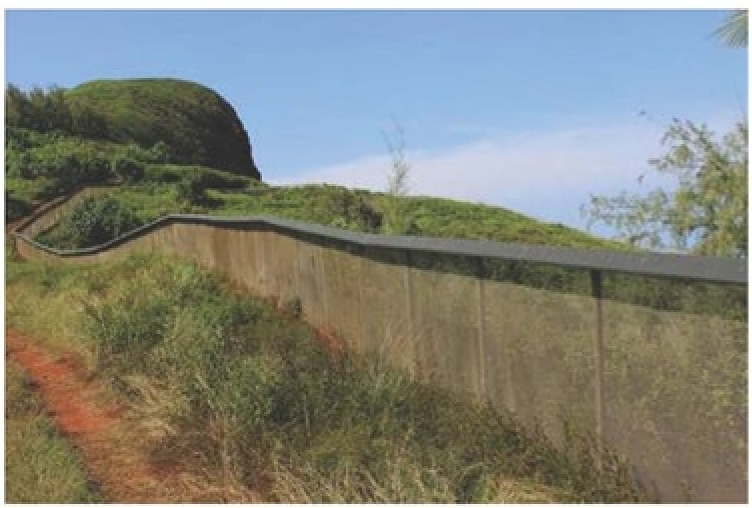
As described above under *Predator Control*, other types of predator fences are present in the conservation sites, constructed and maintained by other entities, that either partially or entirely surrounds those conservation sites. Although KIUC did not construct these fences and will not be responsible for their maintenance, they will benefit the covered seabird species within those six HCP conservation sites.

Fencing Specifications

For a fence to be capable of excluding all terrestrial predators, it must meet the following four biosecurity criteria: (1) be sufficiently high that animals cannot jump over it; (2) have a V-shaped hood on top to prevent animals from climbing over it; (3) use small-aperture mesh to prevent animals from squeezing through; and (4) include an underground skirt to prevent animals from digging underneath it (Figure 4-7). Once the fence is constructed and predators are eradicated within the fence, the protected seabird colonies will be inaccessible to terrestrial predators. This will eliminate the threat of terrestrial predator reinvasion into the protected seabird colonies, as long as the fencing remains in good condition.



SOURCE: Pacific Rim Conservation 2017



SOURCE: Young and Eric VanderWerf 2016

Figure 4-7. Predator Exclusion Fencing Design

To achieve these four biosecurity criteria, all predator exclusion fencing will conform to the following specifications (Young and VanderWerf 2014).

- Height[18] of 6.6 feet (2 m) with a 6.6-foot (2-m) buffer immediately on either side of the fence clear of rocks, structures, or trees. These fences will be the same height as other DOFAW-constructed predator exclusion fences on Kauaʻi.
- Fence base or frame constructed using 8.8-foot-long (2.7-m) posts spaced at approximately 6.6-foot (2-m) intervals along the fence length. Spacing in areas of high winds along ridge lines should be closer together.
- Single-strand wires tensioned to 330 pounds (150 kilograms) horizontally between the posts of poles.
- No fence corner should turn more sharply than 45 degrees.
- No gaps greater than 0.3 inch (7 millimeters [mm]), including the mesh.
- A 1-foot-long (30-centimeter [cm]) taut mesh skirt will be secured to the ground with pins or cement and buried to a depth of approximately 4 inches (10 cm).
- All fence materials will be made of marine-grade "316" stainless steel to minimize rusting and corrosion. The face of the fence and the horizontal skirt would have an aperture no larger than 0.5 inch by 0.5 inch (13 mm by 13 mm).
- A V-shaped, cat-proof hood will be installed on top and on the outside of the fence to allow animals to jump out of the enclosure but not to jump inside.
- Single half-door design lockable pedestrian access gates will be located along the fence edge that do not extend to ground level. Pedestrian gates will be installed every 1,640–3,281 feet (500–1,000 m). Gates will be constructed so they can be padlocked to prevent trespass.
- Fences will be continuous except across streams, rivers, pools, and other drainageways.[19] Where there is a fencing gap due to a drainage, two parallel fences will be installed to create a containment zone on both sides of the gap. The fence sections immediately above the drainage will be constructed as break-away panels that are not as tightly fastened to the rest of the fence so that in the event a large flood damages the fence, it would only damage these small, replaceable sections.
- Cliff-face tie-ins may be necessary to secure fencing to cliffs.[20]
- To the extent practicable, fences will avoid the need for culverts by using waterfalls and other topographic features for closure instead. In the event that culverts become necessary, all culverts, drainage pipes, and other water channels should pass under the fence in a pest-proof manner and would have the outside entrance to the culvert sealed with a pest-proof culvert screen.

[18] Height is measured from a point 3.3 feet (1 m) out from the base of the fence, representing the likely jumping position of a cat, vertically to the top of the fence (i.e., the highest point of the hood).

[19] Generally, this means a small gap at the top of a high (greater than 20 feet [6.1 m]) waterfall and/or a small gap at a pool immediately above the waterfall.

[20] If cliff-face tie-ins are deemed necessary, that portion of the fence line will be constructed outside the nesting season (i.e., from December to April) to avoid adverse impacts on occupied burrows.

- Earthwork will be kept to a minimum. Fence post holes will be roughly 3.3 feet (1 m) deep and soil or fill will be used to form a gentle mound along the fence alignment so that stormwater will not pass through the fence.
- Fencing must be constructed in locations where extensive vegetation does not overhang the fence or where vegetation can be controlled to prevent encroachment and overhanging.
- Fence construction must not damage or destroy threatened or endangered plants or habitat for any listed species (Appendix 1A, *Evaluation of Species Considered for Coverage*, Attachment 1 for required avoidance measures for Hawaiian hoary bat [ʻōpeʻapeʻa] [*Lasiurus cinereus semotus*], Attachment 2 for avoidance measures for listed plants).
- Fencing must be constructed in locations where human access is possible on both sides of the fence for patrols, monitoring, and fence repair.
- Fencing must be constructed in locations accessible by helicopter to ferry staff, equipment, and materials.

Each predator exclusion fence will be constructed in the following stages: (1) vegetation removal from a 13-foot-wide (4-m-wide) swath along the fence alignment; (2) necessary earthwork; (3) base fence erection; (4) attachment of mesh; (5) attachment of a cat-proof hood; and (6) installation of access components. The fencing crew and fencing materials will be transported to the site either by vehicle, helicopter, or both, which typically takes between 90 and 120 days. Construction of the predator exclusion fences at the Upper Limahuli Preserve and Conservation Site 10 conservation sites is expected to be completed by 2024 to 2025 (Young pers. comm.) (*Interim Management Actions* provides more details on construction schedule).

Replacement of the predator exclusion fence is not expected in its entirety during the 50-year permit term. However, segments of the fence may need to be replaced (especially after large storm events that knock down trees or cause landslides). Replacement of fencing segments would entail the same activities as are required for the initial installation as well as the removal and disposal of damaged fencing materials. The replaced segments would be built to meet the same four biosecurity criteria and with the same specifications as the original fence.

There are a number of factors that can constrain the construction of predator exclusion fences within a conservation site. Large sites with steep valleys, dense vegetation, drainages, or crumbling/friable substrate can make predator exclusion fencing very challenging or impracticable. In combination with the high level of infrastructure required for a fence to completely exclude terrestrial predators, these factors may physically prohibit achieving total terrestrial predator exclusion.

To minimize the likelihood of rats stowing away in materials transported into the fenced predator exclusion areas by helicopter, all gear that is to be transported to a conservation site will be packed in an area free of rodents and inspected prior to loading into the helicopter. In addition, traps will be placed in two concentric rings of four traps approximately 33 feet (10 m) and 66 feet (20 m) from each other around helicopter landing zones.

Fence Condition

KIUC will maintain the condition of the terrestrial predator exclusion fencing over the 50-year permit term. KIUC will be responsible for assessing the condition of each predator exclusion fence throughout the permit term according to the following schedule to avoid fence breaches. Acts of nature, accidents, and vandalism are likely to damage the fence over time. Therefore, it is essential to have an effective assessment, maintenance, and repair program to minimize and address fence damage as soon as practicable. If breaches occur, rapid response will be targeted to specific species that have invaded the site. Cat and rodent traps will be purchased in year one of the permit term and kept in reserve for rapid response in the event of a breach.

The following fence assessment schedule is designed to: (1) detect damage quickly after it occurs; (2) ensure that people and resources are available so that emergency repairs can be made in a timely fashion; and (3) that if any predators permeate the fence boundary, they are limited to a small area and removed as quickly as practicable.

- Opportunistic observations of the fence during every trip into and out of a conservation site on helicopters.
- Opportunistic observations of the fence condition when working within the conservation site on other tasks.
- Once a month, in the course of accessing a conservation site via helicopter, fly along the fence alignment and record observations concerning fence condition. This will be done during flights when the weather conditions allow and as soon as practicable after significant storm events (i.e., tropical storms or hurricanes for which the National Weather Service issues warnings for Kauaʻi). If any issues are noted from the air, the fence section in question will be inspected by the ground crew as soon as practicable following the observation.
- Every 3 months, personnel will walk the entire length of the fence on both sides and inspect it for breaches or deterioration.
- Inspections in high-risk areas (e.g., near cliffs, large trees, or streams) as soon as reasonably and safely practicable, following storm events.
- In the event of a predator incursion from an unidentified breach, the fence will also be inspected.

KIUC will have people and resources in place to make emergency repairs, thereby reducing the likelihood of predator expansion if a breach occurs. This will be achieved as follows.

- A single individual designated as the primary point of contact and made responsible for scheduling maintenance and monitoring visits and receiving/acting on reports of a breach or any other relevant observations on the fence.
- An annual risk analysis to identify possible areas of weakness.
- Signs placed at high-risk areas and access points that provide contact information for whom to call in the event that a breach is noticed.
- Fence repair supplies stored near high-risk areas to facilitate efficient repairs.

Social Attraction

More than 95 percent of seabirds are colonial (including the covered seabird species), which means they are attracted to breeding sites by the presence of individuals of the same species and other seabird species (Jones and Kress 2012). Social attraction is a technique that uses attractive social stimuli, generally the sight and sound of the same species, to promote nest initiation by colonial seabirds. Social attraction is used on sites that currently lack social cues but otherwise the location is suitable for nesting (Jones and Kress 2012). Because of their nocturnal flight behavior, acoustical rather than visual techniques are considered to be the most successful means of attracting the covered seabirds as they fly over or near suitable habitat (Miskelly et al. 2009; Young et al. 2019; Raine et al. 2019a). If successful, the strategy can result in relatively high productivity within a small area (Young et al. 2019).

Social attraction using acoustical playbacks in combination with artificial burrows and invasive plant species removal, is a proven method to establish new or enhance existing colonies of burrow-nesting seabirds (Gummer 2003; Sawyer and Fogle 2010; McIver et al. 2016; U.S. Fish and Wildlife Service 2016). For example, Newell’s shearwater (‘a‘o) have nested at the Kīlauea Point National Wildlife Refuge on Kaua‘i for over 10 years, due to a combination of an egg swap project coupled with social attraction (Byrd et al. 1984; Raine et al. 2021). Artificial burrows are used to increase nesting density and to eliminate the time a seabird would normally spend digging a burrow to accelerate breeding (Raine et al. 2021b).

Social attraction will only be implemented within predator exclusion fencing (at four conservation sites) because the fencing will eliminate the threat of predation, increasing the site’s carrying capacity and potential for colony expansion or creation (i.e., successful social attraction). Social attraction techniques will be used to expand existing colonies and establish new colonies in the conservation sites within otherwise suitable breeding habitat. The methods for social attraction include vegetation clearing, broadcast calls, and artificial burrows using the following three steps.

- **Step 1. Restore targeted habitat to be suitable for nesting.** This step involves removing unsuitable vegetation (e.g., guinea grass [*Megathyrsus maximum*]) from an area at least 1 acre (0.4 hectare) in size and planting suitable native species such as false staghorn fern (uluhe) (*Dicranopteris linearis*). Selected locations should be large enough that they can be incrementally restored and expanded over time to increase the colonies’ productivity.
- **Step 2. Install artificial burrows.** Artificial seabird burrows consist of wooden boxes with open bottoms, removable lids, and plastic tunnels for burrow entrances. They are very durable and strong enough to resist warping or physical damage from trampling, tree-fall, and rock-fall in most circumstances, especially when buried in soil substrate. The lids provide easy access and the modular tunnel component can be cut to any length and include turns to keep out light. The artificial burrows are placed in holes dug to half the height of the burrow (if the site does not allow holes to be dug to the desired depth, then the burrow is covered with sand). Burrows are then painted with reflective paint and the lid weighed down with a sand bag—this, coupled with planting native shade plants around the burrows, minimizes the threat of overheating in the burrow chamber.
- **Step 3. Install social attraction equipment.** A solar-powered sound system is installed in the social attraction site to broadcast calls over the restored habitat with the artificial burrows.

As stated in *Predator Exclusion Fencing*, there will be four predator exclusion fences in place in the conservation sites by 2025 at the Upper Limahuli Preserve, Conservation Site 10, Pōhākea PF, and Honopū PF conservation sites. Upper Limahuli Preserve, Conservation Site 10, and Pōhākea PF are social attraction sites for Newell’s shearwater (‘a‘o), while the Honopū social attraction site will primarily target Newell’s shearwater (‘a‘o) and band-rumped storm-petrel (‘akē‘akē) due to its location adjacent to the cliffs of Honopū Valley.

Invasive Plant Species Management

Invasive plant species can degrade covered seabird nesting habitat across the state (Young et al. 2018). Invasive plant species displace and out-compete native vegetation, which alters vegetation composition and structure (Simberloff et al. 2013; VanZandt et al. 2014) and can make nesting burrows inaccessible by the covered seabirds (Raine pers. comm (a).). Significant colony reduction has been recorded in several historical colonies on Kauaʻi due to multiple reasons, including the rapid spread of invasive plant species (e.g., at Kalāheo, Makaleha, Wailua; based on Kauaʻi Endangered Seabird Recovery Project unpublished data).

The following list of species are those on Kauaʻi that have been identified as the chief invasive plant species to remove from the Upper Limahuli Preserve because of their rapid growth and capability to significantly alter forest structure and understory and thus degrade covered seabird habitat (Raine pers. comm.). Appendix 4C, *Invasive Plant Species Control Methods*, provides a full list of species.

- Australian tree fern (*Sphaeropteris cooperi*)
- Strawberry guava (*Psidium cattleianum*)
- Himalayan ginger (kāhili ginger) (*Hedychium garderianum*)
- Octopus tree (*Schefflera actinophylla*)
- Pink melastome (*Melastoma candidum*)
- African tulip (*Spathodea campanulata*)
- Passion fruit (*Passiflora* spp.)

KIUC will fund continual invasive plant species management focused on the list of species in Appendix 4C, *Invasive Plant Species Control Methods*, within the Upper Limahuli Preserve and the four social attraction sites (including a 30-foot perimeter around the outside of the predator exclusion fences). Invasive plant species control will occur in the other conservation sites on an as-needed basis, when observed and documented during monitoring and determined to be spreading or otherwise problematic (Chapter 6, *Monitoring and Adaptive Management Program*). Invasive plant species control methods will include cutting, digging, and herbicide application consistent with best management practices developed by the National Tropical Botanical Garden and others involved in the control of these species in the wet upland forests of Kauaʻi (Appendix 4C, *Invasive Plant Species Control Methods*). The methods will be updated as deemed necessary to allow the use of more cost-effective techniques and products if they become available. Invasive plant species control must not damage or destroy threatened or endangered plants or habitat for any listed species (Appendix 1A, *Evaluation of Species Considered for Coverage*, Attachment 1 for required avoidance measures for Hawaiian hoary bat [ʻōpeʻapeʻa]; Attachment 2 for avoidance measures for listed plants).

Interim Management Actions

KIUC has been conducting some of the management actions included under this conservation measure within some of the conservation sites. These management actions occurred both during implementation of the Short-Term HCP (counted as 2011–2019) and since then (counted as 2020–2022) to prepare for implementation of this HCP. KIUC has been funding extensive predator control within the Upper Limahuli, North Bog, Pihea, and Pōhākea conservation sites since 2011. Invasive plant species control has been partially funded by KIUC since 2011 in the Upper Limahuli Preserve conservation site. KIUC's ongoing management (and, in some cases, long history of management) illustrates the practicability of these conservation measures and the fact that the protocols and specifications described in this conservation measure have been applied, tested, and refined for many years.

In addition, KIUC has been planning and preparing (e.g., surveys, design, permitting) for installation of the predator exclusion fence at the Upper Limahuli Preserve conservation site. KIUC expects construction of the Upper Limahuli Preserve and Conservation Site 10 conservation site fences will be completed by 2024–2025. Regular monitoring and maintenance will be conducted to maintain the condition of the terrestrial predator exclusion fencing over the 50-year permit term (Chapter 6, *Monitoring and Adaptive Management Program*).

Management Timing to Minimize Effects on Covered Seabirds

KIUC and its contractors will implement all management actions (i.e., predator control, construction of predator exclusion fences, invasive bee control, social attraction, and invasive plant species management) within protected conservation sites that contain nesting colonies of the covered seabird species (Table 4-5, Figure 4-6) in ways that minimize effects on the covered seabirds. Certain management actions that could disturb nesting seabirds (e.g., construction of predator exclusion fences) can be implemented from December to March, which is outside of the nesting season (April to mid-December) while the covered seabirds are at sea. In other cases, actions such as social attraction will be performed during the nesting season with protocols in place to limit disturbance as much as practicable.

Other activities such as infrastructure maintenance and inspections and site preparations (e.g., weatherport or fence maintenance) will also be performed outside of the nesting season, whenever practicable. Certain predator control activities can likely occur outside of the nesting season to minimize impacts on the covered seabird species; however, the primary predator control activities must occur within an active colony in order to be effective in protecting seabirds from ongoing threat of depredation in areas where predator exclusion fencing is not present.

KIUC and its contractors will decide on a case-by-case basis if the location where the conservation measure will be implemented is close enough to a breeding colony to disturb it. Some fencing segments may be far enough from the breeding colony within the conservation site that it can be completed at any time of year.

4.4.5 Conservation Measure 5. Implement a Green Sea Turtle Nest Detection and Temporary Shielding Program

This conservation measure describes the nest detection and shielding program that KIUC will implement to minimize and offset the effects of light attraction from KIUC streetlights. This action will meet the green sea turtle (honu) biological goals and objectives. The nest detection and shielding program will be implemented throughout the entire 50-year permit term at locations visually affected by KIUC streetlights. However, if KIUC demonstrates to the satisfaction of USFWS, DOFAW, and DAR that they have avoided take of green sea turtle (honu) through permanent modification of existing target streetlights, then KIUC would no longer need to implement nest shielding (Section 4.4.5.4, *Program Duration*).

4.4.5.1 Nest Detection

Protecting green sea turtle (honu) hatchlings from light disorientation first requires determining which KIUC streetlights are visible from suitable nesting habitat and then locating active nests (i.e., nests at which eggs are present or thought to be present) on those beaches before hatching occurs. There is currently no formal program on Kaua'i to detect, mark,[21] and protect sea turtle nests.

To detect all green sea turtle (honu) nests at risk of light disorientation from KIUC streetlights, KIUC will establish a nest detection program using drone surveys and/or a network of volunteers led by a project coordinator. Monitoring may occur with or without the use of drones, depending on what method is determined most suitable during implementation.

On an annual basis, KIUC will first survey all beaches in the Plan Area with suitable green sea turtle (honu) nesting habitat and KIUC streetlights between March 1 and April 30 to identify locations where KIUC streetlights are visible from the surface of the beach. Once identified, nest detection surveys are required in those locations between May 15 and December 15. Surveys will include all sandy areas visually affected by KIUC streetlights to look for evidence of nesting (e.g., turtle tracks, digging, presence of turtles). Surveys should be completed at least once per week during peak nesting season (May through July) and bi-weekly for the remainder of the nesting season (August to December).

The following sections provide an overview of the green sea turtle (honu) nest detection program; further details are provided in Chapter 6, *Monitoring and Adaptive Management Program*.

Drone Surveys

Drones may be utilized to monitor all accessible Plan Area beaches with suitable nesting habitat for green sea turtle (honu) that may be visually affected by KIUC streetlights on an annual basis (May 15 through December 15). The drone surveys may occur at all accessible Plan Area beaches and the data will be included with island-wide data on the timing, extent, and trends of green sea turtle (honu) nesting.

There are multiple steps required for drone operations, including the following.

- Identify drone no-fly zones on Kaua'i.
- Conduct required training and licensing for drone operators.
- Purchase equipment (primary and backup) and procure storage space for equipment/supplies, and drone footage.
- Identify safe and accessible drone launch areas for maximum beach coverage that also avoid no-fly zones.
- Finalize data and information transfer protocols from drone flights to project coordinator to inform subsequent site visits (ground truthing) by field volunteers.

If drones are utilized, KIUC's funding will be used to purchase the materials (e.g., drones, vehicle) necessary for the drone surveys. The drone surveys would require two field staff; one staff member

[21] Marking nests may not be appropriate in all situations because it may draw attention to the nest and lead to vandalism. Nest marking will be determined on a case-by-case basis depending on nest location.

to set up, manage data, and serve as a back-up operator, and the second staff member to operate the drone during the green sea turtle (honu) nesting season.

Volunteer Monitoring Program

A volunteer monitoring program will also operate between May 15 and December 15 to supplement the drone surveys. This program will be modeled after Kauaʻi's Hawaiian monk seal (ʻilio holo i ka uaua) (*Neomonachus schauinslandi*) volunteer network that is organized and managed by the DLNR DAR Protected Species biologist on the island. The purposes of the volunteer monitoring program will be to do the following.

- Conduct monitoring surveys in areas where drone surveys are not permitted or not practicable to detect possible active nests of green sea turtle (honu).
- Visit all nesting sites identified during drone surveys to field verify them and determine if the nests are active.
- Nightly, monitor active nests that are in view of KIUC streetlights starting within 15 days of estimated emergence.

The volunteer monitoring program is expected to require one full-time project coordinator. Network set-up, training, scheduling, and oversight will be provided by the project coordinator.

Once an active nest is confirmed through the volunteer monitoring program, the volunteer coordinator will work with KIUC to determine if the nest is within view of any KIUC streetlights. Each nest will be visited after dark (as soon as possible following its discovery) when the streetlights are illuminated to determine whether any KIUC streetlight can be observed near the surface of the nest location. The monitor will stand behind the nest at the sand surface to see if KIUC streetlights are visible. If they are not visible, the monitor will note the reason why (e.g., vegetation or buildings blocking the light, light too far away or at an angle where it cannot be seen). The monitor will note if the luminaire face (i.e., the portion of the head from which light emanates—the very bright point-source of the light) itself is directly visible from the nest location. Photographs will be taken from the nest location facing the streetlights and from the streetlights facing the nesting location for inclusion in the annual report.

For active nests that require shielding, volunteers will estimate the age of the nest. KIUC will submit this information to USFWS, DOFAW, and DAR within 30 days of nest discovery for their review.

4.4.5.2 Shield Active Nests from Streetlights

Program staff will shield all active green sea turtle (honu) nests that have any potential to be at risk of light impacts from KIUC streetlights using the protocols described in this section. The monitor will be conservative in their streetlight assessment and assume that any nest with even a low potential to be affected by a KIUC streetlight will require shielding.

In 2020, KIUC conducted a field assessment of all its coastal streetlights and identified 29 streetlights that are visible from the following seven beaches (Figures 4-8a through 4-8g).

- Two streetlights at Keālia Beach (Figure 4-8a)
- Four streetlights at Kapaʻa Shoreline (Figure 4-8b)

- Seven streetlights at Wailua Beach[22] (Figure 4-8c)
- Three streetlights at Po‘ipū Shoreline (two on Figure 4-8d and one on Figure 4-8e)
- Three streetlights at Kukui‘ula Harbor (Figure 4-8e)
- Three streetlights at Waimea Shoreline (Figure 4-8f)
- Seven streetlights at Kekaha Shoreline (Figure 4-8g)

Program staff will, at a minimum, install nest shielding on these seven beaches when active green sea turtle (honu) nests are detected (see Section 4.4.5.1, *Nest Detection*). However, nest shielding is expected to be necessary at additional Plan Area beaches during the 50-year permit term if changes in environmental conditions[23] expose nesting habitat to light from additional existing streetlights or from new streetlights installed in coastal areas. In contrast, some beaches at which green sea turtle (honu) nests are shielded may be removed from the program if conditions change to eliminate light attraction risk (e.g., vegetation growth, new structures, beach erosion). As stated above under Section 4.4.5.1, *Nest Detection*, KIUC will survey all suitable habitat within the Plan Area on an annual basis to identify these environmental changes and expand or decrease nest shielding as necessary to respond to the changes. Changes to monitored beach locations require consultation with USFWS, DOFAW, and DAR, as described in Section 6.2.2, *Adaptive Management*.

Program staff will install light-proof fencing (Witherington et al. 2014; Witherington and Martin 2003), which is a small, removable light-proof silt fence made of wooden stakes and opaque black silt fence fabric. The light-proof fence will be erected around the nest after approximately 45 days of incubation to minimize the potential for vandalism. The following barrier technique is recommended wherever light visibility from the nests, as visible from the sand surface, cannot be eliminated or shielded at the light source.

1. The fence must be tall enough to shield the active nest site from lights from nearby streetlights.
2. Photographs and GPS coordinates of each green sea turtle (honu) nest will be documented.
3. The fence will be placed approximately 15 days prior to the expected emergence date, or when a sandy depression is visible within the defined nest area, to indicate hatchlings are in the process of emerging. Placement must be approved by a qualified biologist (e.g., DAR, National Marine Fisheries Service, DOFAW, USFWS, biological consultant).
4. Photographs of lights at night from the nest surface before and after the fence installation will be taken to confirm the effectiveness of the fence shield.
5. The fence will be in place and maintained daily prior to hatchling emergence to be effective. Adjustments to the fence may be made with approval of a qualified biologist.
6. If hatchlings move beyond the barrier into view of the light source and deviate from a path directly towards the ocean they will be captured and returned to the sheltered path by a permitted biologist.

[22] In 2020, beach erosion removed most of the suitable habitat for green sea turtle (honu) below the high tide line at Wailua Beach. As such, the current condition of the beach has limited suitability for nesting sea turtles but these lights are identified in the event that the habitat becomes more suitable in the future.

[23] Changes that may affect which green sea turtle (honu) nesting habitat is exposed to lights from streetlights may include vegetation clearing, vegetation damage from storms, construction of structures, demolition of structures, beach erosion, or beach accretion.

After the green sea turtle (honu) hatchlings have emerged and entered the ocean, a permitted biologist will remove the fence. The permitted biologist will then be responsible for nest excavation following the *Standard Research Protocols for Nesting and Basking Marine Turtles in the Pacific Region* (U.S. Fish and Wildlife Service and National Oceanic and Atmospheric Administration 2019) (or another accepted protocol during the 50-year permit term) to confirm the species and determine hatching and emergent success. The permitted biologist will also send any remaining unhatched eggs, deceased hatchlings, or samples (training required) of eggs or deceased hatchlings to the National Oceanic and Atmospheric Administration for DNA analysis.

Figure 4-8a. Streetlights Visible from Green Sea Turtle Nesting Habitat at Keālia Beach in 2020

Figure 4-8b. Streetlights Visible from Green Sea Turtle (honu) Nesting Habitat at Kapa'a Shoreline in 2020

Figure 4-8c. Streetlights Visible from Green Sea Turtle (honu) Nesting Habitat at Wailua Beach in 2020

Figure 4-8d. Streetlights Visible from Green Sea Turtle (honu) Nesting Habitat at Po'ipū Shoreline in 2020

Figure 4-8e. Streetlights Visible from Green Sea Turtle (honu) Nesting Habitat at Kukuiʻula Harbor and Poʻipū Shoreline in 2020

Figure 4-8f. Streetlights Visible from Green Sea Turtle (honu) Nesting Habitat at Waimea Shoreline in 2020

Figure 4-8g. Streetlights Visible from Green Sea Turtle (honu) Nesting Habitat at Kekaha Shoreline in 2020

4.4.5.3 Monitoring Schedule

The green sea turtle (honu) monitoring schedule was developed to increase the frequency of site visits as a nest approaches its estimated hatching date. The objective for increasing the monitoring frequency over time as the nest incubates is to ensure that the monitor is present at the time of hatching to record the outcome and rescue any hatchlings that head away from the shoreline. The following list outlines the monitoring schedule to ensure that monitoring starts as soon as an active nest is located and determined to be at risk of light disorientation from a KIUC streetlight.

- Initially, active nests will be visited every other day to check their status (e.g., was it washed away by a king tide, was it run over by a vehicle).
- Within 15 days of the estimated hatching date, nests will be visited daily to check for signs of emergence (at which time the temporary light shield will also be installed in anticipation of hatching).
- Within 5 days of the estimated hatching date (assuming a green sea turtle [honu] nest emerges approximately 2 months after egg laying [Seminoff et al. 2015]), monitored nests will be visited twice per day, once during the daytime and once after dark.

If the monitor is not present at the time of emergence, monitors will record (including photographs to supplement the written documentation) the direction and distance of all hatchling tracks away from the nest and search for any evidence of hatchling mortality that may have resulted from disorientation.

Evidence of emergence and take (if any occurs) will be reported to USFWS, DOFAW, and DAR within 24 hours. USFWS, DOFAW, DAR, or their designee will then be responsible for final nest excavation to determine species, proportion of eggs that hatched and to send remaining eggs to the National Oceanic and Atmospheric Administration for DNA analysis. Any take of a green sea turtle (honu) hatchlings (Chapter 5, Section 5.5, *Effects on Green Sea Turtle (honu)*) will be counted on an annual basis based on the results of that year's monitoring program.

4.4.5.4 Program Duration

KIUC will fund and implement this conservation measure throughout the 50-year permit term or until such time as KIUC modifies all the streetlights potentially affecting nesting green sea turtle (honu) habitat to eliminate these effects. If KIUC modifies all the streetlights identified as a risk to green sea turtle (honu) habitat[24] consistent with Conservation Measure 6 (Section 4.4.6, *Conservation Measure 6. Identify and Implement Practicable Streetlight Minimization Techniques for Green Sea Turtle*) to eliminate light attraction of green sea turtle (honu), and commits to continue to modify both new streetlights and additional existing streetlights that become exposed (e.g., vegetation removal) in the same manner, then KIUC will no longer be required to fund the installation of temporary light shields under this conservation measure after consultation with USFWS, DOFAW, and DAR (Chapter 6, Section 6.2.2, *Adaptive Management*). However, nest detection and nest monitoring on beaches exposed to existing streetlights will continue for a period of 5 years after the installation of the streetlight retrofits to determine their effectiveness. If nest monitoring

[24] There are 29 streetlights currently identified as a risk, but this number may go up or down depending on environmental conditions at these locations.

determines that the permanent light minimization techniques are not effective, this will be addressed through the HCP's adaptive management program.

In addition, KIUC will continue to fund the nest detection and temporary shielding program required under this conservation measure throughout the permit term to identify locations where beach conditions change, resulting in non-minimized streetlights casting light onto suitable green sea turtle (honu) habitat. These additional streetlights will either be modified to eliminate light attraction of green sea turtle (honu), or active nests will be temporarily shielded in these locations consistent with this conservation measure.

4.4.5.5 Annual Training and Reporting

All staff and volunteers will be required to complete annual training provided by USFWS, DAR, or trainers approved by USFWS and DAR. This training will allow them to recognize and differentiate green sea turtle (honu) tracks, signs of nesting, and hatchling activity from other sea turtle species, as well as the proper techniques for installing temporary light shields. The training will also discuss timing of nesting and hatching, other green sea turtle (honu) behaviors that might be observed, and law protecting green sea turtles (honu) when they are on land (State of Hawaiʻi Division of Forestry and Wildlife 2020). KIUC will provide information on the approach and protocol for the streetlight assessment and will provide staff and volunteers with data collection forms to use in the field.

KIUC will develop a data collection form for the monitoring program, which will also be included in the annual report. KIUC will develop a standardized data collection form for use during green sea turtle (honu) monitoring that will ensure that all necessary information is collected by green sea turtle (honu) monitors, so that it can be reported accurately in the annual report. The data collection forms will include the following information, which has been adapted from the Kauaʻi Seabird Habitat Conservation Plan (State of Hawaiʻi Division of Forestry and Wildlife 2020).

- Date, weather conditions, personnel surveying, time spent on survey.
- Names of beaches monitored, and length of beach surveyed.
- Number of nests found.
- Assessment of potential threats at the nest, including light visibility from nest.
- Status of light shield (i.e., if installed, for future streetlights).
- Evidence of hatchling emergence and condition of the nest area (description and photos).
- Date and time of emergence.
- Direction of tracks.
- Hatchling emergence success as determined by final nest excavation.

KIUC will report the number and location of beaches surveyed (including which were surveyed via drones or on foot), the number of active nests identified at each location, the light attraction risk assessment for each nest, the number and location of shielded nests, and the hatching success and outcome for each nest (number of hatchlings that made it out of the nest and to the ocean), including the level of shielding effectiveness. In addition, if any active nests are missed by the monitoring program and if any resulting take occurs that can be attributed to KIUC streetlights, KIUC will also report these incidents as soon as possible to USFWS, DOFAW, DAR, and in the annual report.

KIUC will also create a map for each annual report showing the locations of all of beaches surveyed and active nests detected during the green sea turtle (honu) nesting season, lights visible from the beach, and identify which nests were shielded. Nests will be mapped with a GPS unit to accurately map their locations.

4.4.6 Conservation Measure 6. Identify and Implement Practicable Streetlight Minimization Techniques for Green Sea Turtle

As described in Conservation Measure 2, in 2017 KIUC retrofitted all streetlights on Kaua'i with full-cutoff shielded fixtures to direct light toward the ground (below the 90-degree horizontal plane) to minimize light attraction of the covered seabirds. In addition, in 2019 KIUC replaced all green light bulbs with white light bulbs to further reduce light attraction. These modifications were aimed at minimizing the impact of the streetlights on the covered seabirds but do not reduce streetlight visibility from the perspective of green sea turtle (honu) hatchlings. As described in Conservation Measure 5, KIUC determined in 2020 that 29 streetlights were visible from suitable green sea turtle (honu) nesting habitat in the Plan Area.

Additional modifications are needed to reduce light attraction of green sea turtle (honu) hatchlings without compromising public health or safety. KIUC owns and operates all streetlights, but this operation is governed in part by State and County regulation and according to national standards. Both the County and the State have their own sets of limitations and regulations. As a public utility, KIUC cannot unilaterally change its operation of streetlights to protect green sea turtles (honu). Instead, changes in local regulations are needed to allow these changes to be consistent with public health and safety. For example, most counties and cities in coastal Florida have passed ordinances restricting the types and uses of lights adjacent to beaches in order to protect nesting sea turtles.[25] In Hawai'i, only Hawai'i County has a lighting ordinance, but it is not designed specifically to protect nesting sea turtles.[26]

KIUC will work with the County and State to determine the range of available practicable minimization measures and their timeline for implementation. Practicable light minimization measures are those that are: (1) practicable from an engineering standpoint (e.g., what is compatible with current streetlight equipment), (2) legal (e.g., what is allowed by State/County regulations and safety risk management), (3) financially practicable (i.e., not cost prohibitive), and (4) will benefit the species (i.e., what is known to benefit sea turtles). Light minimization may include techniques such as shielding or change in wattage. All KIUC streetlight modifications require County and State agreement prior to implementation.

4.4.6.1 Identify and Install Practicable Light Minimization Techniques

In 2020, KIUC began discussions with the County and State regarding potential light minimization measures for green sea turtle (honu) that would be practicable (i.e., not compromise public safety, be practicable from an engineering standpoint, and be affordable to KIUC). In 2021, KIUC began

[25] See https://myfwc.com/media/3150/seaturtle-lightordmap.pdf for a map of jurisdictions in Florida that have passed sea turtle lighting ordinances.

[26] See Chapter 14, Article 9 of the Hawai'i County Code: http://nenue.cfht.hawaii.edu/ObsInfo/IslandLights/ordinance.html

testing different shield designs to determine if they are effective in removing light penetration and at the same time will not increase risk to public safety.

The outcome of these discussions may be that there are no practicable light minimization measures for green sea turtle (honu) that can be agreed to between KIUC, the County, and the State. If this is the case, KIUC would not be required to implement this conservation measure further, and instead would continue to implement the temporary shielding required under Conservation Measure 5 throughout the life of the permit term.

If KIUC, the County, and the State reach agreement on practicable minimization measures that can be implemented to reduce potential light effects on green sea turtle (honu) hatchlings, the minimization techniques will be submitted to USFWS, DOFAW, and DAR for their review and approval. Once USFWS, DOFAW, and DAR concur, the agreement between KIUC, the County, and the State will be finalized. KIUC will then install the agreed-upon light minimization techniques within an agreed-upon timeframe after execution of the final agreement with the County and the State. The final agreement and timeline for its implementation will be included in the next annual report submitted to USFWS and DOFAW.

If new locations are identified where beach conditions change that expose additional green sea turtle (honu) nesting habitat to light from streetlights, KIUC will install the agreed-upon light minimization techniques on those non-minimized streetlights as soon as practicable (and if practicable based on the site-specific considerations), regardless of historic or current green sea turtle (honu) nesting activity. In addition, new streetlights installed in locations where light could be cast onto suitable green sea turtle (honu) habitat will include light minimization techniques consistent with this conservation measure during construction to the degree practicable based on the site-specific considerations. Changes to beach locations where minimization will be applied for green sea turtle (honu) requires consultation with USFWS, DOFAW, and DAR, as described in Section 6.2.2, *Adaptive Management*.

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Chapter 5
Effects

5.1 Overview

This chapter describes how the KIUC HCP covered activities would affect the covered species and presents conclusions regarding expected outcomes from implementing the conservation strategy (described in Chapter 4, *Conservation Strategy*). Those conclusions are reached through a systematic, scientific evaluation of the estimated adverse, beneficial, and net effects on the covered species because of the HCP covered activities and its effects pathways. This chapter provides the information for the U.S. Fish and Wildlife Service (USFWS) and Hawaiʻi Department of Land and Natural Resources, Division of Forestry and Wildlife (DOFAW) to evaluate whether the criteria for an incidental take permit and incidental take license, respectively, have been met. For additional details on the ecology of the covered species or threats to these species, see Appendix 3A, *Species Accounts*.

This chapter is organized into four sections. Section 5.2, *Effects Pathways*, describes the effects pathways for each effect mechanism. Section 5.3, *Effects on Covered Seabirds*, Section 5.4, *Effects on Covered Waterbirds*, and Section 5.5, *Effects on Green Sea Turtle (honu)* address effects on covered seabirds, covered waterbirds, and green sea turtle (honu) (*Chelonia mydas*), respectively. For each species or group of species, this chapter describes the analytical methods and results for estimating take, the impacts of the taking on the species, the beneficial effects of the conservation strategy, and the net effects on each species.

5.2 Effects Pathways

This section describes the mechanisms by which the covered activities affect the covered species, called effects pathways. The section characterizes factors that influence the type and extent of covered species take, thereby informing the avoidance and minimization measures and effects. Effects pathways are described for each of the two primary mechanisms of effects of KIUC's covered activities: powerlines and light attraction. Light attraction is discussed separately for covered seabirds and green sea turtle (honu) because of the distinct mechanisms of effects on these covered species.

5.2.1 Powerlines

This section describes the various factors influencing covered bird species collisions with powerlines, and the effects these collisions have on the covered bird species. The effects on covered bird species are described separately for the covered seabirds and covered waterbirds.

5.2.1.1 Variables Influencing Powerline Strikes

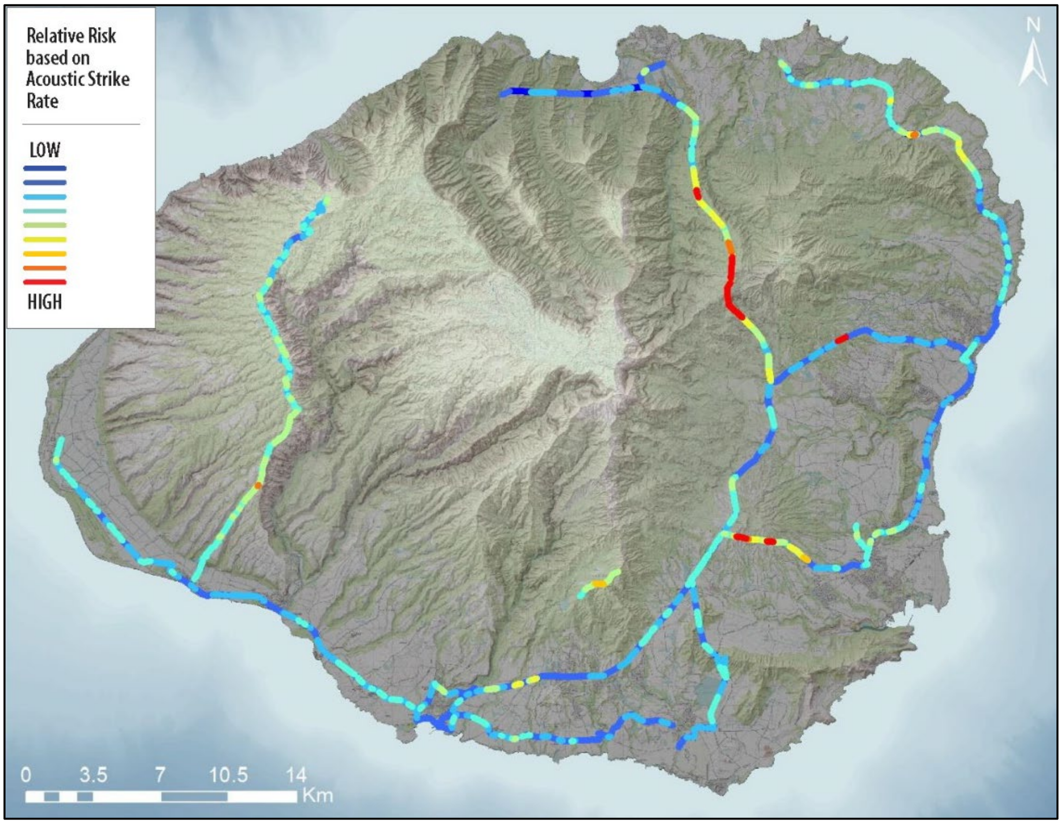
A range of variables play a role in the likelihood of the covered bird species striking powerlines. These variables include, but are not limited to, the following.

- Location of powerlines
- Seasonality
- Topography
- Height of vegetation as it relates to the powerlines and level of shielding
- Height and configuration of wires, including wire thickness, number of wires, and vertical arrangement of wires
- Flight height and speed of birds and their ability to maneuver
- Number of birds in transit in a region
- Wind speed and direction
- Flight paths relative to wind
- Ambient light levels (Travers et al. 2021)

In some areas of Kaua'i two or more of these variables contribute to increased risk, which increases the overall risk level in those areas. For example, the location of powerlines combined with flight height and speed may increase the risk level at certain spans. Powerlines that are downslope of a covered seabird nesting colony may be at a higher risk for seabird-powerline collisions due to the speed at which the birds leave their montane burrows, especially if those lines are not shielded by vegetation. Powerlines that cross a valley or drainage typically result in wires being positioned higher above the ground at mid-span compared to powerlines traversing flat terrain. Increased aboveground wire height places the wires into higher airspace, where a greater proportion of the local seabird passages occur. Powerlines located near or between wetlands and other water features present a relatively high risk to covered waterbirds because of their proximity to high-use habitat areas. Each of the variables influencing powerline strikes, with an emphasis on seabirds, is described in greater detail in Appendix 5A, *Variables Influencing Powerline Strikes.*

Newell's shearwater ('a'o) (*Puffinus auricularis newelli*) and Hawaiian petrel ('ua'u) (*Pterodroma sandwichensis*) flight paths between the ocean feeding areas and montane breeding habitats intercept powerlines, static wires, and fiber optic cables owned and operated by KIUC. Since 2011, KIUC has funded extensive powerline monitoring across most of their transmission line system on Kaua'i. The goal of this monitoring has been to better understand the amount, location, and nature of powerline interactions with the covered seabirds to inform the most effective ways to reduce collision risk. Although this program has been designed to detect seabird collisions, there have also been incidental observations of collisions by the covered waterbirds. This powerline monitoring program, formerly called the Underline Monitoring Program (UMP), and now called Infrastructure Monitoring and Minimization Project (IMMP), consists of visual observations and acoustic monitoring. Data from visual observations are used to determine species composition, passage rate, flight height, and behavior at powerlines on Kaua'i. These data are then used to estimate collision risk and how risk varies across the powerline grid. Visual observations are also used to determine the immediate fate of birds when a collision occurs (Travers et al. 2021) and validate acoustic monitoring to quantify collisions when observers are not present. Acoustic monitoring consists of strategically placing acoustic recording devices along powerlines to detect strikes and determine which powerline sections pose the greatest risk to endangered seabirds.

Based on 2013 to 2019 acoustic strike monitoring data, Figure 5-1 shows the relative collision risk in the Plan Area of Newell's shearwaters (ʻaʻo) and Hawaiian petrels (ʻuaʻu) (Travers et al. 2020). Locations with higher acoustic detected collision risk are those which coincide with observed collision risk for these species. Observations indicate that the covered waterbirds are also susceptible to powerline collisions most concentrated at powerlines near wetlands (see Appendix 5B, *Rapid Waterbird Powerline Collision Assessment*).



Source: Travers et al. 2020:40

Figure 5-1. Estimated Relative Rates of Bird Strikes per Wire Span

5.2.1.2 Effect of Powerline Strikes on Covered Seabird Species

Powerlines are one of the most significant threats to Newell's shearwater (ʻaʻo) and Hawaiian petrels (ʻuaʻu) on Kauaʻi. Although there have been no documented powerline strikes associated with band-rumped storm-petrels (ʻakēʻakē) (*Oceanodroma castro*), observations of this species skimming over a section of powerlines in Waimea Canyon indicate that this species may also occasionally strike powerlines (Travers et al. 2021). The sections below describe the best available information on the effect of powerline collisions on these covered seabird species.

Injury or Mortality

Although numerous studies have been conducted on avian injury or mortality as a result of powerline strikes, most have been based on surveying search corridors along powerlines for grounded birds (Bernardino et al. 2018). In these studies, the number of actual line strikes is unknown, and any estimates of the number of injuries or mortalities are limited by the biases of birds flying beyond the search corridor and later succumbing to injury, birds being removed from the search corridor by scavengers, and observers missing some of the birds within the search corridor. On Kaua'i, a novel approach for monitoring powerline collisions has been employed, using acoustic monitoring devices. These devices are either deployed under the powerlines at the base of the power poles or mounted high up on the poles within the line array (depending on the scenario) and record the sound caused by a seabird striking the lines. While acoustic monitoring provides data on the number of birds colliding with lines, these data cannot provide information on the proportion of those collisions that result in injuries or mortality (Travers et al. 2021).

Understanding true survival post collision requires the colliding bird to have been previously captured and tagged with a tracking device. Due to the logistical challenges, no such study has been conducted. Travers et al. (2021) provided an alternative method in the absence of a tagging study. The authors used observations of seabird powerline collisions to determine the percentage of birds that drop immediately under or near powerlines, or lose elevation. Post-collision flight characteristics and elevation drop was used to describe the collisions impact on all other birds' flight capabilities. The authors also reported the injuries on the seabirds found grounded from powerline collisions. Overall, it was reported that 14.8 percent of seabird powerline collisions resulted in the observation of immediately grounded birds that did not regain flight within the observer's field of view, 7.4 percent had seriously compromised flight, and 6.5 percent had compromised flight but gained flight control within the observer's field of view. The birds involved in 67.6 percent of the collisions were able to regain powered flight after collision, and the remaining 3.7 percent had inconclusive post-collision flight characteristics. The immediately grounded birds were most commonly the result of a direct head-on collision with the powerlines causing head and neck injuries. Overall, the observed powerline collision outcomes, post-collision flight, grounded seabird injuries, and grounded seabird distances from powerlines indicated a probable overall grounding rate of 28.8 percent (Travers et al. 2021). Travers et al. (2021) also provided results that indicated grounded seabirds that do not die immediately from the collision injury will remain on the ground and die without human intervention. Types of injury resulting from powerline collisions include the following (Haas et al. 2003; Cooper and Day 1998; Travers et al. 2021).

- Internal injuries (e.g., bone fractures)
- Plumage damage (e.g., missing feathers; primaries and secondaries sheared off, preventing the bird from flying; head, belly, and flank feathers removed in patches, which may cause waterproofing issues, leading to hypothermia and death)
- Eye injuries
- Head injuries (physical injuries and neurological injuries that are not detectable from visual inspection)
- Skin injuries (e.g., torn open and torn off skin, open muscle, sinew, and bone tissue)

In this effects analysis, KIUC conservatively assumes all covered seabirds that become grounded (28.8 percent) experience mortality. The covered seabirds nest on steep slopes in montane areas, which gives them the necessary elevation to take off from burrow sites and clear surrounding obstacles, but they do not have this advantage at strike locations (Travers et al. 2021). These birds may occasionally climb nearby trees or rock outcrops to take flight because they have difficultly taking off from flat ground (Telfer et al. 1987; Ainley et al. 2019). They have been observed on occasion to fly away after becoming grounded when winds were strong and there were no flight path obstructions, but this is rare (Ainley et al. 1995). Grounded seabirds that survive the collision and are not able to regain flight likely succumb to mortality from other sources (if unassisted) including vehicle collision, dehydration, starvation, or predation (Rodríguez et al. 2017a; Travers et al. 2021).

Energetic Costs, Reduced Survival or Reduced Reproductive Success

As described above, a majority of the observed powerline collisions did not result in immediate grounding or altered flight indicative of an injury that would result in grounding shortly thereafter (Travers et al. 2021). However, the 71.2 percent of birds observed flying away from the powerline collision with typical/normal flight, may have injuries not detectable in the short window of time observers can track a bird post collision. These less severe injuries or subsequent behavior changes can result in reduced survival, increased energy costs or reduced reproductive success due to injuries suffered (e.g., loss of feathers or eye, head, or skin injuries). These injuries that are not observable post collision (e.g., loss of feathers, scratches to the eye, bruising, lacerations) may affect the ability of the bird to fly, gain or maintain flight, steer, balance, or slow down, leading to loss of control and increased energetic costs to maintain altitude (Croll and McLaren 1993). Most importantly, the loss of feathers may result in the loss of waterproofing, which is of particular concern for the deep-diving Newell's shearwater (ʻaʻo). This loss of feathers would then affect the ability of a bird to thermoregulate, which may be an important factor in increasing mortality (Weimerskirch et al. 2019).

If a breeding adult collides with a powerline and survives but does not return to its breeding grounds, it does not breed that year or its egg or chick will not survive, and this results in a loss of productivity. For example, to date, eight adult Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) that collided with powerlines and were grounded have been released with a satellite tag after being rescued, rehabilitated, and released by the Save Our Shearwaters (SOS) Program. While 75 percent of these seabirds survived (only as a result of human intervention), none returned to a breeding colony that year, suggesting that all had a failed breeding season (Raine and Driskill 2020). Furthermore, if either seabird parent dies due to a powerline collision, its egg or chick is assumed to be lost because the egg/chick relies on both parents for incubation, provisioning, protection from predators, and chick rearing (see Appendix 3A, *Species Accounts*).

If a powerline collision results in death of a breeding adult, there is a loss of productivity for what would have otherwise been the remainder of that individual's lifespan. Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) are long-lived species (30 or more years in the wild) which return to breed every year (Raine et al. 2017). The death of one individual in a breeding pair also has implications for the surviving bonded mate. The surviving bird will lose reproductive capacity until it secures a new partner. It is very unlikely that the surviving bird will find a mate and successfully breed in the year following the loss of a mate (Raine pers. comm.), so it will lose offspring for at least 1 year and possibly more (Ainley et al. 2001).

5.2.1.3 Effect of Powerline Strikes on Covered Waterbird Species

This section describes the best available information on how powerline collisions affect the covered waterbird species. There is no available scientific literature that estimates the proportion of the covered waterbirds (or any waterbird species) colliding with powerlines that are injured or killed as a result. For the purpose of assessing effects of the HCP's take on the covered waterbirds, this HCP assumes 28.8 percent of the waterbirds colliding with powerlines become grounded (Appendix 5B, *Rapid Waterbird Powerline Collision Assessment*). Because there is no reliable information on grounding rates for waterbirds, this estimate is based on the best available information on grounding rates based on observational data from seabirds as described in Section 5.2.1.2, *Effect of Powerline Strikes on Covered Seabird Species.* Unlike the covered seabirds, however, this HCP does not assume that all of the grounded covered waterbirds experience mortality, because grounded waterbirds are generally more capable of regaining flight than the covered seabirds. The covered waterbirds spend large proportions of their lives on the ground or waterbodies and are able to regain flight. Grounded waterbirds that survive and do not regain flight, however, are more vulnerable to predation and vehicle collisions, and may experience loss of productivity through energetic costs or other injury.

Linking specific mortality causes such as powerline collisions to population-level impacts is exceptionally difficult in the absence of large samples of species-specific mortality data and comprehensive population monitoring information (Loss et al. 2014; Bernardino et al. 2018). Despite the challenge of linking collision rates to population declines for the waterbirds, many authors note that some regions and bird species could experience significant population-level impacts, and that the absence of a clear link between mortality at powerlines and population impacts should not prevent mortality reduction measures from being taken, especially given imperfect understanding about how multiple mortality threats interact to cumulatively affect wildlife populations.

The life history of the covered waterbirds is substantially different than the covered seabirds, resulting in less vulnerability than the seabirds to population effects resulting from powerline collisions. That is, the covered waterbirds produce four or more offspring per year, mature much earlier in age than the covered seabirds (the covered waterbirds breed in their second year), and require much less parental care (i.e., young of the covered waterbirds leave the nest within days of hatching and become independent in several weeks); therefore, populations of the covered waterbirds are far less vulnerable to individual mortalities than the covered seabirds (see Appendix 3A, *Species Accounts*).

5.2.2 Light Attraction

5.2.2.1 Light Attraction and Fallout of Covered Seabirds

This section describes the various factors influencing fallout of the covered seabirds and its effects on these species. There is no evidence that the covered waterbirds are impacted by light attraction and the resultant fallout, so they are not discussed further in this section.

Factors Influencing Light Attraction and Fallout

Fallout of covered seabirds resulting from light attraction occurs seasonally during the autumn months in conjunction with the seabird fledging season (September 15 to December 15). Light attraction primarily affects fledgling seabirds on their first flight from their nesting colonies to the ocean (Reed et al. 1985; Telfer et al. 1987). However, adults may also be attracted to artificial lights when transiting to and from their nesting colony during the breeding period, particularly when lights are near the breeding colony (Raine et al. 2018).

KIUC operates three types of lights that potentially attract covered seabirds—streetlights, external lights at its covered facilities, and night lighting for emergency repairs. KIUC has taken steps to reduce light attraction at its streetlights and covered facilities by shielding light fixtures using full-cutoff shields and dimming covered facility lights during the seabird fledging season (see Chapter 4, Section 4.4.2, *Conservation Measure 2. Implement Measures to Minimize Light Attraction*).

Even with the streetlight modifications to reduce light output and direct all light at the ground, streetlights remain a source of light attraction. However, it is rare to be able to pinpoint which streetlight is the cause of light attraction fallout incidents because most streetlights are found in areas with many other light sources (Appendix 5C, *Light Attraction Modeling*). Additionally, for covered facilities, the covered seabirds may be attracted to non-KIUC lights in the surrounding area but land within the facility and vice-versa. Newell's shearwaters ('a'o) are regularly found under streetlights every year.

Effect of Light Attraction on Covered Seabirds

Artificial lighting often attracts the covered seabirds, and after flying around the lights, birds can tire or inadvertently hit a structure and may become grounded, an event referred to as fallout (Imber 1975; Telfer et al. 1985). Although adults can be affected by light attraction (Center for Biological Diversity 2016), fledglings are the primary age class affected. When fledglings leave their nest for the first time in the hours following sunset, they are at risk for becoming attracted to artificial lights. This attraction may also occur after young fledglings reach the ocean and are then attracted inland by coastal lights, which explains why they are frequently grounded in coastal areas that are quite distant from their colony (Troy et al. 2013; Rodríguez et al. 2015). There is also a potential for attraction to occur on their outbound journey prior to reaching the ocean (Troy et al. 2013).

Although patterns of fallout on Kaua'i are complex and result from various independent conditions (Troy et al. 2013), the primary source of attraction is bright lights. An early study on Kaua'i showed that the shielding of bright lights can reduce fallout by 40 percent (Reed et al. 1985), and recent studies continue to indicate that the reduction of lateral light spillage is beneficial to reducing light-induced fallout (Rodríguez et al. 2017a, 2017b). While efforts to shield lights can effectively reduce fallout, these efforts do not appear to eliminate it. Several studies have shown that fallout patterns are also influenced by the location and brightness of artificial lights relative to seabird colonies, the proximity of lights to the coastline, and the wavelengths emitted by different light types (Troy et al. 2011, 2013; Rodríguez et al. 2015, 2017a, 2017b, 2017c; Longcore et al. 2018). Facility lights and night lighting for repairs to restore power can also attract seabirds and result in fallout.

Injury or Mortality

When attracted to artificial lights, seabirds can become confused, disoriented, or blinded by the light. Light-attracted birds may circle repeatedly and become grounded, which involves landing on the ground in locations where they usually do not land and from which they are unable to take off due to injury, exhaustion, and confusion. Before grounding, seabirds may collide with structures (e.g., powerlines, poles, buildings) and be injured or killed (Reed et al. 1985).

If light-attracted individuals that become grounded are not rescued, they are at risk for succumbing to injury or mortality due to starvation, predation, collisions with cars, or a combination thereof. Covered seabirds have difficulty resuming flight from level ground (Telfer et al. 1987). Once grounded, covered seabirds are susceptible to dehydration, starvation, predation from introduced predators, or collision with a vehicle (Telfer et al. 1987).

Studies conducted by Travers et al. (2013) and Podolsky et al. (1998) reported mortality rates[1] of grounded Newell's shearwaters (ʻaʻo) between 40 and 43 percent. The actual rate is likely higher, since some grounded birds are removed by predators, some land on private property and may not be found or reported, and some birds hide under vegetation or structures and are not found[2] (Podolsky et al. 1998; Ainley et al. 2001; Travers et al. 2013; Raine et al. 2018).

Energetic Costs, Chick or Egg Mortality

Birds that become disoriented by lighting but do not become grounded may experience energetic costs in reorienting themselves. If either seabird parent dies due to fallout, the loss of its egg or mortality of its chick occurs because the egg/chick relies on both parents for incubation, provisioning, predator protection, and chick rearing (Ainley et al. 1997). Fallout is primarily experienced by fledglings; therefore, effects on parents and hence on eggs and chicks are expected to be relatively infrequent except in fallout events related to breeding adults such as the mass fallout event at Kōkeʻe Air Force Station in 2015 (Raine et al. 2018).

5.2.2.2 Light Attraction and Disorientation of Green Sea Turtle (honu)

Sea turtles typically arrive on beaches to nest at night and emergence occurs nocturnally (Witherington et al. 2014). Artificial lighting visible from the nesting location can disorient hatchlings as they emerge from sand nests at night, leading them to wander aimlessly or head inland (Witherington et al. 2014). Hatchlings normally orient themselves based on the brightest light sources, which is usually the moon, but can become disoriented when there is a brighter light source nearby. For additional details on the ecology of green sea turtle (honu) or threats to this species, see Appendix 3A, *Species Accounts*.

Hatchlings unable to find the ocean are likely to die due to dehydration, predation, or from vehicular collision should they enter roadways (Witherington and Martin 2000; Witherington et al. 2014). While a considerable amount of research has been conducted to identify what levels of artificial lighting may be problematic for nesting behaviors, there is no simple measure of how various light intensities affect sea turtles, or what level of light intensity may be tolerable without impact (see, for example, Witherington and Martin 2003).

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[1] Also referred to in literature and in the glossary (Chapter 10) as "crippling rate."

[2] In August and September 2015 at the Kōkeʻe Air Force Station on Kauaʻi at least 123 Newell's shearwaters (ʻaʻo) and six Hawaiian petrels (ʻuaʻu) had fallen out and were recovered. Many of these birds were found hiding under structures (Raine et al. 2018). All of the recovered seabirds were adults, the majority of which had brood patches, indicating that even experienced breeding adults, once grounded, may not be able to take off and are likely to hide in vegetation or under buildings (Raine and Banfield 2015). This situation also indicates that adults are susceptible to groundings in areas where inappropriate lighting is set up near breeding colonies (Raine et al. 2018). Once grounded, uninjured birds seek shelter, utilizing any nearby crawl spaces or dense bushes. This makes them particularly difficult to find by human searchers.

5.2.3 Conservation Strategy Implementation

The conservation strategy will result in multiple beneficial effects on covered seabirds. Powerline minimization measures will reduce seabird powerline collisions. Management and enhancement of breeding colonies will reduce the abundance and distribution of seabird predators and increase the number of chicks produced annually. The SOS Program will minimize covered seabird mortalities from various sources (KIUC and non-KIUC) through rescue and release of injured covered seabirds.

The conservation strategy may also result in a minimal amount of take of covered seabirds as individual birds may be caught in leg hold or other traps placed for predator control. The number of birds anticipated to be taken as a result of conservation measures is described in Section 5.3.3, *Species-Specific Seabird Effects.*

5.3 Effects on Covered Seabirds

This section describes the estimated effects of the covered activities on the covered seabirds over the life of the 50-year permit term. Section 5.3.1, *Methods for Quantifying Take and Assessing Effects on the Covered Seabirds*, describes the methods used to quantify these effects; Section 5.3.2, *Effects Common to All Covered Seabirds*, describes the effects of the covered activities that are common to all the covered seabirds; and Section 5.3.3, *Species-Specific Seabird Effects*, provides species-specific analyses in the context of the species abundance, distribution, and other relevant factors. The last subsection also describes the levels of take requested for each covered seabird, the impact of the taking on the population of each covered species, and the expected beneficial and net effects on each species.

5.3.1 Methods for Quantifying Take and Assessing Effects on the Covered Seabirds

This section describes the methods KIUC applied to quantify take and assess the effects of the covered activities on the covered seabirds, and includes methods used to estimate the adverse effects of powerline collision, the adverse effects of fallout from light attraction, and the beneficial effects of the conservation strategy.

5.3.1.1 Powerline Collisions—Methods

This section describes KIUC's methods for estimating take of covered seabirds associated with powerline collisions. Take of the covered seabirds can take several forms, including injury or mortality of adults or juveniles. Take could also occur in the form of the loss of chicks or fledglings as a result of the injury or mortality of a breeding adult. This section also includes the assumptions used for the purpose of estimating amounts for each of these forms of take.

Estimating Anticipated Number of Collisions (Measurable Unit of Take)

No studies of powerline strikes on the covered birds to date have been able to quantify the exact number of birds injured or killed as a result of powerline collisions. This would require not only recording all birds striking powerlines, but also tracking the outcome of all of those strikes (Travers et al. 2021; Bevanger 1998). Various estimates of injury or mortality have been made, but these have been based on untestable assumptions about data biases (Bevanger 1998). While these estimates are useful in tracking overall effects of powerline collisions on the covered seabird species, they are not estimates that can be measured in the field and verified through monitoring. Therefore, based on current technology and techniques, the exact amount of take (mortality or injury) of the covered seabirds from powerline strikes is indeterminable.

As described in the HCP Handbook, if take by number of individuals cannot be determined accurately, take limits can be expressed in a variety of ways, provided (1) there is a causal link between the surrogate unit of take and actual take of the species, and (2) a clear standard is determined for when the level of anticipated take has been exceeded (U.S. Fish and Wildlife Service and National Marine Fisheries Service 2016). Consistent with this guidance, KIUC is expressing its take request for each covered seabird as the number of powerline strikes. In other words, the number of powerline strikes serves as a reasonable and measurable surrogate for the amount of actual take of Newell’s shearwater (‘a‘o) and Hawaiian petrel (‘ua‘u).

KIUC applied the following analytical steps to estimate the number of powerline strikes anticipated for Newell’s shearwater (‘a‘o) and Hawaiian petrel (‘ua‘u) over the 50-year permit term. The method for establishing the take limit for of band-rumped storm-petrel (‘akē‘akē) is described separately in Section 5.3.3.3, *Band-Rumped Storm-Petrel (‘akē‘akē)*. Take from powerline collisions expressed as the total number of collisions (strikes) was quantified using the following steps, each of which is described below:

1. Estimated the pre-HCP annual collision rate for both species combined.
2. Used the observed passage rates, flight heights, and powerline interaction data on each 328 feet (100 meters) of powerline to determine the proportion of strikes attributable to each species. These proportions were then applied to the total annual collision rate to estimate the number of annual strikes for each species.
3. Estimated the anticipated reduction in powerline collisions that would result from powerline minimization measures described in Chapter 4, *Conservation Strategy*. This proportion was then applied to pre-HCP collision rates.
4. Calculated the annual strike number of strikes over time as a function of changing abundance.
5. Estimated the amount of additional powerline collisions expected from new powerlines built during the permit term.

Step 1: Estimate Pre-HCP Annual Collisions with Existing Powerlines

KIUC based its pre-HCP (i.e., before the HCP permit term begins) annual strike estimates on a 2020 Bayesian acoustic strike model, using data from 2013 to 2019 (Travers et al. 2020). Appendix 5D, *Bayesian Acoustic Strike Model*, outlines the methods and results for this model. In summary, the model is based on data gathered from acoustic sensors placed on power poles throughout the island to record powerline strikes, combined with data collected from more than 6,000 hours of observer monitoring to assess the initial mortality rate of seabirds hitting powerlines and species composition. A Bayesian hierarchical modeling framework was employed to estimate the annual rate of bird-powerline collisions based on the acoustic sensor data from 2013 through 2019. The cumulative mean annual number of bird strikes for all powerline spans was estimated at 16,642.[3]

[3] This number is slightly reduced from the number reported in the 2020 Bayesian model (Appendix 5D, *Bayesian Acoustic Strike Model*) due to minor errors resulting from double counting of strikes on Powerline Trail and duplicate span numbers causing doubling of strikes for those spans.

The model used data that included minimization efforts for the Short-Term HCP (Travers et al. 2020), so the annual starting point for the KIUC HCP was reduced by the number of strikes that were attributed to minimization measures implemented through the Short-Term HCP (244 strikes) (i.e., so that KIUC did not get credit for this reduction twice) to 16,398 total strikes annually. After 545 annual strikes were attributed to waterbirds based on observations at Mānā, as described in Appendix 5B, *Rapid Waterbird Powerline Collision Assessment*, the number of annual strikes attributed to Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) was reduced to 15,853.

Step 2: Determine Proportion of Powerline Strikes Attributed to Each Covered Species

The acoustic strike estimates quantify collisions of all birds combined (i.e., covered seabirds, covered waterbirds, and non-covered birds). Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) vary in their flight behavior, data about which can be used to estimate the proportion of collisions attributed to each species. Strike estimates were allocated to species by using a combination of observations of passage rate, observations of flight height, and powerline interaction data per unit length of wires by time of day and night. Additionally, an assessment of the proportional risk of powerline collisions based on powerline observations at Mānā, as described in Appendix 5B, *Rapid Waterbird Powerline Collision Assessment*, resulted in an estimated 545 of all bird strikes being attributed to waterbirds.[4]

Therefore, the total estimated annual strikes attributed to Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) is 15,853 (16,398 minus 545). Of these 15,853 birds, 70 percent are assumed to be Newell's shearwater (ʻaʻo) and 30 percent are assumed to be Hawaiian petrel (ʻuaʻu) (Appendix 5D, *Bayesian Acoustic Strike Model*; Appendix 5E, *Population Dynamics Model for Newell's Shearwater (ʻaʻo) on Kauaʻi*). This provides an estimated annual collision number prior to minimization of 11,097 for Newell's shearwater (ʻaʻo) and 4,756 for Hawaiian petrel (ʻuaʻu).

There have been no direct observations of band-rumped storm-petrel (ʻakēʻakē) colliding with powerlines (Travers et al. 2021). In addition, band-rumped storm-petrel (ʻakēʻakē) can be visually confused with bats. Based on the extreme rarity of strikes and the challenge of species identification, a reliable collision estimate could not be determined. Instead, a small amount of take was estimated for this species independent of the calculations above, as described in Section 5.2.1.2, *Effect of Powerline Strikes on Covered Seabird Species*. The effects analysis for band-rumped storm-petrel (ʻakēʻakē) is based on this take limit.

Step 3: Apply Anticipated Reduction in Collisions due to Minimization Measures

As described in Chapter 4, Section 4.4.1, *Conservation Measure 1. Implement Powerline Collision Minimization Projects*, KIUC is in the process of minimizing the impacts of its powerlines on covered species by implementing physical modifications to and/or using flight diverters on all feasible spans of existing transmission and distribution lines. Travers and Raine used the 2020 Bayesian model results (Appendix 5D, *Bayesian Acoustic Strike Model*) to estimate the minimization efficacy and potential benefit of these minimization actions. Based on these results, they concluded that KIUC's powerline minimization projects range in efficacy from 42 to over 95 percent, depending on the covered species and the location and type of the minimization project (Travers et al. 2020).

[4] As described in Appendix 5B, *Rapid Waterbird Powerline Assessment*, this estimate is for all species of waterbirds potentially colliding with KIUC powerlines at Mānā, not just covered waterbirds.

To determine how much take to request, KIUC applied the minimization efficacy rates from the Bayesian model to calculate the reduction in seabird strikes for each existing powerline span, taking into account all completed and planned minimization projects from 2020 through 2023. The predicted strike reduction (i.e., number of bird strikes reduced) was estimated for all powerline spans in KIUC's system based on the type of minimization project, the length of the span, and the collision risk estimated at that location. A total of 1,682 separate calculations were made, one for each span. The estimated strike reductions for each powerline span were then summed to calculate an island-wide strike total and minimization efficacy. Minimization efficacy was calculated by dividing the number of strikes reduced, either annually or cumulatively, by the baseline annual strike total, which represents the total island-wide strike total accounting for all minimization projects completed through the end of 2019 (the final year of KIUC's Short-Term HCP). KIUC expects to complete all minimization projects by the end of 2023. At that time, KIUC commits to achieving an island-wide minimization efficacy of at least 65.3 percent (i.e., a reduction in powerline strikes of at least 65.3 percent compared to the 2019 baseline).

Assuming 2023 will be the first year of HCP implementation and minimization will not be complete until the end of 2023, KIUC assumed a 55.0 percent minimization rate the first year of HCP implementation (all of 2023), and a 65.3 percent minimization rate for each of the remaining 49 years (2024 through 2073). Table 8 of Appendix 5D provides the annual powerline minimization schedule.

Step 4: Calculate Annual Strike Numbers over Time as a Function of Changing Abundance

An important element of the conservation strategy is the management and enhancement of 10 conservation sites (see Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites). An important goal of these conservation sites is to substantially increase the population of Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) to offset expected continued declines of these species in other parts of Kauaʻi that are not managed (i.e., no predator control) and continue to be subject to some powerline collision. As different subpopulations of Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) fluctuate over time either up or down, amounts of powerline collisions will change even if collision risk remains constant.

- Calculating annual unminimized mortality rate for each species from powerline strikes by multiplying 2019 unminimized strikes by 28.8 percent (see *Annual Mortality and Injury from Powerline Strikes*, below, for an explanation of why 28.8 percent was used).
- Calculating changing annual mortality over time as a function of changing abundance and powerline strike minimization (see Appendix 5E, *Population Dynamics Model*, for a detailed description of this step).
- Dividing annual mortality by 28.8 percent to determine estimated annual strike numbers for each species over time.

Step 5: Estimate Strikes from New Powerlines

This HCP covers KIUC's installation of up to 360 miles (579.4 kilometers [km]) of new powerlines, or an average of 7 miles (11.3 km) of new wires per year for 50 years (see Section 2.1.2.2, *Adding New Powerlines*). As described in Chapter 4, Section 4.4.1.3, *Future Transmission and Distribution Lines*, KIUC commits in this HCP to apply the latest standards of collision minimization to all new powerlines and site new powerlines in low collision risk areas (to the maximum extent practicable) in order to minimize strikes from new powerlines. Based on estimated efficacy rates ranging from

42 percent to over 95 percent for reconfiguration, static wire removal, and bird flight diverters (Travers and Raine 2020), KIUC has estimated that powerline collisions resulting from the installation of new powerlines can be reduced by 80 percent for the covered seabirds. A total of 360 new miles (579.4 km) of powerlines would be a 34 percent increase from the 1,057 miles (1,701 km) of existing transmission and distribution (360/1,057=.34) throughout the permit area (see Chapter 2, *Covered Activities*, for more details). With 80 percent minimization of powerline strikes, a 6.8 percent increase in strikes is anticipated from the new powerlines (34 percent x 0.20 strikes remaining= 6.8 percent).

- 360 miles (579.4 km) of new powerlines divided by 1,057 miles (1,701 km) of existing transmission and distribution lines = 21.4 percent increase.
- 21.4 percent increase in miles of existing transmission and distribution lines multiplied by the percentage of strikes remaining after 80 percent minimization (i.e., 20 percent) = 6.8 percent increase in strikes from new powerlines.
- Conservatively assuming an even pace of new construction through year 50, the increase in future strikes was calculated by applying a linear increase in the strike mortality rate each year (i.e., increase by another 0.136 percent each year), such that by buildout at year 50, the strike mortality rate was equal to the estimated 6.8 percent increase in strikes.

Estimating the Form of Take

KIUC is quantifying and tracking take from powerline collisions in terms of the total number of strikes, as described above. Based on these estimates, KIUC has also estimated take by the form of take likely to occur from powerline collisions (i.e., injury, mortality, or indirect take of chicks or eggs). As described in Section 5.2.1.2, *Effect of Powerline Strikes on Covered Seabird Species*, estimating the number of avian mortalities and injuries resulting from powerline collisions is challenging because the fate of individuals is very difficult to determine after a collision in samples large enough to generate statistically valid estimates. Estimating bird mortality and injury has typically been done by conducting ground searches and then adjusting counts to account for biases related to factors such as searcher efficiency, carcass removal rate by scavengers, searchability of the habitat, and crippling bias.[5] These correction factors are often subjective and based on limited data (Bevanger 1995; Travers et al. 2021).

While relevant to some studies, these bias factors are not relevant to the KIUC HCP because powerline monitoring estimates powerline collisions directly through acoustic monitoring of wire strikes rather than individuals found during ground-level searches. The best available data to date regarding the outcome of bird collisions is a study by Travers et al. (2021) in which 206 seabird collisions with powerlines on Kaua'i were observed over a 6,000-hour observation period to evaluate post-collision elevation loss and flight characteristics. This study is described in Section 5.2.1.2, *Effect of Powerline Strikes on Covered Seabird Species*.

Annual Mortality and Injury from Powerline Strikes

As described in Section 5.2.1.2, *Effect of Powerline Strikes on Covered Seabird Species*, it is not possible to definitively know the fate of seabirds that strike powerlines unless they are found under

[5] Crippling bias is a measure used for monitoring techniques that involve estimating the number of dead or injured birds by searching under powerline corridors. It is the measure of the number of birds that hit a powerline (or any other structure) but continue to transit beyond the range of the search corridor before dying undetected.

the powerlines or tagged. Instead, KIUC used the best available data from Travers et al. (2021) to estimate these outcomes. Based on this study, 28.8 percent of the covered seabird powerline strikes are assumed to result in grounded birds (regardless of species). All grounded birds are assumed to die immediately due to impact or shortly thereafter due to starvation, dehydration, or predation.

Estimating the number of non-lethal injuries resulting from powerline collisions is even more challenging than estimating mortality, since non-lethally injured birds generally leave the search corridor under powerlines and cannot be observed. KIUC used as a proxy for non-lethal injury the proportion of birds that were observed in Travers et al. (2021) to lose elevation after striking powerlines. Based on this approach, 24.5 percent of covered seabird collisions are assumed to result in non-lethal injury (regardless of species).

Indirect Take of Eggs or Chicks

As described in Section 5.2.1.2, *Effect of Powerline Strikes on Covered Seabird Species*, an egg or chick may be lost when a parent seabird strikes a powerline. Both parents are required to care for chicks and eggs, so if one parent dies or is injured, it is likely the chick or egg will be lost. KIUC therefore assumed the loss of one egg or chick for each adult bird killed or injured as a result of powerline collisions, assuming an 80:20 proportion of subadult to adult powerline strikes (Cooper and Day 1998).

5.3.1.2 Light Attraction and Fallout—Methods

Appendix 5C, *Light Attraction Modeling*, describes the process for quantifying take of the covered seabirds from attraction to lights owned and operated by KIUC. KIUC light sources covered in the HCP include streetlights, two KIUC covered facilities covered (Port Allen Generating Station or Kapaia Power Generating Station), and night lighting for emergency repairs. These methods are summarized in the following subsections. KIUC assumed take associated with light attraction primarily for non-breeding birds (i.e., fledglings); therefore, a negligible amount of indirect take of eggs or chicks from killed or injured adults is anticipated.

Fallout from Streetlights

The streetlight assessment applied an approach developed in collaboration with USFWS and DOFAW to assign fallout documented by the SOS Program to streetlights based on the proportional contribution of those lights to the lightscape of Kaua'i. The proportional assessment was developed using remotely sensed radiance (brightness) collected by a sensor on the Suomi National Polar-Orbiting Partnership Satellite. This sensor is designed to provide global measurements of the intensity of nocturnal visible and near-infrared light on a daily basis (Cao et al. 2020). The process used to estimate fledgling fallout due to streetlights included the following steps.

1. Partition radiance data from 2018 on Kaua'i according to the existing spatially explicit SOS sectors that encompass all areas of the island with streetlights.[6]
2. Assess recent island-wide satellite data of the lightscape on Kaua'i.
3. Estimate the radiance generated by a single streetlight based on a sample of remote streetlights that are isolated from other sources of nighttime light.

[6] Save Our Shearwaters (SOS) has partitioned Kaua'i into 35 spatially explicit sectors to understand the spatial distribution of seabird injuries.

4. Estimate the proportional contribution of streetlights to radiance by sector.
5. Derive an estimate of fallout occurring due to streetlights in each sector.
6. Apply a correction factor to account for seabirds that were grounded but not detected.

KIUC compared three methods for estimating radiance per streetlight: nonparametric bootstrapping, Bayesian regression, and cross validation. All three methods produced similar estimates with overlapping confidence limits. KIUC concluded from its variance analysis that, during the months of maximal fallout (October and November), there is a predictable relationship between streetlight count per sector and the radiance of that sector, and that this relationship can be used to predict the radiance of an area given the number of streetlights. This held true regardless of whether the method used to estimate variance was derived from bootstrapping, Bayesian regression, or cross validation. Given the insensitivity of the results to the alternative analytical approaches examined, and that the bootstrapping approach relies on fewer parametric assumptions than the alternatives, the original method of bootstrapping was applied to the analysis (Appendix 5C, *Light Attraction Modeling*).

The correction factor KIUC used to account for seabirds that were grounded but not detected by citizens and turned in to SOS was based on literature that provided insight into the lower limit of detectability. Podolsky et al. (1998) evaluated two parallel seabird recovery programs searching for dead birds—one that used SOS and another that used biologists to intensively search for grounded birds. Podolsky et al. (1998) searched intensively for dead birds in proximity to powerlines in urban and suburban areas, inconspicuously marked all dead individuals, and coordinated with the SOS Program to determine if any of these dead birds were subsequently turned in by citizens. Of 50 dead birds located by biologists, 8 were found by citizens and turned in to SOS (16 percent detection). Recognizing that citizens are less likely to turn in dead birds than live ones, and based on Travers et al. (2021) reporting that 35 percent of seabirds they detected were dead, KIUC used a conservative approach by assuming all 50 birds were alive and there were an additional 26 dead birds available to be found (= (50/0.35) - 50). Thus, SOS would have found 8 birds out of 76 (50 + 26), resulting in a 10.5 percent detectability. The assumed detectability rate of 10.5 percent that KIUC used in their take estimates for the effects of streetlights is highly conservative; the actual detectability rate is expected to be higher, as described in Appendix 5C, *Light Attraction Modeling*. Fallout, whether detected or not, is assumed to result in 100% mortality in the model.

Appendix 5C provides further details on this analysis and assumptions applied. Although KIUC has applied measures to minimize light attraction and will continue to apply minimization as described in Chapter 4, Section 4.4.2, *Conservation Measure 2. Implement Measures to Minimize Light Attraction*, the extent to which these measures reduce take attributed to KIUC streetlights is not quantifiable; therefore, the assumed take is as described above and in Appendix 5C.

Fallout from Lights at KIUC Covered Facilities

For the two covered facilities, Port Allen Generating Station and Kapaia Power Generating Station (Chapter 2, *Covered Activities*), take was estimated using the average number of downed birds located at each facility as documented in KIUC monitoring logs (Kaua'i Island Utility Cooperative 2019) and the SOS database. This is a conservative estimate, since KIUC began dimming the lights in 2019 during the fallout season and drastically reduced fallout/take to zero birds in 2019 and one bird in 2020.

KIUC factored in a searcher efficiency correction of 50 percent for the data from covered facilities. A detectability factor much greater than the detectability factor for streetlights was used for a number of reasons. First, it matches the detectability rate used for similarly monitored facilities covered in the Kaua‘i Seabird HCP (State of Hawai‘i Division of Forestry and Wildlife 2020). Also, KIUC covered facilities are fenced and monitored for pests, which greatly reduces predation of downed birds prior to detection and rescue. KIUC uses traditional pest control methods such as traps and pest control services for rats and mice. Any stray cats that make it into the fenced facilities are captured using live traps and removed from the property. KIUC trains staff to identify and search for covered species and these trained staff conduct searches for downed seabirds during the seabird fallout season twice daily (Chapter 6, *Monitoring and Adaptive Management Program*). Searchers are equipped with an Oppenheimer Seabird Recovery Kit and recovered birds are transported to an SOS Aid Station (Appendix 5C, *Light Attraction Modeling*). KIUC staff have monitored and maintained inspection logs for these facilities during the seabird fallout season (September 15 through December 15) since 2011.

Fallout from Night Lighting for Restoration of Power

In rare cases when KIUC must illuminate work areas at night to restore power when equipment failure or powerline damage occurs, this may cause covered seabird fallout. As described in Chapter 2, Section 2.1.4, *Night Lighting for Restoration of Power*, an estimated 85 hours of night lighting during the seabird fallout period will be needed for repairs on an annual basis, in limited locations where repairs are needed. Because the take estimate for streetlights is conservative as described above, and fallout from lighting at temporary work areas is expected to be rare, this HCP assumes no change in take of the covered seabirds from the operation of night lighting for restoration of power.

Estimating the Form of Take

KIUC is quantifying take from light attraction in terms of the amount of fallout (i.e., number of birds that fall out of the sky), as described above. There are no data or estimates available on the fate of all birds that fall out from light attraction. For the purposes of this HCP, KIUC assumes 100 percent of fallout results in mortality. Although some of the seabirds experiencing fallout will be rehabilitated by SOS, KIUC applied an assumption of 100 percent mortality for a conservative estimate of effects. Because fallout is assumed to consist primarily of non-breeding birds (i.e., fledglings), (see Section 5.2, *Effects Pathways*), fallout is expected to result in a negligible amount of indirect take of eggs or chicks.

5.3.1.3 Take from Traps—Methods

To estimate the number of covered seabirds anticipated to be taken as a result of trapping predators at conservation sites, KIUC evaluated trapping data from 2015 through 2022 for all of KIUC’s conservation sites. Based on this data, the maximum number of covered seabirds caught in a single year (2021) was eight individuals. Because this was a recent year, KIUC conservatively estimated the baseline annual number of birds caught in traps as eight individuals, or 0.013 percent of the population at all conservation sites in 2021. KIUC made a conservative assumption that all individuals caught in traps were breeding adults, then multiplied the projected annual number of breeding adults at conservation sites by 0.013 to estimate the annual number of birds trapped during the permit term and summed these annual estimates over 50 years.

Based on a 64:36 split in population numbers between Hawaiian petrel ('ua'u) and Newell's shearwater ('a'o) at the conservation sites, KIUC assigned 64 percent of the 50-year take to Hawaiian petrel ('ua'u) and 36 percent of the take to Newell's shearwater ('a'o). Based on the Hallux trapping data, all but eight of the 34 birds trapped were immediately released (of the eight, six were dead and two were taken to SOS); therefore, KIUC conservatively estimated that 23 percent (eight divided by 34) of birds trapped in the future would be killed and the remainder would be injured.

5.3.2 Impacts of the Taking—Methods

The federal Endangered Species Act requires that the HCP applicant analyze the impact of the taking on the covered species, which should be described relative to the species' reproduction, numbers, and distribution (U.S. Fish and Wildlife Service and National Marine Fisheries Service 2016). The Hawai'i Endangered Species Act has the same requirement.[7] This analysis evaluates the *impacts* of the taking on the species as a whole (or a portion of the species' range that coincides with the HCP Plan Area), and on the species' long-term survival and likelihood of recovery. Although there has been historic take of the covered seabirds from KIUC operations, the impact of the taking assessed in an HCP is based on the take authorized under the HCP's permit term.

To evaluate the impacts of the proposed (minimized) taking on Newell's shearwater ('a'o) and Hawaiian petrel ('ua'u) prior to mitigation, KIUC used a custom population dynamics model for the Kaua'i metapopulation[8] of each of the covered seabirds. Appendix 5E, *Population Dynamics Model for Newell's Shearwater ('a'o) on Kaua'i*, describes the model and results for Newell's shearwater ('a'o). Appendix 5F, *Population Dynamics Model for Hawaiian Petrel ('ua'u) on Kaua'i*, describes the model and results for Hawaiian petrel ('ua'u). Both models use the same structure for each species and only differ in some assumptions used. The model considered take resulting from KIUC activities each year over the permit term, after minimization actions were applied. Impacts of historic take are factored into the model because of the current status of the population. Using estimated trends from radar data to initialize the model also integrates the effects of powerline collisions and light fallout prior to the HCP, to the extent available data allow, because the trend estimate is based on radar survey data starting in 1993.

The model results were compared with a hypothetical *no-take scenario* in which there would be no take resulting from KIUC activities, and no mitigation.[9] Under the no-take scenario, predation and other non-KIUC-related mortalities would continue, and KIUC's mitigation measures would not be implemented. Table 5-1 describes this scenario and other scenarios used to analyze effects on the species. To evaluate the impacts of the taking on the species, the no-take scenario was compared with a proposed take scenario. The *proposed take scenario* assumes the proposed take occurs (i.e., KIUC's take is minimized according to Conservation Measure 1, *Implement Powerline Collision Minimization Projects*, and Conservation Measure 2, *Implement Measures to Minimize Light Attraction*, in Chapter 4, *Conservation Strategy*), but KIUC does not implement mitigation

[7] Hawai'i Revised Statute Section 195D-21(b)(2)(C).

[8] A metapopulation is a group of populations that periodically interbreed. Newell's shearwater ('a'o) populations on Kaua'i are recognized as a distinct metapopulation (Vorsino 2016).

[9] Since KIUC powerlines are already in operation and their removal would be infeasible, this no-take scenario is hypothetical and used only as a basis for evaluating the impact of the taking on the species. This hypothetical no-take scenario is also helpful in isolating and separating impacts on the species from unmitigated predation versus impacts from KIUC facilities.

measures.[10] By isolating the effects of the proposed, minimized take from mitigation measures, and by comparing that scenario to the hypothetical scenario without any take or mitigation measures occurring (i.e., the no-take scenario), KIUC can quantitatively estimate the impacts of the taking on the metapopulation of Newell's shearwater (ʻaʻo) on Kauaʻi. The Kauaʻi metapopulation was chosen as the unit of analysis for Newell's shearwaters (ʻaʻo) because an estimated 90 percent of all Newell's shearwater (ʻaʻo) breed on Kauaʻi and because that metapopulation coincides with the Plan Area for this HCP. Similarly, the Kauaʻi population of Hawaiian petrel (ʻuaʻu) was chosen as the unit of analysis because a large share of the species[11] occurs on Kauaʻi.

Using this approach, KIUC determined the impacts of the taking by comparing the metapopulation trajectories of two hypothetical future scenarios that would not include mitigation measures: (1) without take from KIUC activities (the no-take scenario), and (2) with take from KIUC activities including minimization but without conservation actions (proposed take scenario).

Although not a required component of an HCP, KIUC also evaluated the extent to which the proposed minimization measures are expected to benefit the Newell's shearwater (ʻaʻo) metapopulation on Kauaʻi compared with a scenario in which this minimization did not occur. To do this, KIUC compared the proposed take scenario with a scenario in which powerlines had no minimization applied that is proposed in this HCP[12] (i.e., static wires not removed, no powerline reconfiguration, no bird flight diverters installed), called the "unminimized take" scenario (Table 5-1).

A population dynamics model could not be developed for band-rumped storm-petrel (ʻakēʻakē) due to their rarity and a lack of species-specific data. Impacts of the taking on band-rumped storm-petrel (ʻakēʻakē) were addressed qualitatively by evaluating the taking in the context of the overall distribution and abundance of this species. The impacts of the taking on this species were also evaluated relative to the estimated population on Kauaʻi.

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[10] In other words, Conservation Measure 4, *Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites*, is not implemented.

[11] Estimates of the share of breeding individuals of Hawaiian petrel (ʻuaʻu) on Kauaʻi range from approximately 33 percent (Raine pers. comm.) upward. Recent work suggests that the number of breeding individuals on Maui, Lānaʻi, and possibly Molokaʻi are substantially greater than previously believed. For details see Section A.2.4 in the species account for Hawaiian petrel (ʻuaʻu) in Appendix 3A, *Species Accounts*.

[12] In this scenario, minimization that occurred for the Short-term HCP is still applied.

Table 5-1. Explanation of Population Dynamics Model Scenarios Used for Effects Analysis Purposes

Scenario	Take from KIUC Activities	KIUC HCP Powerline Minimization	KIUC HCP Conservation Strategy	Purpose
No-Take	No	Yes (100% Effective)	No	A hypothetical scenario in which the take proposed for authorization under the HCP does *not* occur because powerline minimization is 100% effective and there are no other sources of KIUC take for 50 years. The purpose of this scenario is to compare against the proposed take scenario, to evaluate the impacts of the take on the species. While this scenario begins with a baseline at which KIUC take has occurred in the past, comparing this scenario with the proposed take scenario isolates factors that are *not* related to the proposed take so that impacts of the proposed take can be clearly evaluated.
Unminimized Take	Yes	No	No	A scenario in which powerline minimization measures attributed to this HCP do not occur. The purpose of this scenario is to isolate the beneficial effects of KIUC's minimization measures by comparing outcomes with and without these measures (i.e., by comparing the unminimized take with the proposed take).
Proposed Take	Yes	Yes	No	A scenario in which the proposed, minimized take occurs, but with no additional measures to offset impacts. The purposes of this scenario are (1) to compare against the no take scenario for analyzing effects of the proposed take; (2) to compare against the unminimized take for analyzing the effects of minimization; and (3) to compare against the HCP to analyze the effects of compensatory mitigation.
HCP	Yes	Yes	Yes	This is the scenario proposed in the HCP, including the minimized take and the compensatory mitigation of the conservation strategy. The purposes are (1) to evaluate against the proposed take scenario to analyze the beneficial effects of compensatory mitigation, and (2) to compare against the no-take scenario to analyze the net adverse and beneficial effects of the proposed (minimized) take and the compensatory mitigation combined.

5.3.3 Benefits of the Conservation Strategy and Net Effects—Methods

For each covered seabird species, KIUC assessed the benefits of the conservation strategy and evaluated these benefits in combination with the impacts of the taking to ascertain the net effects of the HCP on the species.

To evaluate the benefits of the conservation strategy and net effects on Newell's shearwater ('a'o) and Hawaiian petrel ('ua'u), KIUC used the population dynamics model summarized above and described in detail in Appendix 5E, *Population Dynamics Model for Newell's Shearwater ('a'o) on Kaua'i*. Using this model, KIUC compared the population trajectories between the proposed take scenario (without mitigation) and a scenario that assumes full implementation of the HCP (HCP scenario) (Section 5.3.3.1, *Newell's Shearwater ('a'o)*, under the subsection *Beneficial and Net Effects*) (Table 5-1). KIUC quantified the net effect of the proposed, minimized take and all conservation measures on the species. The population dynamics model is subdivided into 14 subpopulations. Ten of these subpopulations are the proposed ten conservation sites described in Chapter 4, *Conservation Strategy* (Conservation Measure 4, *Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites*). The remaining four subpopulations correspond to portions of Kaua'i with available population estimates and that share similar population characteristics. Appendix 5E, *Population Dynamics Model for Newell's Shearwater ('a'o) on Kaua'i*, provides descriptions and a map of these subpopulation locations. Benefits of the conservation strategy and net effects on Hawaiian petrel ('ua'u) and band-rumped storm-petrel ('akē'akē) were estimated qualitatively, incorporating the impacts of the taking (*Impacts of the Taking* in Section 5.3.3.2, *Hawaiian Petrel ('ua'u)*, and Section 5.3.3.3, *Band-Rumped Storm-Petrel ('akē'akē)*), and making qualitative assumptions regarding the benefits of the conservation measures on these species.

5.3.4 Effects Common to All Covered Seabirds

Tables 5-2, 5-3, and 5-4 provide the estimated take amounts for Newell's shearwater ('a'o), Hawaiian petrel ('ua'u), and band-rumped storm-petrel ('akē'akē), respectively. The following subsections describe effects common to all covered seabirds.

Table 5-2. Newell's Shearwater (ʻaʻo) Requested Take by Unit of Take, and Estimated Amount by Form of Take

		Average Annual[a]				Total Over 50 Years			
			Estimates by Form of Take[b]				Estimated Amount by Form of Take[b]		
	Unit of Take	Estimates by Unit of Take[f]	Mortality	Non-lethal Injury	Indirect Take of Eggs and Chicks	Requested Take by Unit of Take[g]	Mortality[c]	Non-lethal Injury[d]	Indirect Take of Eggs and Chicks[e]
Existing and new powerlines	Powerline strikes[f]	705	203	173	75	35,236	10,148	8,633	3,756
Existing streetlights and facilities	Fallout	72	72	-	-	3,605	3,605	-	-
New streetlights	Fallout	21	21	-	-	1,025	1,025	-	-
Conservation program	Individuals caught in traps	4	1	3	4	177	42	135	177
Total		**801**	**296**	**175**	**79**	**40,043**	**14,820**	**8,767**	**3,933**

[a] These are annual averages for the entire 50-year permit term. Actual annual numbers are expected to be highly variable. The take limit is established for the 50-year term, not annually. Additionally, the take limit applies only to the total estimate for each species, not to each type of covered activity. In other words, if the actual amount of take from one type of covered activity exceeds the estimate, that is not a permit violation as long as the total amount of take for all covered activities remains below the limit for the total amount of take for all covered activities.

[b] These are rough estimates based on the best available data, although little to no data are available for some of these estimates.

[c] For powerline strikes, uses 28% of strikes as a proxy for mortality based on proportion of birds grounded from Travers et al. (2021). For fallout, assumes 100% of fallout results in mortality. Although some of birds experiencing fallout will be rehabilitated by SOS, KIUC applied an assumption of 100% mortality for a conservative estimate of effects. For individuals caught in traps, estimated based on trapping data that 24% birds caught would be killed and the remainder would result in non-lethal injury.

[d] For powerline strikes, uses 24.5% of powerline strikes as a proxy for non-lethal injury based on proportion of birds that lose elevation but are not grounded from Travers et al. (2021). For fallout, assumes 100% of fallout results in mortality . Although some of birds experiencing fallout will be rehabilitated by SOS, KIUC applied an assumption of 100% mortality for a conservative estimate of effects.

[e] For powerline strikes, assumed 20% of injuries and mortalities are breeding adults and one egg or chick is taken for every breeding adult injured or killed. For lights, assumed primarily fledglings are affected and therefore a negligible number of eggs or chicks are indirectly lost. For traps, assumed conservatively that all trapped birds are breeding adults.

[f] For powerline strikes, the number of strikes are a surrogate metric for take. KIUC requests take of covered seabirds in all forms (mortality, injury, and indirect take of eggs and chicks) associated with the requested take as measured by number of powerline strikes.

Table 5-3. Hawaiian Petrel ('ua'u) Requested Take by Unit of Take, and Estimated Amount by Form of Take

		Average Annual[a]				Total Over 50 Years			
			Estimated Amount by Form of Take[b]				Estimated Amount by Form of Take[b]		
	Unit of Take	Estimates by Unit of Take	Mortality	Non-lethal Injury	Indirect Take of Eggs and Chicks	Requested Take by Unit of Take	Mortality[c]	Non-lethal Injury[d]	Indirect Take of Eggs and Chicks[e]
Existing and new powerlines	Powerline strikes[f]	424	122	104	45	21,196	6,104	5,193	2,259
Existing streetlights and facilities	Fallout	4	4	0	-	205	205	-	-
New streetlights	Fallout	1	1	-	-	60	60	-	-
Conservation Program	Individuals caught in traps	6	2	5	6	315	76	239	315
		436	128	109	51	**21,776**	**6,445**	**5,433**	**2,574**

[a] These are annual averages for the entire 50-year permit term. Actual annual numbers are expected to be highly variable. The take limit is established for the 50-year term, not annually. Additionally, the take limit applies only to the total estimate for each species, not to each type of covered activity. In other words, if the actual amount of take from one type of covered activity exceeds the estimate, that is not a permit violation as long as the total amount of take for all covered activities remains below the limit for the total amount of take for all covered activities.

[b] These are rough estimates based on the best available data, although little to no data are available for some of these estimates, and it is not possible to track how many birds are injured or killed or how many eggs or chicks are lost due to powerline strikes and fallout.

[c] For powerline strikes, uses 28% of strikes as a proxy for mortality based on proportion of birds grounded from Travers et al. (2021). The HCP assumes that 100% of fallout due to light attraction results in mortality. Although some of the seabirds experiencing fallout will be rehabilitated by SOS, KIUC applied an assumption of 100% mortality for a conservative estimate of effects. For individuals caught in traps, estimated 24% birds caught would be killed and the remainder would result in non-lethal injury based on trapping data.

[d] For powerline strikes, uses 24.5% of powerline strikes as a proxy for non-lethal injury based on proportion of birds that lose elevation but are not grounded from Travers et al. (2021). For fallout due to light attraction, assumes 100% of fallout results in mortality. Although some of the seabirds experiencing fallout will be rehabilitated by SOS, KIUC applied an assumption of 100% mortality for a conservative estimate of effects.

[e] For powerline strikes, assumed 20% of injuries and mortalities are breeding adults and one egg or chick is taken or every breeding adult injured or killed. For lights, assumed negligible amount of breeding adults (primarily fledglings). For traps, assumed all trapped birds are breeding adults.

[f] For powerline strikes, the number of strikes are a surrogate metric for take. KIUC requests take of covered seabirds in all forms (mortality, injury, and indirect take of eggs and chicks) associated with the requested take as measured by number of powerline strikes.

Table 5-4. Band-Rumped Storm-Petrel (ʻakēʻakē) Requested Take and Estimated Amount by Form of Take

		Average Annual[a]				Total Over 50 Years			
			Estimated Amount by Form of Take[b]				Estimated Amount by Form of Take[b]		
	Unit of Take	Estimated Take by Unit of Take	Mortality	Non-lethal Injury	Indirect Take of Eggs and Chicks	Requested Take by Unit of Take	Mortality[c]	Non-lethal Injury[d]	Indirect Take of Eggs and Chicks[e]
Existing and new powerlines	Powerline strikes[f]	<1	<1	<1	<1	22	6	5	2
Existing streetlights and facilities	Fallout	<1	<1	<1	0	40	20	20	-
New streetlights	Fallout	<1	<1	<1	0	46	46	0	-
Conservation Program	Individuals caught in traps	0	0	0	0	0	0	-	-
		<1	<1	<1	<1	**108**	**92**	**5**	**2**

[a] These are annual averages for the entire 50-year permit term. Actual annual numbers are expected to be highly variable. The take limit is established for the 50-year term, not annually. Additionally, the take limit applies only to the total estimate for each species, not to each type of covered activity. In other words, if the actual amount of take from one type of covered activity exceeds the estimate, that is not a permit violation as long as the total amount of take for all covered activities remains below the limit for the total amount of take for all covered activities.

[b] These are rough estimates based on the best available data, although little to no data are available for some of these estimates, and it is not possible to track how many birds are injured or killed or how many eggs or chicks are lost due to powerline strikes and fallout.

[c] For powerline strikes, uses 28% of strikes as a proxy for mortality based on proportion of birds grounded from Travers et al. (2021). For fallout, the HCP assumes 100% of fallout results in mortality. Although some of the seabirds experiencing fallout will be rehabilitated by SOS, KIUC applied an assumption of 100% mortality for a conservative estimate of effects. For individuals caught in traps, estimated 24% birds caught would be killed and the remainder would result in non-lethal injury based on trapping data.

[d] For powerline strikes, uses 24.5% of powerline strikes as a proxy for non-lethal injury based on proportion of birds that lose elevation but are not grounded from Travers et al. (2021). For fallout, the HCP assumes 100% of fallout results in mortality. Although some of the seabirds experiencing fallout will be rehabilitated by SOS, KIUC applied an assumption of 100% mortality for a conservative estimate of effects.

[e] For powerline strikes, assumed 20% of injuries and mortalities are breeding adults and one egg or chick is taken or every breeding adult injured or killed. For lights, assumed negligible amount of breeding adults (primarily fledglings). For traps, assumed all trapped birds are breeding adults.

[f] For powerline strikes, the number of strikes are a surrogate metric for take. KIUC requests take of covered seabirds in all forms (mortality, injury, and indirect take of eggs and chicks) associated with the requested take as measured by number of powerline strikes.

5.3.4.1 Powerline Effects

Requested Take from Powerline Collisions

KIUC is seeking state and federal authorization for the take from powerline collisions that would remain after it implements the minimization measures detailed in Chapter 4, Section 4.4, *Conservation Measures*. The total annual number of projected strikes varies by year but the HCP will cover take associated with no more than 35,236 Newell's shearwater (ʻaʻo) strikes, 21,196 Hawaiian petrel (ʻuaʻu) strikes, and 22 band-rumped storm-petrel (ʻakēʻakē) strikes over the 50-year permit term (Tables 5-2, 5-3, and 5-4).

Monitoring conducted since 2013 indicates there are natural annual variations that affect the number of covered seabirds visiting Kauaʻi, the flight patterns of those that do visit, and other factors affecting the number of collisions that occur in any given year. Such variation makes it difficult to set specific annual limits; therefore, take limits are defined as the total number of birds taken during the permit term. A 5-year rolling average of the annual take amounts will be monitored against annual performance standards for the purpose of adaptive management (see Chapter 6, *Monitoring and Adaptive Management Program*), but no annual take limits are established. Therefore, if the 5-year rolling average of annual take exceeds the amount projected based on the model (Appendix 6A, Table 6A) adaptive management is triggered but it is not a violation of the incidental take permit/incidental take license. The overall requested take from powerlines is established based on the assumption that KIUC can achieve a 65.3 percent reduction in powerline collisions by the end of year one. The take limit also takes into account local increases in collision risk that may result from exposing powerlines as a result of vegetation maintenance or raising the height of powerlines (i.e., KIUC will be held to the same take limit even with modifications such as exposing or raising powerlines). Additionally, the take limit applies only to the total estimate for each species, not to each type of covered activity. In other words, if the actual amount of take from one type of covered activity exceeds the estimate, that is not a permit violation as long as the total amount of take for all covered activities remains below the limit for the total amount of take for all covered activities.

5.3.4.2 Light Attraction Effects

Requested Take from Light Attraction

As described in Chapter 4, Section 4.4.2, *Conservation Measure 2. Implement Measures to Minimize Light Attraction*, KIUC has minimized and will continue to minimize its light-related impacts on the covered seabirds throughout the life of the permit term.

- Using full-cutoff shields for streetlights and covered facility lights
- Using white light-emitting diode (LED) lights on outdoor lights at its covered facilities.
- Managing the use of facility lighting so that lights are dimmed during the fledgling fallout season (September 15 to December 15).

These measures have reduced the risk of take from light attraction of the covered seabirds to the maximum extent practicable. Despite these efforts, some risk of light attraction and fallout remains. Table 5-5 provides the estimated take of the covered seabirds resulting from light attraction with the existing minimization in place throughout the permit term. These estimates are based on the analysis and calculations described in detail in Appendix 5C, *Light Attraction Modeling*. The requested take authorization is considered a conservative estimate for the following reasons.

- Streetlight take estimates are based on remotely sensed radiance data in October 2018. This precedes KIUC's minimization of light attraction at KIUC's facilities through light dimming.
- KIUC included all streetlights for which ownership was uncertain in Appendix 5C, *Light Attraction Modeling*. This approach assumes that some non-KIUC streetlights are included in the take estimate.
- KIUC used a constant annual rate of light attraction, with the maximum amount of annual take from full buildout of streetlights assumed in Year 1 of plan implementation, when in fact full buildout will occur gradually through the permit term.

KIUC may implement additional minimization measures to further reduce take through the monitoring and adaptive management strategies described in Chapter 6, *Monitoring and Adaptive Management Program*.

Table 5-5. Estimated Take of Covered Seabirds from Light Attraction After Minimization[a]

	Estimated Average Annual Mortality				
	Existing Streetlights[b]	Future Streetlights	Covered Facility Lights[b, c]	Total Average Annual	50-Year Take[d]
Newell's shearwater ('a'o)	66.9	20.5	5.2	92.6	4,630
Hawaiian petrel ('ua'u)	4.0	1.2	0.1	5.3	265
Band-rumped storm-petrel ('akē'akē)	0.7	0.1	0	0.9	46

[a] Based on analysis provided in Appendix 5C, *Light Attraction Modeling*. Assumes constant annual rate. The take limit for light attraction is only for the 50-year permit term. Average annual mortality is expected to vary considerably; estimates provided for average annual mortality are not take limits.

[b] With continued full implementation of minimization measures in Chapter 4, Section 4.4.2, *Conservation Measure 2. Implement Measures to Minimize Light Attraction*.

[c] Midpoint between long-term average and average considering data in 2019 and 2020 after KIUC began dimming facility lights during the fallout season, which would continue throughout the permit term (Appendix 5C, *Light Attraction Modeling*).

[d] Take estimates assume a stable metapopulation on Kaua'i. Take estimates would be an overestimate if the metapopulation on Kaua'i declines, or an underestimate if the Kaua'i metapopulation increases over the permit term. These estimates are considered conservative because the metapopulation is not expected to increase to the extent that take would exceed the estimated amounts (Appendix 5E, *Population Dynamics Model for Newell's Shearwater ('a'o) on Kaua'i*).

5.3.4.3 Conservation Measure Effects

Requested Take from Conservation Measure Implementation

Section 5.3.1.3, *Take from Traps—Methods*, describes how KIUC estimated the amount of take that may occur because of covered seabirds being caught in traps. Tables 5-2 and 5-3 provide the resulting take estimates for Newell's shearwater ('a'o) and Hawaiian petrel ('ua'u), respectively.

Management of Conservation Sites

As described in Chapter 4, *Conservation Strategy*, KIUC will offset the requested take of Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) by managing and enhancing breeding colonies of these species, and reducing the abundance and distribution of seabird predators in northwestern Kauaʻi. Through these measures, KIUC will increase the number of chicks produced annually to reverse the historic downward trend of the Kauaʻi metapopulations of this species as determined by radar and acoustic call rates.

Management actions with proven success at improving the reproductive success of Newell's shearwater (ʻaʻo) breeding colonies are ongoing and would continue and be expanded by the HCP for the duration of the permit term. Expanding the scale and types of these conservation actions (e.g., installing predator-proof fencing at feasible sites) is expected to further reduce predation and increase the survivorship of chicks produced each year. Social attraction within the fenced conservation sites is also expected to accelerate colony recruitment.

Predator control at the conservation sites is expected to significantly increase the reproductive success rate of Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu). Predator control that either establishes predator-free breeding habitat or substantially reduced predation is required to successfully restore productive seabird colonies (Buxton et al. 2014; Jones and Kress 2012; Raine et al. 2020). Given the length of time necessary to produce one chick (5–6 years of age) (Ainley et al. 2020), adult mortality is particularly harmful to the species. Predation by introduced species have depressed seabird populations to a level where they are extremely vulnerable to extirpation (U.S. Fish and Wildlife Service 2018). Terrestrial predator control has been proven to increase seabird nesting productivity on Kauaʻi. Raine et al. (2020) found that between 2011 and 2017, Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) reproductive success rates increased by a mean of approximately 36 percent and 48 percent, respectively, following predator control operations within managed breeding sites. Additionally, Raine et al. (2020) found that barn owl (*Tyto alba*) control measures, when implemented in a concentrated and systematic fashion, can significantly decrease seabird depredations. Without predator control, Raine et al. found that modeled population trajectories within all management sites declined rapidly over a 50-year period. The conservation measures to offset take are designed to result in early improvements in the viability of the Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) metapopulation on Kauaʻi by focusing conservation efforts in areas expected to have the greatest benefit to the species. Substantial metapopulation increases at the conservation sites and improved survival at the monitoring sites, in combination with minimizing take, are expected to reverse the current island-wide population decline and establish a viable metapopulation of each species on Kauaʻi (as defined by meeting the HCP biological objectives associated with biological goals 1 and 2).[13]

Save Our Shearwaters Program

The HCP includes a $300,000 annual funding commitment to continue to the SOS Program, which is a sufficient level of funding to support KIUC's HCP commitments. The benefit of continuing this program to the covered seabirds is quantified in Table 5-6. Chapter 6, Table 6-3, outlines an

[13] No population viability analysis has been conducted for the covered seabirds. However, USFWS and DOFAW (Nagatani 2022) estimate that for the Kauaʻi metapopulation of Newell's shearwater (ʻaʻo), 10,000 individuals (and 2,500 breeding pairs) represent a minimum viable level viable for the Plan Area.

adaptive management trigger to further ensure this funding is sufficient throughout the entire permit term.

The SOS Program has been active since 1979. However, in the early years of the program it operated with a limited budget and inconsistent staffing levels; it also lacked the systematic protocols for bird rescue, rehabilitation, and release that exist today. As a consequence, data from the program's early years provide an inaccurate estimate of bird rescues expected during the permit term. To estimate benefits to the covered seabirds during the permit term, more recent and reliable SOS Program data was used from 2009 to the present. This range captures the period over which the SOS Program has used consistent, systematic protocols and staffing levels that are expected to continue throughout the permit term given the funding commitment by KIUC.

Table 5-6 provides the number of covered seabirds recovered or rehabilitated and released by the SOS Program from 2009 to 2019 (the last full year from which data are available), and the estimated annual and 50-year recovery, rehabilitation, and release based on projections into the future of this historical data.

Table 5-6. Covered Seabirds Expected to be Rehabilitated and Released through the SOS Program, by Species

Covered Seabird Species	No. of Individuals Recovered and Released 2009–2019	Average Annual Historic Rate of Recovery and Release	Estimated 50-Year Recovery and Release[a]
Newell's shearwater (ʻaʻo)	1,600	160.0	8,000
Hawaiian petrel (ʻuaʻu)	64	6.4	320
Band-rumped storm-petrel (ʻakēʻakē)	4	0.4	20
Total	**1,668**	**166.8**	**,8,340**

[a] Assumes the average historic rate of recovery and release from 2009 to 2019 would continue throughout the 50-year permit term. This table makes no assertions about rate of survival for recovered and released birds. SOS recoveries are an assumed benefit to the species but these benefits were not quantified and were not factored into the population dynamics model to calculate effects and offsets to the Kauaʻi metapopulation.

The SOS Program recovered and released 1,668 of the covered seabirds from 2009 through 2019 (Table 5-6). Approximately 60 percent of the covered species that are handled by the SOS Program are rehabilitated and released back into the wild[14] (Bache 2019), with the expectation that they will successfully reproduce in future nesting seasons. There is evidence that rehabilitated and released fledglings of covered seabirds have reduced survivorship compared with wild fledglings, but a substantial proportion of rehabilitated fledglings have been documented to successfully migrate to their wintering grounds (Raine et al. 2020). Using satellite tags, Raine et al. (2020) found that 21 days after release that 28.9 percent of 38 SOS-rehabilitated fledglings were still transmitting in comparison with 50 percent of a similar sample of 12 wild fledglings. It is assumed that all of the rehabilitated seabirds would have died as a result of collision or grounding injuries, starvation, dehydration, predation, vehicle interactions, or other sources of mortality, if not retrieved, treated, and released by the SOS Program. Consequently, the SOS Program plays an important role in improving populations of the covered species on Kauaʻi.

[14] The remaining 40 percent are dead on arrival or their injuries are so severe they must be euthanized.

Because there is evidence that rehabilitated and released birds have reduced survivorship, the population dynamics model takes a conservative approach and does not reduce mortality to account for birds recovered and released. That is, the effects of rehabilitating and releasing covered seabirds is not factored into the population dynamics model. Table 5-6 provides the anticipated number of birds to be rehabilitated and released during the 50-year permit term, rather than number of birds expected to survive after rehabilitation, because this is a quantifiable amount that can be tracked during HCP implementation.

5.3.5 Species-Specific Seabird Effects

5.3.5.1 Newell's Shearwater (ʻaʻo)

Effects and Level of Take

Table 5-2 provides the requested take amounts for Newell's shearwater (ʻaʻo) and estimated amounts for each form of take. KIUC requests all forms of take of Newell's shearwater (ʻaʻo) that result from the following.

- Up to 35,236 strikes over 50 years from existing and new powerlines.
- Fallout of up to 3,605 individuals over 50 years from light attraction of existing KIUC-operated streetlights and facilities.
- Fallout of up to 1,025 individuals over 50 years from light attraction of new KIUC-operated streetlights.
- Injury or mortality of up to 177 individuals (injury of 135 and mortality of 42) over 50 years as a result of traps used for the conservation program.

The estimates for amount of take associated with each form of take (Table 5-2) is a rough approximation based on the best available data. Because each form of take resulting from powerline collisions and fallout cannot be measured in the field (see explanation in Section 5.3.1, *Methods for Quantifying Take and Assessing Effects on the Covered Seabirds*), take from these sources will not be tracked according to each form of take (i.e., injury, mortality, or indirect take of eggs or young).

Impacts of the Taking

The range-wide breeding population of the Newell's shearwater (ʻaʻo) occurs mostly on Kauaʻi (Appendix 3A, *Species Accounts*). Breeding populations of Newell's shearwater (ʻaʻo) on Kauaʻi declined by an estimated 94 percent over a 20-year period from 1993 to 2013 (Raine et al. 2017).

Because the Newell's shearwater (ʻaʻo) reproductive strategy has evolved to have high adult survivorship with a relatively low number of offspring, adult mortality is particularly detrimental to the species. Left unchecked, low adult survivorship (i.e., high adult mortality), along with reduced reproductive success and chick survivorship, will depress the population to a level where they can become vulnerable to extirpation. Small population sizes can result in poor colony recruitment, which further decreases the species population viability. The historic decline of the Newell's shearwater's (ʻaʻo) metapopulation on Kauaʻi is the result of a variety of factors including powerline strikes, light attraction fallout, predation by introduced species, stochastic events such as hurricanes that damage breeding habitat, and climate shifts altering shearwater food availability.

Operation of KIUC infrastructure has had substantial adverse effects on the Kauaʻi metapopulation of this species. The current rate of seabird powerline collision is affecting the age structure of the population by removing large portions of subadult and adult individuals annually from the population. Collectively, the long-term effects of powerline collisions and fallout from attraction to streetlights, combined with severe predation, are likely a primary reasons the metapopulation is at historically low levels. Because at least 90 percent of the range-wide individuals of Newell's shearwater ('aʻo) occur on Kauaʻi, a viable metapopulation in the Plan Area is critical to species recovery.

Reduction of annual Newell's shearwater ('aʻo) collisions with existing powerlines consistent with Objective 1.1 is a significant step toward reducing the decline of this species on Kauaʻi. The minimization measures will result in substantial ongoing reduction in take throughout the permit term. Take limits have been established for the HCP based on this expected take minimization, and Chapter 6, Section 6.4.1.2, *Take Monitoring*, describes how take will be monitored and minimization measures will be adaptively managed to ensure the take limit is not exceeded. As shown by comparing the unminimized take (red line) and proposed take (grey line) scenarios on Figure 5-2 (see Table 5-1 for description of each scenario), this reduction in collisions is expected to improve the population rate of change. This is the anticipated result of retaining more adults and subadults, thereby improving demography, age class structure, and population size.

As described in Section 5.3.1.4, *Impacts of the Taking—Methods*, KIUC evaluated the impacts of the taking by comparing a hypothetical no-take scenario with the proposed take scenario (and no mitigation measures). The difference between the no-take (purple line) and proposed take (grey line) scenarios in Figure 5-2 reflects the impact of KIUC's requested take on the species throughout the permit term in the absence of mitigation measures. As described in Appendix 5E, *Population Dynamics Model for Newell's Shearwater ('aʻo) on Kauaʻi*, in the hypothetical absence of take related to KIUC operations,[15] the Kauaʻi metapopulation would continue to decline at an estimated annual rate of 1.8 percent per year (Lambda = 0.982[16]; Figure 5-2, purple line). This is the modeled rate of decline that results from setting powerline and fallout mortality rates to zero and applying the predation mortality and reproductive success rates estimated at conservation sites prior to implementation of KIUC's predator control measures. This assessment suggests that the effects of predation and other threats to the species remain substantial even without the adverse effects of KIUC covered activities.

As shown by the grey line on Figure 5-2, even with minimization, the continued loss of Newell's shearwaters ('aʻo) as a result of KIUC covered activities could have an appreciable negative effect on the metapopulation of Newell's shearwaters ('aʻo) in the absence of mitigation measures to offset these effects. The net effects of the KIUC HCP on the species, considering both the adverse effects of the proposed take and the beneficial effects of the proposed mitigation measures, are described below.

[15] Since KIUC powerlines are already in operation and their removal would be infeasible, this no-take scenario is hypothetical and used only as a basis for evaluating the impact of the taking on the species.

[16] Lambda (λ) represents the annual population multiplier. A lambda of 1.0 indicates a population that is replacing itself but not growing or declining (i.e., a stable population). A lambda above 1.0 indicates a growing population. A lambda below 1.0 indicates a declining population.

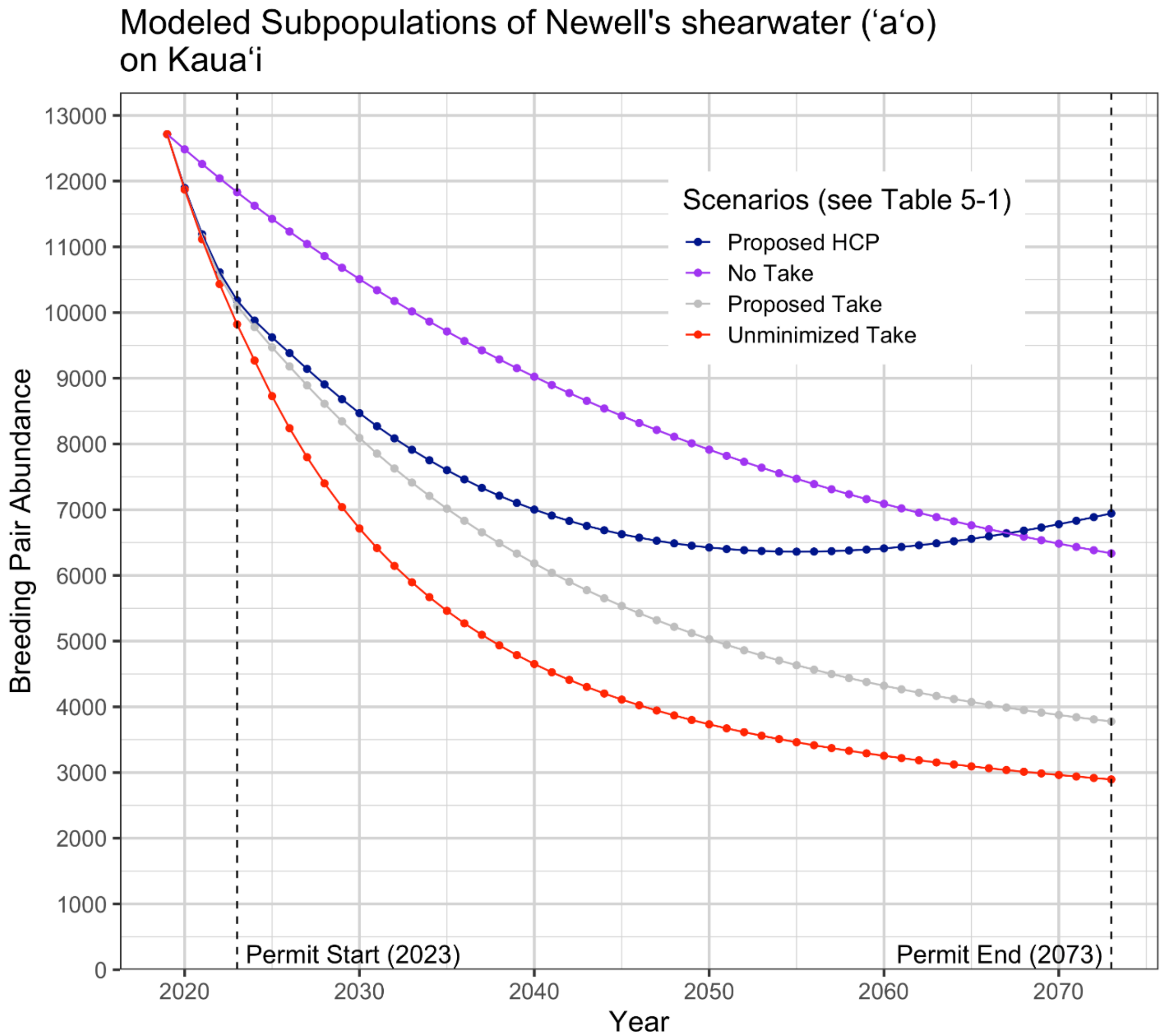

Figure 5-2. Newell's Shearwater ('a'o) Population Dynamics Model: Island-wide Outcomes for All Scenarios[17]

[17] See Table 5-1 for a description of each scenario evaluated to assess effects of the take and the conservation strategy. See Appendix 5E, *Population Dynamics Model for Newell's Shearwater ('a'o) on Kaua'i* for details on the model structure and assumptions.

Beneficial and Net Effects

The measure described in Chapter 4, Section 4.4.4, *Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites,* is expected to mitigate the impact of Newell's shearwaters (ʻaʻo) mortalities resulting from KIUC covered activities. KIUC will offset the impact of the requested take of Newell's shearwaters (ʻaʻo) by implementing management actions with proven success at improving the reproductive success of Newell's shearwater (ʻaʻo) breeding colonies by reducing predation and increasing the survivorship of chicks produced each year. Social attraction within the fenced conservation sites is also expected to accelerate colony recruitment. The conservation measures to offset take are designed to result in early improvements in the viability of the Newell's shearwater (ʻaʻo) metapopulation on Kauaʻi by focusing conservation efforts in areas expected to have the greatest benefit to the species.

Metapopulation Viability

Substantial population increases at the conservation sites and improved survival of the species on Kauaʻi outside the conservation sites, in combination with minimizing take, are expected to reverse the current island-wide population decline and establish a viable metapopulation of Newell's shearwater (ʻaʻo) on Kauaʻi consistent with Goal 1 in Chapter 4, *Conservation Strategy* (Figure 5-2). Chapter 4, Section 4.3.1, *Newell's Shearwater (ʻaʻo)*, describes how *viable* is defined in the context of population dynamics modeling. The population dynamics model indicates that the KIUC HCP would achieve Goal 1 for Newell's shearwater (ʻaʻo), resulting in a viable metapopulation on Kauaʻi as represented by the following characteristics.

- Number of breeding pairs
- Population growth rate
- Age structure and demography
- Distribution

Each of these characteristics is described below in relation to the output of the population dynamics model.

<u>**Number of breeding pairs**</u>. Consistent with Objective 1.3, KIUC will (1) maintain an annual minimum of 1,264 breeding pairs of Newell's shearwater (ʻaʻo) in the conservation sites throughout the permit term, (2) reach a target of 2,371 breeding pairs by year 25 of the permit term, and (3) reach a target of 4,313 breeding pairs on the conservation sites by the end of the permit term. As described in Chapter 6, Section 6.4.4, *Conservation Site Monitoring and Adaptive Management*, and Table 6-2, KIUC will monitor the conservation sites and adaptively manage them to ensure these commitments are met.

The population dynamics model is consistent with a metapopulation size for Newell's shearwater (ʻaʻo) on Kauaʻi of over 6,300 breeding pairs at the lowest point of forecasted abundance during the 50-year permit term (Appendix 5E, *Population Dynamics Model for Newell's Shearwater (ʻaʻo) on Kauaʻi*). A metapopulation size at this abundance level is well within the range of what has been suggested in meta-analyses of minimum viable population sizes integrating a wide range of case studies for birds and other taxa (Trail et al. 2007; Reed 2003). These estimates take into account the roles of age structure, catastrophes, random demographic and environmental fluctuations (stochasticity), and inbreeding depression. The model projects that the population size will consist of an estimated 6,958 breeding pairs by the end of the permit term, with the population continuing to increase beyond the permit term. This is well above estimates by USFWS and DOFAW (2022) that for the Kauaʻi metapopulation of Newell's shearwater (ʻaʻo), 10,000 individuals and 2,500 breeding pairs represent a minimum viable abundance level for the Plan Area. As shown in Figure 5-2, no other scenario except the proposed HCP reaches this level of abundance or produces a positive growth trajectory of the island-wide metapopulation by the end of the permit term.

Population growth rate. Consistent with Objective 1.3, KIUC will maintain an annual growth rate for breeding pairs of at least 1 percent as measured by a 5-year rolling average, and maintain a 5-year rolling average of 87.2 percent reproductive success rate at reference burrows. As described in Chapter 6, Section 6.4.4., *Conservation Site Monitoring and Adaptive Management* and Appendix 6A, *Adaptive Management Comparison Tables*, KIUC will monitor the conservation sites and adaptively manage them to ensure these commitments are met.

The results of KIUC's population dynamics model indicates that after a period of decline in the metapopulation size on Kauaʻi, the conservation actions included in the HCP would result in a reversal of the modeled initial downward trend that would begin at approximately Year 33 of the permit (2056) (Figure 5-2). This upward population growth trend is expected to continue for the remainder of the permit term, approximately 17 years. This positive growth for 17 years would result in population growth island-wide (Figure 5-2, dark blue line) that would also continue after the permit term if the same conservation measures remained in place. This positive rate of change in metapopulation size before the end of the permit term is a key result of the population dynamics model that is consistent with metapopulation viability on Kauaʻi under the HCP.

Age structure and demography. Modeled metapopulation numbers for Newell's shearwater (ʻaʻo) that are increasing are, by definition, consistent with viability because an increase in the modeled metapopulation size occurs when the total annual number of fledglings produced is greater than the number of deaths on an island-wide basis. This positive productivity by approximately Year 33 of the HCP will result in a net benefit to the modeled metapopulation of Newell's shearwater (ʻaʻo). This modeled metapopulation on Kauaʻi by approximately Year 33 is expected to overcome the reductions in survival and reproductive success resulting from future predicted levels of powerline strikes, light fallout from KIUC streetlights and covered facilities, and reduced levels of introduced predators in and near the conservation sites.

Distribution. As described in Chapter 4, *Conservation Strategy*, there are practical limitations precluding conservation efforts in areas of Kauaʻi outside the conservation sites; therefore, future populations are likely to become spatially concentrated in remote locations with rugged terrain that are distant from most powerlines and lights, and where conservation efforts from this HCP, other HCPs, and other conservation and mitigation actions are focused. Figures 5-3 and 5-4 show the projected population trajectories for subpopulations inside and outside the 10 conservation sites proposed by this HCP, respectively.

The results of the population dynamics model are consistent with the future breeding distribution of Newell's shearwater (ʻaʻo) on Kauaʻi becoming spatially more concentrated towards the conservation sites, the Wainiha and Lumahaʻi Valleys, and the Nā Pali Coast in the future (i.e., areas close to the conservation sites). Although the population dynamics model results suggest that some subpopulations outside of the conservation sites would not be considered viable, the conservative biological assumptions underlying the results for these subpopulations result in modeled rates of decline that are consistent with the largest estimated rate of decline observed across individual radar monitoring sites. That is, prior to the HCP, is the model assumes that the Hanalei to Kekaha area has been experiencing a -10.7 percent annual rate of decline, corresponding to the estimated trend at the Hanelei radar site. Of the 13 radar sites that have been systematically monitored since 1993, Hanalei produced the largest rate of decline that has been observed at any of the individual radar monitoring sites between Hanalei and Kekaha. By comparison, the average rate of decline when averaged across the 13 radar sites during the same 1993–2020 time period is -6.9 percent per year (Raine and Rossiter 2020). Furthermore, during the last decade (2010–2020), the overall trend across radar sites has been stable (Raine and Rossiter 2020). If the actual population trend in this area (and other areas included in the most recent analyses of the radar survey data) has been stable over the last decade, the results of the HCP population dynamics model would substantially *overestimate* the extent to which the future spatial distribution of breeding Newell's shearwaters ('a'o) on Kaua'i might be decreased by KIUC's take. Nevertheless, as stated above, modeled metapopulation numbers that are increasing by approximately Year 33 of the permit term are consistent with a viable metapopulation, despite a shift in distribution to concentrate populations in areas with high long-term conservation value.

Beneficial Effects of the Conservation Strategy

KIUC compared a scenario without the proposed conservation strategy (i.e., the unminimized take scenario) with the HCP scenario to evaluate the beneficial effects of the conservation strategy. Appendix 5E, *Population Dynamics Model for Newell's Shearwater ('a'o) on Kaua'i*, and Figures 5-2 through 5-5 provide relevant results from the population dynamics model. The red lines on each figure indicate the estimated population trajectory of the unminimized take scenario based on the following assumptions.

- Predation rates measured at monitored colonies prior to dedicated predator control are applied to every subpopulation.
- No predator control occurs at any of the HCP conservation sites.
- Powerline strikes and light attraction continue, but no powerline minimization occurs, other than what previously occurred as part of the Short-Term HCP.

The section below titled *Addressing Uncertainty* explains why the initial rate of population decline of -7.4 percent for the scenario in which take is neither minimized nor mitigated (unminimized take scenario) is conservative. Under this unminimized take scenario, all subpopulations are projected to decline rapidly until approximately 2060 and then begin to level off, but with a continuing decline (Figures 5-2, red line).

Figure 5-3 demonstrates that the conservation measures implemented at four of the conservation sites will substantially benefit Newell's shearwater ('a'o) and do so relatively quickly. The three conservation sites that see only moderate levels of benefit for Newell's shearwater ('a'o) are Hanakāpi'ai, Hanakoa, and North Bog, which are designed primarily to benefit Hawaiian petrel ('ua'u). HCP benefits are greatest at the four conservation sites with predator exclusion fencing and social attraction, as expected. Figure 5-4 illustrates that subpopulations outside the conservation sites show little to no benefits compared to a scenario with unminimized take and no mitigation.

Continued predator control of the remaining six conservation sites by the HCP, combined with powerline collision minimization, will prevent substantial declines of existing subpopulations of Newell's shearwater ('a'o) and likely prevent local extirpation (red lines). Four of these conservation sites with predator control (Pōhākea, Hanakāpi'ai, Hanakoa, and Honopū) collectively contribute substantial numbers of new breeding pairs to the Kauaʻi metapopulation of Newell's shearwater (ʻaʻo) with the proposed HCP (dark blue lines; Figure 5-3).

The population trajectory for Newell's shearwater (ʻaʻo) at all conservation sites combined is shown in Figure 5-5 and demonstrates substantial benefits resulting from the conservation strategy. According to the model, the total population size of Newell's shearwater (ʻaʻo) at all of the conservation sites combined is expected to increase immediately with the rate increasing gradually through approximately 2035. After that, the population increases steadily and more substantially due to the contributions of the four social attraction sites (Site 10, Upper Limahuli, Pōhākea PF,[18] and Honopū PF[19]). Of these four sites, Upper Limahuli contributes by far the greatest number of new birds because of its much larger starting population. It is possible that the social attraction sites will attract new breeding pairs to their sites sooner than expected; if this happens, the population growth within the conservation sites will likely occur even faster.

The increase in subpopulations of Newell's shearwater (ʻaʻo) within the conservation sites is expected to overcome the substantial declines projected in the largest subpopulation (Hanalei to Kekaha; see black line in Figure 5-4). The increases in subpopulations of the four conservation sites combined is therefore expected to provide a substantial benefit to Newell's shearwater (ʻaʻo) on Kauaʻi, with a reverse in the species' downward population trend and with increasing species abundance by approximately Year 33 of the permit term.

[18] PF stands for predator exclusion fence.

[19] Honopū PF awaits final approval from the landowner.

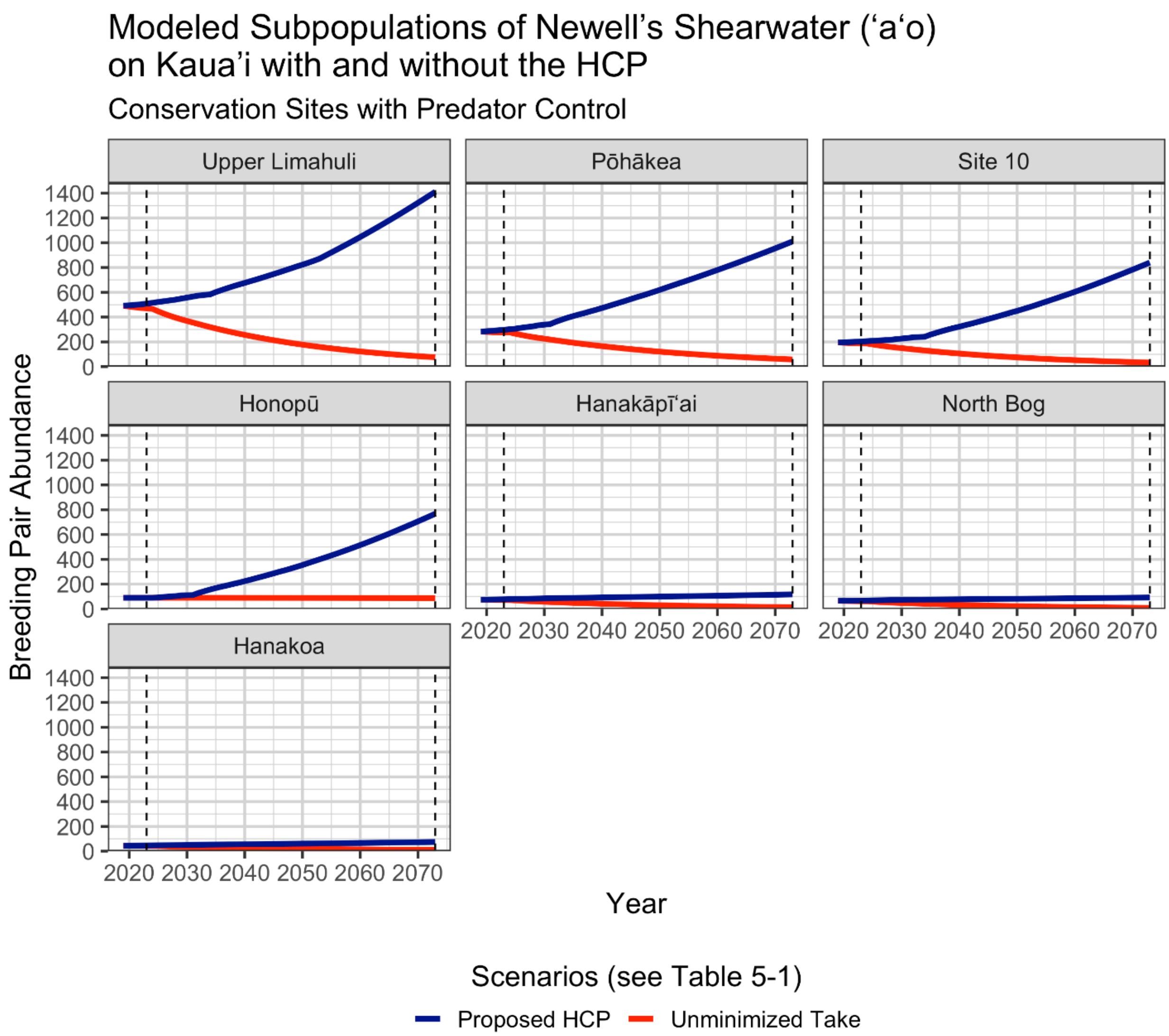

Figure 5-3. Population Dynamics Model Results for Newell's Shearwater ('a'o) for Each Conservation Site

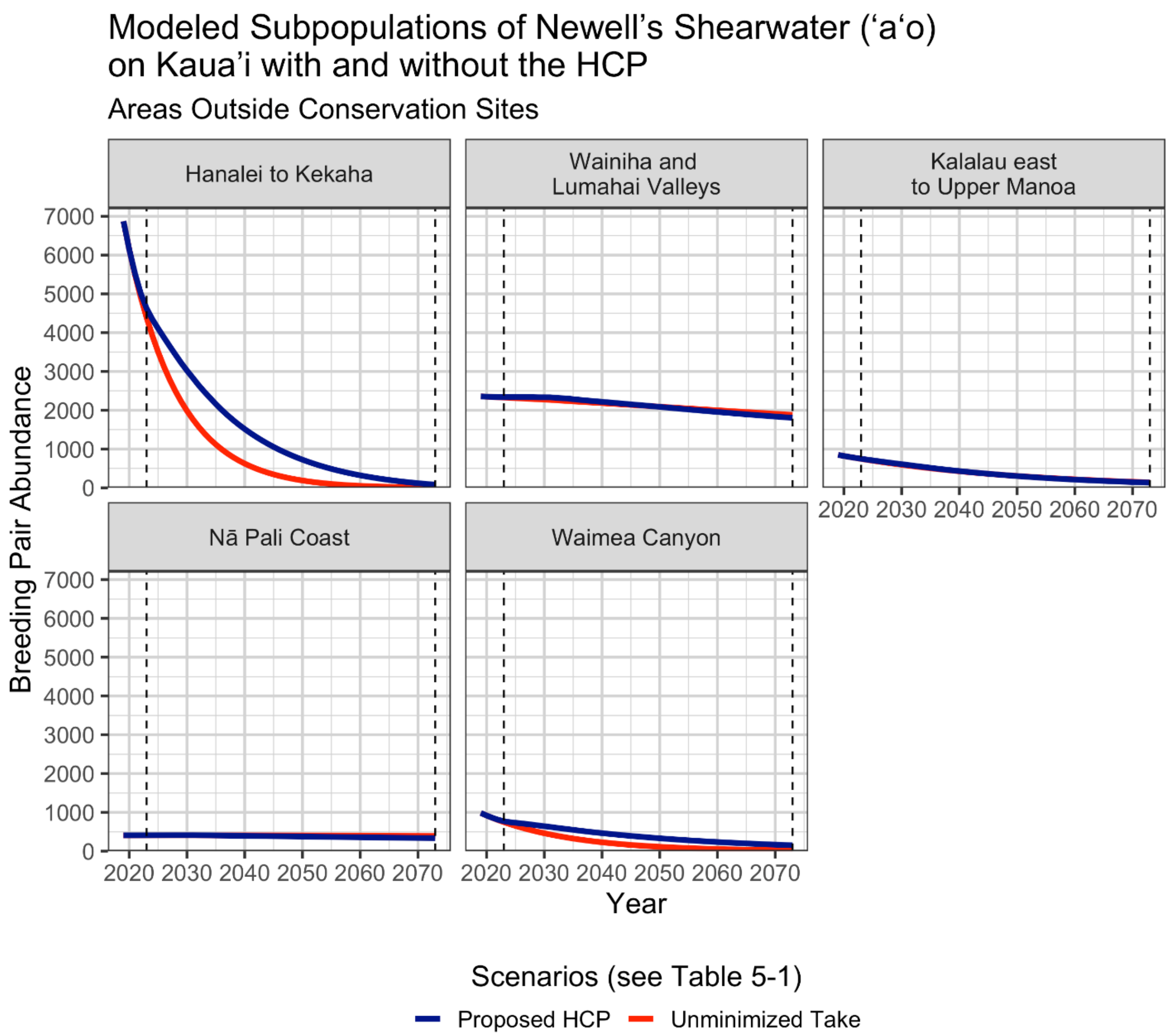

Figure 5-4. Population Dynamics Model Results for Newell's Shearwater ('a'o) for Subpopulation Outside Conservation Sites

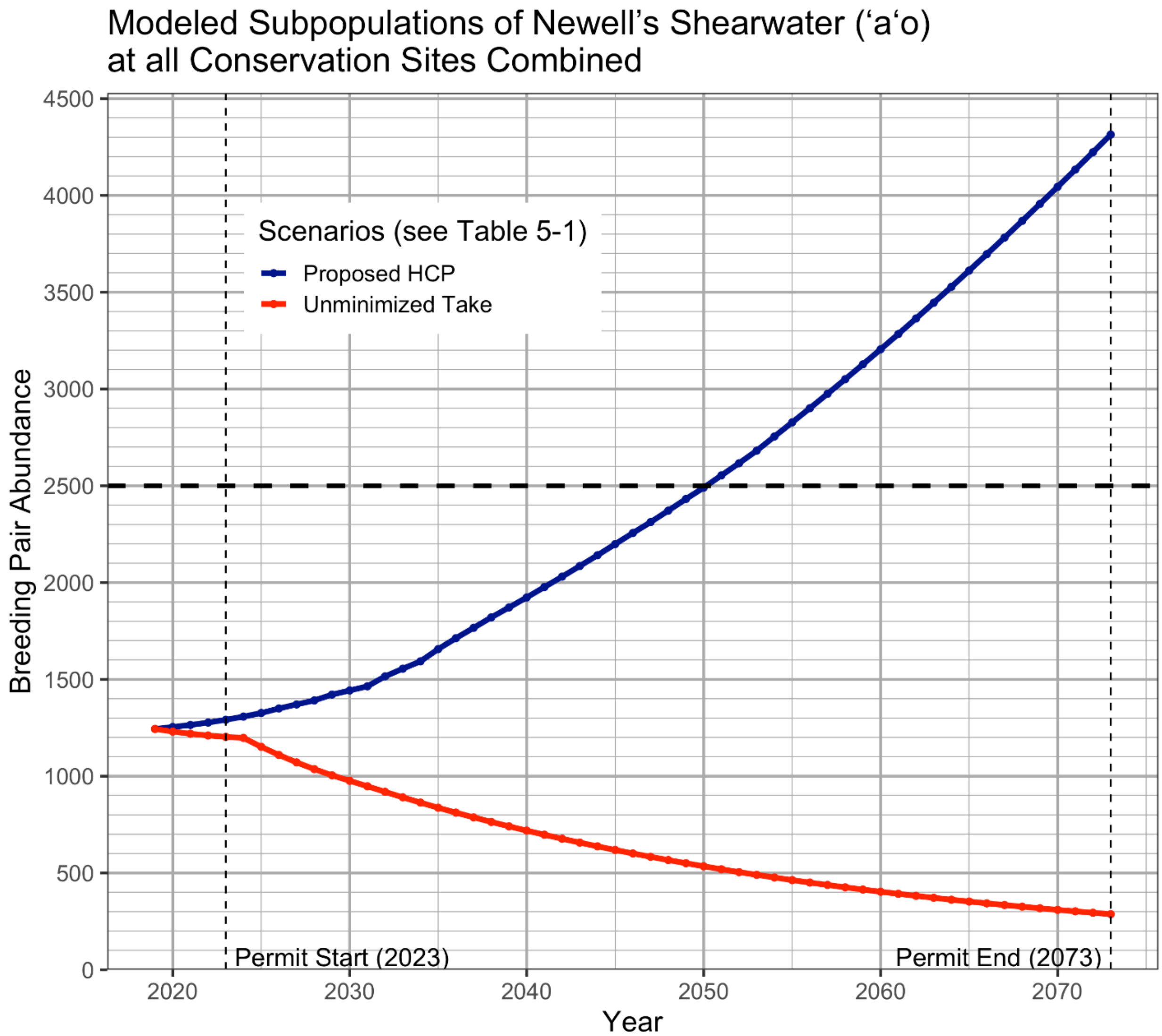

Figure 5-5. Population Dynamics Model Results for Newell's Shearwater (ʻaʻo) for all Conservation Sites Combined

Net Effects

As described in Section 5.3.1.5, *Benefits of the Conservation Strategy and Net Effects—Methods*, the difference between the no-take scenario and the proposed HCP scenario (with its proposed conservation strategy) represents the net effects. These net effects include both the adverse effects of the proposed take and the beneficial effects of the proposed conservation strategy. The hypothetical scenario of no KIUC take during the 50-year permit term (Figure 5-2, purple line) shows a downward species decline resulting from factors other than KIUC's proposed take. In other words, even if KIUC was able to eliminate all take associated with its current and future facilities (i.e., 100 percent minimization), the Newell's shearwater (ʻaʻo) metapopulation on Kauaʻi is predicted to decline substantially and continue declining well after the 50-year permit term.[20]

In contrast, the HCP conservation measures including minimization and mitigation are projected by approximately Year 33 of the permit term to begin to reverse this decline and result in a net benefit to the Kauaʻi metapopulation for 17 years of the permit and until the end of the permit term (Figure 5-3, dark blue line) compared to a scenario with no take and no KIUC conservation (Figure 5-3, purple line). HCP conservation measures are projected to slow the decline considerably between 2040 and 2050 and stabilize the island-wide metapopulation. After approximately 2056, the metapopulation is projected to increase gradually until the end of the permit term, with a net increase in numbers of breeding pairs (dark blue line) compared with a hypothetical scenario in which the proposed take did not occur (purple line). Hence, the HCP provides a net benefit to Newell's shearwaters (ʻaʻo).

Addressing Uncertainty

The modeling used to estimate adverse, beneficial, and net effects on Newell's shearwaters (ʻaʻo) required the application of assumptions that in some cases have a high level of uncertainty.[21] KIUC addressed this uncertainty by using conservative assumptions that err on the side of the species. In other words, the assumptions would tend to overestimate impacts, underestimate benefits, or both. For example, the initial modeled rate of decline without conservation measures represents an island-wide metappopulation that is decreasing at -7.4 percent per year, which is faster than the long-term trend in radar data across monitoring sites during 1993–2020 (radar lambda = 0.931, or a -6.9 percent decline per year; Raine and Rossiter 2020). Also, the model only takes into account the benefits to the species of one other conservation action on Kauaʻi, the Kauaʻi Seabird HCP conservation site. Other conservation actions implemented by others or expected in the future by others are not included in the model.

As noted above, an example of a conservative model assumption is the initial rate of metapopulation decline. The model assumes an initial rate of metapopulation decline under the unminimized take scenario of -7.4 percent per year. This estimate is conservative because it is greater than the -6.9 percent per year population decline from radar data (1993–2020). The radar trend, unlike the modeled metapopulation trend, only covers those areas of the island with breeding colonies most affected by powerlines and fallout. The radar survey estimate does not incorporate trends from breeding colonies in northwestern Kauaʻi, including the conservation sites. Trends in abundance at the conservation sites have been positive since 2014–2015, as estimated through acoustic call rate monitoring data (Raine et al. 2022). Therefore, the modeled trend for the metapopulation is conservative, because it includes areas which are increasing in abundance, yet matches the long-term average radar site trend which only covers those areas of Kauaʻi that have been most affected by powerline collisions and fallout. Moreover, trend data from independent data sources suggest that current trends may be less negative than they have been historically, and that abundance levels may have stabilized during the last decade for those areas of the island most affected by powerline collisions and fallout. SOS rescue data in recent years is consistent with a population at a stable level, on average. Additionally, Raine and Rossiter (2020) showed that the trends in radar estimates of

[20] Additional modeling would be needed to determine whether a future stable state of the metapopulation of Newell's shearwater (ʻaʻo) on Kauaʻi without take from KIUC covered activities would be viable or not.

[21] Appendix 5E, *Population Dynamics Model for Newell's Shearwater (ʻaʻo) on Kauaʻi*, provides a description of these sources of uncertainty.

population size have leveled out since about 2009, indicating that after a very large population decline before 2009, the population trend may now be relatively stable (a regression of radar data for the last decade [2010–2020] was flat with no significant change). Given the recent radar data that suggests a relatively consistent (albeit low) population of Newell's shearwater (ʻaʻo), projections for the unminimized take scenario (red lines) are likely overestimating potential population declines in the future in the absence of predator control or powerline minimization. For a description of these assumption and additional examples of how the model is likely conservative, see Appendix 5E, *Population Dynamics Model for Newell's Shearwater (ʻaʻo) on Kauaʻi*.

The monitoring and adaptive management strategy described in Chapter 6, *Monitoring and Adaptive Management Program*, is designed to monitor the success of KIUC's minimization and conservation measures throughout the permit term and adjust measures as needed. This will provide additional safeguards around the uncertainties associated with the population dynamics model because ongoing monitoring data gathered during implementation will be compared against model projections, and conservation measures will be adaptively managed to ensure the species' biological goals and objectives are met.

5.3.5.2 Hawaiian Petrel (ʻuaʻu)

Effects and Level of Take

Table 5-3 provides the requested take for Hawaiian petrel (ʻuaʻu) and estimated amounts for each form of take. KIUC requests all forms of take of Hawaiian petrel (ʻuaʻu) that result from the following.

- Up to 21,196 strikes over 50 years from existing and new powerlines.
- Fallout of up to 205 individuals over 50 years from light attraction of existing KIUC-operated streetlights and facilities.
- Fallout of up to 60 individuals over 50 years from light attraction of new KIUC-operated streetlights.
- Injury or mortality of up to 315 individuals (injury of 76 and mortality of 239) over 50 years as a result of traps used for the conservation program.

The estimates for amount of take associated with each form of take (Table 5-3) is a rough approximation based on the best available data. Because each form of take resulting from powerline collisions and fallout cannot be measured in the field (see explanation in Section 5.3.1, *Methods for Quantifying Take and Assessing Effects on the Covered Seabirds*), take from these sources will not be tracked according to each form of take (i.e., injury, mortality, or indirect take of eggs or young).

Impacts of the Taking

Breeding populations of the endangered Hawaiian petrel (ʻuaʻu) on Kauaʻi declined by an estimated 78 percent over a 20-year period from 1993 to 2013 (Raine et al. 2017). This decline is the result of a variety of factors including powerline strikes, light attraction fallout, predation by introduced species, and stochastic events such as hurricanes that damage breeding habitat, and climate shifts altering shearwater food availability. As with Newell's shearwater (ʻaʻo) (Section 5.3.3.1, *Newell's Shearwater (ʻaʻo)*), the Hawaiian petrel's (ʻuaʻu) reproductive strategy renders adult mortality particularly harmful to the species; high adult mortality may depress the population to a level that is vulnerable to extirpation.

Reduction of annual Hawaiian petrel (ʻuaʻu) collisions from existing powerlines consistent with Objective 2.1 is a significant step toward reducing the decline of this species on Kauaʻi. The minimization measures will result in substantial ongoing reduction in take throughout the permit term, and take limits have been established for the HCP based on this expected take minimization. Chapter 6, Section 6.4, *Take and Effectiveness Monitoring and Adaptive Management Triggers*, describes how take will be monitored and minimization measures will be adaptively managed to ensure the take limit is not exceeded. As shown by comparing the unminimized take (red line) and proposed take (grey line) scenarios on Figure 5-6 (see Table 5-1 for description of each scenario), this reduction in collisions is expected to improve the population rate of change. This is the anticipated result of retaining more adults and subadults, thereby improving demography, age class structure, and population size.

As described in Section 5.3.1.4, *Impacts of the Taking—Methods*, KIUC evaluated the impacts of the taking by comparing a hypothetical no-take scenario with the proposed take scenario (and no mitigation measures). The difference between the no-take (purple line) and proposed take (grey line) scenarios in Figure 5-6 reflects the impact of KIUC's requested take on the species throughout the permit term in the absence of mitigation measures. As described in Appendix 5F, *Population Dynamics Model for Hawaiian Petrel (ʻuaʻu) on Kauaʻi*, in the hypothetical absence of take related to KIUC operations during the 50-year analysis period,[22] the Kauaʻi metapopulation would continue to decline at an estimated annual rate of 4.7 percent per year (Lambda = 0.963[23]; Figure 5-6, grey line). This is the modeled rate of decline that results from setting powerline and fallout mortality rates to zero and applying the predation mortality and reproductive success rates estimated at conservation sites prior to implementation of KIUC's predator control measures. The purple line on Figure 5-6 suggests that the effects of predation and other threats to the species remain substantial even without the adverse effects of KIUC covered activities. The difference between no take (purple line) and minimized, proposed take (grey line) scenarios in the absence of mitigation reflects the impact of KIUC's requested take on the species throughout the permit term. Even with minimization, the continued loss of Hawaiian petrel (ʻuaʻu) as a result of KIUC covered activities could have an appreciable negative effect on the metapopulation of Hawaiian petrel (ʻuaʻu) in the absence of mitigation measures to offset these effects. The net effects of the KIUC HCP on the species, considering both the adverse effects of the requested take and the beneficial effects of mitigation measures, are described below.

[22] Since KIUC powerlines are already in operation and their removal would be infeasible, this no-take scenario is hypothetical and used only as a basis for evaluating the impact of the taking on the species.

[23] Lambda (λ) represents the annual population multiplier. A lambda of 1.0 indicates a population that is replacing itself but not growing or declining (i.e., a stable population). A lambda above 1.0 indicates a growing population. A lambda below 1.0 indicates a declining population.

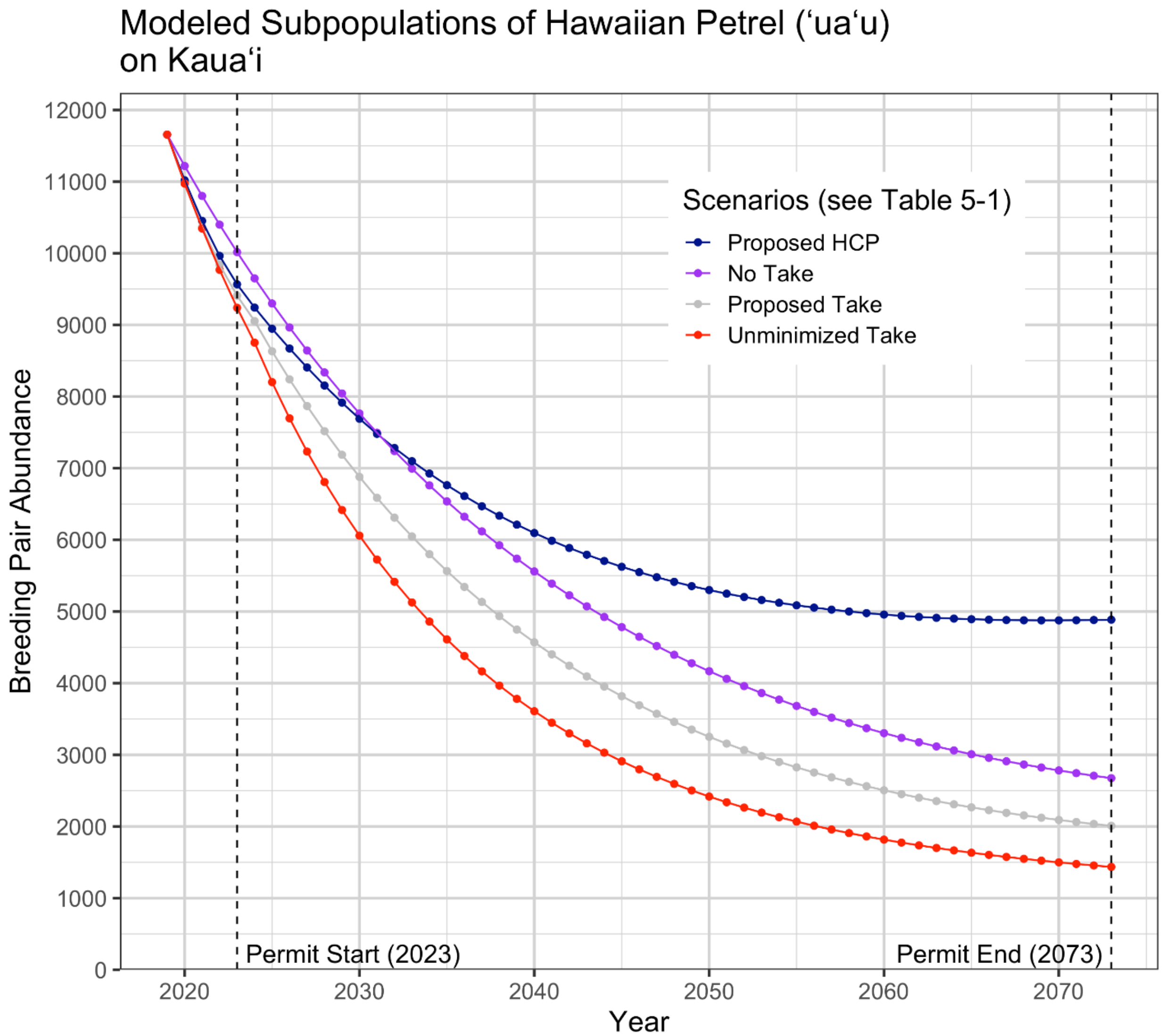

Figure 5-6. Population Dynamics Model Results for Hawaiian Petrel (ʻuaʻu) Island-wide for All Four Scenarios

Beneficial and Net Effects

The measure described in Chapter 4, Section 4.4.4, *Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites,* is expected to mitigate Hawaiian petrel (ʻuaʻu) mortalities resulting from KIUC covered activities through management and enhancement of breeding colonies and reduction of predators (the same as Newell's shearwater [ʻaʻo] described in Section 5.3.3.1, *Newell's Shearwater (ʻaʻo)*, subsection *Beneficial and Net Effects*).

Metapopulation Viability

Substantial population increases at the conservation sites and improved survival outside the conservation sites, in combination with minimizing take, are expected to eventually reverse the current island-wide population decline and establish a stable, viable metapopulation of Hawaiian petrel (ʻuaʻu) on Kauaʻi consistent with Goal 2 in Chapter 4, *Conservation Strategy*. Chapter 4, Section

4.3.2, *Newell's Shearwater ('a'o)*, describes how *viable* is defined in the context of population dynamics modeling. The population dynamics model indicates that the KIUC HCP would meet Goal 2 for Hawaiian petrel ('ua'u), resulting in a viable metapopulation on Kaua'i as represented by the following characteristics.

- Number of breeding pairs
- Population growth rate
- Age structure and demography
- Distribution

Each of these characteristics is described below in relation to the output of the population dynamics model.

Number of breeding pairs. Consistent with Objective 2.3, KIUC will maintain an annual minimum of 2,257 breeding pairs on the conservation sites throughout the permit term, reach a target of 5,851 breeding pairs by year 25 of the permit term, and reach a target of 7,429 breeding pairs on the conservation sites by the end of the permit term. As described in Chapter 6, Section 6.4.4, *Conservation Site Monitoring and Adaptive Management*, and Appendix 6A, *Adaptive Management Comparison Tables*, KIUC will monitor the conservation sites and adaptively manage them to ensure these commitments are met.

The model predicts that the population size consists of an estimated 5,288 breeding pairs by the end of the permit term, with the population stabilizing and slightly increasing beyond the permit term. This is well above estimates by USFWS and DOFAW (2022) that for the Kaua'i metapopulation of Hawaiian petrel ('ua'u), 10,000 individuals (and 2,500 breeding pairs) represent a minimum viable level viable for the Plan Area.

Population growth rate. Consistent with Objective 2.3, KIUC will maintain an annual growth rate for breeding pairs of at least 1 percent at all conservation sites combined as measured by a 5-year rolling average, and maintain a 5-year rolling average of 78.6 percent reproductive success rate at reference burrows. As described in Chapter 6, Section 6.4.4, *Conservation Site Monitoring and Adaptive Management*, and Appendix 6A, *Adaptive Management Comparison Tables*, KIUC will monitor the conservation sites and adaptively manage them to ensure these commitments are met. As shown on Figure 5-9, the population growth rate at all conservation sites combined is expected to be between 1.008 and 1.011 throughout the permit term (a number greater than 1.0 indicates a growing population). As shown in Table 5-6, by the end of the permit term the metapopulation of Hawaiian petrel on Kaua'i is modeled to be stable. Although difficult to see in the graph, the modeled metapopulation of Hawaiian petrel ('ua'u) begins to grow slightly starting in Year 47 of the permit term (2075). All else being equal (i.e., the HCP conservation measures remaining in place), this positive growth trajectory would continue after the permit term and continue to increase, similar to the result for Newell's shearwater ('a'o) (see Figure 5-2).

Demography and age structure. Modeled metapopulation numbers that are stable or increasing are consistent with viability because a stable or increasing modeled metapopulation size occurs when the total annual number of fledglings produced is equal to or greater than the number of deaths on an island-wide basis. This stable or slightly positive productivity at the end of the HCP will result from achieving the biological objectives, resulting in a net benefit to the modeled metapopulation that overcomes the reductions in survival and reproductive success resulting from future levels of powerline strikes, light fallout, and introduced predators. As shown on Figure 5-9, the combined conservation sites are expected to demonstrate a relatively high rate of population growth reflecting an age structure and demography consistent with a viable population.

Spatial distribution. As described in Chapter 4, *Conservation Strategy*, there are practical limitations precluding conservation efforts in areas of Kauaʻi outside the conservation sites; therefore, future populations are likely to become spatially concentrated in remote locations with rugged terrain that are distant from powerlines and lights, where conservation efforts are focused. The results of the population dynamics model are consistent with the future breeding distribution of Hawaiian petrel (ʻuaʻu) on Kauaʻi becoming spatially more concentrated towards the conservation sites and Wainiha and Lumahaʻi Valleys in the future.

Although the population dynamics model results suggest that some subpopulations outside of the conservation sites would not be considered viable, the conservative biological assumptions underlying the results for these subpopulations follow modeled rates of decline that are based on the largest estimated rate of decline observed across individual radar monitoring sites. That is, prior to the HCP, it is assumed the Hanalei to Kekaha area has been experiencing a -8.1 percent annual rate of decline, corresponding to the estimated trend at the Waiakalua Stream radar site. Of the 13 radar sites that have been systematically monitored since 1993, this is the most drastic rate of decline that has been observed at any of the individual radar monitoring sites between Hanalei and Kekaha. By comparison, the average rate of decline when averaged across the 13 radar sites during the same 1993–2020 time period is -4.6 percent per year (Raine and Rossiter 2020). Furthermore, during the last decade (2010–2020), the overall trend across radar sites has been stable (Raine and Rossiter 2020).

If the actual population trend in this area, and other areas included in the most recent analyses of the radar survey data has been stable during the last decade, the results of the population dynamics model would substantially *overestimate* the extent to which the future spatial distribution of breeding Hawaiian petrel (ʻuaʻu) on Kauaʻi might be decreased by take of KIUC covered activities. Nevertheless, as noted above, a stable population well above the abundance threshold is consistent with a viable metapopulation, despite a shift in distribution to concentrate populations in areas with higher long-term conservation value.

Beneficial Effects of the Conservation Strategy

KIUC compared a scenario without the proposed conservation strategy (i.e., the unminimized, proposed take scenario) with the proposed HCP scenario to illustrate the beneficial effects of the proposed conservation strategy. Appendix 5F, *Population Dynamics Model for Hawaiian Petrel (ʻuaʻu) on Kauaʻi*, and Figures 5-6 through 5-9, provide relevant results from the population dynamics model. The red line on Figure 5-6 indicates the estimated population trajectory of a scenario with ongoing take and no minimization or other conservation measures, based on the same assumptions described above for Newell's shearwater (ʻaʻo).

When all subpopulations are combined for Kauaʻi (Figure 5-6), the Hawaiian petrel (ʻuaʻu) metapopulation is projected to continue to decline with ongoing take and no minimization or other KIUC conservation measures (red line). By the end of the analysis period (2073), the Kauaʻi metapopulation would be close to extirpation. Depending on the age structure and spatial distribution of the species at that time, it may be functionally extinct due to its slow reproductive rate. In contrast, the HCP conservation measures are to slow the decline considerably between 2040 and 2060 and stabilize the island-wide metapopulation (Figure 5-6, dark blue line).

With an initial rate of population decline under the unminimized take scenario at -5.4 percent per year, nearly all subpopulations are projected to be extirpated by approximately 2050 or soon afterwards (Figure 5-6). The population dynamics results in Figure 5-7 demonstrate that the conservation measures at all the conservation sites will benefit Hawaiian petrel (ʻuaʻu), with substantial benefits at North Bog and Pihea. HCP benefits are greatest at the four conservation sites with predator exclusion fencing and social attraction, with slight to substantial population declines outside conservation sites as shown on Figure 5-8. The population trajectory for Hawaiian petrel (ʻuaʻu) at all conservation sites combined shown in Figure 5-9 shows that the total population size of Hawaiian petrel (ʻuaʻu) at all of the conservation sites is expected to increase steadily.

Net Effects

The difference between the no-take scenario and the HCP with its proposed conservation strategy represents the net effect resulting from the proposed take combined with the proposed conservation. The hypothetical scenario of no KIUC take during the 50-year permit term (Figure 5-6, grey line) shows a downward species decline resulting from factors other than KIUC's proposed take. In contrast, the HCP conservation measures including minimization and mitigation are projected by the end of the permit term to provide net benefits to the species by year 10 and these net benefits increase through the remainder of the permit term, as shown by comparing the grey and dark blue lines on Figure 5-6. There is projected to be a net increase in numbers of breeding pairs (dark blue line) compared with a hypothetical scenario in which the proposed take did not occur (grey line). Hence, the HCP provides a substantial net benefit to Hawaiian petrel (ʻuaʻu).

Addressing Uncertainty

Uncertainties around the modeling used to estimate adverse, beneficial, and net effects on Hawaiian petrel (ʻuaʻu) are addressed in the same manner as described above for Newell's shearwater (ʻaʻo). That is, conservative estimates were used in the model, and model projections will be compared against monitoring data during implementation to adjust the conservation strategy as needed and ensure the biological goals and objectives are met for the species.

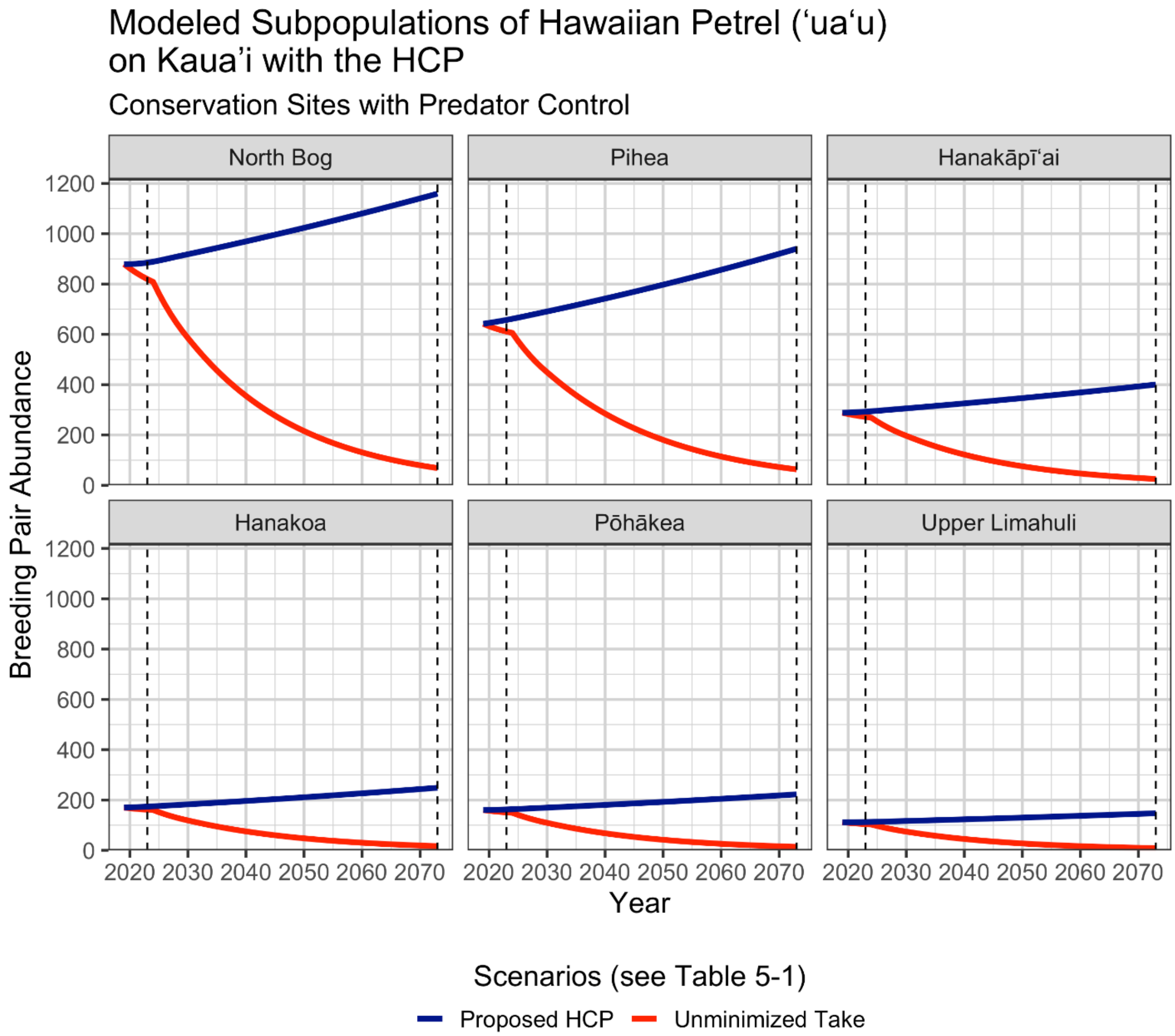

Figure 5-7. Population Dynamics Model Results for Hawaiian Petrel (ʻuaʻu) for Each Conservation Site

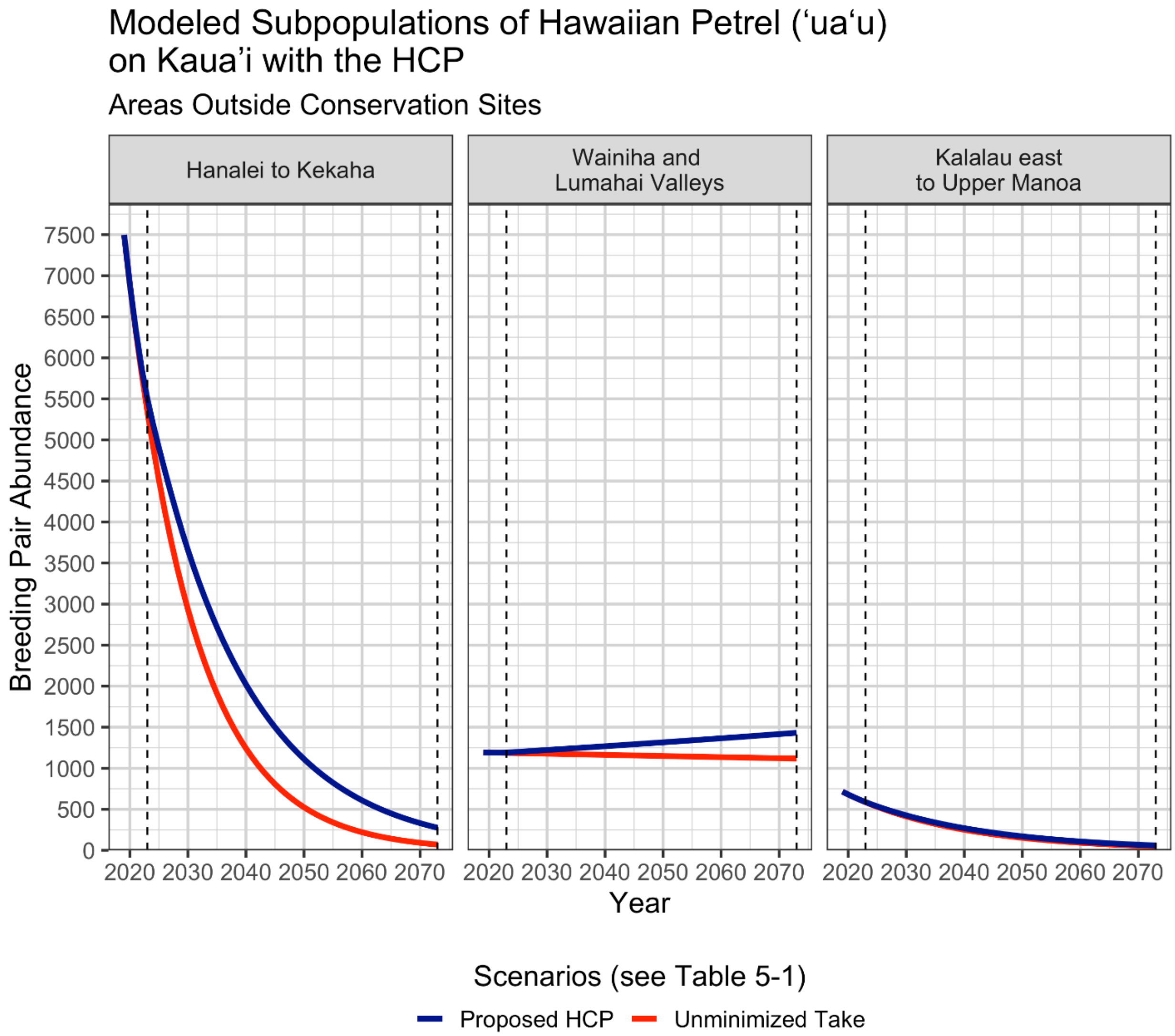

Figure 5-8. Population Dynamics Model Results for Hawaiian Petrel (‘ua‘u) for Unmanaged Sites

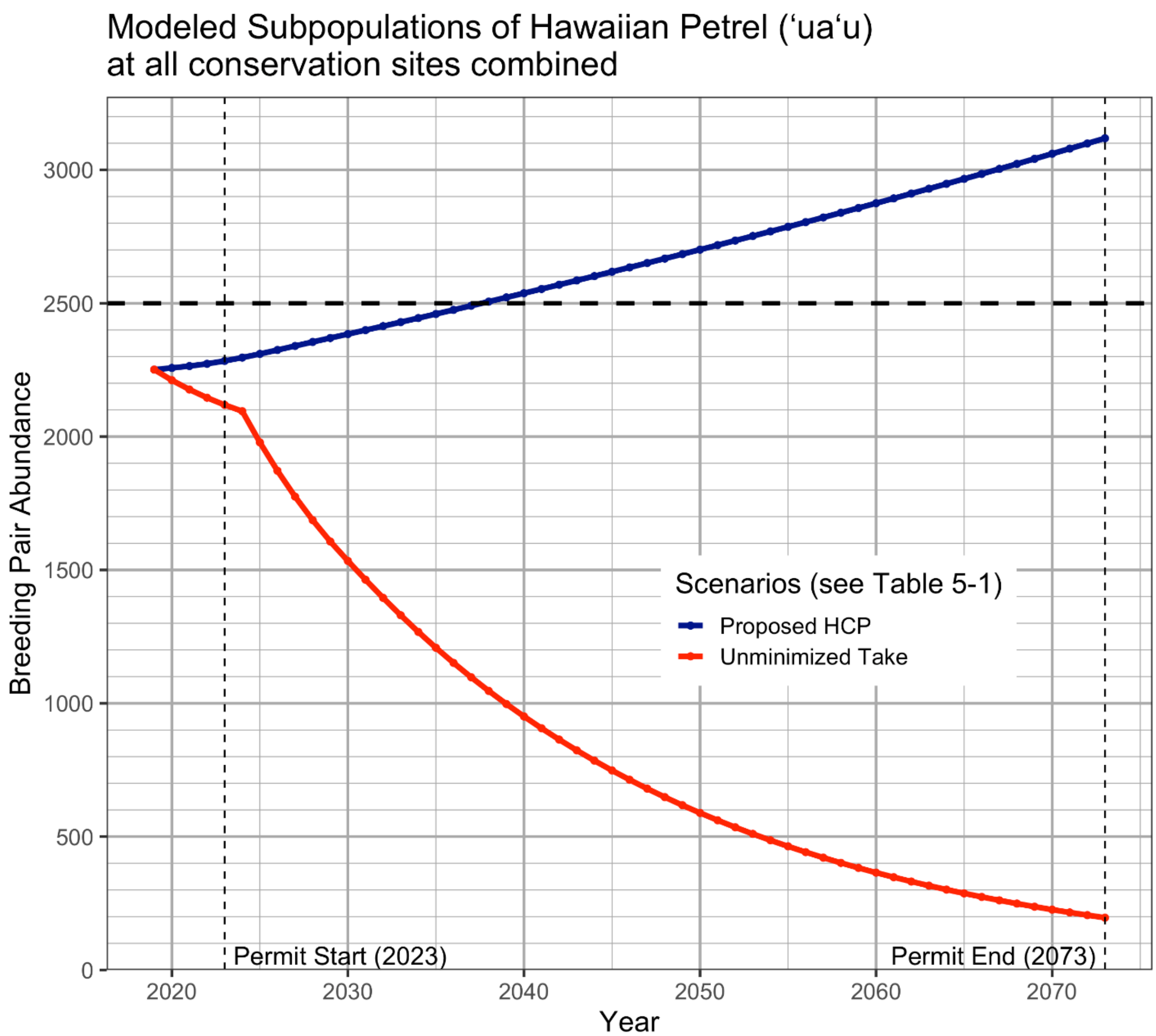

Figure 5-9. Population Dynamics Model Results for Hawaiian Petrel (ʻuaʻu) for all Conservation Sites Combined

5.3.5.3 Band-Rumped Storm-Petrel (ʻakēʻakē)

Effects and Level of Take

Table 5-4 provides the requested take for band-rumped storm-petrel (ʻakēʻakē) and estimated amounts for each form of take.

There are no reliable estimates for take of band-rumped storm-petrel (ʻakēʻakē) resulting from powerline collisions because the species is relatively rare on Kauaʻi and powerline strikes are thought to be very rare (even relative to their low abundance). For the purpose of this analysis, KIUC assumed a total mortality of 16 band-rumped storm-petrels (ʻakēʻakē) from existing powerlines and 6 from new powerlines over the 50-year permit term. Ongoing research and monitoring will evaluate the levels of take during implementation and provide measures to ensure the effects on the species do not exceed those limits, as described in Chapter 6, *Monitoring and Adaptive Management Program*.

Impacts on band-rumped storm-petrel (ʻakēʻakē) from light attraction are difficult to estimate because it is a very small and cryptic seabird that is difficult to find once grounded. Work in remote colonies of band-rumped storm-petrels (ʻakēʻakē) indicate this species is extremely susceptible to light attraction (Raine in litt.). Thus, light attraction of this species is likely underreported (Raine et al. 2017). The estimated annual band-rumped storm-petrel (ʻakēʻakē) mortality resulting from fallout is an average of 0.8 bird from streetlights and no birds from covered facility lighting (Appendix 5C, *Light Attraction Modeling*), resulting in total take estimate from fallout of 40 birds over the 50-year permit term.

The estimates for amount of take associated with each form of take (Table 5-4) is a rough approximation based on the best available data. Because each form of take resulting from powerline collisions and fallout cannot be measured in the field (see explanation in Section 5.3.1, *Methods for Quantifying Take and Assessing Effects on the Covered Seabirds*), take from these sources will not be tracked according to each form of take (i.e., injury, mortality, or indirect take of eggs or young).

Impacts of the Taking

The worldwide population size of the band-rumped storm-petrel (ʻakēʻakē) is uncertain, but is most likely around 150,000 birds (Appendix 3A, *Species Accounts*). The Hawaiʻi distinct population segment (DPS) of the band-rumped storm-petrel (ʻakēʻakē) represents a small, remnant population of possibly 400–500 birds (Appendix 3A, *Species Accounts*) or an estimated 221 breeding pairs (U.S. Fish and Wildlife Service 2020). Based on the scarcity of known breeding sites in Hawaiʻi, the remote and inaccessible locations where they are suspected to occur today, and compared to prehistoric population levels and distribution, the Hawaiʻi DPS of band-rumped storm-petrel (ʻakēʻakē) appears to be significantly reduced in numbers and range following human occupation of the Hawaiian Islands (Appendix 3A, *Species Accounts*). The mortality of an estimated 0.51 adult band-rumped storm-petrel (ʻakēʻakē) per year due to powerline strikes represents 0.15 percent of the estimated Hawaiʻi DPS (0.4300/400=0.0015 or 0.15 percent). Additionally, the mortality of 1.0 fledgling band-rumped storm-petrel (ʻakēʻakē) per year (Table 5-7) represents 0.38 percent of the estimated total fledglings produced annually by this species (221 breeding pairs; 1.0/211 = 0.0047 = 0.47 percent). The loss of 108 band-rumped storm-petrels (ʻakēʻakē) over the 50-year permit term, as described in the previous section, is not likely to have an appreciable effect on the survival and recovery of the Hawaiʻi DPS of band-rumped storm-petrel (ʻakēʻakē). The net effects of the KIUC HCP on the band-rumped storm-petrel (ʻakēʻakē), taking both the adverse and beneficial effects into account, are described below.

Beneficial and Net Effects

The measure described in Chapter 4, Section 4.4.3, *Conservation Measure 3. Provide Funding for the Save Our Shearwaters Program*, is expected to minimize and partially offset effects of powerline strikes for band-rumped storm-petrel (ʻakēʻakē). Based on SOS data from 2009 through 2019, an estimated 20 band-rumped storm-petrels (ʻakēʻakē) will be rescued and released over the 50-year permit term (Table 5-6), minimizing and partially offsetting the 44 mortalities from KIUC covered activities conservatively estimated for this species over the permit term. Management of the conservation sites are not expected to directly benefit this species because no band-rumped storm-petrels (ʻakēʻakē) have been observed at these sites to date. However, the species is likely to benefit from predator control at the Honopū conservation site because of its proximity to the Nā Pali Coast where most band-rumped storm-petrel (ʻakēʻakē) are thought to occur on Kauaʻi. Barn owl control at all conservation sites is likely to benefit band-rumped storm-petrel (ʻakēʻakē)by reducing predation at their breeding sites from these wide-ranging predators. KIUC expects funding of the SOS Program, in addition to the conservation measures for the other two covered species, are sufficient to offset the impact of the taking on band-rumped storm-petrel (ʻakēʻakē). Considering both the take associated with KIUC activities and the effects of SOS recoveries and regional predator control, the KIUC HCP will have a net benefit on band-rumped storm-petrels (ʻakēʻakē) on Kauaʻi.

5.4 Effects on Covered Waterbirds

5.4.1 Methods for Assessing Effects on Waterbirds

The covered waterbirds are susceptible to powerline strikes but not susceptible to light attraction, so the analysis focuses only on estimating the effects of powerline strikes. The effects analysis for covered waterbirds is based on an assessment provided as Appendix 5B, *Rapid Waterbird Powerline Collision Assessment,* completed by Marc Travers and André Raine in 2020. This section summarizes the methods of this assessment.

A combination of acoustic data of recorded strikes and observations of waterbird behavior around powerlines were used to estimate powerline collisions for three of the covered waterbirds: Hawaiian stilt (aeʻo) (*Himantopus mexicanus knudseni*), Hawaiian duck (koloa maoli) (*Anas wyvilliana*), and Hawaiian goose (nēnē) (*Branta sandvicensis*). Observational and acoustic data were not available for the other two covered waterbirds, Hawaiian common gallinule (ʻalae ʻula) (*Gallinula galeata sandvicensis*) and Hawaiian coot (ʻalae keʻokeʻo) (*Fulica alai*), so strike estimates were not developed for these species. Rather, analysis of grounded bird detections was used to estimate the number of powerline mortalities (not strikes) for these two species.

All waterbird collisions were assigned to one of three geographic areas: (i) Mānā, (ii) Hanalei wetlands, and (iii) all other areas (Figure 4-1). Mānā is the only area with a full range of monitoring data including observation data, acoustic detections of strikes, and modeling of acoustic strike patterns across a season. Hanalei wetlands (east of the town of Hanalei) includes the Hanalei National Wildlife Refuge; this area has a large concentration of suitable breeding and foraging habitat for all of the covered waterbirds, is known to support a large share of the island's population of each species and overlaps with powerlines. However, no monitoring data is available for this area.

All other sites on Kauaʻi where covered waterbirds occur have (1) relatively low densities of occurrences, (2) are far from powerlines and therefore have low risks of collisions, or (3) both; for these reasons, all other sites on the island were combined into a single category. Because of the lack of observational or acoustic data at Hanalei wetlands and all other areas, observational and acoustic data from Mānā was used as the basis for the determination of waterbird powerline collisions in the other two areas.

To partition the total number of powerline collisions by species, a collision risk score was developed that ranked each species' (covered and noncovered) relative collision risk at Mānā. The collision risk score for each species was based on a combination of observational data including the frequency of powerline crossings, the flight height of the birds crossing the wires (i.e., proximity of flight to wires), and whether the covered waterbirds tend to fly singly or in pairs or flocks (birds in pairs or flocks have a higher collision risk than single birds). Each species' proportion of risk was then calculated by dividing each species' risk score by the total risk scores for all covered waterbirds.

For Mānā, night strikes and crepuscular strikes (i.e., dawn and dusk) were estimated separately because the Bayesian acoustic strike model does not address crepuscular strikes (Appendix 5D, *Bayesian Acoustic Strike Model*). The Bayesian acoustic strike model results in an estimated 640 night strikes of all birds (covered seabirds, covered waterbirds, and non-covered birds) annually at Mānā. The total night strikes were multiplied by each species' proportion of risk to estimate annual night strikes for each species at Mānā. For crepuscular strikes, the raw crepuscular strike numbers were adjusted to a strike estimate proportionally equivalent to the Bayesian model estimate (i.e., the proportion of Bayesian night strike estimates to raw night strike estimates was applied to the crepuscular raw strike data to arrive at crepuscular night strike estimates). Night strike estimates and crepuscular strike estimates were then added together for the total annual take estimate for Mānā.

Powerline collision rates at Hanalei were estimated based on Mānā estimates and adjusted proportionately by the relative length of powerlines at each site (powerline configuration and heights are similar between the sites). The Hanalei section of powerlines is 95 percent of the length of powerlines at Mānā, so Mānā strike rates were multiplied by 0.95 to estimate the Hanalei strike rates.

To assess strike rates at all other sites, the collision risk score was calculated for each waterbird species based on island-wide observational monitoring data from all other powerlines. The proportion of all strikes that occur in monitored areas outside Mānā was then estimated by dividing the collision risk score outside Mānā by the risk score at Mānā. This proportion was multiplied by the estimated strike rate at Mānā to estimate the strike rate in other areas. Appendix 5B, *Rapid Waterbird Powerline Collision Assessment*, provides additional detail on these methods, and describes limitations to the analysis and the estimates.

Take of covered waterbirds anticipated from future powerlines was estimated using the same methods as described for covered seabirds in Section 5.3.1.1, *Powerline Collisions—Methods.* The locations for future powerlines are currently unknown, but take limits were established based on an assumed 6.8 percent increase in strikes over the permit term.

As described for covered seabirds in Section 5.3.1.1, *Powerline Collisions—Methods,* the measurable units of take for covered waterbirds are powerline strikes. Requested take limits for waterbirds were established based on the estimated proportion of injuries and mortalities along powerline spans associated with the greatest amount of waterbird habitat and movement, which is at Mānā (spans 1–113) and Hanalei (spans 462–478 and 1297–1328); these areas have had confirmed waterbird take in previous years from powerline collisions and had a total annual rate of collisions of 985 for all birds, 729 of which were for covered waterbird species.[24] Assuming 90 percent minimization during implementation, the annual total rate of collisions of the covered waterbird species would be 72.9, with a total number of collisions of 3,645 over the 50-year permit term (72.9 x 50). (Table 5-7). The proportion of total covered waterbird strikes on the affected spans during the permit term would therefore be an estimated 74 percent (3,645/4,925= 74 percent). Covered waterbird take will be tracked over the permit term as 74 percent of all collisions along these spans, and it will be assumed that the proportion of injuries and mortalities by species are as provided in

[24] These numbers came from adding up all annual strikes from Appendix 5B, *Rapid Waterbird Powerline Collision Assessment*, Tables 2, 3, and 4.

Table 5-7. Assuming a 6.8 percent increase in strikes with new powerlines, the total number of covered waterbird collisions estimated for the 50-year permit term is 3,893.

There are no published data available regarding the grounding rate of covered waterbirds (i.e., the rate at which waterbirds that collide with powerlines are grounded) on Kaua'i or elsewhere. Similarly, no published data exist on the mortality rate of grounded waterbirds on Kaua'i or elsewhere. In the absence of such data, for the purposes of this HCP, the same grounding rate assumption used for seabirds are used for waterbirds (28.8 percent). The analysis also assumes that 69.7 percent of grounded waterbirds die (Travers et al. 2021). While the seabird analysis assumes all grounded seabirds result in mortality, the waterbird analysis assumes that grounded waterbirds without severe injuries after an initial collision are likely to continue surviving. This is because they are primarily ground-dwelling species thus are more mobile when grounded and have greater capacity to regain flight than grounded seabirds (Section 5.2.1.3, *Effect of Powerline Strikes on Covered Waterbird Species*).

For Hawaiian common gallinule ('alae 'ula) and Hawaiian coot ('alae ke'oke'o), data on dead bird detections were used to estimate powerline collision mortalities (not strikes), because neither of these species have supporting observational data (Appendix 5B, *Rapid Waterbird Powerline Collision Assessment*). Dead birds were classified in the field as either confirmed, probably, or possibly a result of KIUC powerline strikes based on the location of the dead bird relative to powerlines, roads, and nearby water features.[25]

For all covered waterbirds, KIUC expects to minimize strikes at powerlines where waterbirds are vulnerable by 90 percent by the end of 2023 (Shaw et al. 2021), when the HCP is expected to take effect. As such, the number of estimated strikes was multiplied by 10 percent to estimate powerline strikes post-minimization.

The limitations of the assessment are described in Appendix 5B, *Rapid Waterbird Powerline Collision Assessment.* Despite these limitations, the analysis provides the best available information to conservatively estimate the effects of powerline collisions on the covered waterbirds, as described above and in Section 5.4.2, *Effects Common to All Covered Waterbirds*, and Section 5.4.3, *Species-Specific Waterbird Effects.*

5.4.2 Effects Common to All Covered Waterbirds

Effects and Level of Take

KIUC requests take of the covered waterbirds associated with 74 percent of all KIUC powerline collisions along powerline spans in Mānā (spans 1–113) and Hanalei (spans 462–478 and 1297–1328) during the permit term. Because species identity cannot be determined using acoustic strike data, KIUC requests take authorization for all covered waterbirds combined as a constant proportion of 74 percent of all powerline strikes along these spans as determined from acoustic strike data, adjusted for minimization. KIUC will also apply this proportion to future lines associated with covered waterbirds.

[25] Appendix 5B, *Rapid Waterbird Powerline Collision Assessment*, provides details and a description of how each category was assigned. Categories of "definitive" and "probable" (not "possible") were used to estimate mortality for Hawaiian gallinule ('alae 'ula). For Hawaiian coot ('alae ke'oke'o), there were no observations of "definitive" or "probable" category birds; to avoid a zero estimate, the "possible" category was used for this species.

There will be an estimated 98.5 annual powerline collisions along spans in Mānā (spans 1–113) and Hanalei (spans 462–478 and 1297–1328) (Travers et al. 2020) for all birds (covered and non-covered); after 90 percent minimization up to 4,925 powerline collisions may occur throughout the 50-year permit term for all bird species recorded along these spans (98.5 X 50). In these areas, 74 percent of all bird collisions are attributed to the covered waterbirds, for a total of 3,645 covered waterbird collisions over the permit term. Assuming a 6.8 percent increase in collisions with new powerlines, an estimated 3,893 covered waterbird collisions are anticipated over the permit term. Chapter 6, *Monitoring and Adaptive Management Program*, describes how KIUC will monitor powerline collisions to ensure take does not exceed this level.

Section 5.2.1.3, *Effect of Powerline Strikes on Covered Waterbird Species*, describes the ways in which powerline strikes can adversely affect the covered waterbirds. Table 5-7 provides the annual and 50-year estimates for number of powerline strikes and number of covered waterbirds injured and killed based on the methods described above in Section 5.4.1, *Methods for Assessing Effects on Waterbirds*. These estimates are for the purpose of analyzing effects on the species but not for tracking take, as described in Chapter 6, *Monitoring and Adaptive Management Program*.

Table 5-7. Estimated Effects on Covered Waterbirds from Powerline Strikes

Species	Estimated Annual Strikes without Min-imization[a]	Percent of Total Waterbird Strikes	Estimated Annual Strikes with Min-imization[b]	Est. Annual Ground-ings[c]	Est. Annual Injury[g]	Est. Annual Morta-lity[d]	50-Year Strikes without New Power-lines[b,f]	50-Year Strikes with New Powerlines (6.8% increase)	50-Year Ground-ing[c]	50-Year Injury[g]	50-Year Powerline Mortality[d,f]	50-Year Projected SOS Rescues[e,f]
Hawaiian stilt (aeʻo)	60	<1	6	2	1	1	300	320	92	28	65	69
Hawaiian duck (koloa maoli)	203	<1	20	6	2	4	1,015	1,084	312	94	219	763
Hawaiian coot (ʻalae keʻokeʻo)	N/A	N/A	N/A	1	0	1	NA	NA	60	17	42	219
Hawaiian common gallinule (ʻalae ʻula)[h]	N/A	N/A	N/A	4	1	3	NA	NA	238	67	167	175
Hawaiian goose (nēnē)[h]	466	1	47	13	4	9	2,330	2,488	717	215	502	1,106
TOTAL	729		72.9	26	8	18	3,645	3,893	1,419	420	993	2,333

[a] Estimated annual strikes prior to minimization, from Appendix 5B. Hawaiian coot (ʻalae keʻokeʻo) and Hawaiian common gallinule (ʻalae ʻula) strikes not estimated in Appendix 5B (only mortality estimated). See footnote h.

[b] Assumes 90% minimization by 2023, year 1 of the HCP.

[c] Assumes 28.8% of strikes result in grounded birds. See Section 5.4.1, *Methods for Assessing Effects on Waterbirds.*

[d] For Hawaiian stilt (aeʻo), Hawaiian duck (koloa maoli), and Hawaiian goose (nēnē), assumes 70% of groundings result in mortality, based on Travers et al. (2021) observations that 70% of seabirds found were dead and 30% were alive. This is a conservative estimate because seabird mortality is likely higher than waterbird mortality from powerline strikes. For Hawaiian common gallinule (ʻalae ʻula), based on Appendix 5B, 20.8 birds with *definitive* and *probable* powerline collision as source of mortality, multiplied by 0.15 to account for 90% minimization. For Hawaiian coot (ʻalae keʻokeʻo), based on 5.2 *possible* powerline collisions as source of mortality, since there were zero birds of this species in the *definitive* or *probable* categories.

[e] Based on average annual number of SOS rescues from 2012 through 2019 (time span within which SOS consistently collected waterbird data).

[f] Rounded up to next whole number.

[g] Grounded birds that are not killed are assumed to be injured.

[h] For Hawaiian common gallinule (ʻalae ʻula) and Hawaiian coot (ʻalae keʻokeʻo), mortality was estimated as described in footnote d. Groundings were estimated by dividing mortality by 0.7 (70% of groundings result in mortality). Strikes were estimated by dividing groundings by 0.288 (28.8% of strikes result in grounding).

Beneficial and Net Effects

As described in Chapter 4, *Conservation Strategy*, rescue and recovery efforts through the SOS Program will minimize and offset the number of mortalities from powerline strikes. In addition, the SOS Program is expected to fully offset mortalities through the rescue, recovery, and release of waterbirds back into the wild that are affected by factors unrelated to KIUC's covered activities (non-take situations such as botulism). Rescuing, treating, and releasing covered waterbirds in this situation contributes to the species recovery by increasing their survival and reproduction. Section 5.4.3, *Species-Specific Waterbird Effects*, provides an analysis of the beneficial effects of the SOS Program on each covered waterbird species.

Table 5-8 summarizes the number of individuals of each covered waterbird species recovered or released from the SOS Program from 2012 through 2019, which is when SOS consistently collected data on waterbirds (Raine pers. comm.). This cumulative amount is converted to an average annual rate of recovery and release and multiplied by 30 to estimate the total number of waterbirds expected to be recovered and released during the permit term. This estimate is likely conservative since the earlier years of the SOS Program recovered fewer birds than in later years of the program because the program was smaller and less well known than it is today, with fewer volunteers or paid staff, and less visibility to the public.

Table 5-8. Covered Waterbird Species Recovered or Rehabilitated and Released by SOS Program

Species	No. of Individuals Recovered and Released 2012–2019 [a]	Average Annual Rate of Recovery and Release (No. of Individuals)	Assumed 50-Year Recovery and Release (No. of Individuals)[b]
Hawaiian stilt (ae'o)	11	1.37	69
Hawaiian duck (koloa maoli)	122	15.25	763
Hawaiian coot ('alae ke'oke'o)	35	4.37	219
Hawaiian common gallinule ('alae 'ula)	28	3.5	175
Hawaiian goose (nēnē)	177	22.13	1,106

[a] Source: SOS Program data.
[b] Rounded up to whole number.

5.4.3 Species-Specific Waterbird Effects

The effects and level of take for the covered waterbirds are described in Section 5.4.2, *Effects Common to All Covered Waterbirds*, and Table 5-7. The sections below describe the impacts of the taking and the beneficial and net effects of the KIUC HCP on each species.

5.4.3.1 Hawaiian Stilt (ae'o)

Impacts of the Taking

Long-term census data indicate that the statewide population Hawaiian stilt (ae'o) increased from 1985 to 2004 and have been roughly stable since then with approximately 1,500 to 2,000 individuals statewide (U.S. Fish and Wildlife Service 2020; Paxton et al. 2021). Populations have been increasing on Kaua'i over the last 31 years (Paxton et al. 2022). The USFWS formally proposed downlisting the species from endangered to threatened in May 2021 (U.S. Fish and Wildlife Service 2021). Because the covered powerlines have been present throughout the census period, it is reasonable to assume that the population trajectory of Hawaiian stilt (aeʻo) has been stable or slightly increasing despite ongoing powerline collisions. The stable or increasing population even with this ongoing source of mortality therefore indicates that the species' population is sustainable with current levels of powerline collision mortality (and with other sources of mortality unrelated to KIUC covered activities). Powerline collisions will be reduced by 90 percent by the minimization measures of this HCP (see Chapter 4, Section 4.4.1, *Conservation Measure 1. Implement Powerline Collision Minimization Projects*).

Beneficial and Net Effects

The measure described in Chapter 4, Section 4.4.3, *Conservation Measure 3. Provide Funding for the Save Our Shearwaters Program,* is expected to minimize and fully offset the effects of powerline strikes on Hawaiian stilts (aeʻo) and contribute to the species' recovery. Based on SOS data since 2012, an estimated 69 Hawaiian stilts (aeʻo) will be rescued and released over the 50-year permit term, exceeding the 65 mortalities from powerline strikes conservatively estimated for this species over the permit term (Table 5-7).

5.4.3.2 Hawaiian Duck (koloa maoli)

Impacts of the Taking

The Hawaiian duck (koloa maoli) population has been estimated by USFWS to be about 2,000 true Hawaiian ducks (koloa maoli) (i.e., not hybridized) on Kauaʻi and Niʻihau, and 200 on the Island of Hawaiʻi (U.S. Fish and Wildlife Service 2011, 2015). Paxton et al. (2021) estimated a 5-year average population size between 2012 and 2016 on Kauaʻi of 751 to 1,185 individuals. Hawaiian duck (koloa maoli) survey counts on Oʻahu, Maui, and Hawaiʻi are confounded by the difficulty in distinguishing in the field Hawaiian duck (koloa maoli) from mallards and hybrids of mallards and Hawaiian duck (koloa maoli). Because of these issues, there is currently no credible population estimate for Hawaiian duck (koloa maoli) at any scale (U.S. Fish and Wildlife Service 2018). The Kauaʻi population of this species increased between 2006 and 2016 (Paxton et al. 2021).

Since its listing under the federal Endangered Species Act in 1967, the Hawaiian duck (koloa maoli) population has increased on Kauaʻi, though it is declining on other Hawaiian Islands (U.S. Fish and Wildlife Service 2011). The Hawaiian duck (koloa maoli) population on Kauaʻi is substantially larger than the populations on all other Hawaiian Islands combined. This comparatively large population size is likely due to the lack of an established population of mongooses and very low occurrence of hybridization (U.S. Fish and Wildlife Service 2011).

Because the population on Kauaʻi has been increasing even with the ongoing source of powerline mortality, the species' metapopulation on Kauaʻi is likely sustainable and viable into the future with substantially reduced levels of powerline collision mortality under this HCP.

Beneficial and Net Effects

The measure described in Chapter 4, Section 4.4.3, *Conservation Measure 3. Provide Funding for the Save Our Shearwaters Program*, is expected to minimize and fully offset effects of powerline strikes on Hawaiian ducks (koloa maoli) and contribute to the species' recovery. Based on SOS data since 2012, an estimated 763 Hawaiian ducks (koloa maoli) will be rescued and released over the 50-year permit term, exceeding the 219 mortalities from powerline strikes conservatively estimated for this species over the permit term (Table 5-7).

5.4.3.3 Hawaiian Coot (ʻalae keʻokeʻo)

Impacts of the Taking

The Hawaiian coot (ʻalae keʻokeʻo) population was estimated to be 1,248 to 2,577 birds across the state of Hawaiʻi as an annual average from 2012 to 2016 (Paxton et al. 2021). Survey data from biannual waterbird counts suggest that the population on Kauaʻi has been increasing from 2006 to 2016 (Paxton et al. 2021). Due to the relatively high reproductive rate of Hawaiian coot (ʻalae keʻokeʻo) and its upward population trend even with the ongoing losses from powerline strikes, ongoing but substantially reduced powerline strikes are not expected to adversely affect the long-term survival or potential for recovery of Hawaiian coots (ʻalae keʻokeʻo) on Kauaʻi.

Beneficial and Net Effects

The measure described in Chapter 4, Section 4.4.3, *Conservation Measure 3. Provide Funding for the Save Our Shearwaters Program,* is expected to mitigate and fully offset effects of powerline strikes on Hawaiian coots (ʻalae keʻokeʻo) and contribute to the species' recovery. Based on SOS data since 2012, an estimated 219 Hawaiian coots (ʻalae keʻokeʻo) will be rescued and released over the 50-year permit term, exceeding the 42 mortalities from powerline strikes conservatively estimated for this species over the permit term (Table 5-7).

5.4.3.4 Hawaiian Common Gallinule (ʻalae ʻula)

Impacts of the Taking

Hawaiian common gallinule (ʻalae ʻula) counts indicate that the statewide population is small but relatively stable with an average of 947 birds (678-1,235) over 5 years (2012–2016), on Kauaʻi (Paxton et al. 2021). Count totals, however, are extremely variable between summer and winter surveys (U.S. Fish and Wildlife Service 2011). However, the annual surveys may be flawed; actual population size is thought to be greater because of the species' secretive behavior. Thus, an accurate population estimate is not available (U.S. Fish and Wildlife Service 2011). Paxton et al. (2021) report an increasing population trend on Kauaʻi for this species over the last 11 years.

Research has shown that broadcasting calls increases the number of individuals counted by as much as 30 percent on Oʻahu and 56 percent on Kauaʻi (Desrochers et al. 2008). Based on a minimum population size of 313 birds (287 x 1.30), the loss of an average of four birds annually (1.0 percent) to powerline strikes could have a substantial adverse effect on the long-term survival and recovery of the species. However, the measured stability of the Hawaiian common gallinule (ʻalae ʻula) population, despite the historic impacts of powerline strikes and other sources of mortality (e.g., vehicle strikes, predators), suggests that ongoing but substantially reduced powerline strikes are not expected to adversely affect the long-term survival or potential for recovery of Hawaiian common gallinule (ʻalae ʻula).

Beneficial and Net Effects

The measure described in Chapter 4, Section 4.4.3, *Conservation Measure 3. Provide Funding for the Save Our Shearwaters Program,* is expected to minimize and fully offset effects of powerline strikes on Hawaiian common gallinules ('alae 'ula) and contribute to the recovery of the species. Based on SOS data since 2012, an estimated 175 Hawaiian common gallinules ('alae 'ula) will be rescued and released over the 50-year permit term, exceeding the 167 mortalities from powerline strikes conservatively estimated for this species over the permit term (Table 5-7).

5.4.3.5 Hawaiian Goose (nēnē)

Impacts of the Taking

The Hawaiian goose (nēnē) population throughout Hawai'i is estimated as 3,865 individuals: 1,099 on Hawai'i, 477 on Maui, 23 on Moloka'i, 2,266 on Kaua'i (59 percent), and 0 on O'ahu (Nēnē Recovery Action Group 2020). Hawaiian geese (nēnē) appear to be increasing on Kaua'i (U.S. Fish and Wildlife Service 2018; Nēnē Recovery Action Group 2020), partially as a result of the release of captive breeding and translocation (U.S. Fish and Wildlife Service 2018). The growing population of this species with historical and ongoing take from KIUC powerlines suggests ongoing but substantially reduced powerline strikes are not expected to adversely affect the long-term survival or potential for recovery of Hawaiian goose (nēnē) on Kaua'i.

These historic levels of collision will be reduced substantially (90 percent) by the minimization measures of this HCP (Chapter 4, Section 4.4.1, *Conservation Measure 1. Implement Powerline Collision Minimization Projects*).

Beneficial and Net Effects

The measure described in Chapter 4, Section 4.4.3, *Conservation Measure 3. Provide Funding for the Save Our Shearwaters Program,* is expected to minimize and fully offset effects of powerline strikes on Hawaiian geese (nēnē) and contribute to the species' recovery. Based on SOS data since 2012, an estimated 1,106 Hawaiian geese (nēnē) will be rescued and released over the 50-year permit term, exceeding the 502 mortalities from powerline strikes conservatively estimated for this species over the permit term (Table 5-7).

5.5 Effects on Green Sea Turtle (honu)

5.5.1 Methods for Assessing Effects

There has been no systematic monitoring to assess effects of KIUC streetlights on green sea turtles (honu). There was an incident in September 2020 on Kaua'i where green sea turtle (honu) hatchlings at night moved toward a KIUC streetlight and some of the hatchlings were crushed by vehicles before a concerned citizen collected some and called local police to assist. Other than that recent incident, there are no records of KIUC streetlights affecting green sea turtle (honu) hatchlings. However, adverse effects of lights on green sea turtle (honu) hatchlings are well documented in other areas (see Section 5.2.2.2, *Light Attraction and Disorientation of Green Sea Turtle (honu)*) and assumed to occur from KIUC streetlights near suitable green sea turtle (honu) nesting habitat.

KIUC conducted a field evaluation in 2020 to assess the extent to which KIUC streetlights might affect green sea turtles (honu), and to evaluate where additional minimization measures are needed. During the evaluation, all sandy beaches on Kaua'i with KIUC streetlights that are potentially visible from the surface of beaches where suitable green sea turtle (honu) nesting habitat was present were evaluated. Suitable nesting habitat was considered regardless of whether or not turtles had been recorded nesting in those locations. The primary criterion for determining whether streetlights could affect green sea turtles (honu) was whether the streetlights were visible from the surface of sandy beaches. Seven beaches were determined to have streetlights that were visible from potentially suitable green sea turtle (honu) nesting habitat at the time of the evaluation: Keālia Beach (2 streetlights), Kapa'a Shoreline (4 streetlights), Wailua Beach (7 streetlights), Po'ipū Shoreline (3 streetlights), Kukui'ula Harbor (3 streetlights), Waimea Shoreline (3 streetlights), and Kekaha Shoreline (7 streetlights). KIUC will reevaluate all suitable habitat near KIUC streetlights on an annual basis to add or remove locations that may affect green sea turtle (honu) hatchlings as environmental conditions change (Section 4.4.5.2, *Shield Active Nests from Streetlights*).

5.5.2 Effects and Level of Take

As described in Appendix 3A, *Species Accounts*, average annual nesting density of green sea turtles (honu) at all Kaua'i beaches are very low, ranging from less than one (i.e., one nest every several years) to one to two nests per year between 2015 and 2020 (State of Hawai'i Division of Aquatic Resources 2020). Without minimization, the number of green sea turtle (honu) nests affected by KIUC streetlights is expected to be less than one per year due to limited extent of effects on suitable beaches. Although nesting density is low, observations of nesting have increased over the past 5 years (State of Hawai'i Division of Aquatic Resources 2020), suggesting that effects of KIUC streetlights could increase slowly over time if no action is taken.

KIUC assumes that with the monitoring and minimization measures to be conducted under Conservation Measure 5, *Implement a Green Sea Turtle Nest Detection and Temporary Shielding Program*, in Chapter 4, *Conservation Strategy*, most or all take resulting from KIUC streetlights will be avoided. Despite this, KIUC requests take authorization of 50 green sea turtle (honu) nests over the 50-year permit term, which is equivalent to an average of one nest every year. This requested take accounts for the possibility of green sea turtle (honu) nests going undetected by monitors and not being temporarily shielded from a KIUC streetlight. Alternatively, temporary shielding may be ineffective at some nest sites due to incorrect placement or vandalism, in which case hatchlings may be affected by KIUC streetlights.

Based on the methodology and assumptions described above, KIUC requests take of 50 green sea turtle (honu) nests over the 50-year permit term (an average of one nest per year), where take in the form of disorientation, injury, or mortality of any hatchlings in a nest counts as take of that nest. This approach was selected because of the difficulty of observing all hatchlings in any one nest since hatching occurs at night and its timing is unpredictable. KIUC believes that this take request is conservative. KIUC assumes that with the monitoring and minimization measures under Conservation Measure 5, *Implement a Green Sea Turtle Nest Detection and Temporary Shielding Program* in Chapter 4, *Conservation Strategy*, most and potentially all take of green sea turtle (honu) from KIUC streetlights can be avoided.

5.5.3 Impacts of the Taking

As described in the species account (Appendix 3A, *Species Accounts*), the estimated number of female green sea turtles (honu) that nest in the Plan Area is 16, representing only 0.39 percent of the total of 3,864 breeding females estimated for the entire Central North Pacific DPS of green sea turtle (honu) (Seminoff et al. 2015). Of 20 nesting sites documented on Kaua'i, all but two were described as having intermittent or indeterminate use (Parker and Balazs 2015). At the French Frigate Shoals, the principal nesting site for the green sea turtle (honu) where approximately 95 percent of all nesting occurs, nesting green sea turtles (honu) increased by an estimated 4.8 percent annually from 1966 to 2006 (over 40 years) (Appendix 3A, *Species Accounts*; Balazs and Chaloupka 2006). Information on at-sea abundance trends has been consistent with the increase in nesting (Balazs et al. 1996, 2005; Balazs 2000; Seminoff et al. 2015), although Hurricane Walaka in 2018 resulted in substantial loss of nesting habitat and the long-term effects of this catastrophic event have not been fully analyzed. The loss of up to 50 nests over a 50-year period resulting from KIUC streetlights, where most or all of the take is expected to consist of small fraction of the hatchlings in each nest, is not expected to adversely affect the population or appreciably reduce the likelihood of the species' survival and recovery in the wild.

5.5.4 Beneficial and Net Effects

The green sea turtle (honu) monitoring and minimization measures described in Conservation Measure 5, *Implement a Green Sea Turtle Nest Detection and Temporary Shielding Program* in Chapter 4, *Conservation Strategy*, will not only minimize take resulting from KIUC streetlights (possibly to zero), but is also expected to minimize take resulting from other proximate light sources. On six of the seven beaches identified[26] in KIUC's 2020 streetlight assessment, most of the light is from sources other than KIUC streetlights, including residential buildings, commercial buildings (e.g., restaurants, resorts, shopping centers), and beach infrastructure (e.g., restrooms, parking lot lighting, walking path lighting). As described in Chapter 4, *Conservation Strategy*, KIUC's nest shielding program will shield any nests that have even the smallest potential to be affected by KIUC streetlights. This will result in the shielding of green sea turtle (honu) nests affected by non-KIUC light sources. As such, the take of hatchlings in up to 50 nests over 50 years is expected to be fully offset through the reduction of take from non-KIUC light sources. The nest shielding program is also expected to provide a net conservation benefit to green sea turtle (honu) because over the 50-year permit term KIUC will be shielding more nests than would be affected by their own streetlights.

[26] At the Kekaha Shoreline, the primary light source is KIUC streetlights. Surrounding lights in the vicinity are sparse and therefore contribute little to the beach lightscape.

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Chapter 6
Monitoring and Adaptive Management Program

6.1 Introduction

This chapter describes the monitoring and adaptive management program for the KIUC HCP. The goal of the monitoring component of the program is to evaluate on an ongoing basis whether the HCP is meeting or is likely to achieve the biological goals and objectives. The goal of the adaptive management component of the program is to outline a system for adjusting the KIUC HCP management strategy using the monitoring results. Specifically, the purposes of the monitoring and adaptive management program are to do the following.

- Ensure that KIUC remains in compliance with the HCP, the federal incidental take permit (ITP), and the state incidental take license (ITL).
- Ensure take of the covered species does not exceed the maximum limits set by the federal ITP and state ITL.
- Evaluate the effectiveness of the conservation measures (Chapter 4, *Conservation Strategy*) on an ongoing basis and identify when adaptive management must be applied to improve their effectiveness.

Adaptive management and monitoring will be integrated into one program. This chapter begins with an overview of the monitoring and adaptive management program. The chapter then provides details on the required monitoring and adaptive management actions. Finally, the chapter provides a description of all HCP data and reporting requirements (refer to Chapter 7, *Plan Implementation*, for details regarding data management and reporting).

6.1.1 Regulatory Context

As discussed in the *Habitat Conservation Planning and Incidental Take Permit Processing Handbook* (HCP Handbook) (U.S. Fish and Wildlife Service and National Marine Fisheries Service 2016), monitoring and reporting are mandatory elements of all HCPs.[1] When properly designed and implemented, monitoring programs should provide the information needed to answer the following questions.

- Is the permittee (KIUC) in compliance with its HCP, federal ITP, and state ITL?
- Is progress being made toward meeting the HCP's biological goals and objectives by the deadlines established in the HCP?
- Is the HCP's conservation strategy effective at minimizing and mitigating impacts as defined in the HCP?
- Is there a need to adjust conservation measures through adaptive management to improve the outcomes of the conservation strategy to meet established goals and objectives?

[1] 50 Code of Federal Regulations 17.22, 17.32, and 222.307; 65 *Federal Register* 35242 (June 1, 2000).

Adaptive management programs are recommended for programmatic HCPs and those with data gaps or scientific uncertainty that could affect how species are managed during implementation. The HCP Handbook (U.S. Fish and Wildlife Service and National Marine Fisheries Service 2016) describes adaptive management as a method for addressing uncertainty in natural resource management and states that management must be linked to measurable biological goals and monitoring. Conservation measures proposed in Chapter 4, *Conservation Strategy*, could be adapted in response to new information within an adaptive management framework if the commitments defined under the HCP's regulatory assurances (Chapter 7, *Plan Implementation*) are maintained.

The Hawai'i Endangered Species Act has similar requirements for HCP monitoring and adaptive management programs.[2] HCP monitoring programs must do the following.

- Include monitoring of the threatened and endangered species in the HCP.
- Include periodic monitoring by representatives of the Hawai'i Department of Land and Natural Resources or the Endangered Species Recovery Committee (ESRC), or both.
- Provide for an adaptive management strategy that specifies the actions to be taken periodically if the plan is not achieving its goals.

6.2 Overview of Monitoring and Adaptive Management Program

6.2.1 Types of Monitoring

KIUC will oversee and implement two types of monitoring: compliance monitoring and effectiveness monitoring. A description of each of these elements is provided below.

6.2.1.1 Compliance Monitoring

Compliance monitoring tracks the status of HCP implementation and documents that HCP requirements are being met. Compliance monitoring verifies that KIUC is carrying out the terms of the HCP, the federal ITP, and the state ITL. KIUC conducted compliance monitoring during the active period of the 5-year Short-Term HCP (2011 to 2016). The goals of compliance monitoring under the Short-Term HCP included, but was not limited to, data collection to inform take levels and minimization potential that would be used to inform this HCP. Under the KIUC HCP, the goal of compliance monitoring will shift to (1) confirming implementation of the conservation measures, (2) confirming estimated strike reductions, and (3) tracking annual take over the 30-year permit term.

- Tracking implementation of the conservation measures, including commitments on location, extent, and schedule, as show in Tables 6-1 and 6-2.
- Tracking KIUC's annual funding contribution to the Save Our Shearwaters (SOS) Program, as described in Chapter 7, Section 7.5, *Funding Assurances*.

[2] Hawai'i Revised Statutes Sections 195D-21(b)(2)(G) and 195D-21(b)(2)(H).

- Tracking implementation of the monitoring and adaptive management program, as described in this chapter.
- Reporting implementation progress on an annual basis (see Section 7.7, *Annual Reporting*, for details).

U.S. Fish and Wildlife Service (USFWS) staff, State of Hawai'i Department of Land and Natural Resources staff (including the State of Hawaiʻi Division of Forestry and Wildlife [DOFAW] and the State of Hawaiʻi Division of Aquatic Resources [DAR]), or members of the ESRC may visit any KIUC locations associated with this HCP[3] upon request to ensure that conservation measures are being implemented in accordance with the HCP, the federal ITP, and state ITL. If, during any site visit, agency personnel note any apparent discrepancies and bring them to KIUC's attention, KIUC will investigate the apparent deviation and report its findings and recommended course of action to the agencies within 10 business days.

6.2.1.2 Take Monitoring

Take monitoring compares the actual take that occurs during implementation to the take limit authorized by the federal ITP and state ITL. KIUC will track impacts on the covered species to ensure that the take limit defined in Chapter 5, *Effects*, is not exceeded. Actual take will be estimated using the same methods that were developed to predict take by the covered activities.

6.2.1.3 Effectiveness Monitoring

Effectiveness monitoring assesses the biological performance of the HCP. Specifically, effectiveness monitoring evaluates the implementation and success of the conservation strategy described in Chapter 4, *Conservation Strategy*. Effectiveness monitoring will determine the effectiveness of KIUC's minimization and conservation actions. For example, effectiveness monitoring in the 10 conservation sites will determine whether predator control is as effective as predicted in the HCP, and whether the actions are on track to achieve the biological goals and objectives of the HCP (Chapter 4, Section 4.3, *Biological Goals and Objectives*).

6.2.2 Adaptive Management

Based on the best scientific information currently available, KIUC believes that the HCP conservation measures will achieve the biological goals and objectives described in Chapter 4, *Conservation Strategy*. Over time, however, conditions in the Plan Area or the status of the covered species may change in ways that could change the effectiveness of the conservation measures. It is also possible that new approaches or new technology will prove more effective at achieving the biological goals and objectives than what is currently described in the HCP. Finally, it may be found that conservation measures are less effective at achieving the biological goals and objectives than expected. The adaptive management process described here is intended to address all these situations.

Adaptive management is a structured approach to decision-making in the face of uncertainty that makes use of the experience of management and monitoring results in an embedded feedback loop of monitoring, evaluation, and adjustments in management strategies. The kinds of uncertainties it

[3] For example, powerline minimization project areas, covered facilities, or conservation sites.

is intended to address include a lack of biological information about the covered species or uncertainty in the effectiveness of minimization or mitigation techniques.

Adaptive management is a required component of HCPs that allows for the incorporation of new information into conservation and mitigation measures during HCP implementation. Effective implementation of this approach requires explicit and measurable objectives, and identifies what actions are to be taken and when they are to occur. Adaptive management changes do not trigger the need for an amendment of the HCP or the associated federal ITP or state ITL.

The adaptive management process is often represented as a cycle of *plan*, *do*, *monitor*, *learn, and adjust* (Webb et al. 2017). Large programs and complex situations often contain multiple cycles of adaptive management operating simultaneously at different scales, but nested within the larger adaptive management framework (Bormann and Stankey 2009).

6.2.2.1 Minor Adjustments vs. Adaptive Management

To define adaptive management, it is helpful to first describe what adaptive management is not. As the HCP operator, KIUC will be making decisions daily about the best approaches to use in implementing the HCP. HCP implementation will necessarily involve many minor adjustments to the conservation measures described in Chapter 4, *Conservation Strategy*, to remain consistent with the HCP, perform effectively, and remain cost efficient.

KIUC has complete authority over changes and adjustments that are related to day-to-day management and monitoring responsibilities. Throughout the year, KIUC will need to plan and implement simple adjustments to routine activities that are small in size or effect or need to be implemented rapidly. These types of changes are not adaptive management and therefore do not require consultation with USFWS or DOFAW.

Day-to-day activities must fit within the framework of the HCP's conservation strategy and be implemented consistent with the HCP's biological goals and objectives. Such changes will be reported in each Annual Report (Chapter 7, Section 7.7, *Annual Reporting*) and at monthly coordination meetings. The following types of actions are considered minor adjustments. However, this list cannot encapsulate all minor adjustments that may occur during HCP implementation.

- Day-to-day conservation site management and monitoring activities. Examples include the location of wildlife cameras or predator traps, predator control techniques like selection of predator traps, placement of traps, and frequency and intensity of trapping, fence repairs, debris removal, methods and timing of invasive plant removal, and methods and timing to install artificial burrows.
- Methods and equipment to install bird flight diverters on new powerlines.
- Repair or replacement of existing and future powerline collision minimization infrastructure that is included in KIUC's powerline collision minimization plan.
- Repair or replacement of existing and future light minimization infrastructure for the covered seabirds and green sea turtle (honu).

- Adjustments in green sea turtle (honu) nest monitoring methods, locations,[4] and approaches that are consistent with the conservation measure (e.g., beach shielding locations, monitoring techniques)

6.2.2.2 Adaptive Management Decisions

It may become clear from monitoring results or from external scientific information that certain conservation measures need to be adjusted in more substantial ways that go beyond the day-to-day minor adjustments. Adaptive management actions are intended to capture substantial changes to the HCP that are needed to achieve a biological objective in the event the conservation measures are not working as intended. For example, monitoring results may reveal that conservation measures, despite many minor adjustments, are not expected to meet a metric within a biological objective. Alternatively, new techniques may become available that have the potential to dramatically improve the performance of a conservation measure but are untested on Kaua'i or with the covered species. Such substantial changes to conservation measures are considered adaptive management actions that require following the adaptive management decision making process described in the next section.

Adaptive management changes may require multiple years to assess, plan, and implement. Adaptive management actions require clear objectives, success criteria, and implementation schedules. The following actions are considered adaptive management actions and require consultation with and pre-approval from USFWS and DOFAW (and DAR for green sea turtle [honu]), following the decision making process described in the next section below. Only the actions listed below are considered adaptive management for the purposes of this HCP.

- Actions to ensure an estimated strike reduction below those forecast in Chapter 4, Section 4.4.1, *Conservation Measure 1. Implement Powerline Collision Minimization Projects* (i.e., 65.5 percent by the end of 2023 for covered seabirds, and 90 percent for covered waterbirds).
- Any modifications to KIUC's streetlight or facility light minimization techniques (e.g., removing shields, changing the type of shields, changing dimming protocols).
- Any modifications to SOS Program funding, other than annual adjustments for inflation.
- Implementation of any new techniques to minimize green sea turtle (honu) hatchling disorientation.
- Adding or discontinuing conservation sites.
- Adding, removing, or changing the location of predator exclusion fences, ungulate fences, or social attraction sites.
- Changes to any of the timelines in the HCP conservation strategy that delay completion of minimization or mitigation actions.
- Reducing the monitoring frequency for any conservation action.

[4] Changes to locations within beaches do not require agency consultation (e.g., moving fences from year to year depending on nest location) because these areas have already been reviewed and approved by USFWS and DOFAW in this HCP. Only new beach locations are considered an adaptive management action.

Strong adaptive management programs include pre-defined thresholds for adaptive management actions. That is, when a threshold is crossed (or likely to be crossed) for a particular important metric, the adaptive management decision making process is triggered. This "automatic" trigger helps to ensure that appropriate assessments are conducted and, if necessary, action is taken. Thresholds can be defined as either qualitative metrics or quantitative. In either case, a threshold can be set so that it serves as an "early warning" for a conservation measure that may be off track but has not yet failed. In this way, the adaptive management process can function to improve performance well in advance of serious issues that may be difficult and expensive to address. In this HCP, these thresholds are called *adaptive management triggers*. Section 6.3, *Compliance Monitoring and Adaptive Management Triggers*, and Section 6.4, *Take and Effectiveness Monitoring and Adaptive Management Triggers*, define the adaptive management triggers and responses for this HCP.

6.2.2.3 Adaptive Management Decision-Making Process

KIUC will consult with USFWS and DOFAW (DAR will be included when addressing green sea turtle [honu]) before making any decisions regarding adaptive management actions as defined above. The adaptive management decision-making process consists of the following steps.

1. As part of their annual reporting requirements (Chapter 7, Section 7.7, *Annual Reporting*), KIUC will report the results of compliance monitoring, take monitoring, and effectiveness monitoring, including any supporting monitoring or other data necessary to determine whether the HCP is on track to meet the biological goals and objectives. As part of this assessment, KIUC will assess whether an adaptive management trigger is likely to be reached within the next reporting year, has already been reached, or has been exceeded (see the next sections for triggers).

2. If an adaptive management trigger has been reached or exceeded, this will trigger a mandatory collaborative process between KIUC, USFWS, and DOFAW[5] to define and implement an agreed-upon response. KIUC will identify a recommended approach after reviewing the appropriate adaptive management section and list of potential adaptive management changes in this chapter or will develop an approach for adaptive management if no practicable pre-defined response exists. The potential need for adaptive management may also be identified by KIUC, USFWS, DOFAW, or DAR at any time based upon sufficient evidence that an adaptive management trigger has been reached or exceeded or biological objectives are not being met or are unlikely to be met. KIUC, USFWS, DOFAW, or DAR may also identify the potential need for adaptive management if an adaptive management trigger is likely to be met.

3. KIUC will receive input from USFWS, DOFAW, and in some cases the ESRC,[6] on the recommended adaptive management action or actions. USFWS or DOFAW may approve or disapprove of the proposed changes. However, KIUC will make the final decision on adaptive management changes after discussion with and input from USFWS and DOFAW. KIUC will remain responsible for permit compliance and meeting the biological objectives of the KIUC HCP.

4. USFWS and DOFAW will decide whether an amendment to the HCP or federal ITP/state ITL is necessary, and if so, the necessary steps to follow. They will further determine whether the proposed adaptive management actions will result in physical changes to the environment that

[5] DAR will be included when the adaptive management trigger involves green sea turtle (honu).

[6] Consistent with Hawai'i Revised Statutes Chapter 195D, the ESRC will make adaptive management recommendations at their annual review meeting for this HCP.

were not addressed in the original analyses, and if so, whether there is a need for updates to the EIS, federal Endangered Species Act Section 7 Biological Opinion, or Findings documents.

5. KIUC will report to USFWS and DOFAW as soon as practicable regarding the implementation and results of any adaptive management action. The subsequent Annual Report will discuss the adaptive management action implemented by KIUC and the preliminary outcomes, if available.

Any adaptive management changes selected and implemented by KIUC will be consistent with and support the achievement of the biological goals and objectives (Chapter 4, *Conservation Strategy*) and will consider the take limit (Chapter 5, *Effects*) and the commitments of the funding strategy (Chapter 7, *Plan Implementation*), as well as the commitments of KIUC's No Surprises regulatory assurances (Chapter 7).

Most adaptive management actions are expected to either be cost neutral or funded by cost savings (e.g., reduction or cessation of ineffective conservation measures). If adaptive management actions result in additional costs, those costs will be funded through KIUC's letter of credit (Chapter 7, Section 7.5, *Funding Assurance*). KIUC, USFWS, DOFAW (and DAR when applicable for green sea turtle [honu]) will evaluate a range of adaptive management responses across a range of costs, and will, when possible, balance the action and the cost, but will ultimately select an adaptive management response based its ability to support the biological goals and objectives.

6.3 Compliance Monitoring and Adaptive Management Triggers

As described above, compliance monitoring tracks the status of HCP implementation and documents that KIUC is implementing the conservation measures as described, including required methods and timing. KIUC will closely monitor the implementation of all conservation measures to ensure that they are being implemented properly and on time. If there are delays in implementation, KIUC will report these delays in monthly coordination meetings with USFWS and DOFAW and as part of the annual report (Chapter 7, Section 7.7, *Annual Reporting*). Compliance monitoring results will be the primary tool for USFWS and DOFAW to verify that KIUC remains in compliance with the HCP requirements, the federal ITP, and state ITL. As defined by this HCP, compliance monitoring is comprised of the components listed below.

Compliance monitoring is typically not associated with adaptive management. However, because of the importance of implementing conservation measures on schedule and to the specifications of the HCP, KIUC has included two components here: (1) a compliance schedule (Table 6-1) and (2) adaptive management triggers and responses for all relevant compliance monitoring actions (Table 6-2). Adaptive management triggers are often tied to HCP deadlines to ensure that key compliance actions are implemented according to the HCP schedule and if they are not, immediate responses are implemented. If an adaptive management trigger is reached or is likely to be reached as determined by KIUC, USFWS, or DOFAW, these three agencies will first jointly perform an assessment described in the column *Adaptive Management Response Step 1*. Based on the initial assessment, KIUC may implement a response, with input from USFWS, DOFAW (and DAR, when applicable), identified in the last column as *Adaptive Management Response Step 2*. KIUC will designate or hire a compliance monitor to track and report on KIUC's compliance with the requirements identified in Table 6-1. The compliance monitor will also assist with the adaptive management process, including the assessments identified in *Adaptive Management Response Step 1*.

Compliance monitoring and adaptive management will allow KIUC to document that all the requirements of the HCP are being met and will allow USFWS and DOFAW (and DAR, when applicable) to determine, using the success metrics in Table 6-2, whether the HCP is on track both in terms of scope and schedule.

Table 6-1. Schedule for HCP Compliance

Key Task with Deadline Tied to Permit Compliance	Deadline
Key Initial Deadlines	
Complete Powerline Minimization Plan (Appendix 4B, *KIUC Minimization Projects*)	End of 2023
Eradicate predators and initiate social attraction in Pōhākea PF and Honopū PF	End of 2023
Select and approve Conservation Site 10	End of 2023
Complete installation of predator exclusion fencing at Upper Limahuli and Conservation Site 10	End of 2025
Eradicate predators and initiate social attraction in Upper Limahuli and Conservation Site 10	End of 2026
Complete strike reduction monitoring for Powerline Minimization Plan (Appendix 4B, *KIUC Minimization Projects*) to determine final reduction amount	End of 2026
Key Annual Deadlines	
Shield all new or damaged streetlights	September 15
Dim or turn off facility lights at Port Allen Generating Station	September 15
Complete training program for covered seabird facility monitoring	August 15
Complete training program for green sea turtle (honu) nest monitoring	March 1
Complete Annual Work Plan	December 31
Submit Annual Report	June 1

[a] This table is only intended to identify key deadlines. Annual monitoring activities that will occur every year are not included in this table but described below in this chapter.

Table 6-2. Compliance Monitoring Adaptative Management Triggers

Conservation Measure	Metric of Success	Adaptive Management Triggers	Monitoring Strategy	Adaptive Management Response Step 1	Adaptive Management Response Step 2
Conservation Measure 1. Implement Powerline Collision Minimization Projects	All minimization in KIUC's minimization plan (Appendix 4B, *KIUC Minimization Projects*), is complete by the end of 2023	All minimization in KIUC's minimization plan (Appendix 4B, *KIUC Minimization Projects*), is not complete by the end of 2023.	KIUC compliance monitoring. Annual reporting and annual work plan	Assess, in coordination with USFWS and DOFAW, whether the expected delay in completing powerline collision minimization will affect overall estimated annual strikes	If the expected delay is affecting overall estimated annual strikes and is likely to result in an exceedance of the 50-year take request, KIUC will, by the end of 2028, implement additional minimization (this may also include the same amount/location using a technique with a higher strike reduction) to make up the difference, where it will be implemented, and timeline for implementation and monitoring. If additional minimization cannot offset the deficit and annual strikes are exceeding what is expected (65.3% reduction in strikes), by the end of 2032 (which gives KIUC time to measure the performance of the new minimization) evaluate whether the 50-year take limit is likely to be exceeded. If the take limit is likely to be exceeded, a permit amendment may be needed.
Conservation Measure 1. Implement Powerline Collision	No more than 16% (27.2 miles [43.8 km]) of total transmission wire length will include wire height	An average of more than 4.4 miles (7.1 km) of wire height in any 5-year period results in a height increase	KIUC compliance monitoring. Annual reporting and	Assess, in coordination with USFWS and DOFAW, whether the above-average rate of wire height increases is expected to continue, is likely to exceed the metric of success by the end of	If the increased rate is affecting overall estimated annual strikes and is likely to result in an exceedance of the 50-year take request, KIUC will identify additional minimization within 1

Conservation Measure	Metric of Success	Adaptive Management Triggers	Monitoring Strategy	Adaptive Management Response Step 1	Adaptive Management Response Step 2
Minimization Projects	increases by the end of the 50-year permit term		annual work plan	the permit term. and would affect KIUC's 50-year take request.	year to make up the difference, where it will be implemented, and a timeline for implementation and monitoring. If this option is not possible, KIUC, USFWS, and DOFAW will determine if a permit amendment may be necessary.
Conservation Measure 1. Implement Powerline Collision Minimization Projects	No more than a 34% (348 miles [560 km]) increase in new powerlines within KIUC's approximate 1,000-mile (1,609-km) system over the 50-year permit term	An average of more than 34.8 miles (56 km) of new wires in any 5-year period	KIUC compliance monitoring. Annual reporting and annual work plan	Assess, in coordination with USFWS and DOFAW, whether the rate of installation of new powerlines is expected to continue, is likely to exceed the metric of success by the end of the permit term and would affect KIUC's 50-year take request.	If the increased rate is affecting overall estimated annual strikes and is likely to result in an exceedance of the 50-year take request, KIUC will identify additional minimization within 1 year to make up the difference, including where it will be implemented, and a timeline for implementation and monitoring. If this option is not possible, KIUC, USFWS, and DOFAW will determine if a permit amendment may be necessary.
Conservation Measure 1. Implement Powerline Collision Minimization Projects	KIUC determines using existing data, in areas where vegetation management has exposed wires, that minimization can be implemented to reduce the strike rate, or conducts monitoring to determine	Minimization is not installed on newly exposed wires (due to vegetation management) where data indicates it is necessary and practicable to reduce the strike rate within 1 year of determination	KIUC compliance monitoring. Annual reporting and annual work plan	Assess, in coordination with USFWS and DOFAW, whether the newly exposed area is expected to continue (e.g., vegetation may grow back) and would affect KIUC's 50-year take request.	If the area(s) will affect overall estimated annual strikes and is likely to result in an exceedance of the 50-year take request, KIUC will identify additional minimization within 1 year to make up the difference, including where it will be implemented, and a timeline for implementation and monitoring. If this option is not possible, KIUC, USFWS, and DOFAW will

Conservation Measure	Metric of Success	Adaptive Management Triggers	Monitoring Strategy	Adaptive Management Response Step 1	Adaptive Management Response Step 2
	whether minimization is needed				determine if a permit amendment may be necessary.
Conservation Measure 1. Implement Powerline Collision Minimization Projects	No static wires on new powerlines	Static wires placed on new powerlines	KIUC compliance monitoring. Annual reporting and annual work plan	KIUC compliance monitor will evaluate new powerline design prior to construction	KIUC will remove the static wire
Conservation Measure 1. Implement Powerline Collision Minimization Projects	New distribution lines will be no more than 45 feet (13.7 m) above ground	New distribution lines are more than 45 feet (13.7 m) above ground	KIUC compliance monitoring. Annual reporting and annual work plan	KIUC compliance monitor will consult with a qualified avian biologist to determine whether the spans(s) greater than 45 feet (13.7 m) above ground increases the collision risk of the covered birds and could result in an increased strike rate.	If the area(s) will affect overall estimated annual strikes and is likely to result in an exceedance of the 50-year take request, KIUC will identify additional minimization within 1 year to make up the difference, including where it will be implemented, and a timeline for implementation and monitoring. If this option is not possible, KIUC, USFWS, and DOFAW will determine if a permit amendment may be necessary.
Conservation Measure 1. Implement Powerline Collision Minimization Projects	One vertical wire level on new distribution and transmission lines where possible	More than one vertical wire level on a new distribution and transmission lines	KIUC compliance monitoring. Annual reporting and annual work plan	KIUC compliance monitor will consult with a qualified avian biologist to determine whether the new powerline design increases the collision risk of the covered birds and could result in an increased strike rate.	If the area(s) will affect overall estimated annual strikes and is likely to result in an exceedance of the 50-year take request, KIUC will identify additional minimization within 1 year to make up the difference, including where it will be implemented, and a timeline for implementation and monitoring. If this option is not possible,

Conservation Measure	Metric of Success	Adaptive Management Triggers	Monitoring Strategy	Adaptive Management Response Step 1	Adaptive Management Response Step 2
					KIUC, USFWS, and DOFAW will determine if a permit amendment may be necessary.
Conservation Measure 1. Implement Powerline Collision Minimization Projects	New powerlines located in areas that reduce and minimize collision risk, where possible	New powerlines are planned in a high-risk area, based on existing data, predictive modeling, and/or consultation with qualified avian biologist	KIUC compliance monitoring. Annual reporting and annual work plan	A qualified avian biologist will evaluate the location and all planned minimization against the strike risk using existing strike data (e.g., Bayesian Model) to determine if the location could result in exceedance of KIUC's expected take based on Appendix 6A, *Adaptive Management Comparison Tables*, Tables 6A-1 and 6A-2.	Meet and confer with USFWS and DOFAW to determine best response. Installation of additional or improved minimization may be sufficient to remedy the issue. If possible, also modify location to further minimize risk. If this is not possible, evaluate options that ensure take levels are not exceeded.
Conservation Measure 1. Implement Powerline Collision Minimization Projects	Diverters installed on new powerlines, where practicable. Reflective diverters near roads and LED diverters away from roads	Diverters cannot be installed on new powerlines	KIUC compliance monitoring. Annual reporting and annual work plan	KIUC compliance monitor will consult with a qualified avian biologist to determine if the new powerline locations without diverters could affect overall estimated annual strikes and is likely to result in an exceedance of the 50-year take request	If the area(s) will affect overall estimated annual strikes and is likely to result in an exceedance of the 50-year take request, KIUC will identify additional minimization within 1 year to make up the difference, including where it will be implemented, and a timeline for implementation and monitoring. If this option is not possible, KIUC, USFWS, and DOFAW will determine if a permit amendment may be necessary.
Conservation Measure 2. Implement Measures to Minimize Light Attraction	Streetlights: Full-cutoff shields on all KIUC streetlights, so that light does not shine above 90-	Full-cutoff shields are not installed on new streetlights (shields are installed on all existing streetlights) or	KIUC compliance monitoring. Annual reporting and annual work plan	KIUC personnel are required to report any damaged or removed shields to KIUC compliance monitor. The KIUC compliance monitor is also responsible for ensuring new lights are shielded	KIUC will replace or repair shields on existing streetlights prior to the seabird fallout season. If damage occurs during the seabird fallout season, KIUC will repair shield as soon as possible following damage.

Conservation Measure	Metric of Success	Adaptive Management Triggers	Monitoring Strategy	Adaptive Management Response Step 1	Adaptive Management Response Step 2
	degree horizontal plane	shields that are damaged or removed prior to the seabird fallout season (September 15 to December 15)		and documenting compliance in Annual Report.	Shields missing from new streetlights will be installed prior to the seabird nesting season.
Conservation Measure 2. Implement Measures to Minimize Light Attraction	Streetlights: 1,754 streetlights installed by the end of the 50-year permit	More than 175 new streetlights installed over any 5-year period (the average expected over any 5-year period).	KIUC compliance monitoring. Annual reporting and annual work plan	Assess, in coordination with USFWS and DOFAW, whether the rate of installation of new streetlights is expected to continue and would affect KIUC's 50-year take request.	If the increased rate of streetlight installation is likely to continue, is likely to affect overall estimated annual strikes, and is likely to result in an exceedance of the 50-year take request, KIUC will identify additional light minimization within one year to make up the difference, including where it will be implemented and a timeline for implementation. If this option is not possible, KIUC, USFWS and DOFAW will determine if a permit amendment may be necessary.
Conservation Measure 2. Implement Measures to Minimize Light Attraction	Port Allen Generating Station: Dim/turn off the exterior lighting during the fledgling fallout season (September 15 to December 15)	Lights are not being dimmed/turned off at night during the seabird fledgling fallout season (September 15 to December 15)	KIUC compliance monitoring. Annual reporting and annual work plan	KIUC compliance monitor is responsible for informing staff of requirement annually prior to September 15, conducting periodic spot checks, and documenting compliance in Annual Reports	Correct immediately to ensure lights are dimmed or shielded at night consistent with the HCP
Conservation Measure 2. Implement Measures to	Port Allen Generating Station and Kapia Generating	Lights are not compliant between September 15 and December 15	KIUC compliance monitoring. Annual	KIUC compliance monitor is responsible for informing staff of requirement annually prior to September 15, conducting	Correct immediately to ensure lights are dimmed at night consistent with the HCP

Conservation Measure	Metric of Success	Adaptive Management Triggers	Monitoring Strategy	Adaptive Management Response Step 1	Adaptive Management Response Step 2
Minimize Light Attraction	Station: Turn off interior lights at night, or use retractable screen or shades, during the fledgling fallout season (September 15 to December 15)		reporting and annual work plan	periodic spot checks, and documenting compliance in Annual Reports	
Conservation Measure 2. Implement Measures to Minimize Light Attraction	Port Allen Generating Station: All lights utilize full-cutoff white LED lights and shielded wall-mounted white LED box lighting (including new lights installed during the permit term)	Lights are not compliant	KIUC compliance monitoring. Annual reporting and annual work plan	KIUC compliance monitor is responsible for conducting periodic spot checks, and documenting compliance in Annual Reports	Correct immediately to ensure compliance.
Conservation Measure 2. Implement Measures to Minimize Light Attraction	Kapaia Generating Station: All lights are shielded to direct light downward, away from the sky	Lights are not compliant	KIUC compliance monitoring. Annual reporting and annual work plan	KIUC compliance monitor is responsible for conducting periodic spot checks, and documenting compliance in Annual Reports	Correct immediately to ensure compliance
Conservation Measure 2. Implement Measures to Minimize Light Attraction	85 hours of night lighting for restoration of power during the fledgling fallout season (September 15 to	An average of more than 8.5 hours of night lights during the fledgling fallout season (September 15 to December 15)	KIUC compliance monitoring. Annual reporting and annual work plan	Assess, in coordination with USFWS and DOFAW, whether the rate of nighttime lighting for construction is expected to continue and would affect KIUC's 50-year take request.	If the increased rate of streetlight installation is likely to continue, is likely to affect overall estimated annual strikes, and is likely to result in an exceedance of the 50-year take request, KIUC will identify

Conservation Measure	Metric of Success	Adaptive Management Triggers	Monitoring Strategy	Adaptive Management Response Step 1	Adaptive Management Response Step 2
	December 15) by the end of the 50-year permit term	in any 5-year period			additional light minimization within one year (on lights not owned or operated by KIUC) to make up the difference, including where it will be implemented and a timeline for implementation. If this option is not possible, KIUC will also considered changes to the SOS monitoring program to increase the numbers of covered seabirds rescued and turned in to SOS.
Conservation Measure 2. Implement Measures to Minimize Light Attraction	Annual seabird training program prior to the start of the seabird fallout period (September 15 to December 15) using Appendix 6B, *KIUC Site Monitoring Protocols and Procedures for Protected Seabirds*	Training has not occurred by August 15 of each year	KIUC compliance monitoring. Annual reporting and annual work plan	KIUC compliance monitor checks August 15 of each year to ensure training has occurred. If not, compliance monitor ensures and documents that training has occurred.	None
Conservation Measure 2. Implement Measures to Minimize Light Attraction	Predator control is occurring within KIUC's covered facilities	Predator control is not occurring within KIUC's covered facilities	KIUC compliance monitoring. Annual reporting and annual work plan	KIUC will review and evaluate why predator control was not conducted	Predator control will be implemented immediately once non-compliance is documented.
Conservation Measure 3. Provide Funding	KIUC funds SOS consistent with Section 4.4.3,	KIUC does not fund SOS consistent with Section 4.4.3,	KIUC compliance monitoring.	KIUC will work with USFWS and DOFAW to review and evaluate the reason for non-compliance	KIUC will remedy the SOS funding as determined by outcome of Step 1.

Conservation Measure	Metric of Success	Adaptive Management Triggers	Monitoring Strategy	Adaptive Management Response Step 1	Adaptive Management Response Step 2
for the Save Our Shearwaters Program	*Conservation Measure 3. Provide Funding for the Save Our Shearwaters Program*	*Conservation Measure 3. Provide Funding for the Save Our Shearwaters Program*	Annual reporting and annual work plan		
Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites	KIUC will implement predator control consistent with Section 4.4.4.2, *Management Actions*	KIUC does not implement predator control consistent with Section 4.4.4.2, *Management Actions*	KIUC compliance monitoring. Annual reporting and annual work plan	KIUC will evaluate why predator control is not consistent with Section 4.4.4.2, *Management Actions*. KIUC is permitted to make minor adjustments to the conservation strategy (Section 6.2.2.1, *Minor Adjustments vs. Adaptive Management*)	If for any reason predator control is not consistent with the HCP and is not due to a minor adjustment, meet and confer with USFWS and DOFAW to discuss cause and appropriate response to ensure Objectives 1.3, 2.3, and 3.3 are met.
Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites	KIUC will install and maintain predator exclusion fencing and implement social attraction consistent with Section 4.4.4.2, *Management Actions*	KIUC's predator exclusion fencing or social attraction is not consistent with Section 4.4.4.2, *Management Actions*	KIUC compliance monitoring. Annual reporting and annual work plan	KIUC will evaluate why predator exclusion fencing is not consistent with Section 4.4.4.2, *Management Actions*. KIUC is permitted to make minor adjustments to the conservation strategy (Section 6.2.2.1, *Minor Adjustments vs. Adaptive Management*)	If for any reason predator control or social attraction is not consistent with the HCP and is not due to a minor adjustment, meet and confer with USFWS and DOFAW to discuss cause and appropriate response to ensure Objectives 1.3 and 2.3 are met.
Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites	KIUC will eradicate all predators and initiate social attraction in Pōhākea PF and Honopū PF, consistent with Section 4.4.4.2, *Management Actions*, by no	Predators are not eradicated, or social attraction is not initiated in Pōhākea PF and Honopū PF by the end of 2023.	KIUC compliance monitoring. Annual reporting and annual work plan	Assess, in coordination with USFWS and DOFAW, whether the delay is likely to affect KIUC's ability to meet Objectives 1.3 or 2.3	If the delay will reduce KIUC's take offset, KIUC will identify additional mitigation to make up the difference to ensure Objectives 1.3 and 2.3 are met. If this option is not possible, KIUC, USFWS, and DOFAW will determine if a permit amendment may be necessary.

Conservation Measure	Metric of Success	Adaptive Management Triggers	Monitoring Strategy	Adaptive Management Response Step 1	Adaptive Management Response Step 2
	later than the end of the first year of the permit term (2023).				
Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites	KIUC will select and commit to a location and configuration for Site 10 no later than the end of 2023.	KIUC has not selected a location for Site 10 by the end of 2023	KIUC compliance monitoring. Annual reporting and annual work plan	Assess, in coordination with USFWS and DOFAW, whether the delay is likely to affect KIUC's ability to meet Objective 1.3 or 2.3	If the delay will reduce KIUC's take offset, KIUC will identify mitigation to make up the difference to ensure Objectives 1.3 and 2.3 are met. If this option is not possible, KIUC, USFWS, and DOFAW will determine if a permit amendment may be necessary.
Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites	KIUC will complete installation of predator exclusion fencing at Upper Limahuli Preserve and Conservation Site 10 by the end of 2025	Predator exclusion fencing is not complete at Upper Limahuli Preserve and Conservation Site 10 by the end of 2025	KIUC compliance monitoring. Annual reporting and annual work plan	Assess, in coordination with USFWS and DOFAW, whether the delay is likely to affect KIUC's ability to meet Objective 1.3 or 2.3	If the delay will reduce KIUC's take offset, KIUC will identify mitigation to make up the difference to ensure Objectives 1.3 and 2.3 are met. If this option is not possible, KIUC, USFWS, and DOFAW will determine if a permit amendment may be necessary.
Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites	KIUC will eradicate all predators and initiate social attraction in Upper Limahuli Preserve and Site 10, consistent with Section 4.4.4.2, *Management Actions*, no later	Predators are not eradicated, or social attraction is not initiated in Upper Limahuli Preserve and Conservation Site 10 by the end of 2026.	KIUC compliance monitoring. Annual reporting and annual work plan	Assess, in coordination with USFWS and DOFAW, whether the delay is likely to affect KIUC's ability to meet Objective 1.3 or 2.3	If the delay will reduce KIUC's take offset, KIUC will identify mitigation to make up the difference to ensure Objectives 1.3 and 2.3 are met. If this option is not possible, KIUC, USFWS, and DOFAW will determine if a permit amendment may be necessary.

Conservation Measure	Metric of Success	Adaptive Management Triggers	Monitoring Strategy	Adaptive Management Response Step 1	Adaptive Management Response Step 2
	than the end of 2026				
Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites	KIUC will implement invasive plant species management consistent with Section 4.4.4.2, *Management Actions*	Invasive plant species management not implemented consistent with Section 4.4.4.2, *Management Actions*	KIUC compliance monitoring. Annual reporting and annual work plan	KIUC will evaluate why invasive plant species control is not consistent with Section 4.4.4.2, *Management Actions*. KIUC is permitted to make minor adjustments to the conservation strategy (Section 6.2.2.1, *Minor Adjustments vs. Adaptive Management*)	If for any reason invasive plant species control is not consistent with the HCP and is not due to a minor adjustment, meet and confer with USFWS and DOFAW to discuss cause and appropriate response to ensure Objectives 1.3 and 2.3 are met.
Conservation Measure 5. Implement a Green Sea Turtle Nest Detection and Temporary Shielding Program	KIUC will implement nest detection program consistent with Section 4.4.5.1, *Nest Detection*	Nest detection program not implemented consistent with Section 4.4.5.1, *Nest Detection*	KIUC compliance monitoring. Annual reporting and annual work plan	KIUC compliance monitor tracks compliance and notifies entities responsible for implementation of nest detection program to ensure compliance. KIUC is permitted to make minor adjustments to the conservation strategy (Section 6.2.2.1, *Minor Adjustments vs. Adaptive Management*)	KIUC will correct the issue immediately to ensure compliance. If, for any reason, the nest detection program cannot be implemented consistent with specifications and the change is not due to a minor adjustment, meet and confer with USFWS, DOFAW, and DAR to discuss the cause and appropriate response to ensure Objective 5.1 is met.
Conservation Measure 5. Implement a Green Sea Turtle Nest Detection and Temporary Shielding Program	KIUC will shield active nests from streetlights consistent with Section 4.4.5.2, *Shield Active Nests from Streetlights*	Nests not shielded from streetlights consistent with Section 4.4.5.2, *Shield Active Nests from Streetlights*	KIUC compliance monitoring. Annual reporting and annual work plan	KIUC compliance monitor tracks compliance and notifies entities responsible for shielding nests to ensure compliance. KIUC is permitted to make minor adjustments to the conservation strategy (Section 6.2.2.1, *Minor Adjustments vs. Adaptive Management*)	KIUC will correct the issue immediately to ensure compliance. If, for any reason, the nest detection program cannot be implemented consistent with specifications and the change is not due to a minor adjustment, meet and confer with USFWS, DOFAW, and DAR to discuss the cause and appropriate response to ensure Objective 5.1 is met.

Conservation Measure	Metric of Success	Adaptive Management Triggers	Monitoring Strategy	Adaptive Management Response Step 1	Adaptive Management Response Step 2
Conservation Measure 5. Implement a Green Sea Turtle Nest Detection and Temporary Shielding Program	KIUC will conduct annual training and reporting consistent with Section 4.4.5.5, *Annual Training and Reporting*	Annual training not completed 1 month prior to the start of the green sea turtle (honu) nesting season or reporting is not consistent with Section 4.4.5.5, *Annual Training and Reporting*	KIUC compliance monitoring. Annual reporting and annual work plan	KIUC compliance monitor tracks compliance and notifies entities responsible for implementation of training and reporting to ensure compliance. KIUC is permitted to make minor adjustments to the conservation strategy (Section 6.2.2.1, *Minor Adjustments vs. Adaptive Management*)	KIUC will correct the issue immediately to ensure compliance.
Conservation Measure 6. Identify and Implement Practicable Streetlight Minimization Techniques for Green Sea Turtle	KIUC will install practicable light minimization techniques within a timeframe agreed upon by USFWS, DOFAW, and DAR, consistent with Section 4.4.6.1, *Identify and Install Practicable Light Minimization Techniques*, if an agreement is reached with the County and State	Light minimization techniques are installed within the agreed upon timeframe if an agreement is reached with the County and State that this minimization is practicable.	KIUC compliance monitoring. Annual reporting and annual work plan	KIUC will consult with USFWS, DOFAW, and DAR to determine reason for non-compliance.	KIUC will correct the issue immediately to ensure compliance.

km = kilometer; LED = light-emitting diode; m = meter

6.4 Take and Effectiveness Monitoring and Adaptive Management Triggers

As described above, take monitoring is a component of compliance monitoring that compares the actual take that occurs during implementation to the take limit authorized by the federal ITP and state ITL. Effectiveness monitoring assesses the biological performance of the HCP.

This section describes methods and protocols for take monitoring and effectiveness monitoring actions. The section also describes the adaptive management triggers and responses relevant to each of the six conservation measures and their associated biological goals and objective identified in Chapter 4, *Conservation Strategy*. Table 6-3 summarizes the adaptive management triggers and responses for take monitoring and effectiveness monitoring. The format for Table 6-3 is the same as for Table 6-2. The one exception is that the relevant biological goals and objectives are also include in Table 6-3 to help organize the monitoring actions. Each section after Table 6-3 describes take monitoring, effectiveness monitoring, and adaptive management associated with each conservation measure. For details of the metrics of success, the adaptive management triggers, the monitoring strategy, and the response steps, see the text following Table 6-3.

Table 6-3. Adaptive Management Triggers for Take and Effectiveness Monitoring

Conservation Measure	Metric of Success	Adaptive Management Triggers	Monitoring Strategy	Adaptive Management Response Step 1	Adaptive Management Response Step 2
Take Monitoring					
Objective 1.1 (Newell's shearwater ('a'o)), Objective 2.1 (Hawaiian petrel ('ua'u))					
Conservation Measure 1. Implement Powerline Collision Minimization Projects	No more than 553 annual powerline strikes of Newell's shearwater ('a'o) by year 25 of the permit term (2048) and no more than 203 annual strikes Newell's shearwater ('a'o) by end of permit term (2073) (based on a 5-year rolling average)	Strikes higher than predicted as shown in Appendix 6A, *Adaptive Management Comparison Tables*, Table 6A-1 based on 5-year rolling average	Annual monitoring of high-risk spans. Rover acoustic monitoring and Bayesian model. Proportion by species will be constant and assumed.	Notify USFWS and DOFAW and meet and confer to determine whether modifications to minimization or monitoring are needed. KIUC will evaluate whether the cause is due to strike reduction issues or population increases as measured by radar data or other data available at the time. If difference is likely due to strike reduction issues, see Step 2. If difference is likely due to population increase of subpopulations more susceptible to powerline collisions, coordinate with USFWS and DOFAW to assess whether permit amendment will be needed.	Reduce strikes through additional powerline minimization. KIUC will evaluate the span(s) to determine what minimization technique(s) already identified in the HCP are practicable. KIUC may also test novel minimization techniques that incorporate new technology. KIUC will identify a practicable plan of action within 6 months of annual reporting. The timeline for minimization installation will depend on the technique (i.e., reconfiguration requires more planning and permitting than diverter installation).
Conservation Measure 1. Implement Powerline Collision Minimization Projects	No more than 358 annual powerline strikes of Hawaiian petrel ('ua'u) by year 25 of the permit term (2048) and no more than 203 annual strikes of	Strikes higher than predicted as shown in Appendix 6A, *Adaptive Management Comparison Tables*, Table 6A-1 based on	Annual monitoring of high-risk spans. Rover acoustic monitoring and Bayesian model. Proportion by species will be	Notify USFWS and DOFAW and meet and confer to determine whether modifications to minimization or monitoring are needed. KIUC will evaluate whether the cause is due to strike reduction issues or population increases as	Reduce strikes through additional powerline minimization. KIUC will evaluate the span(s) to determine what minimization technique(s) already identified in the HCP are practicable. KIUC may also test novel minimization techniques that incorporate new technology.

Conservation Measure	Metric of Success	Adaptive Management Triggers	Monitoring Strategy	Adaptive Management Response Step 1	Adaptive Management Response Step 2
	Hawaiian petrel (ʻuaʻu) by end of permit term (2073) (based on a 5-year rolling average)	5-year rolling average	constant and assumed.	measured by radar data or other data available at the time. If difference is likely due to strike reduction issues, see Step 2. If difference is likely due to population increase of subpopulations more susceptible to powerline collisions, coordinate with USFWS and DOFAW to assess whether permit amendment will be needed.	KIUC will identify a practicable plan of action within 6 months of annual reporting. The timeline for minimization installation will depend on the technique (i.e., reconfiguration requires more planning and permitting than diverter installation).
Objective 4.1 (Waterbirds)					
Conservation Measure 1. Implement Powerline Collision Minimization Projects	No more than 65 Hawaiian stilt (aeʻo) mortalities, 219 Hawaiian duck (koloa maoli) mortalities, 42 Hawaiian coot (ʻalae keʻokeʻo) mortalities, 167 Hawaiian common gallinule (ʻalae ʻula) mortalities, or 502 Hawaiian goose (nēnē) mortalities by the end of permit term	More than one Hawaiian stilt (aeʻo) mortality, four Hawaiian duck (koloa maoli) mortalities, one Hawaiian coot (ʻalae keʻokeʻo) mortalities, three Hawaiian common gallinule (ʻalae ʻula) mortalities, and 10 Hawaiian goose (nēnē) mortalities in any year, based on a 5-year rolling average.	Annual monitoring of high-risk spans. Rover acoustic monitoring and Bayesian model. Proportion of strikes attributed to waterbirds will be constant and assumed.	Notify USFWS and DOFAW and meet and confer to determine whether modifications to minimization or monitoring are needed. KIUC will evaluate whether the cause is due to strike reduction issues or population increases as measured by radar data. If difference is likely due to strike reduction issues, see Step 2. If difference is likely due to population increases, coordinate with USFWS and DOFAW to assess whether permit amendment will be needed.	Reduce strikes through additional powerline minimization. KIUC will evaluate the span(s) to determine what minimization technique(s) already identified in the HCP are practicable. KIUC may also test novel minimization techniques that incorporate new technology. KIUC will identify a practicable plan of action within 6 months of annual reporting. The timeline for minimization installation will depend on the technique (i.e., reconfiguration requires more planning and permitting than diverter installation).

Conservation Measure	Metric of Success	Adaptive Management Triggers	Monitoring Strategy	Adaptive Management Response Step 1	Adaptive Management Response Step 2
Objective 1.1 (Newell's shearwater (ʻaʻo)), Objective 2.2 (Hawaiian petrel (ʻuaʻu)), Goal 3, Objective 3.1 (Band-rumped storm-petrel (ʻakēʻakē))					
Conservation Measure 2. Implement Measures to Minimize Light Attraction	No more than 260 groundings (alive or dead) of Newell's shearwater (ʻaʻo), 5 groundings of Hawaiian petrel (ʻuaʻu), and no groundings of band-rumped storm-petrel (ʻakēʻakē) by the end of the permit term at the covered facilities (Port Allen and Kapaia Generating Stations).	Groundings (alive or dead) of six or more Newell's shearwater (ʻaʻo) annually, based on a 5-year rolling average. Any incidents of Hawaiian petrel (ʻuaʻu) or band-rumped storm-petrel (ʻakēʻakē) also trigger adaptive management.	Facility monitoring (Section 6.4.2, *Light Attraction Monitoring and Adaptive Management*)	Notify USFWS and DOFAW and meet and confer to determine whether modifications to management or monitoring are needed. If needed, go to Step 2.	KIUC will investigate causes and evaluate whether further minimization is practicable to reduce fallout or if additional monitoring is needed to reduce mortality. Implement further minimization or monitoring if feasible and appropriate based on causes. See Section 6.4.2.3, *Adaptive Management*.
Conservation Measure 2. Implement Measures to Minimize Light Attraction	Predators are removed from covered facilities consistent with Section 4.4.2.5, *Predator Removal at Covered Facilities*	Any signs of predation on covered species carcass at a covered facility	KIUC compliance monitoring. Annual reporting and annual work plan	Any carcasses found are brought to SOS for examination	KIUC will assess predator source and modify predator control strategy as appropriate to remedy the issue as soon as possible following discovery of carcass.
Conservation Measure 2. Implement Measures to Minimize Light Attraction	Groundings from construction night lighting for the restoration of power is 5 or fewer Newell's shearwaters (ʻaʻo),	Groundings from construction night lighting for the restoration of power is 6 or more Newell's	KIUC compliance monitoring. Annual reporting and annual work plan	Notify USFWS and DOFAW and meet and confer to determine if the number of grounded birds due to night lighting could result in KIUC exceeding its combined take estimate for light attraction	KIUC will investigate whether additional minimization is practicable to reduce fallout or if additional monitoring is needed to reduce mortality. Implement further minimization or monitoring if feasible and

Conservation Measure	Metric of Success	Adaptive Management Triggers	Monitoring Strategy	Adaptive Management Response Step 1	Adaptive Management Response Step 2
	and 0 Hawaiian petrel (ʻuaʻu) or band-rumped storm-petrel (ʻakēʻakē), based on a 5-year rolling average	shearwater (ʻaʻo), and 1 or more Hawaiian petrel (ʻuaʻu) or band-rumped storm-petrel (ʻakēʻakē), based on a 5-year rolling average		(Chapter 5, *Effects*, Table 5-5). If the answer is yes, proceed to Step 2.	appropriate. KIUC, USFWS, and DOFAW may also consider additional powerline minimization to make up the difference if additional light attraction minimization is not practicable.
Objective 1.3 (Newell's shearwater (ʻaʻo)), Objective 2.3 (Hawaiian petrel (ʻuaʻu))					
Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites	No more than 177 Newell's shearwater (ʻaʻo)or 315 Hawaiian petrel (ʻuaʻu) injured or killed from predator traps over the permit term.	Five-year rolling average of more than 4 Newell's shearwater (ʻaʻo) or more than 6 Hawaiian petrel (ʻuaʻu) injured or killed from predator traps in any year.	Conservation site monitoring (Section 6.4.4, *Conservation Site Monitoring and Adaptive Management*)	Notify USFWS and DOFAW and meet and confer to determine whether modifications to management are needed. If needed, go to Step 2.	KIUC will investigate causes and implement modifications as needed based on the best available technology to minimize mortalities.
Objective 5.1 and 5.2 (Green sea turtle (honu))					
Conservation Measure 5. Implement a Green Sea Turtle Nest Detection and Temporary Shielding Program	No more than 50 nests taken over the permit term	Number of nests taken in any year is 2 or greater, or take of any number of hatchlings from undocumented nests	Nest monitoring (see Chapter 4, Section 4.4.5, *Conservation Measure 5. Implement a Green Sea Turtle Nest Detection and Temporary Shielding Program*).	Notify USFWS and DOFAW and meet and confer to determine whether modifications to management or monitoring are needed. If needed, go to Step 2.	KIUC will evaluate potential additional minimization and monitoring measures and implement if practicable. See Section 6.4.5.3, *Adaptive Management*

Conservation Measure	Metric of Success	Adaptive Management Triggers	Monitoring Strategy	Adaptive Management Response Step 1	Adaptive Management Response Step 2
Mitigation Efficacy Monitoring					
Objective 1.1 (Newell's shearwater (ʻaʻo)), Goal 2, Objective 2.1 (Hawaiian petrel (ʻuaʻu))					
Conservation Measure 1. Implement Powerline Collision Minimization Projects	65.3% reduction in seabird strikes	Island-wide seabird annual take over a 3-year average (2024, 2025, 2026) after all minimization is completed (end of 2023) is higher than expected with 65.3% reduction of strikes	Acoustic data from song meters located on powerlines as measured over 3 years after minimization is completed reduction of strikes is measured through take monitoring	Notify USFWS and DOFAW and meet and confer to determine whether modifications to management or monitoring are needed. KIUC will evaluate whether the cause is due to strike reduction issues or population increases as measured by radar data. If difference is like due to strike reduction issues, see Step 2. If difference is due to population increases, coordinate with USFWS and DOFAW to assess whether permit amendment will be needed.	If the cause is minimization not being effective and annual strikes exceed what is expected with 65.3% strike reduction, by the end of 2028 identify additional minimization (this may also include the same amount/location using a technique with a higher strike reduction) to make up the difference, where it will be implemented, and timeline for implementation. If minimization cannot make up the difference, and annual strikes are exceeding what is expected with 65.3% reduction in strikes, by the end of 2028 evaluate whether the 50-year take limit is likely to be exceeded. If so, a permit amendment may be needed.
Objective 4.2 (Waterbirds)					
Conservation Measure 1. Implement Powerline Collision Minimization Projects	90% reduction of waterbird strikes	If annual take as measured and calculated at Mānā and Hanalei spans over a 3-year average (2024, 2025, 2026) after all minimization is completed (end	Acoustic data from song meters located on powerlines as measured over 3 years after minimization is completed reduction of strikes is	Notify USFWS and DOFAW and meet and confer to determine whether modifications to management or monitoring are needed. KIUC will evaluate whether the cause is due to strike reduction issues or population increases as measured by radar data. If difference is like due to strike	If the cause is minimization not being effective and annual waterbird strikes exceed what is expected with 90% strike reduction, by the end of 2028 identify additional minimization (this may also include the same amount/location using a technique with a higher strike reduction) to make up the difference, where it will be

Conservation Measure	Metric of Success	Adaptive Management Triggers	Monitoring Strategy	Adaptive Management Response Step 1	Adaptive Management Response Step 2
		of 2023) is higher than expected with 90% reduction of waterbird strikes	measured through take monitoring	reduction issues, see Step 2. If difference is due to population increases, coordinate with USFWS and DOFAW to assess whether permit amendment will be needed.	implemented, and timeline for implementation. If minimization cannot make up the difference, and annual strikes are exceeding what is expected with 90% reduction in strikes, by the end of 2028 evaluate whether the 50-year take limit is likely to be exceeded. If so, a permit amendment may be needed.
Objective 1.1 (Newell's shearwater (ʻaʻo)), Objective 2.2 (Hawaiian petrel (ʻuaʻu)), Objective 3.1 (Band-rumped storm-petrel (ʻakēʻakē))					
Conservation Measure 2. Implement Measures to Minimize Light Attraction	No more than 260 groundings (alive or dead) of Newell's shearwater (ʻaʻo) and 5 mortalities of Hawaiian petrel (ʻuaʻu) by the end of the permit term.	Groundings (alive or dead) exceed 5 Newell's shearwater (ʻaʻo) annually, based on a 5-year rolling average. Any incidents of Hawaiian petrel (ʻuaʻu) or band-rumped storm-petrel (ʻakēʻakē) also trigger adaptive management.	Facility monitoring (Section 6.4.2, *Light Attraction Monitoring and Adaptive Management*)	Notify USFWS and DOFAW and meet and confer to determine whether modifications to management or monitoring are needed. If needed, go to Step 2.	KIUC will investigate causes and evaluate whether further minimization is practicable to reduce fallout or if additional monitoring is needed to reduce mortality. Implement further minimization or monitoring if feasible and appropriate based on causes. See Section 6.4.2.3, *Adaptive Management*.
Conservation Measure 2. Implement Measures to Minimize Light Attraction	Predators are removed from covered facilities consistent with Section 4.4.2.5, *Predator Removal*	Any signs of predation on covered species carcass at a covered facility	KIUC compliance monitoring. Annual reporting and annual work plan	Any carcasses found are brought to SOS for examination	KIUC will assess predator source and modify predator control strategy as appropriate to remedy the issue as soon as possible following discovery of carcass.

Conservation Measure	Metric of Success	Adaptive Management Triggers	Monitoring Strategy	Adaptive Management Response Step 1	Adaptive Management Response Step 2
	at Covered Facilities				
Objective 3.2 (Band-rumped storm-petrel ('akē'akē)), Objective 4.2 (Waterbirds)					
Conservation Measure 3. Provide Funding for the Save Our Shearwaters Program	Fund SOS or another rehabilitation facility at the level needed to provide rehabilitation care for covered avian species	10% or greater combined increases in covered avian species 3 years in a row	SOS tracking of data and annual reporting of numbers of birds handled for each species	Work with SOS, USFWS, and DOFAW to determine if the current level of funding is sufficient to rehabilitate the increased number of covered species. If the funding level is determined to be insufficient, see Step 2.	KIUC will increase funding by at least 50% relative to the increased covered species (10% increase in covered species turned in equals 5% increase in funding. 20% increase in covered species turned in equals 10% increase in funding, etc.)
Objective 1.3 (Newell's shearwater ('a'o)), Objective 2.3 (Hawaiian petrel ('ua'u))					
All 10 conservation sites combined Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites	Maintain an annual minimum of 1,264 Newell's shearwater ('a'o) breeding pairs	Fewer than 1,264 Newell's shearwater ('a'o) breeding pairs in any given year.	Call rates/breeding rates and modeling	Notify USFWS and DOFAW and meet and confer to determine whether modifications to management are needed. If needed, go to Step 2.	KIUC will evaluate causes and develop an appropriate approach. Options may include modifying predator control strategy or other methods based on available information and technology.
All 10 conservation sites combined Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites	Growth rate for Newell's shearwater ('a'o) breeding pairs annually of at least 1% to reach a target of 2,371 breeding pairs by Year 25 of the permit term and 4,313 breeding	Newell's shearwater ('a'o) breeding pairs in any year is lower than Appendix 6A, *Adaptive Management Comparison Tables*, Table 6A-3 based on 5-year rolling	Call rates/breeding rates and modeling.	Notify USFWS and DOFAW and meet and confer to determine whether modifications to management are needed. If needed, go to Step 2.	KIUC will evaluate causes and develop an appropriate approach. Options may include modifying predator control strategy or other methods based on available information and technology.

Conservation Measure	Metric of Success	Adaptive Management Triggers	Monitoring Strategy	Adaptive Management Response Step 1	Adaptive Management Response Step 2
	pairs by the end of the permit term.	average to account for annual variability			
All 10 conservation sites combined Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites	Maintain an 87.2% reproductive success rate for Newell's shearwater ('a'o)	Less than 87.2% reproductive success rate for Newell's shearwater ('a'o) based on a 5-year rolling average.	Annual colony monitoring at reference burrows: estimate of burrows, chicks, predation/loss, and fledgling success	Notify USFWS and DOFAW and meet and confer to determine whether modifications to management are needed. If needed, go to Step 2.	KIUC will evaluate causes and develop an appropriate approach. Options may include modifying predator control strategy or other methods based on available information and technology.
Upper Limahuli Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites	Maintain an 87% reproductive success rate for Newell's shearwater ('a'o)	Less than 87% reproductive success rate for Newell's shearwater ('a'o) based on a 5-year rolling average.	Annual colony monitoring at reference burrows: estimate of burrows, chicks, predation/loss, fledgling success	Notify USFWS and DOFAW and meet and confer to determine whether modifications to management are needed. If needed, go to Step 2.	KIUC will evaluate causes and develop an appropriate approach. Options may include modifying predator control strategy or other methods based on available information and technology.
Pōhākea Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites	Maintain a 93.7% reproductive success rate for Newell's shearwater ('a'o)	Less than 93.7% reproductive success rate for Newell's shearwater ('a'o) based on a 5-year rolling average.	Annual colony monitoring at reference burrows: estimate of burrows, chicks, predation/loss, fledgling success	Notify USFWS and DOFAW and meet and confer to determine whether modifications to management are needed. If needed, go to Step 2.	KIUC will evaluate causes and develop an appropriate approach. Options may include modifying predator control strategy or other methods based on available information and technology.
Hanakāpi'ai Conservation Measure 4. Manage and Enhance Seabird	Maintain an 86.8% reproductive success rate for Newell's shearwater ('a'o)	Less than 86.8% reproductive success rate for Newell's shearwater	Annual colony monitoring at reference burrows: estimate of burrows, chicks,	Notify USFWS and DOFAW and meet and confer to determine whether modifications to management	KIUC will evaluate causes and develop an appropriate approach. Options may include modifying predator control strategy or other methods based

Conservation Measure	Metric of Success	Adaptive Management Triggers	Monitoring Strategy	Adaptive Management Response Step 1	Adaptive Management Response Step 2
Breeding Habitat and Colonies at Conservation Sites		(ʻaʻo) based on a 5-year rolling average.	predation/loss, fledgling success	are needed. If needed, go to Step 2.	on available information and technology.
Conservation Site 10 Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites	Maintain a 81.3% reproductive success rate for Newell's shearwater (ʻaʻo)	Less than 81.3% reproductive success rate for Newell's shearwater (ʻaʻo) based on a 5-year rolling average.	Annual colony monitoring at reference burrows: estimate of burrows, chicks, predation/loss, fledgling success	Notify USFWS and DOFAW and meet and confer to determine whether modifications to management are needed. If needed, go to Step 2.	KIUC will evaluate causes and develop an appropriate approach. Options may include modifying predator control strategy or other methods based on available information and technology.
All 10 conservation sites combined Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites	Maintain an annual minimum of 2,257 Hawaiian petrel (ʻuaʻu) breeding pairs	Fewer than 2,257 Hawaiian petrel (ʻuaʻu) breeding pairs in any given year.	Call rates/breeding rates and modeling	Notify USFWS and DOFAW and meet and confer to determine whether modifications to management are needed. If needed, go to Step 2.	KIUC will evaluate causes and develop an appropriate approach. Options may include modifying predator control strategy or other methods based on available information and technology.
All 10 conservation sites combined Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites	Growth rate for Hawaiian petrel (ʻuaʻu) breeding pairs annually of at least 1% to reach a target of 2,926 breeding pairs by year 25 of the permit term and 3,751 breeding pairs by the end of the permit term.	Hawaiian petrel (ʻuaʻu) breeding pairs in any year is lower than Appendix 6A, *Adaptive Management Comparison Tables*, Table 6A-4 based on 5-year rolling average to account for annual variability	Call rates/breeding rates and modeling.	Notify USFWS and DOFAW and meet and confer to determine whether modifications to management are needed. If needed, go to Step 2.	KIUC will evaluate causes and develop an appropriate approach. Options may include modifying predator control strategy or other methods based on available information and technology.

Conservation Measure	Metric of Success	Adaptive Management Triggers	Monitoring Strategy	Adaptive Management Response Step 1	Adaptive Management Response Step 2
All 10 conservation sites combined Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites	Maintain a 78.7% reproductive success rate for Hawaiian petrel (ʻuaʻu)	Less than 78.7% reproductive success rate for Hawaiian petrel (ʻuaʻu) based on a 5-year rolling average.	Annual colony monitoring at reference burrows: estimate of burrows, chicks, predation/loss, fledgling success	Notify USFWS and DOFAW and meet and confer to determine whether modifications to management are needed. If needed, go to Step 2.	Evaluate causes and develop an appropriate approach. Options may include modifying predator control strategy or other methods based on available information and technology.
Upper Limahuli Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites	Maintain a 66.7% reproductive success rate for Hawaiian petrel (ʻuaʻu)	Less than 66.7% reproductive success rate for Hawaiian petrel (ʻuaʻu) based on a 5-year rolling average.	Annual colony monitoring at reference burrows: estimate of burrows, chicks, predation/loss, fledgling success	Notify USFWS and DOFAW and meet and confer to determine whether modifications to management are needed. If needed, go to Step 2.	KIUC will evaluate causes and develop an appropriate approach. Options may include modifying predator control strategy or other methods based on available information and technology.
Pihea Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites	Maintain a 80.3% reproductive success rate for Hawaiian petrel (ʻuaʻu)	Less than 80.3% reproductive success rate for Hawaiian petrel (ʻuaʻu) based on a 5-year rolling average.	Annual colony monitoring at reference burrows: estimate of burrows, chicks, predation/loss, fledgling success	Notify USFWS and DOFAW and meet and confer to determine whether modifications to management are needed. If needed, go to Step 2.	KIUC will evaluate causes and develop an appropriate approach. Options may include modifying predator control strategy or other methods based on available information and technology.
North Bog Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites	Maintain a 78% reproductive success rate for Hawaiian petrel (ʻuaʻu)	Less than 78% reproductive success rate Hawaiian petrel (ʻuaʻu) based on a 5-year rolling average.	Annual colony monitoring at reference burrows: estimate of burrows, chicks, predation/loss, fledgling success	Notify USFWS and DOFAW and meet and confer to determine whether modifications to management are needed. If needed, go to Step 2.	KIUC will evaluate causes and develop an appropriate approach. Options may include modifying predator control strategy or other methods based on available information and technology.

Conservation Measure	Metric of Success	Adaptive Management Triggers	Monitoring Strategy	Adaptive Management Response Step 1	Adaptive Management Response Step 2
Pōhākea Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites	Maintain a 75.5% reproductive success rate for Hawaiian petrel (ʻuaʻu)	Less than 75.5% reproductive success rate for Hawaiian petrel (ʻuaʻu) based on a 5-year rolling average.	Annual colony monitoring at reference burrows: estimate of burrows, chicks, predation/loss, fledgling success	Notify USFWS and DOFAW and meet and confer to determine whether modifications to management are needed. If needed, go to Step 2.	KIUC will evaluate causes and develop an appropriate approach. Options may include modifying predator control strategy or other methods based on available information and technology.
Hanakoa Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites	Maintain a 86.4% reproductive success rate for Hawaiian petrel (ʻuaʻu)	Less than 86.4% reproductive success rate for Hawaiian petrel (ʻuaʻu) based on a 5-year rolling average.	Annual colony monitoring at reference burrows: estimate of burrows, chicks, predation/loss, fledgling success	Notify USFWS and DOFAW and meet and confer to determine whether modifications to management are needed. If needed, go to Step 2.	KIUC will evaluate causes and develop an appropriate approach. Options may include modifying predator control strategy or other methods based on available information and technology.
Hanakāpiʻai Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites	Maintain a 85.4% reproductive success rate for Hawaiian petrel (ʻuaʻu)	Less than 85.4% reproductive success rate for Hawaiian petrel (ʻuaʻu) based on a 5-year rolling average.	Annual colony monitoring at reference burrows: estimate of burrows, chicks, predation/loss, fledgling success	Notify USFWS and DOFAW and meet and confer to determine whether modifications to management are needed. If needed, go to Step 2.	KIUC will evaluate causes and develop an appropriate approach. Options may include modifying predator control strategy or other methods based on available information and technology.
Social attraction Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites	Produce at least one Newell's shearwater (ʻaʻo) breeding pair within each of the four social attraction sites by Year 10 of the permit term	One or more social attraction sites without a breeding pair by Year 5	Annual colony monitoring within social attraction sites: estimate of burrows, chicks, predation/loss, fledgling success	Notify USFWS and DOFAW and meet and confer to determine whether modifications to management are needed. If needed, go to Step 2.	KIUC will evaluate causes and develop an appropriate approach. Options may include modifying predator control strategy or other methods based on available information and technology.

Conservation Measure	Metric of Success	Adaptive Management Triggers	Monitoring Strategy	Adaptive Management Response Step 1	Adaptive Management Response Step 2
Predator control and invasive plant species control Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites	Growth rate for Newell's shearwater (ʻaʻo) breeding pairs annually of at least 1% to reach a target of 2,371 breeding pairs by Year 25 and 4,313 breeding pairs by the end of the permit term and for Hawaiian petrel (ʻuaʻu) a target of 2,926 breeding pairs by Year 25 and 3,751 breeding pairs by the end of the permit term.	Newell's shearwater (ʻaʻo) or Hawaiian petrel (ʻuaʻu) breeding pairs in any year is lower than Appendix 6A, *Adaptive Management Comparison Tables*, Table 6A-3 or Table 6A-4, and a determination that this is due to predator control and invasive plant species control efficacy issues.	Predator control monitoring and invasive species control monitoring	Notify USFWS and DOFAW and meet and confer to determine whether modifications to management are needed. If needed, go to Step 2.	KIUC will evaluate causes and develop an appropriate approach. Options may include modifying predator control strategy or other methods based on available information and technology.

6.4.1 Powerline Strike Monitoring and Adaptive Management

6.4.1.1 Effectiveness Monitoring

Biological objectives 1.1, 2.1, and 4.1 (Table 4-1) require that KIUC substantially reduce the extent and effect of collisions of covered seabirds and waterbirds in accordance with the location, extent, and schedule outlined in Chapter 4, Section 4.3, *Biological Goals and Objectives*. To meet these objectives, KIUC has been implementing powerline collision minimization projects (Conservation Measure 1) since 2020 as early implementation for the HCP. (Some minimization actions happened before this time during KIUC's Short-Term HCP as described in Chapter 4, Section 4.4.1, *Conservation Measure 1. Implement Powerline Collision Minimization Projects*.)

KIUC monitors powerline strikes along its powerlines before and after minimization projects are implemented. The goal of this monitoring is to verify and measure the reductions in covered species collisions, evaluating each modification span-by-span. Based on current strike reduction estimates (Travers et al. 2020), KIUC is expected to achieve a 65.3 percent reduction in covered seabird collisions from existing powerlines systemwide.[7] KIUC also expects to achieve a 90 percent reduction in powerline collisions of covered waterbirds (Shaw et al. 2021) using the techniques described under Chapter 4, Section 4.4.1, *Conservation Measure 1. Implement Powerline Collision Minimization Projects*.

KIUC will complete all of its planned powerline minimization projects by no later than the end of 2023. As such, KIUC expects that effectiveness monitoring will be completed by the end of 2026 to account for annual and seasonal variation.

KIUC cannot evaluate minimization effectiveness for new powerlines because there is no baseline (i.e., collision data prior to the installation of minimization techniques) against which to evaluate the percent strike reduction. As stated in Chapter 4, Section 4.4.1.3, *Future Transmission and Distribution Lines*, new powerlines will be installed in a way to reduce strike risk as much as practicable; KIUC is estimating an 80 percent reduction in powerline collisions on new lines for the covered seabirds based on data for existing powerlines and a 90 percent reduction for the covered waterbirds. These estimated strike reductions are assumed for the purpose of this HCP and cannot be included as a specific adaptive management trigger because there is no way to measure it during the permit term. However, KIUC's estimated amount of future powerline buildout (see Chapter 2, *Covered Activities*) is included in KIUC's population dynamics model, and therefore in the modeled future strike projections (Chapter 5, *Effects*). If KIUC's actual strikes are higher than predicted the population dynamics model in any year based on a 5-year rolling average (and powerline strike reduction is determined to be the issue), KIUC will evaluate its entire powerline system, including spans installed during implementation of the HCP.

[7] KIUC is also estimated to achieve an 80 percent reduction in powerline collisions associated with new powerlines installed during the permit term through a combination of sighting in low-risk areas, reconfiguration, and bird flight diverters, to the maximum extent practicable.

6.4.1.2 Take Monitoring

KIUC will use acoustic song meters as described in Section 6.4.1.1, *Effectiveness Monitoring*, to continue estimating the annual number of powerline collisions of the covered seabirds and waterbirds. KIUC will compare the results of the Bayesian Acoustic Strike Model (Bayesian Model) (as described in Appendix 5D, *Bayesian Acoustic Strike Model*) with the strike projections from the Population Dynamic Model for Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) to confirm that the number of powerline collisions attributed to the covered seabirds is not higher than predicted, and therefore is not at risk of exceeding the take limit established in Chapter 5, *Effects*. The results of this comparison will trigger adaptive management if strikes are higher than predicted in any year, based on a 5-year rolling average (Appendix A, Tables 6A-1 and 6A-2).

The Bayesian Model will be applied to the data obtained through acoustic take monitoring to estimate annual powerline strikes during HCP implementation. During implementation, raw strike data will be run through the Bayesian Model, which incorporates variables such as (i) potential geographic predictor variables such as mean slope of the landscape between adjacent poles and mean gradient of the landscape in the area surrounding the span, (ii) potential environmental variables such as mean annual windspeed within 328 feet (100 meters) of the span and (iii) potential structural predictor variables such as the number of wire layers and mean exposure. The resulting outputs are provided on a span-by-span basis.

Powerline strike monitoring will continue to be performed annually during HCP implementation for the duration of the permit term. However, the scope of the monitoring will be narrowed to the following high-risk locations once strike reduction monitoring is complete.

- Powerline Trail
- Mānā (Kekaha)
- Waimea Canyon Drive
- East Kīlauea
- Līhuʻe and Central Region

KIUC will sample high-risk spans in these locations that contain both minimized and unminimized spans to infer trends over its entire powerline system. KIUC specifically chose to minimize all locations in its powerline system with significant levels of take, and thus these areas will be the best indicator of whether take at the end of the permit term is likely to be exceeded. Areas within KIUC's powerline system that are unminimized have low take; in many cases, these spans have zero strikes.

Given that these spans contribute most of the collisions within KIUC's power grid, take estimates in these areas that exceed forecasts could lead to KIUC exceeding its take limit. In addition, because these areas have the most collisions, it is expected that any changes in these areas (whether negative or positive) will be the most apparent over time (i.e., the most quickly detectable). KIUC will track collisions at these spans annually during the permit term and implement adaptive management, if necessary. Trends at these high-risk spans may also result in adaptive management being implemented at non-monitored spans (e.g., if KIUC finds that light-emitting diodes [LEDs] are an issue at a high-risk span, they may implement adaptive management for LEDs systemwide).

As stated in Chapter 5, Section 5.4.2, *Effects Common to All Covered Waterbirds*, KIUC is requesting take of the covered waterbirds associated with 74 percent of all KIUC powerline collisions along powerline spans in Mānā (spans 1–113) and Hanalei (spans 462–478 and 1297–1328), and for each species based on the proportions of injuries and mortalities by species provided in Table 5-7 (8 percent Hawaiian stilt [aeʻo], 23 percent Hawaiian duck [koloa maoli], 4 percent Hawaiian coot [ʻalae keʻokeʻo], 15 percent Hawaiian common gallinule [ʻalae ʻula], 50 percent Hawaiian goose [nēnē]). The actual number of strikes will be estimated annually during HCP implementation by applying the acoustic data from the acoustic monitoring units at Mānā (Kekaha) to the Bayesian Model.

KIUC may also choose to monitor additional powerline spans if needed to accomplish the following. In these cases, observational monitoring may also be employed, at the discretion of KIUC in coordination with USFWS and DOFAW.

- Estimate powerline collisions in areas where conditions have changed (e.g., new line installation, after a large storm, large scale tree felling, or tree growth leading to line shielding).
- Estimate powerline collisions after testing a new minimization approach.
- Document improved minimization beyond the commitments in the HCP and for the purposes of adaptive management (see Section 6.2.2, *Adaptive Management*).
- Confirm take and/or identify issues in other areas not identified above.
- The data will be applied to the 2020 Bayesian Model to verify that powerline collisions at these high-risk spans have not increased beyond what is forecast in the HCP. The modeling results will be included in the following year's Annual Report (see Chapter 7, *Plan Implementation*).

KIUC will determine if the number of collisions identified in the Bayesian Model is higher than predicted (Appendix 6A, *Adaptive Management Comparison Tables*, Tables 6A-1 and 6A-2) using a 5-year rolling average, according to the following timelines, as long as trends are as expected (or better than expected). The first evaluation will occur in Year 5 of the permit term.

- Annual for Years 5 to 10 of the permit term (5 years)
- Every 2 years for Year 10 to 20 (10 years), unless strikes are higher than predicted in which case the adaptive management process identified in Table 6-3 would be triggered, and annual evaluations would be required until strikes were no longer higher than predicted using a 5-year rolling average.
- Every 5 years after Year 20 of the permit term unless strikes are higher than predicted, in which case the adaptive management process identified in Table 6-3 would be triggered, and annual evaluations would be required until strikes were no longer higher than predicted using a 5-year rolling average.

KIUC expects the annual number of strikes will not exceed KIUC's estimated average annual take (Chapter 5, *Effects*) due to significant early implementation of minimization and monitoring prior to the start of the permit term, as well as a robust adaptive management process.

6.4.1.3 Covered Seabirds Monitoring Protocol

As stated in Chapter 5, *Effects*, KIUC based its pre-minimization island-wide strike estimate for the covered seabirds on a 2020 Bayesian acoustic strike model using data from 2013 to 2019 (Travers et al. 2020). In summary, the model is based on data gathered from acoustic song meter sensors placed on power poles throughout the island to record powerline strikes. The sensors are placed at either (1) the base of power poles in quiet soundscapes (typically higher-elevation sites) or (2) were mounted on the power pole just below the lowest transmission lines when the pole was near traffic sounds. The complete data collection methods of the Infrastructure Monitoring & Minimization Project (IMMP) can be found in Appendix 5D, *Bayesian Acoustic Strike Model,* and are summarized below.

Using the results from the Bayesian acoustic strike model, KIUC began early implementation of powerline minimization projects in 2020, targeting high-strike powerline spans to reduce collisions. Following the completion of each powerline minimization project, the modified spans are monitored for one full seabird season using the same sampling methodology described above. This data is used to update the same Bayesian model used for pre-minimization collision estimates to quantify the change in the number of strikes per span to determine the effectiveness of KIUC's minimization actions. The actual strike reduction for each modified span is summed for all the spans thus modified when the island-wide strike models are run to estimate the number of systemwide collisions experienced in any given year.

There are three types of acoustic monitoring that have been used by KIUC since 2011, as follows. All three types of acoustic monitoring are used to collectively document the total number of strikes across KIUC's powerline systems and the strike reduction (i.e., effectiveness of minimization measures) for both existing and new powerlines.

- **<u>Static Site Acoustic Monitoring</u>.** This type of acoustic monitoring uses song meters that are maintained at the same location over the entire seabird season (March through December) and from year to year. Static site acoustic monitoring typically has two song meters units at each location; one for peak time (i.e., sunset to 3.5 hours after and 3.5 hours prior to sunrise to sunrise) recording and one for off-peak (i.e., gap in peak time) recording. The static locations are used to determine the seasonal and annual variation in seabird powerline collision and the increase or decrease in the strike rate. Static song meters must be put in high strike locations (not random) to be able to detect seasonal and long-term patterns robustly.

  Static locations were originally selected to monitor areas with the highest strike rates based on rover site monitoring (see below). Once minimization is implemented by KIUC, the static locations remain the same to determine the resulting strike reduction. If an area does not have static sites, then rover site acoustic monitoring is used to determine the strike reduction.

- **<u>Rover Site Acoustic Monitoring</u>.** Rover site acoustic monitoring uses song meters that are moved from location to location roughly every 30 days to ensure there is equal monitoring across KIUC's powerline system. They records strikes during the peak time (i.e., sunset to 3.5 hours after and 3.5 hours prior to sunrise to sunrise). This type of song meter is deployed based on random stratified design using vegetation height (exposure) and region of the island. Acoustic sensors are randomly assigned to spans, in proportion to the number of spans within each stratum. It ensures that there is sufficient and equal sampling across KIUC's entire system. This strategy ensures that acoustic sensors are sampling powerlines without human influence.

  Originally, rover site acoustic monitoring allowed KIUC to identify collision hot spots across its system, but now that those location are known, this type of monitoring is KIUC's primary tool to determine the amount of strike reduction following minimization implementation. Each minimized section receives random stratified monitoring at a minimum of 25 percent spatial coverage for a minimum of 28 days.

  Rover site acoustic monitoring is always utilized following minimization implementation, even if some static sites are present in the area. Up to 12 roving song meters will be operated at locations that have been modified. Rover song meters will be operated between May 15 and September 15 and will be relocated monthly, for a total of up to 48 unique monitoring locations each year. The rover units will be placed at systematic randomly selected locations such that each of the four types of line modifications (i.e., reconfiguration, static wire, LED diverters, and reflective diverters), will be monitored.

- **Check Site Acoustic Monitoring.** Check site acoustic monitoring is predominantly random rover sites that previously detected strike sounds. Check units are deployed typically in the following season to resample the random rover site and record all night from sunset to sunrise (rather than during the peak period) to provide strike variation across the night and across seasons. Each minimized section receives at least one check site.

In addition, IMMP[8] staff concurrently employ observational monitoring for the powerlines with acoustic monitoring devices using night vision. Observational surveys are used to estimate species-specific passage rates at elevations with powerline collision risk, and record seabird behavioral responses following each observed powerline interaction. The observational data is used to validate the acoustic monitoring system by (1) observing post-strike behavior to ascertain the level of injury or mortality; and (2) determining if there are issues with the acoustic monitoring system (i.e., song meters) in terms of the numbers of strikes versus observations of birds in the vicinity of the recording devices.

To facilitate detection of nocturnal collisions and observe post-collision impacts, night vision goggles in combination with near-infrared illuminators are used to enhance the capabilities of night vision and facilitate better visual tracking of individual seabirds pre- and post-collision. When conducting the surveys, observers are positioned to monitor the wires between two power poles with their field of view oriented from the first pole to the second pole, ensuring that powerlines were always in their view. Monitoring begins near to or following astronomical twilight (i.e., full darkness), requiring the optical equipment described above. The surveys cover approximately 1.5 to 3 hour time windows depending on location. Typically, each staff member conducts two surveys per night totaling 4 to 5 hours a night of observations. The overall observation effort is focused during darkness and the varying light levels that occur at the edge of night. Most observations occur between 15 minutes prior to sunset to 15 minutes after sunrise, and as such most survey effort is concentrated in the 3-hour windows around sunset and sunrise.

Given that new powerlines will have no unminimized spans (i.e., KIUC will install minimization devices at the time of construction), they will be monitored in same ways as other minimized spans on existing lines within KIUC's powerline system, except that there will be no baseline (i.e., no unminimized data) against which to measure the strike reduction. KIUC will only be able to determine the number of strikes resulting from the span or spans with minimization installed, but there will be no estimate of the strike reduction (i.e., amount of change from an unminimized state).

6.4.1.4 Covered Waterbird Monitoring Protocol

Waterbird monitoring also uses acoustic song meters and observations of waterbird movement to quantify collisions before and after minimization and to estimate the change in total strikes as a result of minimization activities. Effectiveness monitoring for the covered waterbird species is similar to that conducted for the covered seabirds, except that the monitoring effort will be focused

[8] Formerly called the Underline Monitoring Program (in reports before 2021).

on KIUC's powerlines spans with the greatest waterbird habitat and movement in the Plan Area (Mānā [spans 1–113] and Hanalei [spans 462–478 and 1297–1328]). KIUC applies a constant value (see Chapter 5, Section 5.4.2, *Effects Common to All Covered Waterbirds*) to estimate the proportion of all bird strikes assumed to be covered waterbirds for the 113 spans in Mānā and the 49 spans in Hanalei where covered waterbirds predominantly occur. As of 2021, KIUC is in the process of collecting data in Mānā to determine the effectiveness of bird flight diverters and transmission line and static wire removal implemented at that location.

6.4.1.5 Adaptive Management

Based on the current strike reduction estimates and KIUC's minimization plan (Appendix 4B, *KIUC Minimization Projects*), KIUC expects to reduce covered seabird strikes by 65.3 and by 90 percent for the covered waterbirds by Year 1 of the HCP (end of 2023). Based on this schedule, KIUC will finish strike reduction monitoring by 2026, allowing 3 years after all minimization is complete to monitor its strike reduction (other than when new powerlines or new/additional minimization methods are installed throughout the permit term). Because KIUC has invested substantial effort into early implementation of powerline minimization, it can implement any necessary adaptive management changes very early in the permit term (as soon as 2027). If KIUC finds that the strike reduction for the covered seabirds is less than 65.3 percent or the strike reduction for the covered waterbirds is less than 90 percent, adaptive management will be triggered and KIUC will implement a response, in consultation with USFWS and DOFAW, as identified in Table 6-3.

KIUC will also implement adaptive management if they find that the collisions are higher than predicted in any year as identified in Appendix 6A, *Adaptive Management Comparison Tables*, Tables 6A-1 and 6A-2, based on a 5-year rolling average. KIUC will work in close collaboration with its contractors, USFWS, and DOFAW to determine the cause and identify possible solutions.

KIUC will follow the process outlined in Section 6.2.2.3, *Adaptive Management Decision-Making Process for this HCP*, to determine the appropriate adaptive management response in close coordination with USFWS and DOFAW. The adaptive management response for the covered seabird and covered waterbirds is the same (i.e., additional minimization), although the trigger for waterbirds is based on the specific waterbird spans. Adaptive management changes for powerline collisions consists of modifying KIUC's minimization plan (Appendix 4B, *KIUC Minimization Projects*) to reduce the numbers of strikes in order to meet biological objectives 1.1, 2.1, and 4.1 (Chapter 4, Section 4.3, *Biological Goals and Objectives*) and to limit the potential for exceedance of the permitted take limit (as described in Section 6.4.1.2, *Take Monitoring*). Adaptive management changes for powerline strike minimization may include the following:

- Minimization on unmodified spans.
- Additional minimization on previously modified spans (e.g., adding bird flight diverters on reconfigured spans).
- Novel minimization techniques that incorporate new technology.
- Replacing less effective techniques with those with higher strike reductions.

KIUC will work in conjunction with USFWS and DOFAW consistent with Section 6.2.2.3, *Adaptive Management Decision-Making Process for this HCP*, regarding new strategies and technologies, as well as any changes (other than minor adjustments) to the monitoring protocols to measure powerlines collisions.

6.4.2 Light Attraction Monitoring and Adaptive Management

Biological objectives 1.2, 2.2, and 3.2 require that KIUC minimize artificial light attraction on the covered seabird fledglings from all existing and future KIUC streetlights and existing covered facilities. KIUC will achieve this by continuing to implement practicable conservation measures through the permit term (Chapter 4, Section 4.4.2, *Conservation Measure 2. Implement Measures to Minimize Light Attraction*).

6.4.2.1 Effectiveness Monitoring

Streetlights

As stated in Chapter 4, Section 4.3.1, *Newell's Shearwater (ʻaʻo)*, KIUC, in partnership with the County of Kauaʻi and State of Hawaiʻi, installed full-cutoff shields on all its streetlights within the Plan Area in 2017. Although KIUC owns and operates the streetlights, KIUC is not able to modify them without County and State approval. As stated above, biological objectives 1.2, 2.2, and 3.2 require that KIUC continue to implement practicable conservation measures throughout the permit term. Accordingly, KIUC will maintain full-cutoff shields on all existing streetlights and install full-cutoff shields on all new streetlights throughout the permit term. No effectiveness monitoring for KIUC streetlights is needed to meet the biological objectives.

Monitoring KIUC streetlights for light attraction is not feasible or practicable given the wide distribution of streetlights across the island and their locations. In most cases, streetlights occur in areas with other (often many other) light sources from residences, vehicles, or commercial operations. In these cases, it is often impossible to determine if a seabird became grounded due to a KIUC streetlight or a non-KIUC light source nearby. KIUC streetlights in more remote areas that are the only light source are often surrounded by private land for which access is often not possible. Full-cutoff shields on streetlights have been determined by KIUC, USFWS, and DOFAW, to be the best practicable minimization measure and for the purposes of this HCP are assumed to be effective.

Covered Facilities

The number of grounded seabirds will determine the efficacy of Conservation Measure 2. Implement Measures to Minimize Light Attraction, at KIUC's covered facilities. KIUC monitors its covered facilities (Port Allen Generating Station and Kapaia Power Generating Station) according to the *KIUC Site Monitoring Protocols and Procedures for Protected Seabirds* (Appendix 6B). During the seabird fallout season (September 15–December 15), responsible KIUC staff at the covered facilities conduct twice daily searches targeted specifically at finding grounded seabirds—once 1 hour prior to sunrise and once 3 to 4 hours after sunset. KIUC will also install panning cameras on building roofs and check these cameras regularly between 10 p.m. and sunrise to monitor for grounded birds on top of KIUC facility buildings.

The following steps will be taken when any downed seabird is discovered alive, as described in Appendix 6B.

- At least one photograph will be taken of the scene showing the bird as it was found.
- The location where the seabird was found will be marked on a satellite image.
- KIUC staff will deploy the KIUC Oppenheimer Seabird Recovery Kit, put on protective gloves, carefully wrap the bird in the clean towel from the kit, and gently place it in the recovery box.

- The KIUC Seabird Recovery Reporting Form (Appendix 6B) will be completed.
- The bird will be placed in the nearest SOS Aid Station, and SOS will be called to report that the seabird has been placed there. KIUC staff will then ensure that the retrieved bird receives prompt attention by SOS staff or volunteers.
- Within 24 hours of finding a seabird, KIUC will inform USFWS and DOFAW via email and include the completed KIUC Seabird Recovery Reporting Form and information concerning the bird's disposition.

If a dead bird is found the protocol is similar except that KIUC staff must place the bird in the refrigerator in two plastic storage bags and contact SOS for retrieval. The KIUC Seabird Recovery Reporting Form (Appendix 6B) will be completed and USFWS and DOFAW will be contacted within 24 hours.

To determine the effectiveness of light attraction minimization at KIUC's covered facilities, KIUC will review the monitoring results from the previous year to determine how many seabirds were grounded with the implementation of KIUC's conservation actions. The results of the covered facility monitoring will also be included in KIUC's annual report (see Section 7.7, *Annual Reporting*).

6.4.2.2 Take Monitoring

Streetlights

Take of covered seabirds from KIUC streetlights was estimated based on inferences used in the light attraction model that is described in Appendix 5C, *Light Attraction Modeling*. Because take from KIUC streetlights cannot be measured in the field, ongoing take from streetlight attraction will continue to be assumed throughout the permit term to be consistent with the model estimate. This approach is consistent with the No Surprises assurances provided by the federal ITP and state ITL.

Covered Facilities

The facility monitoring described under Section 6.4.2.1, *Effectiveness Monitoring*, will allow KIUC to compare the actual number of covered seabirds found in the covered facilities during the permit term to the amount estimated in Table 5-5. If actual take at both covered facilities combined is higher than estimated in the HCP as measured by a rolling 5-year average, KIUC will implement an adaptive management change as shown in Table 6-3.

Night Lighting for the Restoration of Power

As stated in Chapter 5, Section 5.3.1.2, subsection *Fallout from Night Lighting for Restoration of Power*, the take estimate for streetlights is conservative (i.e., likely overestimates take). Fallout during the seabird fledging season (September 15 to December 15) from lighting at temporary work areas is expected to be rare given that the lighting event is short in duration (typically 1 hour on average; see Chapter 2, Section 2.1.4, *Night Lighting for Restoration of Power*). In addition, nighttime work is only associated with emergency outages that happen in the evening hours. Based on these factors, the HCP assumes the operation of temporary lighting for restoring power does not change the overall estimated take of covered seabirds from light attraction. KIUC staff will search for grounded and circling seabirds within 0.1 mile (0.16 kilometer) of the construction site in accessible areas (e.g., public land) according to the same methodologies as the covered facilities (Appendix 6B, *KIUC Site Monitoring Protocols and Procedures for Protected Seabirds*), except that only one search event will be performed following completion of the emergency work.

6.4.2.3 Adaptive Management

As described above, KIUC will continue to implement practicable conservation measures related to covered streetlights throughout the permit term. Because KIUC is already implementing these streetlight minimization measures to the maximum extent practicable, no additional measures or adaptive management changes are required. Adaptive management is triggered if KIUC finds that the number of grounded covered species in the two covered facilities combined in any year (as measured by a 5-year rolling average) is greater than what is expected at the covered facilities (see Chapter 5, Table 5-5) (six or more groundings of Newell's shearwater ['a'o], and 1 or more grounding of Hawaiian petrel ['ua'u] or band-rumped storm-petrel ['akē'akē]). KIUC will follow the process outlined in Section 6.2.2, *Adaptive Management*, to determine the appropriate adaptive management response in close coordination with USFWS and DOFAW. The adaptive management trigger for take and effectiveness monitoring are the same (i.e., number of grounded birds), and they would result in the same response, depending on the cause. Adaptive management changes for light attraction at the covered facilities may include the following.

- Improved or more frequent training for KIUC facility staff to promptly attend to (i.e., improve detectability) and properly handle downed seabirds (i.e., improve survivorship).
- Reassessment of light intensity and light shielding at either or both covered facilities.
- Improved predator control at either or both covered facilities.
- Changing the wavelength of the LED if research shows a different LED wavelength is more bird-friendly.
- Novel technology to improve light shielding or otherwise further reduce light attraction.

Adaptive management for night lighting for the restoration of power is not possible due the emergency nature of the work. As stated above, KIUC will search for grounded birds at construction sites and count these birds against its take limit. If KIUC finds that the number of grounded birds due to night lighting is significantly greater than anticipated and could result in KIUC exceeding its combined take estimate for light attraction (Chapter 5, *Effects*, Table 5-5), KIUC will work with USFWS and DOFAW to find a solution. This may include, but is not limited to, increased minimization, if practicable, at KIUC powerlines, or increased or targeted monitoring to find, rescue, and turn in more covered seabirds to the SOS Program (see Section 6.4.3, *SOS Program Monitoring and Adaptive Management*).

6.4.3 SOS Program Monitoring and Adaptive Management

6.4.3.1 Effectiveness Monitoring

KIUC is required to fund the rescue, rehabilitation, and release of the covered seabirds and the covered waterbirds through the SOS Program. Conservation Measure 3 requires KIUC to fund the operation of the SOS Program at a level sufficient to treat all covered seabirds and covered waterbirds that are provided to the facility.

The SOS Program is based on opportunistic findings of grounded birds by the public and volunteers. As such, there are no monitoring protocols for this program. To determine the effectiveness of

KIUC's funding of the program, KIUC will review and evaluate the SOS Program annual report, which is submitted to KIUC each spring for the previous calendar year. KIUC will also coordinate closely with SOS Program staff, to track the number of covered seabirds and covered waterbirds that are processed each year. KIUC will review data on the numbers of rescues and releases of covered seabirds and covered waterbirds to compare the results with previous years, which will inform adaptive management. The assumption here is that KIUC's funding of the SOS Program during HCP implementation (see Chapter 7 for funding commitments) will be sufficient to process at least the average amount of covered seabirds and covered waterbirds (based on data from 2019–2021, Table 6-4) and some small amount of increase during the HCP permit term. However, the HCP also acknowledges that significant increases in the number of covered seabirds and covered waterbirds processed by SOS could necessitate increased funding beyond the funding commitment of the HCP. Annual assessments of the SOS Program will inform adaptive management, as described below (see Section 6.4.3.2, *Adaptive Management*). In addition, the results of the SOS Program relevant to the covered species will be included in KIUC's Annual Report (see Chapter 7, Section 7.7, *Annual Reporting*).

Table 6-4. Average Number of Covered Species Rehabilitated by the SOS Program

Year	Number of Covered Seabirds[a,b]	Number of Covered Waterbirds[a,b]
2019	105	91
2020	132	99
2021	102	101
3-Year Average	113	97

[a] Totals do not include birds dead on arrival.
[b] Source: Bache 2019, 2020, 2021.

6.4.3.2 Adaptive Management

As described in Section 6.4.3.1, *Effectiveness Monitoring*, KIUC will evaluate the SOS Program's annual reports and coordinate with SOS Program staff. If for 3 years in a row the number of individuals of the covered species turned in to SOS increases by 10 percent or greater as compared to the previous 3-year average, adaptive management will be triggered. KIUC will coordinate with SOS, USFWS, and DOFAW to identify the reason for the change and determine whether the current level of SOS funding is sufficient to process the increased level of covered seabirds coming to SOS. If it is determined that the current level of SOS funding is not sufficient to rehabilitate the increased number of individuals of covered species, KIUC will increase its level of funding by 50 percent of the increase in covered species.[9] Additionally, if the number of birds turned in later drops back to the 3-year historic average (Table 6-4), KIUC will consult with SOS, USFWS, and DOFAW to determine if funding can be reduced back to the original level.

[9] For example, a 10 percent increase in covered species turned in to SOS = a 5 percent increase in KIUC funding; a 20 percent increase in covered species turned in to SOS = a 10 percent increase in KIUC funding.

6.4.4 Conservation Site Monitoring and Adaptive Management

6.4.4.1 Effectiveness Monitoring

KIUC will continue to use the same monitoring protocols that have been used and refined for more than 10 years through the Short-Term HCP to evaluate management effectiveness at the conservation sites to meet the above biological objectives. Each of the following sections describes how KIUC will monitor and collect data from the conservation sites that will allow them to determine the effectiveness of site management. This, in turn, will allow KIUC to determine when biological objectives 1.3 and 2.3 are met.

Monitor Status of Covered Seabird Colonies in the Conservation Sites

KIUC will monitor the covered seabird colonies within the 10 conservation sites annually to ensure that the number of Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) breeding pairs and new chicks produced annually are increasing, as described in Objective 1.3 for Newell's shearwater (ʻaʻo) and Objective 2.3 for Hawaiian petrel (ʻuaʻu). Specifically, monitoring the number of covered seabird breeding pairs, breeding pair growth rate, and reproductive success rate will determine if the management actions (e.g., predator control, social attraction) implemented at the conservation sites are effective at achieving the desired metrics under Objective 1.3 and Objective 2.3.

- Metric 1. Maintain an annual minimum of 1,264 breeding pairs of Newell's shearwater (ʻaʻo) and 2,257 breeding pairs of Hawaiian petrel (ʻuaʻu) for as determined by call rates and burrow monitoring.
- Metric 2. Reach a target of 2,371 breeding pairs for Newell's shearwater (ʻaʻo) and 2,926 breeding pairs for Hawaiian petrel (ʻuaʻu) by year 25 of the permit term and 4,313 breeding pairs for Newell's shearwater (ʻaʻo) and 3,751 breeding pairs for Hawaiian petrel (ʻuaʻu) by the end of the permit term.
- Metric 3. Growth rate for breeding pairs annually of at least 1 percent for both Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu), as measured by a 5-year rolling average.
- Metric 4. Maintain a 5-year rolling average 87.2 percent reproductive success rate for Newell's shearwater (ʻaʻo) and 78.7 percent reproductive success rate for Hawaiian petrel (ʻuaʻu).
- Metric 5. Eradicate terrestrial predators within predator exclusion fencing.
- Metric 6. Produce at least one Newell's shearwater (ʻaʻo) breeding pair within each of the four social attraction sites by Year 10 of the permit term.
- Metric 7. Ensure that invasive plant and animal species do not preclude meeting the objective metrics above.

The monitoring protocol described below was developed by Raine and Travers and is the current method used to document and monitor the covered seabird colonies (Archipelago Research and Conservation 2022).

Burrow Monitoring

Burrows identified as those of either Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) will be monitored at each of the 10 conservation sites to evaluate the effectiveness of the management actions at meeting metrics 1 through 4 and 6 above. In addition, burrows with unidentified seabirds will also be monitored. Burrow monitoring will track the number of breeding pairs in each conservation site, the growth rate of those breeding pairs over time, and the nesting outcomes (i.e., reproductive success). Burrow monitoring also includes camera monitoring at burrows to document predation events (which is relevant to metric 6).

Eight seabird monitoring visits are conducted at each conservation site based on the following schedule, which has been refined over the last decade by Raine et al. The schedule is somewhat flexible each breeding season by necessity due to logistical considerations and weather conditions.

- February (prior to covered species arrival)—Remote wildlife cameras and song meters deployed for the season.
- April (covered species arrival)—Burrow checks, equipment maintenance.
- June (incubation)—Burrow checks, equipment maintenance.
- July (chicks hatching)—Auditory surveys
- August (early chick rearing)—Burrow checks, equipment maintenance.
- October (beginning of Newell's shearwater [ʻaʻo] fledging)—Burrow checks, equipment maintenance.
- November (end of Newell's shearwater [ʻaʻo] fledging, beginning of Hawaiian petrel [ʻuaʻu] fledging)—Burrow checks, equipment maintenance.
- December (end of Hawaiian petrel [ʻuaʻu] fledging)—Final burrow checks, remove remote wildlife cameras.

Each previously located burrow has been marked with a unique identification tag[10] and its location recorded using a handheld global positioning system (GPS) unit. Wherever possible, each burrow had also been identified to species (although in some cases where nest chambers are too convoluted to see the bird, the species is listed as 'UNPE-Unidentified Procellariid' until species confirmation is possible.

Searches are also undertaken to locate new nest sites and new nesting areas within each management area. Searches in each management area employ two methods:

- Evening and dawn auditory surveys supplemented with night-vision equipment, during which birds are observed in flight and their burrow location estimated by where they landed. Those areas were then searched.
- Diurnal cold searches, during which personnel actively search the vegetation for nest sites in areas identified as having high levels of seabird activity, particularly ground activity indicative of breeding birds, during recent auditory surveys.

It is assumed that the numbers of burrows found will increase as the number of seabirds within each conservation site increases over the 50-year permit term. When this occurs, it may not be

[10] Red-colored cattle tags with black numbering for all burrows in Hono O Nā Pali NAR and orange-colored cattle tags with black numbering for all burrows in Upper Limahuli Preserve.

possible to monitor all burrows, at which point it will be necessary to monitor a subset of burrows. If this occurs, the survey team will design their burrow monitoring to represent the spatial distribution of the targeted population using a subset of burrows (e.g., by using a stratified random sample).

During burrow checks, each burrow is inspected to assess breeding status. For deep burrows where direct visual inspection is not possible, a hand-held camera is used to take photos into the back of the burrow. At all times, care is taken to minimize damage to surrounding vegetation and burrow structure.

During each burrow check, data is collected via specially designed apps to record the following signs of activity within or around the nest.

- The presence of adult, egg, or chick
- Scent, signs of digging or trampling
- Presence of feathers, guano, or eggshell

A note is also made as to whether it was possible to see to the back of the burrow (e.g., was the burrow fully inspected, or was there a possibility that something was missed). Any signs of depredation (e.g., a dead adult or chick in front of burrow or inside burrow, chewed feathers or egg) or the presence of scat/droppings/prints that indicate a predator has been in the vicinity of the nest are also recorded. In instances where a seabird carcass is located, it is photographed, collected, and removed for further inspection. Data collected on depredations include a GPS point, the species of predator involved (if known), and species and age of the bird that has been depredated.

At the end of the season, a final status is assigned to each nest using the following categories:

- Active, breeding confirmed, success—Breeding was confirmed as having been initiated during the season through the presence of (i) an adult during the day in June or July, apparently incubating, (ii) an egg, (iii) down, or (iv) chick. Nest successfully fledged a chick. As the site is remote and not visited regularly enough to see the chick fledge, a successful fledging is considered in the following scenario: A chick was confirmed in burrow up until typical fledging month (October for Newell's shearwater ['a'o], November/early December for Hawaiian petrel ['ua'u]) and on the following check the presence of small amounts of down outside the nest site indicate that the chick was active outside the burrow and subsequently fledged. No signs of depredation or predator presence were noted. Burrows with cameras provide information on exact fledging date and time.
- Active, breeding confirmed, failure—Breeding was confirmed as having been initiated during the season through the presence of (i) an adult during the day in June or July, apparently incubating, (ii) an egg, (iii) down, or (iv) chick. Nest did not fledge a chick. The failure stage (egg or chick) and cause of failure (e.g., depredation of chick or egg, abandonment, depredation of breeding adult) is recorded where known. Burrows with cameras can provide information on depredation events and predator visitations pertinent to nest failure.
- Active, breeding confirmed, outcome unknown—Breeding was confirmed as having been initiated during the season through the presence of (i) an adult during the day in June or July, apparently incubating, (ii) an egg, (iii) down, or (iv) chick. Breeding was confirmed at the site; however, no subsequent visits were made, no visits were made late enough in the season to confirm fledging, or signs were inconclusive. A very small number of burrows fit into this category as every effort is made to assess the final status of all burrows.

- Active, unknown—The presence of an adult bird, or signs of an adult bird (e.g., guano, feathers, trampling) indicate that a bird was present during the breeding season, but it was not possible to confirm whether breeding occurred and failed or breeding was never initiated. Either way no chick fledged. Situations like this arise in instances where (i) it was not possible to examine the back of the nesting chamber due to the structure of the burrow or (ii) the burrow is discovered late in the breeding season and, as it was not monitored during the egg-laying period, it is not clear if breeding had been initiated.
- Active, not productive—The presence of an adult bird, or signs of an adult bird (e.g., guano, feathers, trampling) indicate that a bird was present during the breeding season, but burrow inspections reveal that no breeding took place (i.e., no egg was ever laid).
- Active, prospecting—Bird(s) recorded visiting nest, but signs are indicative that these are prospecting and not breeding birds. Examples would be new excavations within a previously inactive burrow, a single visit during the breeding season to a previously inactive burrow, a visit to a burrow where both adults had been confirmed killed the year before, or the preliminary excavation of a burrow-like structure combined with the confirmed presence of a seabird.
- Inactive—No sign (e.g., bird presence, feathers, guano, digging) that the burrow has been visited in that breeding season.
- Status unknown—There was no way to assess what had happened in the burrow during the year (i.e., burrow found at the end of the season with seabird sign but no indication of what happened, or burrow monitored at points during the season but breeding status and outcome unknown).
- Did not monitor—Burrow not checked at all in the year (due to safety reasons, or they could not be located in the following monitoring season).

During colony monitoring visits, surveyors continue to look for any sign of breeding activity (e.g., guano, feathers, scent). If any sign is noticed, the surveyors search the area for new burrows. Newly identified burrows are then included in the monitoring project as outlined above. The addition of new burrows to the overall monitoring project provides a larger sample size to assess breeding probability and breeding success, as well as the impact of introduced predators (which cannot be adequately assessed if only a small number of burrows in a restricted area of the site are monitored). Ultimately, the number of burrows known within each conservation site is used to understand the minimum number of breeding pairs present within each management site, as well as being one of the factors needed in the estimation of site-specific population estimates.

Incidences of depredation (or signs of introduced predators) either at known nesting burrows or along trails are also recorded when they are observed during trips to each area, with locations logged using a handheld GPS. Any depredated seabird bodies or predator scat/pellets are photographed *in situ* and then bagged and removed for further analysis if necessary (i.e., if the cause of depredation is not immediately apparent). If scat is located, it is subsequently examined for the presence of seabird feathers/bones indicative of a depredation event. When instances of depredation or fresh predator sign were recorded, the appropriate predator control team (depending on the conservation site) is notified immediately to ensure that predator control efforts occur in the area as soon as possible to minimize further depredation events. This is particularly important for barn owl, feral pig, and feral cat sightings, as these predators can cause significant damage to the colony in a relatively short time and need to be removed before they become established.

A subset of up to 30 burrows are monitored at each site by remote wildlife cameras[11] each month from March to December, with the exact number depending upon availability of camera units and the number of burrows that are active. These cameras are mounted on poles located 3 to 5 feet (0.9 to 1.5 meters) away from the burrow entrance, with the camera pointed directly at the burrow mouth. Cameras are set on a "rapidfire" setting (motion sensor activated, with a trigger speed of ≤ 1.5 seconds), and are tested at the time of deployment and during battery changes to ensure that the camera would fire when something moved in front of the burrow mouth. These camera stations are useful in identifying individual feral cats to help inform predator control staff whether there is more than one animal in the area and/or the key areas in which the individual animal is concentrating its hunting activities.

Memory cards used to record photographs are switched out on each visit to minimize risk of data loss. Batteries are replaced as needed to ensure continuous coverage over the season. data cards are reviewed while in the field to assess activity levels and presence/absence of seabird predators at the burrow. If any predator is observed, monitoring personnel inform predator control personnel as soon as possible.

If a burrow fails during the season or the chick successfully fledged, then the camera is moved to a new active burrow on the next check, with burrows chosen based on ease of camera placement and field of view. At each check, data are collected via specially designed apps to record battery power, percentage of memory card storage usage, and whether there are any issues with the unit. If a camera is malfunctioning in the field, it is brought back to the office and sent back to the manufacturer for repair; where possible, defective cameras are replaced immediately in the field with a functioning unit.;

Call Rate Monitoring

Call rate monitoring is undertaken using acoustic song meters.[12] Call rate monitoring using song meters is a critical tool for determining trends in abundance. Call rates for both Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) are significantly correlated to the number of breeding birds in an area (Raine et al. 2019). Therefore, plotting the change in call rates allows researchers to assess whether the colony is responding to management actions. This approach allows a larger scale of assessment of management that is not possible through burrow checks alone. Acoustic song meters in conjunction with burrow monitoring data will be used to evaluate the effectiveness of the management actions at meeting metrics 1, 2, 3, 4, and 6 above.

Song meters are attached to poles and elevated 1 foot (0.3 meter) above the ground. One song meter will be placed at each of the previously established static monitoring points (14 static units deployed at Upper Limahuli, 10 each at Pōhākea, Hanakāpiʻai, Hanakoa, North Bog, Honopū, and Pihea) at each of the conservation sites. Song meter locations will be determined within Conservation Site 10 once it is selected. Permanent static locations were selected such that sensor microphones were sheltered from prevailing winds and were well away from moving vegetation such as branches, grasses, or ferns.

Five months of data are collected annually between May and September to cover both the recruitment phase (May to early June) and incubation through early chick rearing (June to September). Five months of data collection allows for a more robust analysis by reducing the

[11] Current model used is the Reconyx Hyperfire HP2X. Other similar models may be used in the future.

potential impact of data loss due to weather or malfunctioning equipment (units are maintained, and thus problems are detected, once per month). Five months also covers the cover the peak vocal period for the two target species.

Song meters are powered by batteries and recordings are stored on memory cards. All sensors are fitted with two omnidirectional microphones that had water repellent applied to them to improve waterproofing. Microphones are arrayed horizontal to the ground and one on each unit had an additional wind screen installed over it. All units also have plastic rain guards erected above them to help waterproof the units.

The song meters record on two channels at a sampling rate of 22 kilohertz and be programmed to record 1 minute out of every 5 minutes for 5 hours after sunset, and 1 minute out of every 10 minutes for 5 hours before sunrise. Song meter recordings will be analyzed[13] for (a) first arrival dates, and (b) calling rates during the recruitment stage and breeding stage (5 months: May through September). Song meters will be analyzed to detect call rates of Newell's shearwater (ʻaʻo), Hawaiian petrel (ʻuaʻu), and barn owls.[14]

At each check, data are collected via specially designed apps to record memory card percentage and functionality of the two microphones. SD cards and batteries were also swapped out regularly (memory cards on every visit and batteries every two visits). If a microphone is malfunctioning, then it is immediately replaced with a new microphone in the field. Even if both microphones are functioning properly, one is switched with a new microphone to decrease the likelihood of microphone failure. Habitat, topography, and vegetation data are also collected on the iPad Mini around all deployed song meters the first year the units are deployed.

A single additional auditory survey trip will be undertaken to each of the conservation sites in July, with the focus dependent on management priorities (e.g., attempting to locate new Newell's shearwater [ʻaʻo] breeding sites, assessing the effectiveness of social attraction sites, updating auditory survey polygons to assess population size changes and assisting with real-time barn owl monitoring). Auditory surveys provide data that are used in the creation of population estimates and seabird distribution mapping, as well as information used by the surveyors to locate new burrow clusters. Data collected on barn owl activity during the surveys is also passed on to predator control teams to help inform predator control operations.

Auditory surveys are not conducted during the week of the full moon, as birds are not vocal during full moon nights. During auditory survey trips, surveys are undertaken in the evening and the early morning, which are the peak periods of seabird movement to and from the sea and breeding colonies. Evening surveys start at sunset and last for 2 hours. Morning surveys start 2 hours before dawn and last for 1.5 hours.

Surveys are split into 30-minute sessions, with 5 minutes allotted for the collection of weather data, 25 minutes for auditory surveying, and 5 to 10 minutes for concurrent night vision. Surveyors record all seabird calls (classified as a single unbroken note or series of notes) heard during the survey period and any bird actually seen during each period (either by eye or through night-vision

[13] Song meter data are currently analyzed by an outside vendor, Conservation Metrics, Inc., although this may change in the future.

[14] Band-rumped storm-petrels (ʻakēʻakē) are not included because they do not breed in the conservation sites, with the exception of Honopū PF where band-rumped storm-petrels (ʻakēʻakē) may breed in future due to social attraction efforts at that site.

equipment). For each record, data are collected on time of observation, species, direction from observer, distance from observer, and the behavior of bird (with particular attention paid to circling behavior and ground-calling).

At the end of the survey trip, observers create polygons on maps of the survey area identifying where seabird activity are recorded. These are categorized using detections such as the following:

- Birds in transient flight between inland nesting areas and the sea
- Birds circling to gain altitude before flying further inland or out toward the sea
- Birds persistently circling and calling within a restricted area over an extended period of time
- Birds calling from the ground

Detections are then translated into polygons on the maps (where applicable), which are defined as hotspot-heavy and hotspot-light. Hotspot-heavy and hotspot-light are defined as polygons where there is aerial calling activity only, with heavy denoting localized aerial activity with continuous calling and light denoting localized aerial activity (i.e., sporadic calling). Hotspot-heavy and ground-calling polygons are the best indicators of actual breeding activity in any given area. These polygons and the definition of the polygons have been the standard protocol since endangered seabird surveys started on Kauaʻi in 2006 and as such are directly comparable with each other across years.

All ground-calling locations are individually recorded on a map in the field and later added to ArcGIS. Ground-calling locations are those where birds are confirmed calling from the ground (as opposed to from the air), as this is indicative of breeding activity and is arguably the most important record of seabird activity in any area. At the end of the season, ground-calling locations from auditory surveys in all years are combined. Any locations that are within 82 feet (25 meters) of each other are removed (to be conservative, as they may have related to the same bird and this helped prevent double counting) as well as any ground-calling locations within 82 feet (25 meters) of a known burrow. All others are included on the distribution maps.

It is possible that call rate saturation may occur during the 50-year permit term if the number of covered birds increases greatly within the conservation sites. Call rate saturation could result in it being impossible to detect trends in calls rates; however it is important to remember that the Population Dynamic Model projects that both species will only increase at a 1 percent growth rate. If call rate saturation does occur, it is expected to happen much later in the permit term because call rates would need to exceed 30 calls per minute[15] on average at each conservation site (Raine pers. comm.). Call rate saturation would be addressed through adaptive management. KIUC would work with USFWS, DOFAW, and the survey team to adjust or revise the monitoring protocol to ensure that call rate saturation does not affect the data necessary to determine the effectiveness of KIUC's management with the conservation sites to meet Objectives 1.3 and 2.3.

Social Attraction Monitoring

Social attraction monitoring is the primary means of determining the effectiveness of the social attraction management action and whether metric 5 is met. Social attraction also contributes to determining the effectiveness of predator control in the conservation sites and meeting the other metrics under Objectives 1.3 and 2.3.

[15] In 2021, calls per minute were lowest at Pihea (6.13 calls/min) and highest at Upper Limahuli Preserve (17.59 calls/min) (Archipelago Research and Conservation 2022).

The solar-powered sound system is installed in the social attraction site to broadcast calls over the restored habitat with the artificial burrows. The calls are broadcast throughout the peak breeding season (April through mid-September) and stopped prior to the emergence of fledglings. The contents of all artificial burrows within the predator exclusion fencing will be checked during the monthly trips to each conservation site to document and record any seabird sign at each burrow. Cameras will also be used to monitor the artificial burrow entrances and trails within area. This data will be used to document burrow occupancy, as well as the presence of predators, should they recur within a fenced area.

Additional Monitoring Activities

In addition to the activities outlined above, during each monitoring trip the following activities will also be performed.

- Data will be collected on any sign of predators (e.g., rats, cats, pigs, barn owls) or predation events (e.g., a dead covered seabird or predator-damaged eggs). In instances where a seabird carcass is located, it will be photographed, collected, and removed for further inspection. If possible, the age of the carcass will be determined.[16] Breeding status of predated adults will also be assessed by looking for evidence of a brood patch.
- Monitoring staff will immediately contact the predator control team to coordinate efforts to locate and remove the predator when (a) a fresh predation event is found; (b) fresh sign of cats, dogs, or barn owl activity are observed; or (c) cats, dogs or barn owls are observed on photographs captured by burrow monitoring cameras.
- If time allows, searches will also be undertaken to locate new burrows and new breeding areas within the conservation sties. Any new burrows found will be tagged and incorporated into the burrow monitoring program unless, as described above, burrow abundance exceeds monitoring capacity, in which case the survey team will design their burrow monitoring to represent the spatial distribution of the targeted population using a subset of burrows, rather than monitoring each burrow. If possible, staff will note any banded birds occupying monitored burrows or otherwise being present at the sites. If any birds are observed on camera or by direct observation to be banded, personnel will attempt to document the band number if it does not interfere with the bird's safety or the day's work plan.
- If KIUC staff note spread or prevalence of invasive plant species in the field they will alert KIUC and KIUC will work with USFWS and DOFAW to address the issue through adaptive management. Invasive plant monitoring occurs incidentally during other activities at the conservation site (e.g., burrow monitoring, predator control). Therefore, there is no specific monitoring protocol or adaptive management triggers for invasive plant species included in this HCP. However, adaptive management responses related to the conservation sites and the covered seabird breeding pairs will evaluate invasive plant species as one possible cause of reduced success.

[16] Age can be determined generally by the wear of primary and secondary feathers and evidence of sun bleaching on the wing coverts or head feathers.

This data will be used to determine if the management actions have been effective at meeting the metrics for biological objectives 1.3 and 2.3 for Newell's shearwater ('a'o) and Hawaiian petrel ('ua'u). The following metrics, as required by the objectives will be evaluated.

- Annual population estimate and growth rate within each conservation site and all conservation sites combined (as determined by call rates and burrow monitoring data).
- Evidence of at least one breeding pair within each of the four social attraction sites by Year 10 of the permit term.
- Call rate and call rate trend within each conservation site and at all conservation sites combined.
- Annual reproductive success rate within each conservation site and at all conservation sites combined.

Population trends of Newell's shearwater ('a'o) and Hawaiian petrel ('ua'u) will be evaluated by updating the population dynamics model (Appendix 5E, *Population Dynamics Model for Newell's Shearwater ('a'o) on Kaua'i*) with monitoring data from all conservation sites each year.

Model parameters other than the performance at the conservation sites will be held constant to facilitate comparisons across years and to assess progress towards meeting biological objectives 1.3 and 2.3. However, if new information strongly suggests that other model assumptions should be adjusted, KIUC may update model parameters and provide these results as well. Any adjustments to model parameters must be mutually agreed to by KIUC, USFWS, and DOFAW and be documented in the next annual report along with a justification for the change.

Monitoring of the conservation sites will continue annually throughout the permit term. However, if biological objectives 1.3 and 2.3 are met and this is confirmed for least 3 consecutive years, KIUC may reduce the frequency and intensity of monitoring at the conservation sites following agreement from USFWS and DOFAW. Specifically, KIUC may reduce monitoring frequency from annual to biannual (every 2 years).

Evaluate the Effectiveness of Predator Control in the Conservation Sites

KIUC has been funding monitoring for the presence of pigs, cats, mice, rats, and barn owls in many of the conservation sites since 2011. Biological objectives 1.3 and 2.3 require that invasive animal species do not preclude meeting the other metrics related to covered seabird population abundance and population growth in the conservation sites. Predator monitoring at each conservation site, outside of areas with predator exclusion fencing, will consist of the following measures.

- Operate 10 camera traps (game cameras) at locations chosen to give a breadth of spatial coverage at each conservation site. The images will be reviewed every 4 to 6 weeks for evidence of predators.
- Review burrow monitoring camera (up to 30 at each site) images every 4 to 6 weeks for evidence of predators.
- Opportunistically observe predator signs (e.g., carcasses, sightings, tracks, scat, fur, wallows) while working in the colonies on other tasks. Any predated seabird bodies or predator scat/pellets will be photographed *in situ* and then bagged and removed for further analysis if necessary. If scat is located, it will be subsequently examined for the presence of seabird feathers indicative of a predation event. Locations of predator evidence will be logged using a handheld GPS and observations recorded.

- Record the location, number, and species of predators trapped or otherwise removed.

For areas within predator exclusion fencing, once the terrestrial predator exclusion fences are complete and predators are eradicated from Upper Limahuli Preserve, Site 10, Pōhākea PF, and Honopū PF (as determined by monitoring, using the above protocol), predator monitoring at those sites will be modified as follows.

- The trail camera traps will be repositioned to selectively monitor the containment zone (Chapter 4, Section 4.4.4.2, *Management Actions*), weatherports, helicopter landing zones, and other areas suspected to be or confirmed to be areas where predator incursions are more likely to occur or be detected. The fence perimeter will be monitored with cameras inside the fence.
- Perimeter walks will occur on a monthly interval and any damage to the fence will be immediately reported and addressed. Monitoring of the fenceline will include searching for any signs of barn owl use/presence.

The results of the monitoring outlined above will be used throughout the year to make minor adjustments to the predator control efforts and methods to be as effective and efficient as possible (Section 6.2.2.1, *Minor Adjustments vs. Adaptive Management*). The effectiveness of predator control and the trigger for adaptive management will be determined based on the outcomes for the covered species metrics under Objectives 1.3 and 2.3. For example, if the number of Newell's shearwaters ('a'o) or Hawaiian petrels ('ua'u) is below 1,264 or 2,257 breeding pairs, respectively, in any year, KIUC would evaluate the cause, which would include an evaluation of the predator control program to determine its effectiveness. Similar evaluations would occur for breeding pair growth rates and reproductive success rates if they were not achieving their metrics of success (Table 6-3).

The following data, collected by the predator control team, will be used to adaptively refine and adjust predator management in the conservation sites (Hallux 2020).

- Average daily animal removal rates (animals removed per trap per day) by species and conservation site examined across all trap types per year.
- Number of animals (by species) captured by trap type.
- Percentage of animals (by species) detected at camera locations by site.
- Number of individual cats by site.
- Daily and monthly probability (i.e., likelihood) of animal presence (by species) by site and year.
- Change in call rate of barn owls at each site, as measured using acoustic monitoring.

Additional metrics may be added in the future if predator control techniques or technology changes.

No effectiveness monitoring is required for Objective 3.3. If predator control is occurring for the other covered seabird species in the conservation sites, Objective 3.1 is assumed to be met. Any minor adjustments or adaptive management changes to predator control for the other covered seabird species is assumed to benefit band-rumped storm petrel ('akē'akē).

6.4.4.2 Adaptive Management

The conservation measures that are proposed in the conservation sites have been implemented and refined for last 10 years and have proven to be highly effective at reducing the abundance of predators and increasing the abundance of the covered seabirds within the conservation sites

(Raine et al. 2020). As such, KIUC does not expect that the conservation measures within the conservation sites will require significant refinement during the permit term.

As stated in Chapter 5, Section 5.3.3.1, *Newell's Shearwater ('a'o)*, and Section 5.3.3.2, *Hawaiian Petrel ('ua'u)*, the data analysis and modeling used to estimate adverse, beneficial, and net effects on these species required the application of assumptions that in some cases have a high level of uncertainty. KIUC addressed this uncertainty, in part, by using conservative assumptions that err on the side of likely overestimating adverse effects to the species and likely underestimating the benefits. Despite these assumptions, adaptive management at the conservation sites may be necessary if the biological objectives are not likely to be met.

Specific adaptive management triggers have been developed for each conservation site or combinations of conservation sites that are relevant to either Newell's shearwater ('a'o) or Hawaiian petrel ('ua'u). These adaptive management triggers were designed with the following goals and constraints in mind:

- Each trigger serves as an early warning to detect potential performance problems at individual conservation sites.
- Utilize metrics that are measured annually in the field at each conservation site.
- Utilize measures such as rolling averages that "smooth" out annual variability but still allow annual assessments of performance.

With these concepts in mind, adaptive management would be triggered if any of the following parameters are not met (Table 6-3).

- Maintain an annual minimum of 1,264 Newell's shearwater ('a'o) breeding pairs at all 10 conservation sites combined.
- Growth rate for Newell's shearwater ('a'o) breeding pairs annually of at least 1 percent to reach a target of 2,371 breeding pairs by Year 25 of the permit term and 4,313 breeding pairs by the end of the permit term, based on a 5-year rolling average, at all 10 conservation sites combined.
- Maintain a 87.2 percent reproductive success rate for Newell's shearwater ('a'o) at all 10 conservation sites combined annually, based on a 5-year rolling average.
- Maintain a 87 percent reproductive success rate for Newell's shearwater ('a'o) at the Upper Limahuli conservation site, based on a 5-year rolling average.
- Maintain a 81.3 percent reproductive success rate for Newell's shearwater ('a'o) at Conservation Site 10, based on a 5-year rolling average.
- Maintain a 93.7 percent reproductive success rate for Newell's shearwater ('a'o) at the Pōhākea conservation site, based on a 5-year rolling average.
- Maintain a 86.8 percent reproductive success rate for Newell's shearwater ('a'o) at the Hanakāpi'ai conservation site, based on a 5-year rolling average.
- Maintain a minimum of 2,257 Hawaiian petrel ('ua'u) breeding pairs annually at all 10 conservation sites combined.
- Growth rate for Hawaiian petrel ('ua'u) breeding pairs annually of at least 1 percent to reach a target of 2,926 breeding pairs by year 25 of the permit term and 3,751 breeding pairs by the end of the permit term, based on a 5-year rolling average, at all 10 conservation sites combined.

- Maintain a 78.7 percent reproductive success rate for Hawaiian petrel (ʻuaʻu) at all 10 conservation sites combined, based on a 5-year rolling average.
- Maintain a 66.7 percent reproductive success rate for Hawaiian petrel (ʻuaʻu) at the Upper Limahuli conservation site, based on a 5-year rolling average.
- Maintain a 80.3 percent reproductive success rate for Hawaiian petrel (ʻuaʻu) at the Pihea conservation site, based on a 5-year rolling average.
- Maintain a 78 percent reproductive success rate for Hawaiian petrel (ʻuaʻu) at the North Bog conservation site, based on a 5-year rolling average.
- Maintain a 75.5 percent reproductive success rate for Hawaiian petrel (ʻuaʻu) at the Pōhākea conservation site, based on a 5-year rolling average.
- Maintain a 86.4 percent reproductive success rate for Hawaiian petrel (ʻuaʻu) at the Hanakoa conservation site, based on a 5-year rolling average.
- Maintain a 85.4 percent reproductive success rate for Hawaiian petrel (ʻuaʻu) at the Hanakāpiʻai conservation site, based on a 5-year rolling average.
- At least one Newell's shearwater (ʻaʻo) breeding pair within each social attraction site by Year 10 of the permit term.

Appendix 6A, *Adaptive Management Comparison Tables*, Tables 6A-3 and 6A-, provides annual rolling averages for the Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) growth at all 10 conservation sites combined during the 50-year permit term, using the outputs from the population dynamics models. These tables will be used on an annual basis during the permit term to evaluate whether the covered seabirds populations in the conservation sites collectively are on track to meeting or exceeding the biological goals and objectives or are underperforming (in which case adaptive management would be triggered, as stated above). It should be noted that by their nature (given that they are averages of multiple years of data), the 5-year rolling averages are slightly lower than the individual number used in the biological objective. However, if the 5-year rolling average is met, the individual year threshold (25 years or 50 years, as required by the biological goals and objectives) is also met.

If any of these thresholds in the bullet list above are not met, an adaptive management change will be triggered (Table 6-3). KIUC will follow the process outlined in Section 6.2.2, *Adaptive Management* and Table 6-3, to determine the appropriate adaptive management responses in close coordination with and in agreement from the USFWS and DOFAW. Adaptive management changes at the conservation sites may include the following.

- Alter the timing, location, intensity, or type of predator control
- Alter the timing, location, intensity, or methods for invasive plant species control
- Increase the number of conservation sites or install additional predator exclusion fencing.
- Increase the number, type, location, or attraction methods for social attraction sites.
- Install artificial burrows in areas where predator exclusion fences are not practicable, but predator control will be conducted.
- Initiate social attraction within predator exclusion fences for Hawaiian petrel (ʻuaʻu)
- Play sounds to deter predators (e.g., play sounds of humans or large predatory cats).

- Use scent camouflage to cover area so predators cannot use scent trails.
- Use scent attraction to encourage nesting.
- Use decoys of nesting birds to attract predators into traps.
- Use drones to locate ungulates and possibly barn owls.
- Novel vertebrate pesticides for predator control.

If adaptive management changes in the conservation sites prove ineffective or infeasible, KIUC may choose to enhance or expand minimization measures to further reduce take of the covered species (i.e., increase strike reduction beyond 65.3 percent).

6.4.5 Green Sea Turtle (honu) Monitoring and Adaptive Management

6.4.5.1 Effectiveness Monitoring

The effectiveness of the green sea turtle (honu) nest detection and shielding program will be evaluated based on the outcomes of the annual monitoring program described under Conservation Measure 5, *Implement a Green Sea Turtle Nest Detection and Temporary Shielding Program*, described in Chapter 4, *Conservation Strategy*. The goal of the green sea turtle (honu) monitoring program is to determine the outcome of shielded nests. The monitoring program endeavors to have monitors present at or near the time of emergence to verify shielding is effective at preventing (or substantially reducing) light disorientation of hatchlings. If any hatchlings are disoriented due to KIUC streetlights, this could indicate that the temporary light shields are not as effective as assumed in this HCP. Please see Section 4.4.5, *Conservation Measure 5. Implement a Green Sea Turtle Nest Detection and Temporary Shielding Program*, for the green sea turtle (honu) monitoring requirements for the KIUC HCP.

6.4.5.2 Take Monitoring

Minimization of green sea turtle (honu) hatchling disorientation will require systematic, intensive surveys that not only locate active nests but also document the fate of every green sea turtle (honu) nest that has the potential to be affected by KIUC streetlights. Take of green sea turtle (honu) nests for the KIUC HCP is defined as a nest (documented or undocumented by the monitoring program) with at least one hatchling disoriented by KIUC streetlights. As described in Chapter 4, Section 4.4.5, *Conservation Measure 5. Implement a Green Sea Turtle Nest Detection and Temporary Shielding Program*, the green sea turtle (honu) monitoring program consists of drone surveys, a volunteer monitoring program, and shielding the nest with shade cloth fencing. This monitoring approach has been adapted from the Kaua'i Seabird HCP (State of Hawai'i Division of Forestry and Wildlife 2020). The complete monitoring methods can be found in the conservation measure in Section 4.4.5, *Conservation Measure 5. Implement a Green Sea Turtle Nest Detection and Temporary Shielding Program*.

6.4.5.3 Adaptive Management

The KIUC HCP assumes that the nest shielding program will be highly effective. As a result, very few green sea turtle (honu) hatchlings are expected to disoriented during the 50-year permit term. As such, the KIUC HCP estimates that no more than one nest will be taken per year. To ensure that this goal is achieved, if there is more than one green sea turtle (honu) nest taken in any year or any hatchlings in an undocumented nest are taken due to KIUC streetlight attraction, adaptive management will be triggered (Table 6-3). KIUC will implement adaptive management changes during the next green sea turtle (honu) nesting season. KIUC will follow the process outlined in Section 6.2.2 *Adaptive Management* and Table 6-3, to determine the appropriate adaptive management change in close coordination with USFWS, DOFAW, and DAR.

KIUC will begin the adaptive management process by investigating the conditions that may have led to the hatchling disorientation, evaluating the following factors.

- Was the beach monitored by drone or on foot?
- Was the nest located during monitoring?
- Was the nest shielded?
- Was the shielding effective at preventing hatchling disorientation?
- Were monitors present at the time of nest hatching?
- Were there any other factors that may have contributed to the taking?

Depending on the answers to these questions, KIUC's adaptive management response will address the specific issue that occurred. For example, if the nest was not located during monitoring, KIUC may need to increase the monitoring frequency, change the monitoring methods, or may need to increase the number of beaches that are monitored on foot. If the issue was that the shielding was not effective, KIUC may need to change the type of shielding material, shield height, or add additional protective mechanisms (e.g., fences around the shields). If the shield was vandalized, KIUC may need to have the monitor visit the shielded nest more frequently prior to hatching.

If take occurs, KIUC will email USFWS, DOFAW, and DAR as soon as possible with the details of the event. KIUC will solicit input from USFWS, DOFAW, and DAR, on possible adaptive management responses according to the procedure described in Section 6.2.2, *Adaptive Management*. KIUC will also describe in the annual report the taking and any adaptive management changes implemented.

6.4.6 Adjusting Monitoring Methods

KIUC's current monitoring efforts are considered the best available science (Chapter 5, *Effects*). However, monitoring methodologies are constantly evolving and become more effective and efficient with new technologies. Hence, improved monitoring methodologies (e.g., better microphones, improved vibration sensors, enhanced analysis software) are expected to become available. KIUC will utilize new technology to the maximum extent practicable and may adopt them into its program under the following circumstances.

- Species experts believe that the newer technology provides more accurate or more reliable results that can be integrated into the pre-existing dataset.
- Data obtained through the updated technology is sufficiently compatible with that collected in earlier years of the monitoring program to allow long-term trend analysis.
- The improved technology does not substantially increase the cost of the monitoring.

KIUC will make changes to monitoring methods only after discussing them with USFWS and DOFAW and gaining their concurrence on the proposed change.

Chapter 7
Plan Implementation

7.1 Overview

This chapter describes how KIUC will implement the HCP. The chapter describes the following implementation topics.

- Implementation structure of the HCP, including the responsibilities of KIUC, U.S. Fish and Wildlife Service (USFWS), and the State of Hawaiʻi Division of Forestry and Wildlife (DOFAW) (Section 7.2, *Implementation Responsibilities*).
- Regulatory assurances requested for this HCP under the federal Endangered Species Act (ESA) and Hawaiʻi Revised Statutes (HRS) (Section 7.3, *Regulatory Assurances*);
- Estimated costs of HCP implementation (Section 7.4, *Costs of KIUC HCP Implementation*) funding assurances (Section 7.5, *Funding Assurances*).
- The process to revise or amend the HCP during implementation (Section 7.6, *Revisions and Amendments*).
- Requirements for annual reporting to USFWS and DOFAW (Section 7.7, *Annual Reporting*).

7.2 Implementation Responsibilities

This section describes the implementation responsibilities of KIUC as the permittee and the responsibilities of USFWS and DOFAW in supporting and overseeing HCP implementation.

7.2.1 Responsibilities of Kauaʻi Island Utility Cooperative

Immediately following issuance of the incidental take permit (ITP) and state incidental take license (ITL), KIUC would fully undertake HCP implementation. KIUC has been conducting early implementation during the HCP preparation phase and in transition from the Short-Term HCP to this HCP. Management actions that have already been implemented for many years will continue (e.g., conservation site management and monitoring). Additionally, some new conservation measures and management actions will be implemented as a part of this HCP. KIUC has an HCP Program Manager who managed HCP preparation and early implementation and will be responsible for day-to-day administration and implementation of the KIUC HCP during the 50-year permit term. KIUC will be responsible for implementing the conservation strategy (Chapter 4, *Conservation Strategy*) to achieve the biological goals and objectives of the HCP. KIUC will implement all the actions described in the HCP, including the following.

- Implementing the HCP conservation measures.
- Implementing the monitoring and adaptive management program.
- Providing oversight and coordination of HCP administration of program funding and resources.
- Preparing annual reports, work plans, and budgets.

- Fulfillment of compliance monitoring, effectiveness monitoring, and HCP reporting requirements.

The following sections describe how KIUC will implement the HCP. Some of these job functions will be performed by KIUC staff. KIUC will also hire contractors to provide many services under the direction and oversight of the HCP Program Manager. As the sole permittee, KIUC is ultimately responsible for the implementation of all HCP conservation measures and other commitments.

7.2.1.1 Conservation Measures and Monitoring Actions

KIUC will implement all the conservation measures described in Chapter 4, *Conservation Strategy*, and the monitoring and adaptive management actions described in Chapter 6, *Monitoring and Adaptive Management Program*. KIUC is also responsible for monitoring for changed circumstances identified in Section 7.3.1, *Changed Circumstances*, that might arise. If any changed circumstances do arise, KIUC must follow the procedures outlined in this chapter to identify and implement the appropriate remedial measure to address the specific changed circumstance.

7.2.1.2 Oversight and Coordination

KIUC is responsible for executing the requirements of the HCP, the federal ITP, and state ITL. Implementation tasks include support of permanent and seasonal administrative and technical staff who will be responsible for overseeing and ensuring the day to-day tasks of implementing the HCP "on the ground." Implementation tasks will also address activities such as managing program funding and resources, ensuring minimization actions are implemented according to the location and schedule identified in the HCP, maintaining a database of relevant information, tracking impacts and conservation, and reporting all relevant information to the Wildlife Agencies annually (Section 7.7, *Annual Reporting*).

KIUC will also prepare an Annual Work Plan to identify ongoing and project-specific actions for the following year. KIUC will develop a budget and schedule for HCP implementation each year and assign staffing responsibilities using the cost estimate (Section 7.4, *Costs of KIUC HCP Implementation*) and schedule (Chapter 6, Table 6-1, *Schedule for HCP Compliance*) identified in this HCP. All of the HCP conservation measures will be implemented on an annual basis (unless USFWS and DOFAW approve a reduced frequency during the permit term) to achieve the HCP biological objectives. The specific techniques that will be used to implement the conservation measures are described in Chapter 4, *Conservation Strategy*. These techniques may change based on HCP monitoring results and adaptive management (see Chapter 6, *Monitoring and Adaptive Management Program*), which could have budget and schedule implications. The Annual Work Plan will be presented at the annual meeting that is held by KIUC near the end of each calendar year in October or November. The Annual Work Plan must be consistent with the HCP and is in addition to the annual progress reporting (see Section 7.7, *Annual Reporting*). KIUC will present the Annual Work Plan to USFWS and DOFAW for comments prior to implementation in the following calendar year.

7.2.1.3 Budget Administration

KIUC will develop, propose, and administer budgets for general plan administration. Specific responsibilities will include developing and monitoring budgets, processing invoices, managing financial reserves, identifying cost savings, and managing administrative contracts (e.g., liability insurance). KIUC is governed by a nine-member board. KIUC Board approval will be required for the

HCP, the Annual Work Plans, and the associated estimated HCP budget as part of their annual operational budget approval process. KIUC will establish processes to ensure timely implementation and proper oversight of annual budgets and related HCP expenditures.

7.2.1.4 Geographic Information System/Database Maintenance

KIUC will use a geographic information system (GIS) or other equivalent spatially explicit database to collect, store, and use the relevant data necessary for HCP implementation. KIUC will maintain the database to track compliance as well as monitoring and adaptive management programs. KIUC will use the database to summarize take and conservation by year and cumulatively, as well as track the spatial location of management actions and monitoring to demonstrate progress of meeting the HCP biological goals and objectives. KIUC may also hire contractors to provide these functions. Data will be made accessible to USFWS and DOFAW.

7.2.1.5 Consultants and Contractors

KIUC will retain consultants to meet any technical, scientific, or other staffing needs that cannot be effectively or efficiently addressed through in-house staff. It is expected that KIUC will use consultants more heavily for administrative tasks during the early stages of HCP implementation, becoming less necessary as KIUC develops systems and processes for HCP implementation. It is expected that consultant and contractors will be used throughout the life of the HCP for management and monitoring of the covered species.

7.2.2 Responsibilities of U.S. Fish and Wildlife Service

Consistent with their authority under the federal ESA, USFWS will have responsibility to monitor implementation of the terms and conditions of the ITP and HCP. Specifically, USFWS will have responsibility during HCP implementation to do the following.

- Review and verify HCP Annual Reports submitted by KIUC for completeness and compliance (see Section 7.7, *Annual Reporting*, for Annual Report requirements) and to determine whether KIUC is making progress towards achieving the biological goals and objectives of the HCP and implementing all applicable requirements of the HCP.
- With DOFAW and the Endangered Species Recovery Committee (ESRC),[1] make recommendations to KIUC regarding adaptive management changes according to the adaptive management process described in Chapter 6, Section 6.2.2, *Adaptive Management*.
- Receive and review reports from KIUC regarding observations of injury or mortality of the covered species.
- Review and verify monitoring reports provided by KIUC.
- Participate in periodic HCP coordination meetings with KIUC and DOFAW as necessary to stay informed about HCP implementation and to provide technical advice to KIUC, as necessary or requested.
- Visit mitigation sites and KIUC facilities as needed to observe the progress and results of HCP conservation measures, which will be coordinated with the KIUC HCP Program Manager.

[1] USFWS is also a member of the ESRC.

- Coordinate with the KIUC HCP Program Manager and DOFAW regarding any potential compliance issues and work cooperatively to resolve these issues. If compliance issues cannot be resolved, take enforcement action as necessary and appropriate.
- Provide technical assistance if KIUC requests a minor modification or major amendment to the HCP (see Section 7.6, *Revisions and Amendments*, for details on these procedures).

7.2.3 Responsibilities of the State of Hawai‘i Department of Land and Natural Resources

The State of Hawai‘i Department of Land and Natural Resources (DLNR) provides regulatory oversight for the State of Hawai‘i, as authorized by statute, to ensure that all HCPs and State ITLs issued by the Board of Land and Natural Resources (BLNR) comply with the provisions of applicable State of Hawai‘i regulations. The DLNR through DOFAW will have the following responsibilities during HCP implementation.

- Review HCP Annual Reports submitted by KIUC for completeness, accuracy, and compliance (see Section 7.7, *Annual Reporting*, for Annual Report requirements) and to determine whether KIUC is making progress towards achieving the biological goals and objectives of the HCP and implementing all applicable requirements of the HCP.
- Provide HCP Annual Reports to the ESRC for their review and recommendations for adaptive management.
- Consider recommendations from the ESRC regarding adaptive management or other changes to the HCP to improve its effectiveness and coordinate with USFWS and KIUC regarding these recommendations.
- With USFWS, make recommendations to KIUC regarding adaptive management changes according to the adaptive management process described in Chapter 6, Section 6.2.2.3, *Adaptive Management Decision-Making Process for this HCP*.
- Receive and review reports from KIUC regarding observations of injury or mortality of the covered species.
- Review and verify monitoring reports provided by KIUC.
- Participate in HCP coordination meetings with KIUC and USFWS as necessary to stay informed about HCP implementation and to provide technical advice to KIUC, as necessary or requested.
- Coordinate with the KIUC HCP Program Manager and USFWS regarding any potential compliance issues and work cooperatively to resolve these issues. If compliance issues cannot be resolved, take enforcement action as necessary and appropriate.
- Visit conservation sites and KIUC infrastructure and facilities as needed to observe the progress and results of HCP conservation measures, which will be coordinated with the KIUC HCP Program Manager.
- Provide technical assistance if KIUC requests a minor modification or major amendment to the HCP (see Section 7.6, *Revisions and Amendments*, for details on these procedures).

7.2.4 Responsibilities of the Endangered Species Recovery Committee

The Hawai'i Revised Statutes (HRS) require the ESRC to review all HCPs annually "to ensure compliance with agreed to activities and, on the basis of any available monitoring reports, and scientific and other reliable data, make recommendations for any changes."[2] To fulfill this requirement, the ESRC will review the KIUC Annual Report (see Section 7.7, *Annual Reporting*, for details on the Annual Report) and any other relevant reports and data to determine whether the KIUC HCP is in compliance with the terms of the HCP and State ITL. The ESRC (and/or DOFAW staff as ESRC representative) may conduct an annual site visit on the Island of Kaua'i to fulfill its statutory duty,[3] which would be coordinated with the KIUC HCP Program Manager. The ESRC is supported and advised by DOFAW and the DLNR as described in the section above. Note that site visits are required prior to ESRC making HCP recommendation to the BLNR.

7.3 Regulatory Assurances

No Surprises assurances are provided by the federal ESA through the "No Surprises" rule (50 Code of Federal Regulations [CFR] Section 17.22.32). This rule provides assurances to ITP holders that USFWS will not require the commitment of additional land, water, or financial compensation; or additional restrictions on the use of land, water, or other natural resources beyond the level otherwise agreed to in the HCP without the consent of the permittee. HCP permittees may provide additional mitigation, but only voluntarily. No Surprises assurances remain in place if the HCP is being properly implemented. For example, the No Surprises assurances would not apply to situations where authorized take levels are exceeded, or the minimization or mitigation measures are not meeting success measure targets.

As part of the No Surprises assurances, an HCP must identify and analyze reasonably foreseeable changed circumstances that could affect a species or geographic area during its term (50 CFR Section 17.3). Should such a changed circumstance occur, the permittee is required to implement the measures specified in the HCP to respond to this change. HCP permittees are not required to implement remedial actions for any unforeseen circumstances. These terms are defined and explained below.

The HRS provides for regulatory "incentives" in Section 195D-23 that are similar to the regulatory assurances provided by the federal ESA. The State cannot, in order to protect a threatened or endangered species, "impose additional requirements or conditions, or modify any existing requirements or conditions to mitigate or compensate for changes in the conditions or circumstances of any species or ecosystem, natural community, or habitat covered by the [HCP]." Allowable exceptions are as follows (any single item alone is an exception).

- KIUC consents to the changes.
- BLNR finds that the changes would not impose new restrictions on land available for development and would not increase cost to HCP parties.

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[2] Section 195D-25(b)(2).

[3] The ESRC may not conduct more than one site visit per year to each property that is the subject of an HCP (HRS Section 195D-25(b)(6)).

- BLNR pays for any additional cost and KIUC consents to the changes.
- Extraordinary new circumstances or information indicates failure to change plan would appreciably reduce likelihood of survival or recovery of any threatened or endangered species. If additional mitigation measures are subsequently deemed necessary to provide for the conservation of a species that was otherwise adequately covered under the terms of the HCP as a result of extraordinary circumstances, the obligation for executing mitigation measures shall rest with the State, or the federal government with its consent, and not with KIUC.

7.3.1 Changed Circumstances

The federal No Surprises regulation defines changed circumstances as those circumstances affecting a species or geographic area covered by the HCP that can be reasonably anticipated by the applicant or USFWS and that can be planned for. Accordingly, this regulation requires that changed circumstances be identified in the HCP along with remedial measures that would be implemented by the permittee to address these changes. The changed circumstances that could arise in the Plan Area have been identified and are described in Section 7.3.3, *Changed Circumstances Addressed by this HCP*.

Changed circumstances are defined by federal regulation as follows.

> changes in circumstances affecting a species or geographic area covered by [an HCP] that can reasonably be anticipated by [plan] developers and the Services and that can be planned for (e.g., the listing of new species, or a fire or other natural catastrophic event in areas prone to such events) (50 CFR Section 17.3).

If a changed circumstance occurs within the Plan Area, KIUC will notify USFWS and DOFAW within 30 days of this changed circumstance. KIUC will evaluate the extent of the changed circumstance and identify and implement an appropriate response based on the remedial measures described in Section 7.3.3, *Changed Circumstances Addressed by this HCP*, to the extent necessary to address the effects of the changed circumstances on the HCP's conservation strategy. KIUC will also notify both agencies of their plans to implement remedial measures to address a changed circumstance. USFWS and DOFAW will not require any additional conservation or mitigation to address changed circumstances that are not identified in the HCP, without the consent of KIUC, if the KIUC HCP is found to be properly implemented. Properly implemented means that the commitments and the provisions of the HCP, ITP, and State ITL have been or are being fully implemented and the biological goals and objectives are being met.

7.3.2 Unforeseen Circumstances

Unforeseen circumstances are defined by federal regulation as follows.

> [Unforeseen circumstances are] changes in circumstances affecting a species or geographic area covered by a conservation plan or agreement that could not reasonably have been anticipated by plan or agreement developers and the Service at the time of the conservation plan's or agreement's negotiation and development, and that result in a substantial and adverse change in the status of the covered species (50 CFR Section 17.3).

In the event of unforeseen circumstances during the permit term, USFWS, DOFAW, and KIUC will work together to identify opportunities to redirect existing resources to address unforeseen circumstances, as needed to maintain the benefits of the HCP. However, the HCP provides regulatory assurances to KIUC consistent with the federal No Surprises regulation and the HRS Section 195D-23 that USFWS and DOFAW will not do the following:

- Require the commitment of additional land, water, or financial compensation by KIUC in response to unforeseen circumstances above and beyond those agreed to elsewhere in the HCP.
- Impose additional restrictions on the use of land, water, or natural resources otherwise available for use by KIUC under the original terms of the HCP in response to unforeseen circumstances.

As described in the No Surprises regulation, it is USFWS' responsibility to demonstrate the existence of unforeseen circumstances using the best scientific and commercial data available. KIUC as the permittee is only responsible for the changed circumstances as defined and described in the HCP. Unforeseen circumstances are circumstances that are highly unlikely and not reasonably foreseeable to occur during the permit term and, as determined by the federal No Surprises regulations, are not the management, monitoring, or funding responsibility of KIUC as the permittee.

The federal No Surprises regulation does not limit or constrain USFWS or any federal, state, local, or tribal government agency, or private entity, from taking additional actions at its own expense to protect or conserve covered species. The federal No Surprises regulation also does not prevent USFWS from asking KIUC to voluntarily undertake additional mitigation on behalf of the affected species.

As described above, an allowable exception to the State's regulatory assurances includes "extraordinary new circumstances or information indicates that failure to modify the plan or agreement is likely to appreciably reduce likelihood of survival or recovery of any threatened or endangered species".[4] Under the Hawai'i ESA (HRS Section 195D-23(a)(5)), "extraordinary new circumstances" represent circumstances that indicate that failure to modify the plan or agreement is likely to appreciably reduce the likelihood of the survival or recovery of any threatened or endangered species in its natural habitat. If additional mitigation measures are subsequently deemed necessary to provide for the conservation of a species that was otherwise adequately covered under the terms of an HCP, safe harbor agreement, or State ITL because of extraordinary circumstances, the primary obligation for executing mitigation measures rests with the State, or the federal government with its consent, and not with KIUC.

7.3.3 Changed Circumstances Addressed by this HCP

The changed circumstances in this section are recognized by this HCP. The descriptions in this section also discuss the risk of these changed circumstances along with remedial actions that would be funded and implemented to address impacts of changed circumstances on the covered species. KIUC will maintain sufficient financial reserves to fund any remedial action described in this section, as they arise. The following changed circumstances are recognized by this HCP and described in the following subsections.

- Severe weather and the effects of climate change (e.g., hurricanes, flooding, landslides, heat waves, sea level rise)
- New invasive species

[4] HRS Section 195D-23(a)(5).

- Disease outbreak in covered species
- Vandalism
- Population declines due to issues at sea

The following information is provided for each identified changed circumstance.

- A brief overview.
- A risk assessment that summarizes historical data to estimate the frequency and intensity of foreseeable impacts over the duration of the HCP.
- A process for coordinating with the agencies for evaluation prior to implementing actions.
- Preventive measures that KIUC has committed to in the HCP that will help reduce the potential for impacts on covered species from the changed circumstance.
- Thresholds for foreseeable rates of occurrence and magnitude derived from the risk assessment.
- Remedial measures that KIUC will implement to address foreseeable impacts on the covered species.
- Thresholds for unforeseeable rates of occurrence and magnitude derived from the risk assessment.

7.3.3.1 Severe Weather, Natural Hazards, and the Effects of Climate Change

Severe weather, natural hazards, and ongoing climate change can reasonably be anticipated to affect covered species or the geographic area covered by this HCP. Severe weather may include hurricanes, flooding caused by tropical storms, and heavy rain events such as Kona storms (Table 7-1). Natural hazards include tsunamis, landslides triggered by heavy precipitation, and wildfire triggered by drying (a combination of reduced moisture and higher temperature in conjunction with flammable invasive grasses). Many of these weather and hazard events may be intensified by climate change. For example, tsunamis deposit large amounts of water ashore and the reach of that water may be exacerbated by sea level rise. Rising temperatures are causing new stressors such as heat waves. Some of these situations are at the scale of the entire Plan Area and may affect all covered species (e.g., hurricanes, heat waves), whereas other severe weather events or natural hazards are expected to only affect a subset of the covered species (Table 7-1).

Risk Assessment

Climate models offer insights into future trajectories of temperature, precipitation, and related variables, as well as sea level rise. However, projections often exhibit considerable variability across models and may even differ on the direction of a future climate change, such as whether a location will become wetter or drier. Different greenhouse gas scenarios or pathways also introduce variability into how models perform and can result in large differences in the projected magnitude of climate change. Climate modeling has less utility for examining trajectories of severe weather because such events are, by their nature, statistically rare occurrences. Trying to extract a clear indication of the likelihood of extreme weather events increasing or decreasing in frequency or intensity by examining the tails (outliers) of climate model distributions is fraught with uncertainty because of the large amount of variability or scatter that is produced across both the suite of models and their tails. While statistical approaches have been proposed for such investigations (e.g., Vavrus et al. 2015), there is no agreed-upon standard. Moreover, severe weather occurs at different geographic scales—from hurricanes and tropical cyclones that travel across hundreds or thousands of miles of ocean, to local and regional storms derived from convective processes (i.e., movement of warm, moist air masses from the Earth) influenced by local topography. Global climate models operate on grid boxes congruent with large-scale events like temperature change or hurricane activity. Those same grid boxes are too large, however, to pinpoint localized events like a heavy rainfall. How severe weather will change in the future due to ongoing climate change is, in many instances, very difficult to estimate due to the complexity of interactions and feedbacks between regional and global processes (Stammer et al. 2018). Our current ability to project changes in the frequency and intensity of tropical cyclones and other extreme precipitation events specific to Kaua'i over the 50-year permit term of the HCP is limited. Examining and extrapolating from past climate trends is one approach to assessing the likelihood of future extreme events because climate change has already been underway for decades and its signature on current extreme events is routinely examined (e.g., Cho 2021).

Changes in the climate of the Hawaiian Islands are already evident. Since 1950, temperatures across the Hawaiian Islands have risen by about 2°F, with a sharp increase in warming over the last decade. The number of hot days and very warm nights increased dramatically during the 2015–2020 period compared to the 1951–1980 average, with 58 days of maximum temperature of 90°F or higher during 2019 as opposed to the long-term average of about eight, and over 80 nights that year at 75°F or higher compared to the long-term average of 27. The rate of temperature increase has been the greatest at high elevations (Stevens et al. 2022).

Under a higher emissions pathway, historically unprecedented warming is projected through 2100. Even under a lower emissions pathway, annual average temperatures are projected to most likely exceed historical levels by the middle of the century (i.e., about halfway through the HCP permit term). However, a large range of temperature increases is projected under both pathways, and under the lower pathway, a few projections are only slightly warmer than historical records. Rising temperatures will cause future heat waves to be more intense. Warming, accompanied by reduced rainfall in some areas, will stress native plants and animals, especially in high-elevation ecosystems.

Precipitation varies greatly across individual islands and the island chain. Nonetheless, precipitation trends are also apparent. Hawai'i has historically experienced drier than normal conditions during the El Niño wet season (November to April) and greater than normal rainfall during the La Niña wet season. Since the early 1980s, Hawai'i has experienced drier conditions during the wet season of La Niña years. In fact, a drying trend in La Niña years has been evident since 1956. Moreover, El Niño events have occurred more frequently over the last two decades, resulting in more drying (Stevens et al. 2022). Both El Niño and La Niña episodes are projected to increase in frequency and magnitude as the world warms (Keener et al. 2018). Larger total acres burned by wildfires are more likely to occur in the year following an El Niño event (Stevens et al. 2022).

Overall, annual rainfall has decreased throughout the island chain since the 1920s and the decrease is particularly in evidence during recent years in the wet season (Frazier et al. 2022). A 500-year historical reconstruction of winter precipitation concluded that a general drying trend, though with substantial decadal and longer-term variability, goes back 160 years (Díaz et al. 2016). In 10 of the 15 years since 2007, wet-season precipitation was below average, with 4 of the remaining 5 years being very near average. All of the 17 significantly above-average wet years occurred prior to 2006. The changing La Niña rainfall pattern and the increasing frequency of El Niño seem to have contributed to a long-term drought that started in 1980. An increase in the frequency of the trade wind inversion is also linked to a decrease in precipitation at high elevations. The number of consecutive dry days across the Hawaiian Islands has increased since the 1950s. An increase in drought conditions has been detected in Kauaʻi in recent years, particularly on the windward side of the island and at high elevations. Such conditions lead to a lack of usable water and an increased risk of fire (Stevens et al. 2022).

Increasing trends in extreme 30-day rainfall and the lengths of consecutive dry-day and consecutive wet-day periods indicate that Hawaiʻi's rainfall is becoming more extreme and suggest that both droughts and floods are becoming more frequent in Hawaiʻi (Kenner et al. 2018). Nonetheless, the most recent analysis by NOAA states that extreme precipitation events have become less frequent on Kauaʻi (Stevens et al. 2022). This is one area in which there appears to be conflicting reports. Any seemingly contradictory information may stem from different time frames of analysis or the lack of weather stations from which to extract data. In revising the Precipitation-frequency Atlas of the United States for the Hawaiian Islands (Volume 4 of its continental Atlas 14 project), NOAA also revised downward the magnitude of 100-year, 60-minute and 24-hour flood events. Over most of Kauaʻi, the 100-year flood has diminished as much as 50 percent since the last atlas was published in the 1960s (Perica et al. 2011).

Precipitation projections for Hawaiʻi are particularly challenging to estimate due to the state's high and steep topography, which leads to pronounced variability in climate over distances much smaller than climate model grid cells. Moreover, natural year-to-year variability in rainfall is much larger than the small changes in precipitation being projected even under higher emissions scenarios for the middle of the century. Hawaiʻi appears to straddle the transition between wetter conditions in the tropics and drier conditions in the subtropics that arises from climate models. It is likely that the currently wet windward sides of the major islands will see an increase in rainfall, while the currently dry leeward sides will experience a decrease. Projected changes in the frequency and magnitude of extreme precipitation events are also uncertain, with some climate models indicating increases and others decreases. The physics of warming suggest that rainfall events are likely to become more extreme because for each 1.8°F (1°C) of temperature increase the atmosphere holds 7 percent more water. Even if average precipitation remains constant, higher temperatures will increase the rate of soil moisture loss during dry periods and potentially increase the intensity of naturally occurring droughts (Stevens et al. 2022).

Kona storms yield disproportionately large amounts of rainfall. Kona storms are cool winter storms associated with a southward shift in the mid-latitude jet stream. They usually affect the state for a week or less and occur, on average, two to three times per year. Kona storms often result in flash flooding and may trigger landslides. Kona storms can produce additional hazards such as hail, heavy mountain snows, waterspouts, and high surf events. Storm tracks are shifting northward due to climate change, which could result in more "noncrossing" (i.e., those that do not cross an island) cold fronts in the future. In addition, warming may also produce fewer cold fronts. On the island of Oʻahu, a study found that Kona storms represent almost 50 percent of total annual precipitation, and that cold fronts that approach but ultimately do not cross the island actually have a drying effect and result in reduced overall rainfall. Because leeward regions are dependent on storm events for much of their rainfall, those areas may be even drier as climate change progresses (Longman et al. 2021).

Hawaiʻi is also susceptible to tropical storms, most often occurring between June and November. Such storms bring heavy rains, high winds, and high waves to the islands. Hurricanes rarely affect the state, with many dissipating into tropical storms or tropical depressions as they approach the islands. Since 1950, 25 hurricanes have affected Hawaiʻi (passing within 200 miles), with only two making landfall. The annual number of tropical cyclones observed in the Central North Pacific has varied over time, with a greater number forming during El Niño years. The most active hurricane season on record in the Central Pacific was 2015, with eight hurricanes and six additional tropical storms. Future tropical cyclone activity remains uncertain. Modeling points to a northward shift in storm tracks in the Central North Pacific that could yield an increase in the frequency of tropical cyclones reaching Hawaiʻi, but it has been noted that tropical cyclone frequency around the Hawaiian Islands is still very low in a warmed climate, and that a quantitative evaluation of future change involves significant uncertainties (Kenner et al. 2018).

Sea level rise is another concern. Rates of sea level rise in Hawaiʻi vary among the islands; it has been 0.6 inch per decade for Kauaʻi. By 2100, increases of 1–4 feet in global sea level are very likely, with even higher levels than the global average projected for Pacific Islands including Hawaiʻi. In fact, the Pacific Basin is likely to experience the highest rates of sea level rise on the planet (Kenner at al. 2018). A Hawaiian assessment of sea level rise concluded that at least 1 foot of rise could be reached by mid-century (Hawaiʻi Climate Change Mitigation and Adaptation Commission 2017). That same assessment chose 3.2 feet of rise as its high-end planning scenario for the latter half of the 21st century because models suggest an acceleration in sea level rise by the end of the century. The Fourth U.S. National Climate Assessment found that 3.2 feet was an intermediate scenario and one that could be reached as soon as 2060 (Kenner et al. 2018). Sea level science is dynamic and rapidly evolving, and modeling results rapidly become outdated. Sea level rise is projected to cause an increase in tidal floods associated with nuisance-level impacts. Nuisance floods are events in which water levels exceed the local threshold (set by NOAA's National Weather Service [NWS]) for minor impacts on infrastructure, cause road closures, and overwhelm storm drains. Continued sea level rise will also present major challenges to Hawaiʻi's coastline through coastal inundation and erosion (Stevens et al. 2022).

Pacific climate variability is a governing element that amplifies many aspects of global climate change, such as drought, sea level, storminess, and ocean warming. Overall, there is great uncertainty about how Pacific variability occurring on short timescales, such as El Niño and La Niña, will combine with multidecadal changes in temperature, waves, rainfall, and other physical factors to influence future patterns of climate change (Kenner et al. 2018).

The Fourth U.S. National Climate Assessment summarized its findings as follows (Kenner et al. 2018):

> There is very high confidence in further increases in temperature in the region, based on the consistent results of global climate models showing continued significant increases in temperature for all plausible emissions scenarios.
>
> There is low confidence regarding projected changes in precipitation patterns, stemming from the divergent results of global models and downscaling approaches and from uncertainties around future emissions. However, for leeward areas of Hawaiʻi, future decreases in precipitation are somewhat more likely, based on greater agreement between downscaling approaches for Hawaiʻi.
>
> There is very high confidence in future increases in sea level, based on widely accepted evidence that warming will increase global sea level, with amplified effects in the low latitudes.
>
> There is medium confidence in the increasing risk of both drought and flood extremes patterns, based on both observed changes (for example, increasing lengths of wet and dry periods) and projected effects of warming on extreme weather globally.

Thresholds for Changed Circumstances

For the purposes of this HCP, foreseeable frequency thresholds for severe weather events have been estimated based on historic observed rates of each type of severe weather. Based on the discussion above, climate modeling does not provide clear direction regarding the changes in frequency of these events. Instead, thresholds are provided based on historic observed frequencies that already include climate change as explained above. Current scientific understanding of the expected future frequency and intensity of severe weather events in the vicinity of Kaua'i in a warming climate are provided in each subsection below and summarized in Table 7-1.

Table 7-1. Thresholds of Changed Circumstance for Severe Weather and Natural Hazards (see text for details)

Severe Weather[a]	Annual Average	Foreseeable Frequency	Occurrences During 50-year Permit Term	Dataset Length	Temporal Trend	Extent of Damage	Covered Species Affected
Hurricane (Landfall)	0.028	1 per 35 years	1.4 times	70 years	Stable	Widespread, max	Seabirds, Waterbirds, Green sea turtle (honu)
Hurricane (Close approach[b])	0.028	1 per 35 years	1.4 times	70 years	Stable	Regional, mod	Seabirds, Waterbirds, Green sea turtle (honu)
Hurricane (Distant approach[b])	0.056	1 per 17 years	2.8 times	70 years	Stable	Regional, min	Seabirds, Waterbirds, Green sea turtle (honu)
Tsunami	0.07	1 per 14 years	3.5 times	70 years	Stable	Coastlines, max	Waterbirds, Green sea turtle (honu)
Flooding	see text	see text	see text	14 years	Unknown	Localized or regional	Waterbirds, Seabirds
Landslide	see text	see text	see text	15 years[c]	Unknown	Localized or regional	Seabirds
Sea Level Rise	see text	see text	Gradually over the permit term	2060	Stable	Coastlines, max	Waterbirds, Green sea turtle (honu)

[a] For each type of severe weather considered a changed circumstance, the average rate of occurrence per year is provided (annual average) along with foreseeable frequencies of each event. Dataset length indicates the duration of records used to derived annual averages and foreseeable frequencies.

[b] Close approach is defined as 0–50 miles (0–80.5 kilometers) offshore, distant approach is defined as 50–150 miles (82–241.4 kilometers) offshore. Hurricanes have been divided into these categories due to the differences in the potential damage, in terms of extent and magnitude, that may be expected at conservation sites associated with this HCP. Specifically, damage resulting from hurricanes making landfall or closely approaching the island is presumed to be more severe relative to hurricanes whose center remains at a distance from the island. "Distant" is synonymous with "less severe damage expected", and these distances were based on the extent of damage that resulted from various hurricanes passing at various distances from Kaua'i.

[c] The dataset for landslide frequency was anecdotal, rather than authoritative, and the annual average and foreseeable frequency should be considered minimum estimates. Given the regularity of landslides as well as uncertainty in the exact rate, any landslide that has occurred and is deemed to affect conservation site infrastructure, will be considered foreseeable and addressed with remedial measures.

Frequency threshold calculations for different types of severe weather and hazards are based on various lengths of timeseries, in part due to the rarity of some events and also due to the limitations of historical record keeping. Summarized here is justification for the duration chosen for each type of event (Table 7-1):

- Hurricanes: a timeseries of 70 years (1950–2020) is used for determining the frequency of hurricanes with moderate (i.e., distant approach) to extensive (i.e., close approach and landfalls) damage, due to the infrequent, irregular intervals between such events, as well as the differences in how hurricanes track across the Pacific, causing variation in the frequency and severity of hurricane impacts to different islands.
- Tsunamis: a timeseries of 70 years (1950–2020) is used for determining the frequency of major tsunamis, again due to rarity and the irregular intervals between such events. For example, if the analysis considered only the previous 30 years, then the calculated frequency would be one tsunami expected per 30 years rather than one per 14 years.
- Flooding: a timeseries of 17 years (2004–2021) of flash flood warnings issued by the NWS is used for this assessment because reliable tracking of flash flood warnings did not occur prior to 2004. Also, since flash flooding is frequent on Kauaʻi, a shorter timeseries still provides sufficient information to calculate expected frequencies. Given the high foreseeable frequency, any flash flood warning issued by the NWS in the Plan Area would be considered foreseen and addressed with remedial measures if the HCP's minimization measures or conservation measures are compromised.
- Landslides: There is no authoritative database detailing landslide events on Kauaʻi at the time of writing. Instead, anecdotal information on landslides for the period 2006–2012—derived from the County of Kauaʻi Multi-hazard Mitigation and Resilience Plan (County of Kauaʻi 2015)—and for the period 2013–2021—derived from online news outlets—is used to calculate the frequency of known landslides from 2006 to 2021. As noted, this represents a minimum because many areas in the Plan Area, including remote areas where conservation sites are located, are not currently monitored for landslides; an exact rate for landslides cannot be determined, primarily due to a lack of information. Therefore, given the already high foreseeable frequency combined with this uncertainty, any landslide detected in or immediately adjacent to seabird conservation sites should be considered foreseen and addressed with remedial measures if the HCP minimization measures or conservation measures are compromised.
- Sea Level Rise: Sea level rise is predicted to rise by 3.2 feet (0.98 meter) globally by year 2100, however it is projected that this magnitude of sea level rise could occur as early as 2060 (Sweet et al. 2017). Given this uncertainty in the foreseeable frequency, sea level rise in an amount that will affect the lowland covered species may or may not occur during the permit term. If sea level rise does occur there is really no response possible for the loss of green sea turtle (honu) nests due to sea level rise. If nesting habitat lost on the island of Kauaʻi, KIUC has no control over these areas, and thus no way to get it back.

The frequency thresholds are calculated as the likelihood of an event happening over a certain amount of time based on multi-year averages, which is not an absolute time-to-event interval. For extreme weather events, there can be great variation in the interval between events and they may not be regularly spaced across the permit term. As an example, if hurricanes may foreseeably make landfall on Kauaʻi once every 35 years, then a maximum of two hurricane landfalls would be foreseen over a 50-year permit term. Thresholds are not set for either flooding or landslides because of the difficulty of predicting frequency at a scale meaningful to the 10 conservation sites. Instead, no changed circumstance threshold is set for either flooding or landslides, as described further below.

Hurricanes

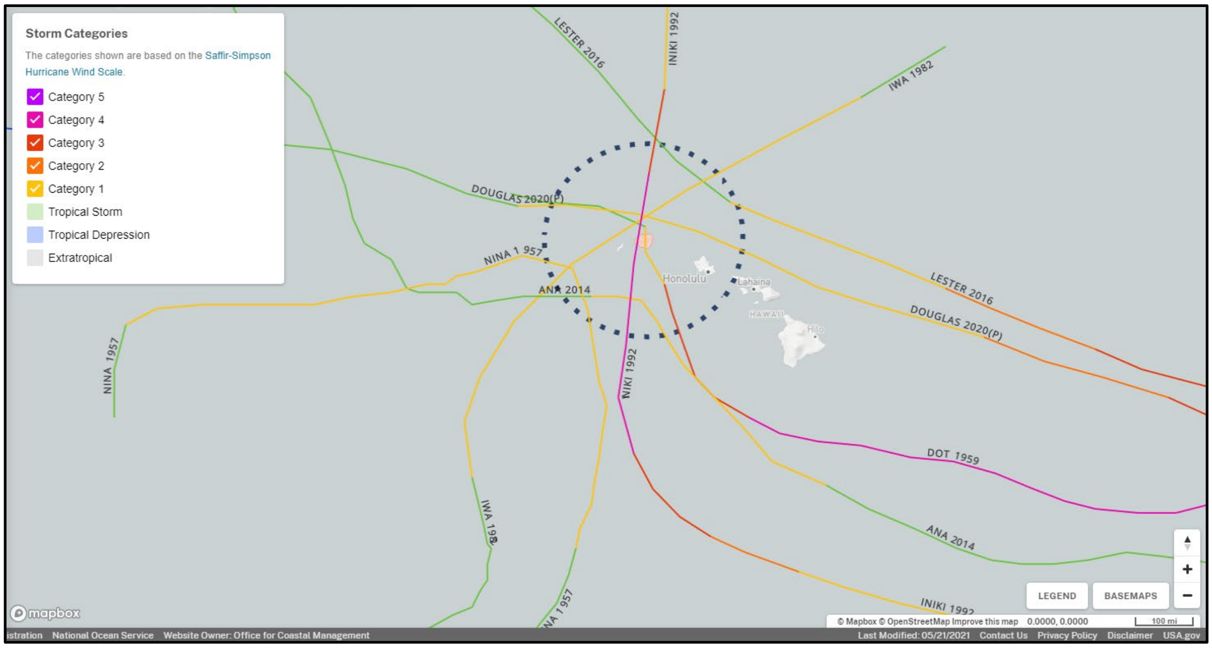
Hurricanes are large weather systems. Hurricane-force winds (i.e., 74 miles per hour [mph] or 119 kilometers per hour [kph]) may extend outward to more than 150 miles (241.4 kilometers [km]) from the center of large (Category 3+) hurricanes (National Oceanic and Atmospheric Administration 1999). At that scale, hurricanes can affect the entirety of Kaua'i even when they do not make landfall. In the central Pacific, hurricanes generally move from east to west but may also swing northward. As a result, all regions of the island have the potential to be affected by the damaging winds and heavy rains associated with hurricanes.

The National Hurricane Center's Hurricane Database (HURDAT) (National Hurricane Center 2021; National Oceanic and Atmospheric Administration 2021a) contains data from 1950 when record-keeping began. Based on the previous 70 years, an average of five hurricanes form in the central Pacific annually, with two of these being Category 3 or greater.

Rarely do hurricanes make landfall on the Hawaiian Islands (Thompson 2014). However, the extent of hurricane damage is a function of the size of the hurricane and the distance between the hurricane and the island, not whether it makes landfall. To estimate the potential for hurricanes damaging Kaua'i, we partitioned historical hurricane records into three categories: (1) landfall, (2) close approach (0–50 miles [0–80.5 km] offshore), and (3) distant approach (51–150 miles [82–241.4 km] offshore).

Of all the islands, Kaua'i has experienced the most direct hits of hurricanes in recorded history (National Oceanic and Atmospheric Administration 2021a; Figure 7-1). Over the last 70 years, two hurricanes have made landfall on Kaua'i—Hurricane Dot in August 1959 (Category 1 at time of landfall) and Hurricane 'Iniki in September 1992 (Category 4 at time of landfall). This equates to a rate of one landfall every 35 years. Over this same period, an additional two hurricanes made close approaches—Hurricane 'Iwa in 1982 (Category 3) and Hurricane Douglas in 2020 (Category 1); this equates to a rate of one close approach every 35 years. Four additional hurricanes have made distant approaches to Kaua'i (Figure 7-1); this equates to a rate of one distant approach every 17.5 years. Tropical storms are more frequent and can also have damaging impacts (e.g., rain, flash flooding, storm surge) but with more modest winds that remain below 74 mph (119 kph).

The rate of hurricane formation including formation of major hurricanes has been stable over the last 40 years (1980–2020; Figure 7-2 generated from National Hurricane Center 2021 data using R package HURDAT by Trice 2020). During this more recent period, one hurricane has made landfall and an additional five hurricanes passed within 150 miles (241.4 km) of Kaua'i, which equates to a rate of one hurricane making landfall every 40 years and one hurricane passing close enough to potentially cause damage to isolated parts of the island every 6 years. These more recent rates of occurrence are similar to the 70-year average indicating that the frequency of impacts due to climate change is undetectable at this point in time.



Source: National Oceanic and Atmospheric Administration 2021a

Figure 7-1. A map of the tracks of all hurricanes within 150 miles (241.4 km) of Kauaʻi (as depicted by the dashed circular outline) between 1950 and 2020, generated using NOAA's Historical Hurricane Tracks Mapbox interface

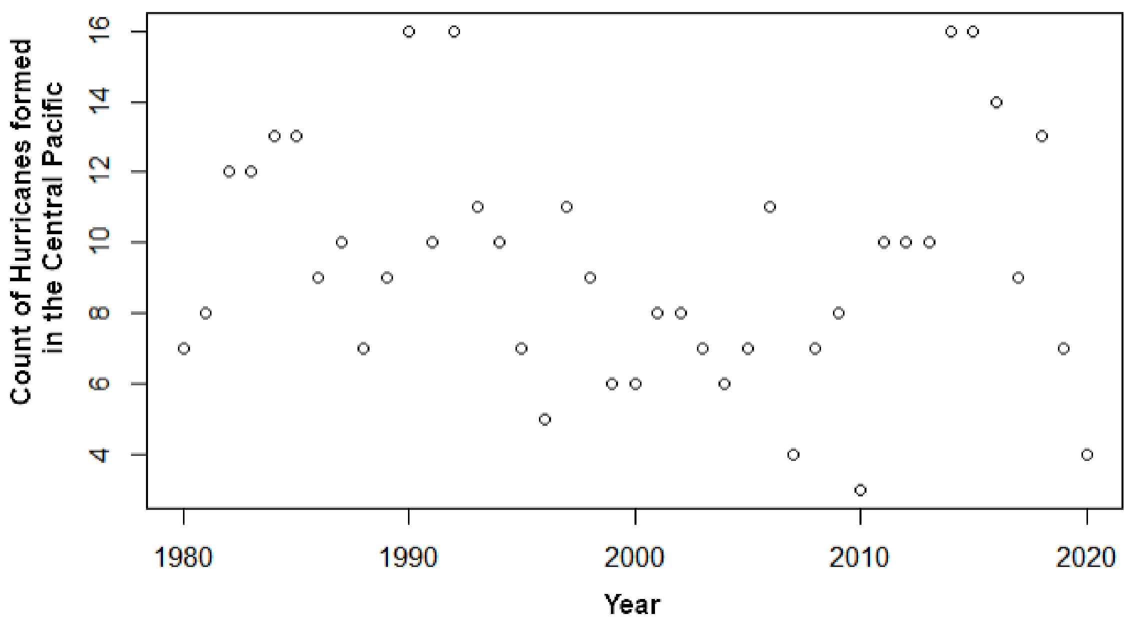


Figure 7-2. Annual count of the hurricanes formed in the central Pacific Ocean based on the National Hurricane Center's Hurricane Database (National Hurricane Center 2021), which shows no evidence of a directed trend in either increasing or decreasing directions.

Hurricane ʻIniki was the most powerful hurricane to strike the state in recorded history (Central Pacific Hurricane Center 1993). Hurricane ʻIniki made landfall on the south-central portion of Kauaʻi at peak intensity and moved across the island in 40 minutes (Central Pacific Hurricane Center 1993). Much of the island experienced sustained winds of 100 to 120 mph (161 to 193 kph), with gusts of 175 mph (282 kph) at landfall along with localized microbursts, sudden downdrafts of wind capable of reaching 200 mph (320 kph). In addition to intense winds, Hurricane ʻIniki created a 13- to 20-foot (4- to 6-meter) storm surge on top of a 17-foot (5.2-meter) swell along the southern Kauaʻi coastline. Because the hurricane moved quickly through the island, there were no reports of significant rainfall (National Oceanic and Atmospheric Administration 1993).

Marked declines in populations of the covered seabirds were documented because of Hurricane ʻIniki. "While it is unlikely that the hurricane itself caused direct mortality of adults [on land] given that it struck the island during the day while adults were out at sea" (Raine et al. 2017), it is likely that chicks were still in burrows when Hurricane ʻIniki made landfall. However, the hurricane may have displaced adults at sea, affecting foraging success and chick provisioning (Schreiber 2002). Additionally, damages resulting from this hurricane likely "increased impacts of introduced predators (by opening ingress routes that act as movement corridors), habitat modification (due to erosion and native vegetation removal), and powerline collisions (the removal of considerable vegetation shielding powerlines after large trees were blown over)" (Raine et al. 2017).

Smaller hurricanes that fail to make landfall can also pose threats but have historically resulted in considerably less damage than Hurricane ʻIniki. Hurricane ʻIwa was the second most damaging hurricane to affect Kauaʻi, passing within 25 miles (40.2 km) of the shoreline as a Category 3 hurricane. The right semicircle of this hurricane extended across Kauaʻi and produced 30-foot (9-meter) swells, an 8-foot (2.4-meter) storm surge, and wind gusts up to 120 mph (193 kph) (Rosendal 1983). The worst damage from Hurricane ʻIwa occurred along the south side of the island, where the rough surf destroyed or severely damaged several exposed luxury hotels, condominiums, and boats (Rosendal 1983). Like Hurricane ʻIwa, the center of Hurricane Douglas passed within 43 miles (69.2 km) of Kauaʻi's north shore but, unlike Hurricane ʻIwa, it was a much smaller storm and hurricane-force winds remained offshore. Overall damage was relatively minor with some moderate flooding on Kauaʻi due to storm surge and rainfall (Brackett 2020).

In certain situations, described above, hurricanes are expected to have the greatest likelihood of affecting the covered seabirds. In some instances, however, hurricanes may also affect the covered waterbirds and green sea turtle (honu) depending on the severity of the event. Hurricanes may result in life-threatening impacts on adults, juveniles, chicks, and eggs, both on land and at sea of the covered species, and by severely altering vegetation and damaging or destroying nests. Hurricanes have the potential to alter the environment in areas important to the life history of covered species, including altering vegetation in breeding areas and other habitats that affect the ability of covered species to survive and reproduce. Considerable damage or destruction of conservation structures (e.g., powerline collision deterrent devices, predator and ungulate exclusion fences, Save Our Shearwaters [SOS] facilities and operations) because of hurricanes may temporarily reduce the effectiveness of the conservation measures. Additionally, damage resulting from hurricanes may temporarily impede access to the conservation sites to implement remedial measures.

Tsunamis

Tsunamis are potentially destructive waves caused by the displacement of a large volume of water resulting from earthquakes, volcanic eruptions, submarine landslides and other underwater explosions. Tsunamis can travel across the Pacific Ocean basin from the point of origin to remote points of impact in a matter of hours.

Terrestrial areas affected by tsunamis may experience widespread inundation by seawater at otherwise unprecedented distances inland. Tsunamis are life threatening to all life forms that are unable to rapidly relocate and/or tolerate long periods of inundation by rushing seawater. Any structures (e.g., houses, bridges, roads) and sensitive habitats in their pathway are at risk of being destroyed.

Due to the sheer size and destruction that can result from tsunamis, frequencies of these events can be reconstructed from paleotsunami (i.e., tsunami occurring prior to the historical record) deposits. Although there is evidence that Hawai‘i was affected by locally generated tsunamis in the distant past (e.g., Moore and Moore 1984; Satake et al. 2002; McMurtry et al. 2004), the most recent event occurred over 10,000 years ago (McMurtry et al. 2004). All recent tsunamis affecting Hawai‘i have been generated by remote earthquakes; the Hawaiian Islands' location in the middle of the Pacific Ocean predisposes them to be threatened by tsunamis from great earthquakes in nearly all directions (Butler et al. 2014). Paleotsunami deposits laid down in the in the Makauwahi Sinkhole on the southwest side of Kaua‘i between 350 and 575 years ago provide evidence of the largest tsunami to hit the island in geologic history, with seawater traveling 328 feet (100 meters) inland and rising 24 feet (7.3 meters) above sea level (Butler et al. 2014).

In the last 70 years, five major tsunamis have affected Kaua‘i. During the 1960 Chilean tsunami, seawater rose a maximum of 10 feet (3 meters) above sea level as measured at the Makauwahi Sinkhole (Butler et al. 2014). The other four major tsunamis that affected Kaua‘i occurred in 1952, 1957, 1964, and 2011 (Butler et al. 2014). This equates to an average impact rate of one major tsunami every 14 years.

Because the frequency of earthquake-generated tsunamis is unrelated to climate change and the scale needed to encompass the full range of potential impacts is on the order of centuries, rather than decades, only the 70-year frequencies will be used to set thresholds for what can be reasonably anticipated over the duration of the federal ITP and State ITL for tsunamis.

Tsunami impacts are restricted to lower-elevation coastal areas, most frequently below 10 feet (3 meters) in elevation based on the last 70 years of data from Kaua‘i. Conservative estimates of sea level rise could add 1–3 or more feet of height to a tsunami. As a result, green sea turtle (honu) and covered waterbird habitat are at risk of being affected by this type of event. Tsunamis that result in significant coastal flooding may temporarily disturb or destroy active waterbird nests and wetland breeding habitat due to inundation. Green sea turtle (honu) nesting habitat and active nests may be affected by tsunamis that inundate or destroy nesting beach habitat. Furthermore, these events could remove coastal vegetation, coastal beach habitat, or structures near nesting habitat that have the potential to increase the impacts of artificial lights on hatchlings trying to make their way to the ocean. A tsunami that struck a green sea turtle (honu) nesting beach could wash away eggs prior to hatching.

Of all the severe weather and natural hazards accounted for, tsunamis are the least likely to affect the covered seabirds because they do not occur near coastal habitat. Perhaps if a tsunami was powerful enough to trigger landslides in the steep cliff nesting areas high above the ocean then seabirds might be affected.

Flooding

Flooding can result from a body of water overflowing onto land, from heavy rainfall that accumulates on the land surface, and, more recently, from sea level rise that causes "sunny day" tidal flooding associated with "king tides," or the highest tides of the year. Flooding may result from other severe weather events already summarized above (e.g., hurricanes) or may be associated with less severe weather systems (e.g., heavy rainfall events, Kona storms, tropical storms). Rapid rise in water can endanger lives, destroy structures, wash out roads and trails, and promote the occurrence of rainfall-triggered landslides that may impede access by blocking roads and trails.

Flooding risks can be assessed various ways. For planning purposes, NOAA calculates precipitation frequency based on historic data (now through 2010 for Hawai'i). The U.S. Geological Survey (USGS) uses its network of streamflow gauges to monitor the flood stage of rivers in real time. The NWS issues flash flood (sudden, violent flooding) warnings using hydrologic tools that are informed by radar-based rainfall rates to forecast the severity, timing, and magnitude of flash flooding.

USGS published updated flood frequency estimates for Hawaiian streams with data through the 2008 water year (Oki et al. 2010). Using 235 gauging stations in unimpacted areas, a trend was detected in only 37 and of those, 27 were downward and 10 were upward. In general, estimated 100-year peak discharges from this study were lower than those from previous studies across all the islands including Kaua'i. These data are consistent with NOAA's Atlas 14 findings. It should be noted that hydrologic data can be highly variable and the inclusion or exclusion of periods of time can change the outcomes of analysis, sometimes quite significantly.

Unlike the previously described severe weather events, the database that has archived all NWS flash flood warnings issued on Kaua'i only begins in 1986 and appears unreliable prior to 2004 due to a marked increase in the frequency of warnings issued starting in 2004 (Iowa Environmental Mesonet 2021). According to the NWS, a flash flood warning is "issued when flash flooding is imminent or occurring;" therefore, warnings represent a reliable proxy for the actualized frequency of flooding events that have occurred over the last 17 years (2004–2021) across the entire island. Due to a lack of records for flash flooding events prior to 2004, an assessment of increased flash flooding due to climate change was not possible.

Since 2004, there have been 244 flash flood warnings issued on Kaua'i, which equates to an average of between 12 and 13 flash floods on the island each year. There is significant interannual variability in flooding, however, and the number of flash flood warnings range from as few as 4 to as many as 58. Within a year, flash flooding can occur in any month but 82.6 percent (n=185) of flash flood warnings issued since 2004 occurred between October and February.

Spatially, some areas are more prone to damage caused by flash flooding due to sloped topography that works to funnel runoff, creating a temporary watercourse or adding to the flow rate of existing watercourses. Areas with this sort of topography are more likely to experience erosion in events of flooding due to fast-moving water flows. Based on the Special Flood Hazard Areas depicted on the Flood Hazard Assessment Tool (State of Hawai'i Department of Land and Natural Resources 2021), areas with the greatest risk of flooding are associated with existing watercourses (i.e., rivers, streams, and marshes) and low-lying areas (e.g., Mānā, Hanalei Valley). Although all areas subject to flooding are not identified on this map, and the lack of Special Flood Hazard Areas in the remote interior and along the northwestern coastline are likely because people do not reside in these areas. Given the steep topography and abundant existing watercourses in the remote, uninhabited areas of the island where the seabird conservation sites are located, localized damage caused by flash flooding, particularly in steep valleys and existing waterways, should be anticipated.

On Kaua'i there have been a few instances in recent history where extensive flooding has occurred in populated areas and has resulted in significant damage to human infrastructure. Four such flooding events have occurred since 1991 (December 1991, October 2006, April 2018, and March 2020; Tetra Tech 2021). The Hanalei National Wildlife Refuge (NWR) on the north side of the island of Kaua'i has the potential to be affected by extensive damage due to flooding as frequently as once every 10 years if all these storm events are considered. However, locational details provided for three of the four events indicate that worst impacts were at a distance from Hanalei NWR (e.g., Hanalei Bridge, Anahola), so the realized frequency of events causing extensive damage at Hanalei NWR may be more on the order of once every 40 years. In the southern portion of Kaua'i flooding near the Waimea River mouth and Mānā have been documented in the last 40 years. However, flood events expected to cause extensive damage to Mānā are expected to be relatively rare and are not anticipated at anything less than a 40-year interval.

The covered seabirds and covered waterbirds could be affected by localized flooding that occurs during the nesting season. Large rain events that result in flooding cause the most risk to seabirds. In 2021, a Hawaiian petrel ('ua'u) chick was found in a flooded burrow in the Hono O Nā Pali Natural Area Reserve in late September; the chick was found covered in mud, soaked, and sitting in an inch of water (Archipelago Research and Conservation 2021). Covered seabird eggs and fledglings could also be affected by large rain events. Flooding may also impact the covered waterbird species. It is unlikely that flooding of waterbird wetland and river habitats, even in extreme cases, will result in a mass mortality event of adult waterbirds. However, if it happens to be nesting season for waterbirds when flooding occurs and their nests become inundated, these events could result in temporary reductions in reproductive outputs of affected species (Byrd and Zeillemaker 1981). In April 2018, an historic rain event resulted in 50 inches of rain falling on Kaua'i in 24 hours, causing the Hanalei River to flood its banks and inundate surrounding low-lying areas, including the wetlands in the Hanalei NWR. Despite this historic flooding, intensive efforts to document impacts on waterbirds located only seven carcasses (based on an interview of K. Uyehara reported by Rogers 2018). Moreover, flooding can create new suitable habitat for the covered waterbird species when properly managed, but these events can also make habitat less suitable or unusable, depending on the water depth and season in which the events occur. Flash flooding can submerge or wash away nests in wetland habitat and can remove nesting substrate. Green sea turtles (honu) do not occur in areas where they are expected to be adversely affected by flooding.

Landslides

Landslides are defined by USGS as the movement of a mass of rock, debris, or earth down a slope. Slope movement occurs when forces acting downslope due to gravity exceed the strength of the earth materials that compose the slope. Landslides can be initiated in slopes already on the verge of movement by rainfall, snowmelt, changes in water level, stream erosion, changes in groundwater, earthquakes, volcanic activity, disturbance by human activities, or any combination of these factors. On land, landslides can endanger lives, destroy structures, and block access to roads and trails. Underwater landslides can generate tsunamis.

Kaua'i primarily experiences rainfall-triggered landslides (County of Kaua'i 2015) due to its steep mountainous topography, which focuses rain onto mountain slopes, causing landslides. There is no authoritative database detailing landslide events on Kaua'i, so generating a robust and long-term average for this type of extreme event and assessing changes in frequency in recent years is not possible. However, the County of Kauaʻi Multi-hazard Mitigation and Resilience Plan (2015) does provide some anecdotal information on landslides. Specifically, this plan notes that flooding and storm events caused landslides affecting highway and coastal roads in 2006, 2008, and 2012. News articles since 2012 indicate additional weather-related landslides occurred in 2014 at Wailua River (Hawaii News Now 2014), in 2018 along the north shore (Parachini 2018), and again in 2021 along the north shore (Bigley 2021). Thus, anecdotal reporting from 2006 to 2021 indicates that landslides are common and landslide-generating events occur at least once every 2.7 years. However, not all landslides are reported, particularly in the uninhabited interior regions of the island, and this is a minimum estimate of landslide frequency rather than an average estimate. Although very little is known about the exact rate of landslides in the uninhabited northwest portions of Kauaʻi where seabird conservation sites are located, landslides do occur frequently in the steep terrain along the Nā Pali Coast and may frequently affect the conservation sites. There are records of landslides affecting the covered seabirds in the Upper Limahuli Preserve, Hanakāpiʻai, and North Bog conservation sites.

The USGS Preliminary Landslide Susceptibility Map for Hawaiʻi depicts areas of steep slopes with moderate, high, and very high risk of landslides across Kauaʻi. These risk categories are based on expert judgement and a slope-stability model applied to digital topography following the methods of Harp et al. (2009). While this information is preliminary or provisional and is subject to revision, it indicates there a risks of landslides throughout the Nā Pali Coast. Each conservation site[5] is primarily designated as the lowest risk category (moderate) with small areas considered to be high risk (Figure 7-3). Generally, areas of very high risk, which are the very steep slopes of the Nā Pali Coast, are outside of the conservation sites, but can overlap slightly with the conservation site boundary, such as is the case along the eastern edge of North Bog.

The location and design of all nine selected conservation sites was informed, in part, by landslide risk. Site locations were chosen, and boundaries were designed to mostly avoid areas with high and very high landslide risk (Figure 7-3). However, a moderate risk of landslides remains throughout all or most the Nā Pali Coast where all the KIUC HCP conservation sites are located. Therefore, landslides are expected to affect the covered seabirds directly and indirectly during the 50-year permit term. Landslides can bury active burrows (including the chicks and any incubating adults inside), remove vegetation and soil, or result in large areas of land breaking off and falling into the ocean. Landslides can also damage or destroy predator fencing, which increases the susceptibility of covered seabirds to predator mortality until the fence can be repaired. Landslides are not expected to affect the covered waterbirds or green sea turtle (honu) because they do not occur in areas susceptible to landslides.

[5] Conservation Site 10 is not shown on Figure 7-3 because it will be selected during the first year of HCP implementation (2023)

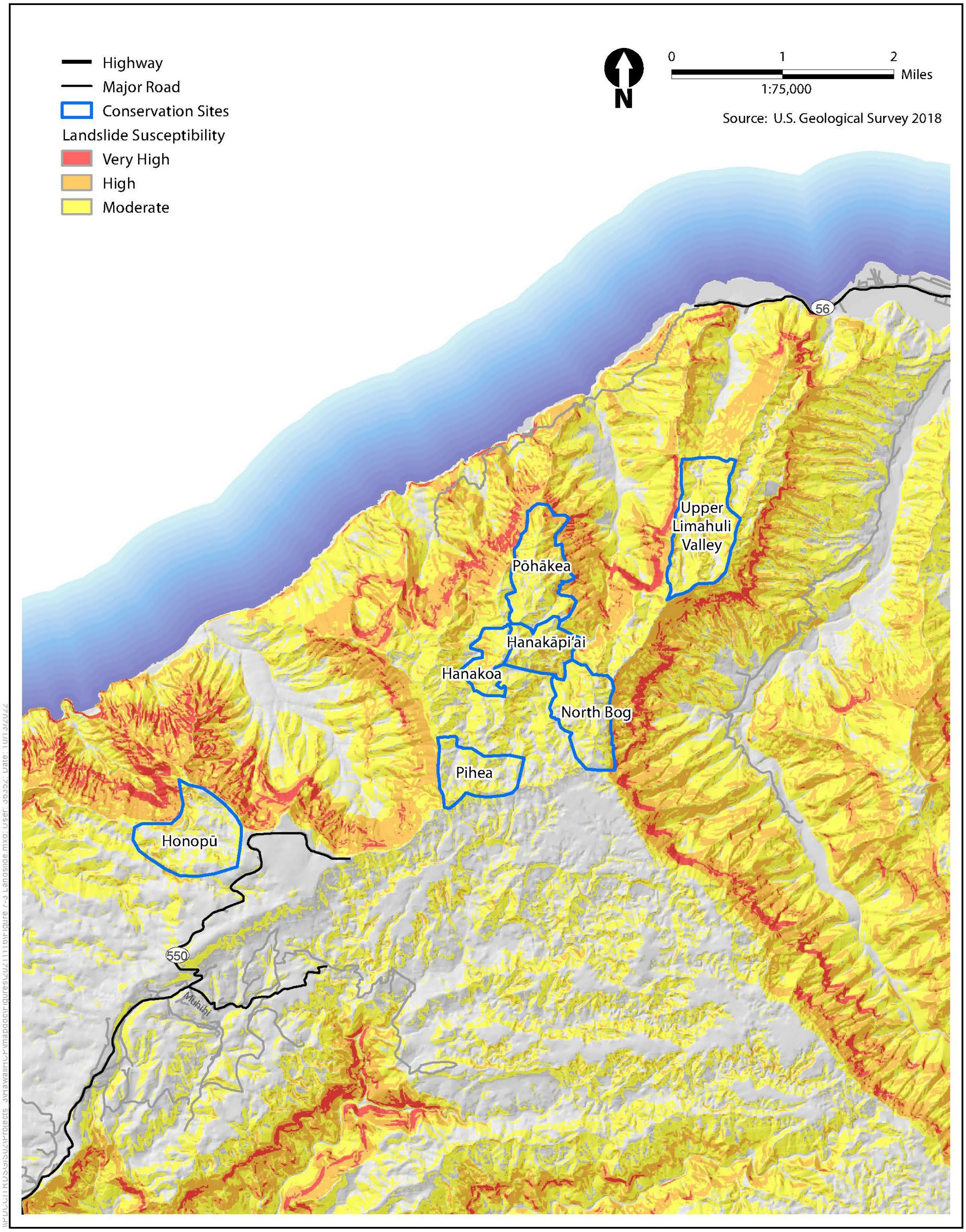


Figure 7-3. Landslide Susceptibility Map for the Conservation Sites

Sea Level Rise

Rising sea levels will both directly inundate areas near shorelines and cause low-lying areas to flood due to the upward displacement of shallow aquifers. Rising sea levels also increase the tendency of large waves to wash inland and flood areas with saltwater, making the soil unsuitable for many plants (Keener et al. 2018).

In addition to water pushing further inland during high tide events, event-based coastal flooding of low-lying areas arising from tropical storms, hurricanes, and tsunamis waves will also be exacerbated by sea level rise. In addition, El Niño and La Niña events affect wave action and model projections indicate changing future wave conditions that will vary in complex ways spatially, by season, and with shoreline exposure and orientation (Kenner et al. 2018).

With 3.2 feet of sea level rise, the level identified by the Hawaiʻi Climate Change Mitigation and Adaptation Commission (2017) as an end-of-century planning target, low-lying coastal areas around the island may become chronically flooded within the mid- to latter-half of this century. This land will become submerged by coastal erosion, direct marine flooding from tides and waves, or become new wetlands behind the shoreline from rising water tables and reduced drainage. Approximately 5,760 acres of land on Kauaʻi is estimated to be vulnerable to 3.2 feet of sea level rise. Some examples of areas that would be exposed to chronic flooding include Kēʻē Beach, Kīlauea, Polihale Beach, and Nāwiliwili Harbor. Seventy percent of Kauaʻi's beaches are subject to chronic erosion and Kauaʻi has lost almost 4 miles of beaches to erosion fronting seawalls and other shoreline armoring (Hawaiʻi Climate Change Mitigation and Adaptation Commission 2017). Nesting waterbirds, turtles and seals, and coastal plants in low-lying areas are expected to experience some of the most severe impacts of sea level rise (Keener et al. 2018).

Preventive Measures

Through implementation of the HCP conservation measures, KIUC will construct and maintain structures in the conservation sites to minimize risks from severe weather events. For example, strong fence construction at the conservation sites will minimize the risk of damage during storm events (Chapter 4, subsection *Predator Exclusion Fencing*, in Section 4.4.4.2, *Management Actions*). In addition, KIUC will proactively clear vegetation and trim trees along a buffer on either side of the fence to protect fences from falling vegetation in strong winds. Remote cameras along the fence line will serve as an early detection monitoring tool to detect fence damage or landslides immediately after storms. For green sea turtle (honu), volunteer monitors will remove shields during a storm to ensure that they are not blown away or damage nests and will visit all potentially suitable habitat on an annual basis to track changes over time (Chapter 4, Section 4.4.5.1*, Nest Detection*).

Changed Circumstance

Given the data regarding annual averages and frequency of occurrence presented in the *Risk Assessment* subsection, a threshold for each changed circumstance has been set for each type of severe weather (Table 7-1). These thresholds indicate the limit of what can be reasonably anticipated in terms of the frequency of occurrence over the 50-year HCP permit term given historical data and long-term trends. Based on the definitions of changed circumstance described above, KIUC would be responsible for remedial measures in the event of damage from severe weather that occurs at or below these frequency thresholds. If the number of occurrences during the permit term exceeds the changed circumstance threshold it becomes an unforeseen circumstance.

KIUC will notify USFWS and DOFAW within 30 days if a severe weather changed circumstance has occurred. Following the occurrence of a severe weather event, KIUC will evaluate the extent of the damage as it pertains to the conservation measures of this HCP, and the resulting impacts on the covered species based on the best available information at that time. Once the extent of the damage has been assessed, KIUC will identify and implement appropriate remedial measures as described below as soon as possible and will notify both agencies of their plans.

Remedial Measures

Damage from severe weather has the potential to be widespread across the island and may affect the success of conservation measures proposed by this HCP. The damage that could result from severe weather types may take various forms that are summarized in Table 7-2. Damages that may affect the success of HCP conservation measures will be remedied using the potential responses in Table 7-2.

Table 7-2. Potential Effects and Potential Responses from Severe Weather

Potential Effect on Covered Species	Potential Response
Damage to powerline minimization devices (e.g., diverters)	KIUC will conduct surveys to assess the damages that may have occurred to powerline minimization devices to determine if repairs/replacement are necessary. Damaged or missing diverters will be replaced; the timing of replacement will be driven by the level of damage and power outages, with first priority being given to restoring power. Power outages from severe weather are often associated with powerlines being down so the potential for take from downed lines is non-existent. Repair or replacement of minimization devices of like kind will be determined by KIUC without consultation. However, if KIUC cannot replace or repair the minimization devices with like kind or KIUC analysis indicates that replacement is not in the best interest of species (e.g., the timing of full replacement/repair), KIUC will consult with USFWS and DOFAW within 30 days to determine an alternative response.
Loss or destruction of entire predator exclusion fence	Should an entire fence be destroyed by severe weather, KIUC will take the following steps within 30 days of the severe weather event: (1) KIUC will analyze damage to the site and determine whether portions of colonies are remaining, whether or not suitable habitat remains, and whether or not fences are replaceable. (2) KIUC will present that analysis to USFWS and DOFAW. (3) KIUC will propose actions to maintain remaining colonies or suitable habitat where fence repair is feasible, and any adjustments needed to ensure HCP goals and objectives are not jeopardized. (4) KIUC will discuss proposed actions with USFWS and DOFAW to verify approach and establish a timeline for implementation.
Temporary loss of accessibility to conservation sites (e.g., damaged helicopters, landing pads, or roads)	KIUC will conduct surveys and confer with appropriate parties (e.g., helicopter operator, Hawai'i Department of Transportation) to determine the extent of access damages. KIUC would be responsible for clearing trails well enough to gain access to conservation sites and repair fences, weatherports, and landing zones. For other damage, KIUC will work with the appropriate party to determine a strategy and timeline for repair.

Potential Effect on Covered Species	Potential Response
Temporary destruction of a portion of a conservation site	Temporary damage to a conservation site (e.g., moderate landslide) will be assessed to determine the extent of damage and implement any remedial measures that can quickly restore some habitat value and speed up the natural recovery of the area (e.g., remove soil and vegetation blocking access to burrow areas).
Permanent destruction of a portion or all a conservation site.	If a portion of or an entire conservation site is permanently lost and unable to be reestablished to provide habitat value (e.g., massive landslide), KIUC will follow the same process as described above under "loss or destruction of entire predator exclusion fence".
Increased accessibility of predators within the conservation sites.	As soon as it is safe to do so following a storm, KIUC will conduct surveys within the conservation sites to determine if increased accessibility (e.g., vegetation removal, erosion) has resulted from storm damage. Depending on the type of damage, responses may include an increased trapping effort, replanting, and/or temporary fencing. KIUC will confer with USFWS and DOFAW to determine the appropriate response and timeline.
Potential escape of domestic animals that are known to depredate covered species (e.g., cats)	KIUC will continue to manage and monitor predators in the conservation sites and regional management sites. If monitoring in the period following severe weather indicates an increase in the presence of domestic animals, KIUC will increase their trapping effort in response to ensure that increased predation on the covered seabirds does not occur. KIUC will work with USFWS and DOFAW to ensure that the level of effort and response timeline is appropriate.
Destruction of green sea turtle (honu) nests	As soon as practically possible following a severe weather event that damages habitat containing active green sea turtle (honu) nests, KIUC monitors will visit the site to determine if any nests remain. KIUC's monitor will document the condition of any remaining eggs and consult with DOFAW, DAR, and USFWS, to determine if they are viable. If they are determined to be viable, KIUC will propose remedial actions on a case-by-case basis (e.g., re-instate KIUC's monitoring and temporary shielding program, collect the eggs for artificial incubation) and discuss proposed action(s) with USFWS, DAR, and DOFAW prior to implementation.
Loss of green sea turtle (honu) habitat due to sea level rise	KIUC will evaluate, in coordination with USFWS, DAR, and DOFAW, where green sea turtle (honu) habitat has been lost due to sea level rise through the HCP's annual nest monitoring program and will adjust the nest detection and temporary shielding program to focus on the remaining suitable habitat.

Given the frequency of widespread hurricane damage, which is expected to occur when hurricanes either make landfall or when their trajectory brings them into close proximity of the island (e.g., within 50 miles [80.5 km]) based on the extent and magnitude of destruction observed to result from all hurricanes passing within 150 miles [241.4 km] of Kauaʻi between 1950 and 2020, it is foreseeable that complete replacement of predator exclusion fence and other conservation infrastructure and equipment may be required up to twice during the permit term. One landfall is expected every 35 years and one close pass is expected every 35 years (see Table 7-1), which equates to the likelihood that two hurricanes with widespread damage will affect Kauaʻi at any point during the next 35 years, which encompasses a 50-year permit term. Minor repairs to infrastructure may be required in any areas that experience severe weather, and infrastructure required for full implementation of the conservation strategy should be inspected as soon as possible following such events.

Unforeseen Circumstance

For each severe weather type, frequencies exceeding the foreseeable frequency presented in Table 7-1 are not anticipated over the permit term of this HCP and are therefore considered unforeseen.

7.3.3.2 New Invasive Species

New invasive species can reasonably be anticipated to become established within the Plan Area over the course of the 50-year permit term. There are many invasive plant and animal species that are already established on Kaua'i that are known to be significant threats to the covered species, as described in Chapter 3, *Environmental Setting,* and addressed in the conservation strategy for the covered seabird species, as described in Chapter 4, *Conservation Strategy*. In particular, conservation measures for the covered seabirds include monitoring and evaluation of conservation sites for invasive plants and feral honeybees and these monitoring efforts will facilitate detection of additional harmful invasive species if they become established at or near these conservation sites. There is potential that new invasive species, especially those that occur on the other Hawaiian Islands, could become established on Kaua'i.

Risk Assessment

Invasive species can harm the covered seabirds, covered waterbirds, and possibly green sea turtles (honu). Both lethal and sublethal effects may occur through various pathways—predation (mammals, birds, reptiles), micro-predation (insects), spread of novel pathogens (mammals, insects), and habitat loss (plants). Based on observations from Kaua'i, other Hawaiian Islands, and Micronesia, it is possible that additional predators that affect covered species, particularly ground-nesting seabirds, could become established on Kaua'i during the permit term. Specific species of concern include mongoose (*Herpestes javanicus*), brown tree snake (*Boiga irregularus*), and yellow crazy ants (*Anopolepis gracilipes*), all of which may be accidentally introduced to Kaua'i during the 50-year permit term. Each of these species is described in the following subsections and assessed for their potential threats to the covered species. Other unidentified species of rodents, insects, or plants could also be accidentally introduced over the next 50 years.

The threat of new invasive species is heightened by the challenge of maintaining biosecurity on imports into the Hawaiian Islands (State of Hawai'i Division of Forestry and Wildlife 2020). In addition to the specific species discussed below, introductions of other invasive insects, fungus, nematodes, mites, and other plant pests that may adversely affect the covered seabirds, waterbirds, and green sea turtles (honu) are possible.

The KIUC HCP conservation strategy does not require habitat management, including invasive species control, as part of the mitigation for the covered waterbirds or green sea turtle (honu). Habitat management is not required to meet the HCP's biological goal for waterbirds (Chapter 4, *Conservation Strategy*, Goal 4) or green sea turtle (honu) (Goal 5). Actions that facilitate the detection of invasive species in habitats utilized by the covered waterbirds are not planned. As such, invasive species control is beyond the scope of this HCP for covered waterbirds and green sea turtle (honu) and is not required to be addressed by KIUC during the 50-year permit term. These covered species are not discussed further in this section.

Mongoose

Mongoose were brought to the Hawaiian Islands in 1883 to control rats and are known to be established on Hawai‘i, O‘ahu, Maui, and Moloka‘i (Duffy et al. 2015). Mongoose presence has already been documented on Kaua‘i; in 1976 a roadkill lactating female was found (Tomich 1986) and three additional individuals were trapped near Līhu‘e—two in 2012, one in 2016 (Kaua‘i Invasive Species Committee 2021). Despite these rare and intermittent detections of mongoose on Kaua‘i, research and trapping efforts to date have yet to confirm an established population (Duffy et al. 2015; Kaua‘i Invasive Species Committee 2021).

Mongoose are opportunistic feeders with a varied diet that includes birds, small mammals, reptiles, insects, fruits, and plants; on other Hawaiian Islands, they are known to prey on the eggs and hatchlings of native ground-nesting birds. If mongoose become established, they may depredate seabirds, including the eggs and young. Given what has occurred on other Hawaiian Islands, establishment of mongoose may result in population reductions of the covered seabirds potentially affecting the success of conservation actions proposed for this HCP.

Brown Tree Snake

Brown tree snakes were accidentally introduced to Guam around 1952 and rapidly extirpated most of the native forest vertebrate species, including birds and reptiles (Fritts et al. 2005). Brown tree snakes can depredate seabirds. Because Guam is a major transportation hub in the Pacific, numerous opportunities exist for the brown tree snakes on Guam to be introduced accidentally to other Pacific Islands as passive stowaways on ship and air traffic. Although they are not thought to be present on the Hawaiian Islands, a total of eight brown tree snakes were found in Hawai‘i between 1981 and 1998. All snakes were associated with the movement of civilian and military vehicles or cargo from Guam. Special searches are now conducted on any cargo or crafts leaving Guam and entering Hawai‘i to minimize the risk of introduction (Hawaiian Invasive Species Council 2021).

Brown tree snakes are primarily arboreal predators that consume many types of small vertebrates (i.e., lizards, birds, and mammals) as well as eggs of an appropriate size, and can eat up to 70 percent of their body weight per day. There are no snakes native to the Hawaiian Islands, so this ecosystem lacks predators that specialize on snakes and the native species have not evolved to defend against snake depredation. Given what has occurred in Guam, the introduction of brown tree snakes to the Hawaiian ecosystem could be potentially devastating in general, but it is unclear to what degree these snakes would affect covered species. Brown tree snakes are primarily arboreal and they target small, tree-nesting forest birds. That said, brown tree snakes have been found on the ground in logs and crevasses, so it is possible that they may encounter and learn to predate the nests and chicks of the covered seabirds and waterbirds in and around forested habitats. If this were to occur, establishment may result in the reductions of covered populations of seabirds and waterbirds, which could affect the success of conservation actions proposed for this HCP.

Yellow Crazy Ant

Yellow crazy ants are originally from Southeast Asia and have been repeatedly transported to various locations throughout the world’s tropics by human-assisted dispersal in shipping containers and freight (Queensland Government 2016), including the Hawaiian Islands. They prey on invertebrates and vertebrates, blinding prey by spraying formic acid. In large numbers, they are capable of preying upon relatively large animals (Queensland Government 2016). At Johnston Atoll

NWR these ants nearly extirpated the red-tailed tropicbird (*Phaethon rubricauda*) colony in just a few years. Intensive ant eradication measures were implemented there to eradicate the ants from the atoll (Romo 2021). Based on research grade observations submitted to iNaturalist by citizens, yellow crazy ants have been documented on the Big Island, O'ahu, Maui, and Kaua'i. With respect to Kaua'i, there are 13 research-grade observations of this ant, with the first observations reported in 2015, with an average of two additional observations per year since 2015 (iNaturalist 2021; Global Biodiversity Information Facility 2021). These observations are distributed across the Plan Area, with five from the southeast region, five from the eastern region, and three from the northern region. The northern observations were all located in the vicinity of Kalalau Trail, which leads into the Nā Pali Coast State Wilderness Park, where the majority of covered seabirds nest.

Yellow crazy ants prefer moist lowland forests but can inhabit a diversity of habitats. Where they have been introduced, they can form large-scale super-colonies that extend more than 247 acres (100 hectares) and reach densities of more than 2,000 foraging ants per meter squared. Their impacts vary considerably from site to site and can take decades to manifest (as on Christmas Island) but, in places where yellow crazy ants flourish, not much else does; they decimate insect population and can kill various small animals including seabirds, lizards, crabs, and other sympatric species. Given what has occurred on other islands, including the Hawaiian Islands, establishment of yellow crazy ants in the Plan Area may result in population reductions of the covered seabirds, waterbirds, and green sea turtle (honu), potentially affecting the success of conservation actions proposed for this HCP.

Invasive Plant Species

Highly invasive plant species that currently do not occur or occur in limited distribution on Kaua'i have the potential to affect the covered seabird burrow habitat or access to their burrows. They can also alter the suitability of covered species habitat by displace native plant species, resulting in habitat loss or degradation from increased erosion and siltation due to shallow root systems, dense vegetation structure limiting burrow density, and loss or alteration of understory vegetation.

Preventive Measures

In the case of introduction of a new mammalian predator (e.g., mongoose), the predator exclusion fencing would prevent access to the social attraction sites for the covered seabirds. In areas where predator exclusion fencing is absent, the high frequency of management and monitoring actions in the seabird conservation sites, including predator control and burrow monitoring (see Chapter 4, Section 4.4.4 and Chapter 6, Section 6.3.4) should be sufficient to allow for early detection of any new invasive species affecting the covered seabirds at the conservation sites.

Similarly, KIUC will monitor the threat posed by new invasive plants in the conservation sites incidentally as other management and monitoring actions are implemented during the seabird breeding season. KIUC will act quickly to remove new invasive plant species that pose a high risk to the covered seabirds. KIUC field staff will continue to implement best management practices to minimize transportation of invasive plants or their seeds into conservation sites (Appendix 4C, *Invasive Plant Species Control Methods*). KIUC will follow the principles of early detection rapid response to ensure that new invasive plants are controlled before they become a problem. KIUC will implement early detection rapid response actions consistent with the current recommended protocols of the Hawaiian Invasive Species Council Prevention/Early Detection Rapid Response Working Group (https://dlnr.hawaii.gov/hisc/meetings/wg/prevention/).

Changed Circumstance

Because mongoose and yellow crazy ants have both been observed on Kauaʻi numerous times over the previous 30 years, it is foreseeable that these species may become established over the next 50 years of the permit term. While less likely, brown tree snakes may also be accidentally introduced and, if so, the effects could be devastating to the covered bird species. Occurrence of any new invasive plant or animal species affecting the success of the conservation strategy for the covered seabirds will be treated as a changed circumstances for this HCP.

KIUC will notify USFWS and DOFAW within 30 days if a new invasive species changed circumstance has occurred. Following this determination KIUC will evaluate the effects and resulting impacts of the new invasive species on the covered species based on the best available information at that time. Once the impacts have been assessed, KIUC will notify both agencies of their plans to implement remedial measures as described below.

Remedial Measures

For conservation sites without predator exclusion fencing, any newly introduced mammalian species will be detected through trapping and camera monitoring. KIUC will consult with USFWS and DOFAW to ensure that the protocols in place are sufficient to control the new mammalian species and will adjust their control techniques as necessary if they are determined to be insufficient. In some cases, this may require new trapping techniques, new equipment, or increased trapping effort.

In addition, if any other types of invasive species are introduced on Kauaʻi (e.g., insects, amphibians, reptiles, fungus, non-native plants), KIUC will employ the following process to identify remedial measures.

1. Evaluate whether the new invasive species has the potential to affect the success of KIUC's conservation measures for the covered seabirds or green sea turtles (honu). This includes review of relevant data collected through the HCP's management and monitoring actions and consultation with USFWS, DOFAW, Hawaiian Invasive Species Council for invasive plants, and species experts. No remedial actions are required if it is determined that the new invasive species is not likely to adversely affect the HCP's conservation measures.
2. If it is determined that the new invasive species is likely to adversely affect the HCP's conservation measures, KIUC will review its existing management and monitoring actions to determine if, as they are currently being implemented, they are sufficient to address the new invasive species.
3. If the HCP's existing management and monitoring actions are determined not to be sufficient to control the new invasive species, KIUC will evaluate whether the existing actions can be adjusted to address the new invasive species.
4. If none of these options are possible, KIUC will propose a new strategy of control specific to the new invasive species, and obtain concurrence from USFWS, DOFAW, and species experts in partnership with other conservation entities on Kauaʻi prior to implementation.

Unforeseen Circumstance

With respect to the covered seabirds and invasive species, there are no unforeseen circumstances. This means that KIUC will evaluate all newly introduced invasive species in the conservation sites to determine if they have the potential to affect the covered seabirds.

7.3.3.3 Disease Outbreak in the Covered Species

Hawaiian endemic species evolved in the absence of various pathogens that have been transported to the islands over the last century because of globalization. Therefore, the exposure of naïve immune systems to novel diseases may have played an important role in the decline of Hawaiian endemic species (e.g., mosquito-borne malaria and Hawaiian honeycreepers; van Ripper et al. 1986; Freed et al. 2005).

Risk Assessment

Disease has not been cited as having long-term population-level impacts on any covered seabirds (Raine et al. 2017), waterbirds (Reed et al. 2011; Underwood et al. 2013; U.S. Fish and Wildlife Service 2021), or sea turtles (Chaloupka et al. 2008; Seminoff et al. 2014). That said, the covered species are all susceptible to various forms of disease and there is potential for disease outbreaks.

With respect to the covered seabirds, Newell's shearwater ('a'o) (*Puffinus auricularis newelli*) fledglings have been found with mild symptoms of mosquito-borne diseases, specifically avian pox (Ainley et al. 2020) and avian malaria (Warner 1968; Raine et al. 2017) but there have been no reports of lethal disease outbreaks in covered seabirds on Kaua'i. Based on studies to date, otherwise healthy seabirds seem to be more resilient to the impacts of avian pox (Young and VanderWerf 2008) and malaria (Quillfeldt et al. 2011) relative to other types of birds.

Avian botulism, a paralytic disease caused by ingestion of a toxin produced by the bacterium *Clostridium botulinum*, is the most significant disease of migratory birds worldwide, especially waterfowl and shorebirds (Rocke and Bollinger 2007). Avian botulism is a chronic issue at the Hanalei NWR since a November/December 2011 epizootic killed hundreds of endangered waterbirds (U.S. Fish and Wildlife Service 2021). Between 2011 and 2018, there were 1,342 cases of avian botulism recorded on the Hanalei NWR (Reynolds et al. 2019). In 2019, the total number of sick and dead native birds affected by avian botulism was 157, with 90 percent of these birds affected between July and December. In 2020, an additional 165 native birds were affected raising the total to 1,664 suspected botulism cases (U.S. Fish and Wildlife Service 2021). These botulism outbreaks have killed individuals of all the covered waterbird species and have been particularly detrimental to the endangered Hawaiian duck (koloa maoli) (*Anas wyvilliana*), which represents 62 percent of birds affected (Reynolds et al. 2019). On Kaua'i, these outbreaks can occur year-round due to lack of seasonal variability in temperatures. An avian botulism task force has been formed and monitoring of birds and water quality has been undertaken to better understand the drivers of the outbreaks in the system (U.S. Fish and Wildlife Service 2021).

Covered sea turtles have primarily been afflicted with a tumor-forming disease called fibropapillomatosis (Chaloupka et al. 2008; Jones et al. 2016). Although this disease is of major concern in some green sea turtle (honu) populations, there is photographic evidence that tumors may spontaneously regress, or increase in size and/or number to the point of debilitation (Herbst 1994; Hirama 2001; Hirama and Ehrhart 2007). The primary impact of fibropapillomatosis is the decrease in ability of sea turtles to forage for food, swim, and avoid predation, affecting the overall survival of affected turtles (Work et al. 2004). Although the primary cause of fibropapillomatosis is unknown (see Blackburn et al. 2021), experts suspect that a herpes virus is the causal agent (Lackovich et al. 1999; Jones et al. 2020). This is reminiscent of human cancers with known viral origins, which, together with other environmental and anthropogenic pressures, have contributed to increases in fibropapillomatosis prevalence (reviewed in Jones et al. 2016). There also is currently no cure (see Blackburn et al. 2021). For sea turtles debilitated by fibropapillomatosis, the current standard of care has been and continues to be preoperative screening to confirm that internal tumors are absent, due to their poor prognosis, followed by surgical excision of external tumors. However, postoperative regrowth is seen in 50 percent of treated turtles and the rehabilitation survival rate of fibropapillomatosis-affected turtles is low (25 percent) (Page-Karjian et al. 2020).

Preventive Measures

Actions to proactively avoid or minimize the impacts of disease outbreaks in the covered species are not planned. The primary preventive measure is monitoring disease outbreaks that are occurring or could occur in birds that are brought into the SOS Program. In addition, KIUC's colony monitoring program would document general deteriorations in health, if observed, while monitoring reproductive success.

Changed Circumstance

One or more of the covered species may be affected by a disease outbreak during the 50-year permit term; therefore, this is considered a changed circumstance. Based on the minor impact disease has had on the long-term population trends of the covered seabirds, covered waterbirds, and green sea turtles (honu), it is foreseeable that disease outbreaks over the next 50 years are expected to be relatively rare and/or inconsequential to the long-term population viability of covered species.

Remedial Measures

In the event of a foreseeable disease outbreak among the covered seabirds or waterbirds, KIUC would cooperate with DOFAW and USFWS and commit to finding a solution within the HCP budget described in this chapter. For example, vaccines could be deployed by the SOS Program consistent with the HCP's estimated budget. The SOS Program will be the likely first line of detection and vaccination for the covered seabirds and covered waterbirds.

There are no remedial measures included in this HCP for disease outbreak for green sea turtle (honu), as fibropapillomatosis is not well understood and there is currently no reasonable remedy (National Oceanic and Atmospheric Administration and U.S. Fish and Wildlife Service 1998; National Oceanic and Atmospheric Administration 2021b). If a remedy for fibropapillomatosis becomes available and the disease outbreak among green sea turtles (honu) directly interferes with the success of biological goal and objectives set forth in this HCP for green sea turtle (honu), KIUC would cooperate with DOFAW and USFWS and commit to finding a solution within the HCP budget described in this chapter.

7.3.3.4 Vandalism

Vandalism is any action involving deliberate destruction of or damage to public or private property. Vandalism can reasonably be anticipated to affect infrastructure associated with Conservation Measure 4 (see Chapter 4, Section 4.4.4, *Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites*) and Conservation Measure 5 (see Chapter 4, Section 4.4.5, *Conservation Measure 5. Implement a Green Sea Turtle Nest Detection and Temporary Shielding Program*).

Risk Assessment

Over the course of the 50-year permit term, the predator exclusion fence, predator control equipment, social attraction equipment, and wildlife monitoring equipment may be subject to vandalism. It is also possible that the light-proof shields and associated signage for green sea turtle (honu) may be vandalized.

Based on long-term, ongoing predator control and seabird monitoring efforts at the conservation sites associated with this HCP, vandalism is expected to be minimal and infrequent. Over an 8-year period (2012–2020), only one instance of vandalism was reported. In that one instance in 2012, the total cost of damages was estimated to be $1,000[6] (Raine and McFarland 2013; Zito 2013). Details in Zito (2013) indicate that this vandalism was rapidly detected by field crews, with less than 1 week elapsing between vandalism and detection. Importantly, this vandalism occurred at Pihea, which is the easiest conservation site for tourists and locals to access, as this site is in close proximity to the popular Pihea Overlook along the Pihea Trail at Kōke‘e State Park.

Vandalism of the light-proof fences for green sea turtle (honu) may occur regularly because it has historically occurred on both Kaua‘i and O‘ahu (Jenkins pers. comm.). Vandalism could occur either through individuals dismantling the fences or vehicles driving on the beach running over the structures and the turtle nesting site.

Preventive Measures

Vandalism at active conservation sites has been very rare and has only been reported once since 2012. Further control of vandalism at the conservation sites is difficult because these sites are generally on state lands and/or are in very remote areas where access by field crews is limited to certain times of year. However, certain actions have been implemented following this vandalism event in 2012 that may have hindered subsequent vandalism events, specifically: (1) following the initial occurrence of vandalism at Pihea, ungulate fencing was installed that clearly indicates the end of Pihea Trail and that public access was prohibited; (2) seabird surveillance equipment and mounting gear were camouflaged to minimize visibility to potential vandals; and (3) as cellphone-enabled video and audio surveillance devices have become more affordable, common, and discreet through time, this may deter vandalism due to the potential of being caught on surveillance. Beyond these actions, the primary measure to control impacts from vandalism is to proactively assess the likelihood of occurrence and the expected impacts over the permit term. That way, remedial measures have already been identified and can be swiftly implemented.

With regard to green sea turtle (honu), there are no actions that can prevent vandalism of the light-proof fences. Monitors will be present at the nest site more frequently closer to the estimated time of nest hatching, which helps to reduce vandalism.

[6] The following items were either stolen or damaged beyond repair: one game camera, four cat traps, two water containers, and two tarps.

Changed Circumstance

Based on long-term, ongoing predator control and seabird monitoring efforts at conservation sites associated with this HCP, vandalism is expected to be infrequent and minimal. Only one vandalism event was reported between 2012 and 2020, and the damages were estimated at $1,000. As described earlier, vandalism has been restricted to the most accessible conservation site, Pihea, and occurred before ungulate fencing was installed, which serves to delineate a clear boundary between Kōke‘e State Park and Hono O Nā Pali Natural Area Reserve. One other conservation site, North Bog, is also in proximity to the popular Alaka‘i Swamp Trail in Kōke‘e State Park and may be similarly vulnerable to vandalism. For these relatively accessible sites, based on historical rates of vandalism, it is foreseeable to anticipate a maximum of one event of vandalism every 10 years costing approximately $1,000 per event. When vandalism does occur, it is expected to be limited and localized in scope, resulting in relatively minimal damage. Thus, over the HCP permit term, three events of vandalism or any number of events that do not exceed $3,000 is considered foreseeable.

The remainder of conservation sites are in very remote areas of the island that require helicopter access for all but the most intrepid explorers; acts of vandalism have not been documented here to date and are not expected to occur in the future.

However, due to the very accessible and public nature of the location of the green sea turtle (honu) nests and the light-proof fences, it is reasonable to expect that vandalism will regularly occur. Any instance of vandalism of light-proof fences will be considered a changed circumstance and therefore require replacement.

Remedial Measures

In the event of vandalism at conservation sites, KIUC needs the ability to respond quickly and effectively (especially in cases where predator exclusion or ungulate exclusion fencing is damaged). KIUC will assess the situation to determine the appropriate remedial measure and implement then repair as quickly as possible.

Given the low frequency of expected vandalism at the conservation sites (as described under *Risk Assessment* above), it is expected that regular predator fence monitoring already included in HCP (Chapter 6, *Monitoring and Adaptive Management Program*) will facilitate timely detection and repair of breaches in the fence lines. Predator control and seabird surveillance equipment would also be checked frequently enough to facilitate timely detection of vandalism. In the case of equipment damage or theft, full replacement will occur.

Similarly, it is expected that daily and sometimes twice daily monitoring of the green sea turtle (honu) nests prior to hatching will help reduce vandalism of the light-proof fences. However, as described above, when monitors are not present, vandalism incidents may occur. KIUC will fund the repair of all instances of vandalism of light-proof fences to stay within requested take limits for this species and full the conservation objective.

In the event of serious or repeated vandalism, law enforcement may need to be engaged to address these events. In the case of the light-proof fences on beaches, if repeated vandalism occurs, KIUC will confer with DOFAW, DAR, and USFWS to design and implement a solution.

7.3.3.5 Population Declines due to Issues at Sea

Risk Assessment

Globally, seabird populations have been in decline due to multiple threats throughout their range including the covered seabird species. Numerous researchers have identified threats originating at sea that include climate change (especially effects on the distribution of prey species and temperature-mediated changes in ocean chemistry that cause the waters to become more acidic), commercial fisheries (through competition for prey), and ocean pollution (oil spills) (see Croxall et al. 2012 and Díaz et al. 2019). Sea surface temperatures and ocean pH, an indicator of acidity, are now beyond levels seen in the instrument record (Kenner et al. 2018).

For this HCP, KIUC's seabird conservation measures are focused on improving the extent, breeding suitability, and numbers of terrestrial nesting areas. At every conservation site there will be a substantial reduction in land-based predation hazards that affect all seabird individuals, including those transiting between land-based nesting habitats and at-sea foraging grounds. Given the multitude of potential threats to the covered seabirds at sea, in addition to threats being explicitly addressed on land by KIUC, there is a real risk that the efficacy of the proposed conservation strategy could be undermined by ongoing and emerging circumstances that threaten the wellbeing of covered seabirds while they are at sea.

Preventive Measures

While KIUC is actively implementing actions that address terrestrial threats to covered seabirds (e.g., predation, powerline collisions, light attraction), implementing actions that prevent or minimize effects of climate change, commercial fisheries, or ocean pollution is beyond the control of KIUC or this HCP.

Changed Circumstance

Based on current observations and future predictions about changes to the marine system, as summarized above, it is foreseeable that threats to the covered seabirds at sea over the 50-year permit term will increase in extent and severity. However, there is great uncertainty in the timeframe, magnitude, and extent of how covered seabirds will be affected by potential at-sea threats. Thus, setting exact thresholds to define what is expected over the next 50 years (necessary to distinguish between changes that can be reasonably anticipated from changes that are unforeseeable), is not possible at this time.

Instead, the trigger for this changed circumstance will be based on reproductive success across all conservation sites combined dropping below a 5-year rolling average of 87.2 percent for Newell's shearwater (ʻaʻo) or 78.7 percent reproductive success for Hawaiian petrel (ʻuaʻu) and that may be due to declines in at-sea conditions. The word "may" is used deliberately because available data is unlikely to be available to identify a specific cause at sea. However, if causes on land for the decline can be eliminated (e.g., predation, disease, or other factors), then undetermined at-sea causes are a likely culprit. KIUC will coordinate with other HCPs on Kauaʻi such as the Kauaʻi Seabird HCP and other conservation projects for the same species[7] to consult with species experts, USFWS, and

[7] Other Kauaʻi HCPs have or are likely to have similar provisions for a changed circumstance from changes in at-sea conditions. Furthermore, any conservation projects on Kauaʻi are likely to be affected by adverse changes in at-sea conditions. Therefore, a coordinated determination and response is likely warranted.

DOFAW to determine if the reduction in reproductive success is likely due to declines in at-sea conditions.

Remedial Measures

While KIUC has no control over events at sea, impacts on seabirds may change the ability of KIUC to offset take, provide a net benefit, and meet HCP biological objectives. KIUC will track the latest research regarding ongoing and new impacts occurring at sea that could potentially cause covered seabird populations to decline. Issues particularly of concern, as summarized above, are population declines resulting from the detrimental effects of marine heat waves and ocean acidification on covered seabirds. However, other issues may arise at sea that could cause declines in covered seabird populations from causes not currently identified.

If the changed circumstance has been determined to occur and more severe at-sea threats are likely to preclude achievement of the biological goals and objectives at the conservation sites for any of the covered seabirds, KIUC will notify USFWS and DOFAW and meet and confer to discuss the addition of one new conservation site that prioritizes the protection of occupied Newell's shearwater ('a'o) burrows, if it is not possible to obtain landowner approval for a location that contains both occupied Newell's shearwater ('a'o) and Hawaiian petrel ('ua'u), if possible. This new conservation site will be managed using predator control but will not include a predator exclusion fence nor a social attraction site. No other remedial actions will be taken beyond the requirement to add one additional conservation site.

7.4 Costs of KIUC HCP Implementation

The cost to implement the KIUC HCP is shown in Table 7-3. Estimating the full costs of the KIUC HCP was an essential step to demonstrate adequate funding to meet regulatory standards. To provide enough funding, all costs associated with the HCP had to be identified. Costs for the KIUC HCP are divided into the following cost categories and summarized in this section.

- Plan Administration
- Powerline Collisions Minimization
- Save our Shearwaters Program
- Manage and Enhance Conservation Sites
- Green Sea Turtle (Honu) Nest Detection and Temporary Shielding Program
- Infrastructure Monitoring and Minimization Program (IMMP; formerly called the Underline Monitoring Program)
- Seabird Colony Monitoring
- Adaptive Management
- Changed Circumstances
- Contingency

These costs are identified for planning purposes only to estimate funding levels needed to implement the KIUC HCP. KIUC will fund the full implementation of the HCP. KIUC is a not-for-profit electric utility governed by a nine-member board and regulated by the Hawai'i Public Utilities Commission (PUC). The KIUC Board will be responsible for reviewing and approving the HCP and the associated funding required to fully implement the HCP each year. Costs associated with the HCP are considered operational costs because they are necessary to KIUC continuing to provide electrical services to Kaua'i. Therefore, the cost of the HCP is considered part of KIUC's overall operating costs paid for by member electric rates. The KIUC Board also reviews and approves Annual Work Plans and associated annual budgets, as part of their annual operational workplan and budget review process.

Table 7-3. Summary of Cost to Implement KIUC HCP

Cost categories	Early HCP implementation cost (2020–2022)	2023	2024	Avg. annual HCP cost (2025–2073)	50-year total HCP cost (2023–2073)	Percentage of 50-year total HCP cost
Plan Administration	N/A	$452,500	$412,500	$412,500	$20,665,000	7.8%
Powerline Collisions Minimization	$19,757,870	$3,885,544	$363,141	$390,791	$23,006,640	8.7%
Save Our Shearwaters Program	$744,344	$300,000	$300,000	$300,000	$15,000,000	5.7%
Manage and Enhance Conservation Sites	$9,015,764	$3,576,627	$3,196,868	$1,538,202	$80,607,204	30.4%
Green Sea Turtle Nest Detection and Temporary Shielding Program	N/A	$158,900	$96,400	$103,119	$5,205,000	2.0%
Infrastructure Monitoring and Minimization Program	$2,746,125	$539,911	$539,911	$539,911	$26,995,544	10.2%
Seabird Colony Monitoring Program	$2,347,023	$952,993	$952,993	$952,993	$47,649,648	18.0%
State Compliance Monitoring	N/A	$50,000	$50,000	$50,000	$2,500,000	0.9%
Changed Circumstances	N/A	$572,934	$572,934	$572,934	$28,646,679	10.8%
Adaptive Management		$394,862	$294,183	$253,744	$12,868,745	4.9%
Contingency	N/A	$145,813	$145,813	$30,378	$1,749,762	0.6%
Total	**$34,611,125**	**$11,030,084**	**$6,924,744**	**$5,144,571**	**$264,894,222**	**100.0%**

7.4.1 Cost Estimate Methodology

To estimate HCP costs, KIUC developed a cost model to identify specific costs in each major cost categories listed above. All potential costs were identified that are expected to be needed to fulfill the requirements of the HCP. The cost model (Appendix 7A, *KIUC HCP Cost Model*) was designed to demonstrate that all HCP-related costs are accounted for and reasonably estimated. The goal of the cost model was to conservatively estimate expenses of KIUC over the permit term so that overall costs are accounted for and understood. During plan implementation, KIUC will update the cost model as needed and as cost assumptions are refined based on actual experience to assist with long-term HCP budget planning.

Model assumptions are summarized in the following sections by cost category. It is assumed that all cost components will increase over time due to inflation. To simplify the presentation, all costs are expressed in current 2021 dollars, allowing comparisons between costs today and costs later in the permit term. KIUC will pay all costs associated with HCP implementation, including inflation, even if those costs are above the costs estimated in Appendix 7A, *KIUC HCP Cost Model*. Average annual costs are based on plan implementation from 2025 to 2073, given that the first 2 years of plan implementation (2023 and 2024) are outlier years associated with the higher on-time costs for installation of powerline minimization and predator exclusion fencing.

Most of the costs in the cost model were based on actual costs to conduct the same or similar action, given that KIUC has been implementing or funding all of the programs in Table 7-3 except for the green sea turtle (honu) nest detection and temporary shielding program. In the case of the management and monitoring of covered seabirds, cost estimates were based on actual costs to date and scaled to new conservation sites. Costs for actions that were not implemented by KIUC during the Short-Term HCP or early implementation of the KIUC HCP (e.g., green sea turtle [honu]) were based on estimates from technical experts and costs incurred by other agencies. Costs for plan administration were estimated by KIUC based on the current costs.

Details of each cost category and the key assumptions that were used to develop the HCP cost estimate are described below. See the cost model in Appendix 7A, *KIUC HCP Cost Model*, for an accounting of all assumptions.

7.4.2 Plan Administration

Plan administration costs are the costs to support staffing, legal defense, and database administration needed by KIUC to carry out the HCP requirements. Plan administration costs are estimated to be $412,500 annually, for a total of $20.6 million over the 50-year permit term (Table 7-4). Costs for plan administration are assumed to be stable throughout the permit term except in the first year. Costs are slightly higher in 2023 ($452,500) due to the need to prepare the first annual report. Once the first annual report is prepared, annual reporting costs are expected to be lower.

Table 7-4. Plan Administration Costs

Program Element	Estimated Annual Costs
Plan management staff	$385,000
Legal support	$25,000
Software license fees	$2,500
Total	**412,500**
*Annual report template**	*$40,000*

The cost to establish the annual report template and author the first annual report in Year 1 of HCP implementation is based on the work being contracted to consultants and expected to cost $40,000 dollars. After the first annual report is completed and the template and content are established, the cost estimate assumes that KIUC will prepare the annual report between Years 2 to 50 of the permit term. As such, costs for preparation of the annual report after Year 1 are subsumed under Plan Management Staff.

Staffing constitutes most of the plan administration cost (Table 7-4). Costs for staffing assumes that the KIUC HCP will be implemented by a team of up to three professionals—Program Manager, Data Analyst/GIS Specialist, and Accountant/Budget Analyst (although one person may do two these tasks or all three). It is assumed that the Program Manager will function both as an organizational leader and as a public presence of the implementation effort. For the purposes of the cost estimate, data management and analysis, including GIS work, were based on the work being contracted to consultants.

KIUC may require legal assistance during implementation. For example, legal resources may be needed to draft and review HCP documents or assist with landowner disputes if they occur. Legal costs are based on the billing rate for legal contractors and the estimated time on an annual basis.

7.4.3 Powerline Collisions Minimization

Conservation Measure 1 in Chapter 4, Section 4.4.1, *Conservation Measure 1. Implement Powerline Collision Minimization Projects*, requires KIUC to reduce covered seabird and covered waterbird collisions throughout its powerline system.

In 2020, KIUC began implementing its powerline collision minimization projects. The cost model identifies costs for early implementation of powerline minimization projects to "Plan Year 0" to recognize investments made to reduce take prior to ITP and State ITL issuance. Costs of both completed and planned minimization projects are estimated by applying the average costs per span reported by KIUC to the number of spans for which future minimization projects are anticipated. Between 2020 and 2022, the cost to implement KIUC's powerline minimization projects during early implementation of the HCP exceeded $19 million.

Costs that will be incurred during the 50-year permit term related to implementation of Conservation Measure 1 total $23 million, and an annual average of $363,141 per year. This cost is lower than the early implementation cost given that the cost estimate assumes that only one additional year (2023) is necessary to implement the remaining powerline collision minimization projects. Costs after 2023 are limited to installation of new reflective diverters on new or extended powerlines[8] and replacement of LED and reflective diverters on existing and new powerlines.[9] KIUC assumed a constant rate of diverter installation given that the schedule and location for installation of KIUC's new and extended powerlines is currently unknown. Therefore, the cost estimate assumes an average installation rate of diverters of seven spans per year.

7.4.4 Save our Shearwaters Program

Conservation Measure 3 in Chapter 4, Section 4.4.3, *Conservation Measure 3. Provide Funding for the Save Our Shearwaters Program*, requires KIUC to provide funding to the SOS Program. KIUC has been funding the SOS Program since 2003 and will continue to fund the program with a contribution of $300,000 per year over the 50-year permit term. As shown in Table 7-5, this amount is, on average, approximately $50,000 above KIUC's annual funding contribution over the last 10 years. This amount has proven adequate to operate a functional SOS Program over that time. As such, $300,000 is an appropriate level of funding over the 50-year permit term.

KIUC's funding will address the rehabilitation of the covered seabird and waterbird species, as well as ensure the SOS Program remains functional (e.g., enough funding to cover staff time and materials) over the life of the permit term. This funding amount will increase on an annual basis during the permit term in accordance with an accepted inflation rate index (such as the Consumer Price Index) for the nearest urban area to ensure a consistent funding stream.

7.4.5 Manage and Enhance Conservation Sites

Conservation Measure 4 in Chapter 4, Section 4.4.4, *Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites*, requires KIUC to manage and enhance covered seabird breeding habitat in all the conservation sites. The costs estimate includes costs related to the following.

- Contractor staff time and training.
- Helicopter leasing and other transportation cost.
- Fencing installation, maintenance, and repair.
- Predator eradication equipment, materials, and contractor time.
- Predator control equipment (e.g., traps), installation, maintenance, and repair.
- Invasive plant species control equipment, maintenance, and repair.
- Social attraction equipment purchase, installation, and maintenance, and repair.

KIUC has been funding habitat management at five of these conservation sites for many years prior to the permit term during implementation of the Short-Term HCP and began managing three additional sites during the HCP's early implementation period (2020–2022). The cost model recognizes early implementation between 2020 and 2022 of conservation site management in the

[8] Reflective diverters are used more widely across KIUC's powerline system (given that LEDs cannot be placed near roads) and are assumed to be representative of the cost that will be incurred by KIUC throughout the permit term to reduce unminimized strikes resulting from new powerlines, even if a small amount of LED diverters are utilized.

[9] Horizontal configuration is not included in the cost estimate because that minimization technique will be part of the project design for new line and rolled up as part of the construction cost, which is not a covered activity under this HCP.

same way as powerline collision minimization (Section 7.4.3, *Powerline Collisions Minimization*), by identifying investments made prior to permit issuance to Plan Year 0. The cost for early implementation of Conservation Measure 4 between 2020 and 2022 was approximately $9 million.

The actual and projected costs from KIUC's contractors during early implementation were used to estimate the cost to manage the conservation sites during the permit term. The total estimated cost to manage and enhance 10 conservation sites throughout the permit term is approximately $80.6 million, and an average annual cost of approximately $1.5 million per year. This is by far the most expensive cost category in the HCP, accounting for a little over 30 percent of all costs. Costs for conservation sites where KIUC has not conducted extensive pre-implementation management were estimated by applying the average actual per-acre management costs and other fixed costs at the other conservation sites to the additional conservation sites (e.g., Honopū) that would be managed during Plan implementation. In addition, costs for Conservation Site 10 were based on the cost of management at Upper Mānoa Valley, assuming that these past costs are a conservative estimate for Conservation Site 10 (Conservation Site 10 must meet or exceed the benefits to the covered species that were expected at Upper Mānoa Valley).

Costs for this conservation measure are greater during the first few years of the HCP implementation at the Upper Limahuli Preserve and Conservation Site 10 conservation sites as predator exclusion fences are built, and predator eradication and social attraction are established. Once these structures and systems are in place, annual costs would be greatly reduced.

7.4.6 Green Sea Turtle (Honu) Nest Detection and Temporary Shielding Program

Conservation Measure 5 in Chapter 4, Section 4.4.5, *Conservation Measure 5. Implement a Green Sea Turtle Nest Detection and Temporary Shielding Program*, requires KIUC to monitor and minimize artificial light disorientation from KIUC streetlights on green sea turtle (honu). As such, KIUC will fund monitoring and light minimization for green sea turtle (honu) to reduce hatchling light disorientation on Kauaʻi's beaches that provide suitable habitat for green sea turtle (honu) and that may be affected by KIUC streetlights. The program is estimated to cost $5.2 million throughout the entire 50-year permit term, and has an average annual cost of $103,119. The cost estimate related to minimizing light effects on green sea turtle (honu) include the following time and materials.

- Project coordinator staff time (12 months per year).
- Data analysis staff time (3 months in Year 1, 2 months in Year 2).
- Additional support staff time (5 months per year).
- Cost to purchase data collection materials (e.g., iPad, software).
- Cost to purchase and maintain fleet vehicle and fuel.
- Cost to purchase light minimization materials (e.g., shade cloth).

The cost to implement the conservation measure is expected to change over time. These costs may increase if green sea turtle (honu) nesting in the Plan Area expands over time or as vegetation or structures are removed, exposing additional beaches to light effects. Conversely, the costs may go down if beach habitat in the Plan Area is lost due to sea level rise, if the green sea turtle (honu) population decreases, or vegetation or structures are installed that screen additional beaches from light effects. Regardless, these changes should not affect the cost estimate in a significant way, given that the monitoring program already assumes that all beaches on Kauaʻi will be monitored for green sea turtle (honu) nesting on an annual basis. Should green sea turtle (honu) nesting increase on new beaches (outside of the beaches identified on Figures 4-10a through 4-10g in Chapter 4, *Conservation Strategy*) where additional minimization and monitoring would be required, this cost would be covered under KIUC's letter of credit (see Section 7.4.11, *Changed Circumstances and Contingency*).

There is no cost assumed for permanent streetlight minimization for green sea turtle (honu) described in Chapter 4, Section 4.4.6, *Conservation Measure 6. Identify and Implement Practicable Streetlight Minimization Techniques for Green Sea Turtle*. Permanent minimization would replace the temporary shielding. Temporarily shielding costs are assumed to be much higher than the costs to install permanent light shields on streetlights (based on the annual costs for future streetlight shielding), so the temporary shielding costs are assumed to cover the permanent shielding costs in any year in which permanent shielding is implemented.

7.4.7 Infrastructure Monitoring and Minimization Program

The IMMP[10] estimates mortality of the covered seabirds and waterbirds resulting from powerline collisions. This monitoring program is used to determine the efficacy of the KIUC's powerline minimization projects (Section 7.4.3, *Powerline Collisions Minimization*) and to model take (extrapolating the amount based on monitoring certain spans) that occurs during the permit term. Costs associated with the IMMP include the following:

- Staff wages and per diem.
- Overhead cost and Hawaiʻi excise tax.
- Equipment and supplies including song meters, trail cameras, and field gear.
- Transportation via helicopter and vehicles.

The IMMP costs also includes additional costs for specific monitoring equipment such as near infrared lights, generators, light shields, weather station, helicopter sling gear, and other miscellaneous supplies.

During the early implementation period for the KIUC HCP (2020–2022), the IMMP cost $2.7 million dollars over the 3-year period. The total cost of the IMMP over the 50-year permit term is estimated at approximately $27 million, with an average annual cost of $539,911. As stated in Chapter 6, Section 6.4.1.2, *Take Monitoring*, the HCP assumes that KIUC will monitor a subset of its high-risk lines during the permit term to inform trends across the island-wide powerline system. This assumption is reflected in the lower annual cost in comparison to the amount that was spent during the early implementation period. This lower cost is also justified because KIUC completed most of its powerline collision minimization projects during the early implementation period.

7.4.8 Seabird Colony Monitoring

Like conservation site management, covered seabird monitoring has been ongoing for many years, both during and following the Short-Term HCP and within many of the conservation sites proposed for this HCP. As such, costs are based on projected monitoring costs for monitoring activities that

[10] Formerly known as the Underline Monitoring Program (UMP) under KIUC's Short-Term HCP.

will be conducted in 2022. The cost estimate assumes that contractors will continue to develop and lead the monitoring program throughout the permit term.

The seabird colony monitoring program is estimated to be $47.6 million over the permit term and $952,993 annually, on average. Conservation site monitoring will document status and trends of the covered seabird species to allow adjustments to the conservation strategy and to ensure the biological goals and objectives of the HCP are met. Monitoring is described fully in Chapter 6, *Monitoring and Adaptive Management Program*. Costs associated with covered seabird monitoring include similar items as described above for the IMMP (Section 7.4.7, *Infrastructure Monitoring and Minimization Program*).

7.4.9 Adaptive Management

Adaptive management includes large-scale changes to the conservation measures that go beyond day-to-day minor adjustment that are needed to achieve a biological objective in the event the conservation strategy is not working as intended (Chapter 6, Section 6.2.2, *Adaptative Management*). These changes will be informed by monitoring described in Chapter 6, *Monitoring and Adaptive Management Program*. Adaptive management includes a specific list of actions identified in Chapter 6, Section 6.2.2.2, *Adaptive Management Decisions*.

The adaptive management decision-making process will be a collaborative process between KIUC, USFWS, and DOFAW (see Chapter 6, Section 6.2.2.3, *Adaptative Management Decision-Making Process for this HCP*). Labor costs associated with the adaptive management process are assumed to be part of costs associated with staff time and consultant costs devoted to HCP implementation. It is also assumed that some of KIUC's adaptive management actions will be cost neutral. That is, the cost of the action that is being replaced or altered may be similar to the cost of the new or improved action (e.g., a cost savings realized by a reduction or cessation of ineffective conservation measures). Some adaptive management changes, however, are likely to result in additional costs. Additional costs associated with adaptive management changes (e.g., adding, removing or changing the alignment of predator exclusion fencing) are estimated to cost $12.8 million over the permit term, or an average annual cost of $247,084.

7.4.10 State Compliance Monitoring

As identified in HRS Chapter 195D, Section G.3 "The applicant shall post a bond, provide an irrevocable letter of credit, insurance, or surety bond, or provide other similar financial tools, including depositing a sum of money in the endangered species trust fund created by section 195D-31, or provide other means approved by the board, adequate to ensure monitoring of the species by the State." KIUC will set aside $50,000 annually to fund state monitoring to comply with this requirement. This amount is assumed to be sufficient for state compliance monitoring of KIUC's implementation of the HCP considering that accessibility to most of KIUC's electrical infrastructure is along roadways or at facilities. Because the conservation sites are typically very difficult to access, state monitoring will not likely occur on an annual basis. This funding will also cover coordination meetings by state staff and review of documents by state staff such as the Annual Report and Annual Work Plan.

7.4.11 Other Costs

7.4.11.1 Changed Circumstance

Remedial measure costs are estimated to address responses to the changed circumstances described above in Section 7.3.3, *Changed Circumstances Addressed by this HCP*. The cost estimate for remedial measures is approximately 10 percent of the total 50-year cost to implement this HCP. This amounts to a total of approximately $28.6 million, with an annual amount of $572,934. The cost estimate for changed circumstances assumes the following.

- Due to damage from severe weather (e.g., hurricane, landslide), KIUC may need to do the following.
  - Replace two predator exclusion fences during the permit term.
  - Replace reflective and LED diverters (assuming that over the course of the permit term all diverters will need to be replaced once due to severe weather in different parts of the Plan Area)
  - Address issues with conservation sites such as temporary destruction of a conservation site or escape of domesticated animals.
  - Replace green sea turtle (honu) permanent light shields or temporary light fencing and/or increased monitoring to determine nest outcomes and document habitat loss and alteration.
- Due to new invasive species, KIUC may need to purchase additional predator control equipment to increase trapping efforts.
- Due to vandalism, KIUC may need to replace up to $3,000 worth of damaged predator control equipment (e.g., cameras, fences).
- Due to vandalism, KIUC may need to replace or repair up to two green sea turtle (honu) temporary light-proof shields per year.

7.4.11.2 Contingency

To account for uncertainties in costs, the cost model includes a contingency cost category that amounts to $31.7 million dollars over the 50-year permit term. The contingency is calculated as 3 percent of the total HCP costs for years 2023 through 2042, and then 2 percent thereafter, assuming that cost uncertainty will decrease over time as plan implementation improves and cost estimating becomes more accurate. Contingency costs are expected to be low enough that they can be funded through KIUC's annual operational budget approval process. The contingency costs will be applied to any program costs that are higher than predicted by this HCP in other categories. Contingency funds may be needed, for example, for the following.

- Buy new or repair existing equipment before replacement or repair costs have been budgeted.
- Acquire materials not forecast in the budgets.
- Add temporary staff to address new issues.
- Implement additional or more expensive minimization projects.
- Apply more expensive management techniques.
- Conduct additional monitoring.

- Address unforeseen administrative costs.

7.5 Funding Assurances

KIUC has the financial capacity and commits to fully fund all costs of the KIUC HCP described above. As shown in Tables 7-3 and Table 7-5 below, KIUC has spent an average of $11 million per year over the last 3 years (2020–2022) on early implementation projects and ongoing tasks (Table 7-3). This amount greatly exceeds the average estimated total cost of HCP implementation of $5.1 million annually throughout the permit term (Table 7-3); however, the first 2 years of HCP implementation are estimated to cost $11.0 million and $6.9 million due to KIUC's remaining powerline collision minimization projects (2023) and predator exclusion fence construction (2023 and 2024) (see Chapter 4, *Conservation Strategy*, for details). As stated above in Section 7.4, *Costs of KIUC HCP Implementation*, the KIUC Board reviews and approves HCP funding on an annual basis that is required to implement the HCP in that year, regardless of whether it exceeds the estimated annual average for the permit term. The HCP identifies as annual average cost that excludes 2023 and 2024 since these are outlier cost years.

To ensure funding for adaptive management and for remedial measures should they be needed to address changed circumstances, KIUC will secure a letter of credit in an amount sufficient to fund a reasonable proportion of expected adaptive management or remedial actions in any one year, as described below. A letter of credit is a document that a financial institution issues on behalf of a client to guarantees payment up to a specified amount during a specified period of time. If funds are paid pursuant to the letter of credit, KIUC would owe that amount to the financial institution according to the terms of a loan agreement established to secure the letter of credit. Typically, letters of credit need to be renewed at regular intervals, sometimes as often as annually. The form of the letter of credit will be reviewed and approved by USFWS and DOFAW prior to the issuance of the ITP and State ITL.

To ensure that this letter of credit remains in place for the duration of the permit term, the letter of credit will have a term providing if a replacement letter of credit is not in place before the expiration period of the existing letter of credit, then the letter of credit becomes immediately payable. This means that KIUC's letter of credit cannot be terminated during the permit term without the approval of USFWS and DOFAW. If it becomes apparent the KIUC's letter of credit will not be renewed during the permit term, KIUC will provide another bank for review and approval by USFWS and DOFAW at a minimum of 3 months prior to the expiration of the previous letter of credit.

The letter of credit will fund annually and continually over the term of the HCP $253,744 for adaptive management plus $572,934 for remedial measures for changed circumstances should they occur (Table 7-2), for a total secured funding level of $603,312. KIUC's Annual Work Plan and annual budget process described in Section 7.2.1, *Responsibilities of Kaua'i Island Utility Cooperative*, will include the letter of credit to account for these costs. Any unused funds in the letter of credit for adaptive management and change circumstances remedial actions will be returned after the 50-year permit term is complete. KIUC may request from USFWS and DOFAW an adjustment in the value of the letter of credit at future renewal periods if HCP; however, any changes in funding amounts must be approved by USFWS and DOFAW.

Costs for implementation of the KIUC HCP are part of KIUC's operational costs, which are passed on to ratepayers. KIUC's costs for implementation of the KIUC HCP are anticipated to be fully covered by its revenues received, electricity rates charged, and debt financing. Collection of these funds is anticipated to be authorized by the Hawai'i PUC for costs associated with the ongoing operation, maintenance, and construction of utility facilities. KIUC will take the appropriate steps to obtain any approvals necessary to obtain sufficient funds for the HCP, including lender approval, regulatory approval, or PUC approval.

KIUC does not anticipate that the PUC will deny any future request for a rate increase because (1) KIUC will already have received approval from the PUC in an adequate amount to provide for expected HCP costs (expected in 2023), and (2) the HCP and its permits will continue to be an obligatory operational cost necessary for KIUC to provide reliable service to its customers. KIUC has applied to the Hawai'i PUC once in 2009 and successfully adjusted their utility rates to pay for the cost of the Short-Term HCP. KIUC intends to apply to the Hawai'i PUC for a utility rate increase or to otherwise authorize expenditures necessary to pay for any HCP costs that exceeds current spending capacity.

KIUC has demonstrated its ability to fund HCP implementation since 2011. Table 7-5 documents what KIUC has spent to date on HCP implementation. From 2011 to 2016 KIUC successfully implemented and completed the Short-Term HCP. Since 2016, KIUC has continued to implement many of the same conservation measures in the Short-Term HCP that are now part of this HCP. In addition, KIUC has implemented many powerline minimization projects during both the Short-Term HCP and afterwards, as early implementation actions for this HCP.

Table 7-5. KIUC Spending on Implementation of Measures Similar to those in this HCP (in 2021 dollars, adjusted for inflation[11])

Year	Powerline Minimization	Streetlight Retrofit	Conservation Site Management and Monitoring	Powerline Collision Monitoring	SOS Program	Total
2011[a]	$5,508,552	$0.00	$1,061,303	$264,569	$316,957	$7,151,381
2012[a]	$281,538	$0.00	$592,019	$278,892	$311,144	$1,463,591
2013[a]	$1,110,983	$0.00	$388,998	$115,220	$308,347	$1,923,550
2014[a]	$1,935,685	$0.00	$710,079	$268,715	$295,204	$3,209,682
2015[a]	$1,254,211	$0.00	$826,635	$263,420	$334,084	$2,678,350
2016[b]	$253,353	$0.00	$2,024,525	$1,365,652	$281,064	$3,924,595
2017[c]	$237,863	$0.00	$1,599,058	$662,862	$291,302	$5,370,350
2018[d]	$455,170	$0.00	$1,774,426	$712,823	$294,493	$3,236,912
2019[d]	$75,574	$0.00	$1,290,704	$673,781	$256,259	$2,296,317
2020	$5,448,795	$0.00	$1,516,682	$595,145	$245,028	$7,805,650
2021	$6,307,575	$0.00	$2,418,771	$1,052,501	$300,000	$10,078,847
2022	$8,001,500	$0.00	$7,370,009	$2,075,985	$300,000	$17,747,494
Total[le]	$30,870,799	$2,579,265	$21,573,209	$8,329,564	$3,533,883	$66,886,719

[a] Short-Term Habitat Conservation Plan Kaua'i Island Utility Cooperative 2015 Annual Report
[b] Short-Term Habitat Conservation Plan Kaua'i Island Utility Cooperative 2016 Annual Report
[c] Short-Term Habitat Conservation Plan Kaua'i Island Utility Cooperative 2017 Annual Report
[d] Short-Term Habitat Conservation Plan Kaua'i Island Utility Cooperative 2018 Annual Report
[e] KIUC funding of the SOS Program dates to 2003. Only funding since 2011 is shown.

[11] U.S. Bureau of Labor Statistics 2021

7.5.1 Funding Adequacy

KIUC has been in existence as a successful electric cooperative since November 2002. In 2020, KIUC received $145.1 million in revenue with expenses that totaled $137.7 million, generating a net margin of $7.4 million (Kaua'i Island Utility Cooperative 2021). Of this total, KIUC spent $20.4 million in 2020 on administrative costs, including regulatory compliance (of which HCP early implementation is a part). KIUC also spent $7.0 million in 2020 to operate and maintain its electric transmission and distribution system. As a non-profit cooperative owned by its member customers, KIUC has access to low-interest loans or loan guarantees provided by the federal government for capital investments through programs such as the U.S. Department of Agriculture Rural Utilities Service. These figures and KIUC's status as a utility cooperative demonstrates that KIUC has the financial ability to pay the HCP implementation costs described in this chapter. The average annual cost of HCP implementation is approximately $5.6 million (Table 7-3). KIUC has equaled or exceeded that level of annual spending on early HCP implementation actions in five of the last 12 years (2011, 2017, 2020, 2021, and 2022 [estimated]) (Table 7-5).

KIUC is solvent and able to meet its current financial obligations, including the conditions and obligations of the KIUC HCP. KIUC will provide adequate resources to fulfill commitments as described in the KIUC HCP. The HCP Accountant/Budget Analyst will forecast anticipated program needs, ensuring that KIUC is able to pay for all conservation measures, monitoring and adaptive management, and HCP administration. The cost estimate for HCP implementation is designed to be conservative; that is, it likely somewhat overestimates future costs. Reasons for this conservative estimate include the following.

- When cost ranges were available, the higher unit cost was chosen as the assumption for the cost model.
- The population dynamics model on which the conservation sites are based (see Chapter 5, *Effects*, and Appendix 5E, *Population Dynamics Model for Newell's Shearwater ('a'o) on Kaua'i*,), is itself conservative. In other words, the conservation sites may produce more covered seabirds than forecast by the current model, allowing KIUC to reduce its level of effort at each conservation site while still meeting or exceeding the biological goals and objectives, saving costs.
- New technologies may be developed during the 50-year permit term that will allow KIUC to achieve the biological goals and objectives of the Plan, or implement the monitoring program, with greater efficiency and lower cost.
- Cost estimates for management of the conservation sites (the largest share of all costs) are based on current KIUC contractor costs that are applied on fewer and smaller conservation sites than will be operational under this HCP. Future unit costs are likely to be lower as KIUC seeks more competitive bids for HCP services and applies them on more and larger conservation sites, realizing more economies of scale.

However, despite the conservative nature of the cost estimate, costs may still exceed predictions. This section describes the safeguards in place if funding needs are greater than those described in this chapter.

7.6 Revisions and Amendments

There are two types of changes that may be made to the HCP: minor modifications or major amendments, each of which is described in the following subsections. All revisions and amendments will be processed in accordance with all applicable legal requirements.

7.6.1 Minor Modifications

Minor modifications are changes to the HCP provided for under the operating conservation program, including adaptive management changes and responses to changed circumstances (Section 7.3.1, *Changed Circumstances*). They also include revisions that do not increase the levels of authorized incidental take and do not materially modify the scope or nature of activities or actions covered by the ITP and State ITL in terms of their effect on the covered species. Minor modifications may include, but are not limited to, the following.

- Correction of any maps or exhibits to correct errors in mapping or to reflect previously approved changes in the HCP.
- Correction of the HCP or its appendices to for any spelling errors or omissions.
- Modifying existing or establishing new conservation measures to further minimize or avoid take of the covered species.
- Modifying reporting protocols for the annual report.
- Minor changes to monitoring or reporting protocols.
- Revising conservation site enhancement and management techniques.

USFWS and DOFAW will confirm receipt of any modification request and will notify KIUC acknowledging the minor modification or determining if such modification request constitutes an amendment as described below.

7.6.2 Major Amendments

Major amendments are changes in the HCP that may affect the impact analysis or conservation strategy. Amendments to the HCP and either the ITP or State ITL follow the same formal review process as the original HCP and permits, including NEPA/Hawai'i Environmental Protection Act (HEPA)[12] review, *Federal Register* notices, an internal Section 7 consultation with USFWS, and approval by the ESRC and BLNR. A major amendment includes but is not limited to the following.

- Adding a new covered species to the HCP and the incidental take authorizations.
- Changes to the covered activities (either deletion or addition) not addressed in the HCP as originally adopted, and which otherwise do not meet the criteria for a minor modification as discussed in Section 7.6.1, *Minor Modifications*.
- Increasing take authorization for any of the covered species.
- Substantial changes to the conservation strategy beyond what is contemplated in the adaptive management process in Chapter 6, *Monitoring and Adaptive Management Program*.

[12] Hawai'i Revised Statute Chapter 343.

- Extending the terms of the ITP or State ITL other than through a permit or license renewal process described below.

A major amendment requires submittal to USFWS and DOFAW of a written application and implementation of all permit processing procedures applicable to an original ITP and State ITL. The specific documentation required to comply with the federal ESA, HRS Chapter 195D, NEPA, and HEPA will vary based on the nature of the amendment.

7.6.3 Permit Suspension or Revocation

USFWS or DOFAW may suspend or revoke their ITP or State ITL if KIUC fails to implement the HCP in accordance with the terms and conditions of the ITP or State ITL or as otherwise provided by law. Suspension or revocation of the ITP or State ITL shall be done in accordance with applicable federal or state law.

7.6.4 Permit Renewal

7.6.4.1 Renewal of Federal Incidental Take Permit

The ITP associated with this HCP is eligible to be renewed before the 50-year permit term expires if it is stated on the original permit. USFWS regulations (50 CFR Section 13.22) allow a permit to remain in effect while USFWS considers a renewal request, but only if the renewal request is received by USFWS at least 30 days before expiration. The permit renewal request will be processed in accordance with federal law applicable at the time the request is made.

7.6.4.2 Renewal of State Incidental Take License

Upon expiration, and to the extent permitted by law, the State ITL may be renewed without the issuance of a new license, provided that the license is renewable, and that biological circumstances and other pertinent factors affecting the covered species are not significantly different than those described in the original HCP. To renew the license, KIUC must submit to DOFAW, in writing, the following.

- A request to renew the ITL.
- Reference to the original license number.
- Certification that all statements and information provided in the original HCP and license application, together with any approved HCP amendments, are still true and correct, or inclusion of a list of changes.
- A description of what take has occurred under the existing license.
- A description of what activities under the original license the renewal is intended to cover.

If DOFAW concurs with the information provided in the request, they will renew the take authorizations consistent with their respective renewal procedures. If KIUC files a renewal request and the request is on file with DOFAW at least 30 days prior to the expiration of the State ITL, the authorizations will remain valid while the renewal is being processed, provided the existing authorization is renewable. If KIUC fails to file a renewal request at least 30 days prior to license expiration, the license will become invalid upon expiration. KIUC must have complied with all annual reporting requirements to qualify for a license renewal.

7.7 Annual Reporting

KIUC will prepare an annual report for each year of the 50-year permit term of the KIUC HCP. The annual reports will summarize implementation activities in the previous calendar year (January 1 to December 31) as well as cumulatively over the permit term. KIUC will submit each annual report by no later than June 1 following the reporting year in order to comply with the reporting deadline established by the Hawaiʻi ESA.[13]

Immediately following each calendar year, KIUC's contractors will submit to KIUC technical reports that summarize their activities in the previous calendar year. Once all of the technical reports are available (usually in the spring of each year), KIUC will prepare an annual report and submit it to USFWS and DOFAW, typically by July or August of each year, but no later than September 28 as required by the Hawaiʻi ESA.

KIUC's annual reports will include the following information.

- A description of all covered activities implemented during the reporting period categorized by major activity type (per Chapter 2, *Covered Activities*).
- An annual and cumulative summary (i.e., from the start of the permit term) of the amount of take of each covered species (see *Take Monitoring* sections in Chapter 6, *Monitoring and Adaptive Management Program*, for the methods for each covered species).
- An accounting of all minimization actions applied to the covered activities during the reporting period.
- A summary of all conservation actions implemented during the reporting period.
- An annual and cumulative summary of the rescues and releases from the SOS Program (or similar rehabilitation program) of each of the covered seabirds and covered waterbirds.
- A description of the monitoring undertaken for covered seabirds and covered waterbirds during the reporting period and a summary of monitoring results.
- A description of the monitoring undertaken for the green sea turtle (honu) during the reporting period and a summary of the monitoring results, including all the reporting requirements described under Section 4.4.5.5, *Annual Training and Reporting*.
- An assessment of the HCP's achievement to date of each of the biological objectives, including an analysis of the problems and issues encountered in meeting or failing to meet the HCP biological objectives.[14]
- A description of the adaptive management process utilized during the reporting period, including any changes implemented because of that process.

[13] HRS Section 195D-21(f) requires HCP permittees to submit an annual report within 90 days of each fiscal year ending June 30.

[14] As required by HRS Section 195D-21(f).

- A summary of any changes to the monitoring program techniques or protocols including monitoring locations, variables measured, sampling frequency, timing, and duration, and analysis methods, and an explanation for those changes.
- An assessment of the efficacy of the minimization, conservation, and monitoring actions and recommended changes based on interpretation of monitoring results and research findings.
- An assessment of whether any changed circumstances have occurred. If a changed circumstance has occurred, a description of any remedial actions taken or planned.
- A summary of planned actions and management objectives for the next fiscal year, including any proposed modifications to conservation measures (as required by HRS Section 195D-21(f)).
- The status of HCP funding (as required by HRS 195D-21(f)).
- A summary of any administrative changes, minor modifications, or major amendments proposed or approved during the reporting year, as defined in Section 7.6, *Revisions and Amendments*.
- A schedule showing when HCP components will be implemented and when each component is completed.
- A description of data and analyses used to run and update models as conducted for the annual report, cumulative report, or other management summaries and assessments.
- An assessment of new and emerging technology that may be useful to meet HCP objectives.

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Chapter 8
Alternatives to Take

Section 10(a)(2)(A) of the federal Endangered Species Act (ESA) requires applicants to consider alternative actions to the take of covered species and to explain the reasons why those alternatives were not selected. The Endangered Species Habitat Conservation Planning (HCP) Handbook (U.S. Fish and Wildlife Service and National Marine Fisheries Service 2016) identifies several types of alternatives commonly used in HCPs: (1) an alternative that would reduce take below levels anticipated for the proposed project, (2) an alternative that would avoid take and hence not require a federal permit, or (3) an alternative where the proposed project would not occur.

This chapter identifies alternative actions considered by KIUC that would avoid or minimize the potential for take of each covered species in the KIUC HCP. Three alternatives are considered:

1. A "no take" alternative,
2. An undergrounding some transmission lines alternative, and
3. An extensive tree planting alternative.

These alternatives were not selected by KIUC because they were not feasible nor practical, as explained below.

This chapter does not include an alternative to reconfigure, relocate, or modify high-collision powerlines to reduce adult mortality because the KIUC HCP includes these types of minimization measures in the conservation strategy (Chapter 5, *Effects*) to the maximum extent that is economically and technologically feasible (*Chapter 4, Section 4.4.1.2, Powerline Collision Minimization Projects*).

8.1 No Take Alternative

The no take alternative would require KIUC to modify all of its existing and future infrastructure (Chapter 2, *Covered Activities*) to prevent any take of the covered species. As discussed in Chapter 5, *Effects*, certain existing and future KIUC powerlines, streetlights, and facility lights result or are likely to result in take of the covered species. Even with substantial avoidance and minimization measures applied, take would continue to result from collisions with powerlines and fallout due to KIUC-owned and -operated street and facility lighting attraction and disorientation.

The only approaches that KIUC could use to completely eliminate the possibility of take from its infrastructure are to: (1) remove all powerlines on the Island of Kauaʻi that result in take; or (2) move underground all powerlines not completely shielded by topography, vegetation, or other structures; and (3) remove all street and facility lighting that results in take.

These no take alternative approaches are neither feasible nor practicable. KIUC cannot remove all of its powerlines that cause take because it is mandated by state regulations to provide reliable electricity to its customers. Similarly, it is not feasible to eliminate nighttime lighting along state and county roadways and at KIUC production and distribution facilities that operate 24 hours per day, 7 days per week, for reasons of public and worker health and safety.

Undergrounding KIUC lines is not feasible because it is cost prohibitive. The existing KIUC transmission, distribution, and communication system includes roughly 1,000 miles of overhead electrical cables. Given that KIUC already has some of the highest electricity rates in the country and a very small base of ratepayers, and given the financial requirements imposed by its federal and private sector lenders, undergrounding all of its powerlines is not financially feasible. See Section 8.2, *Underground Some Transmission Lines*, for additional information on the prohibitive cost of moving all transmission and distribution lines underground.

8.2 Underground Some Transmission Lines

Under this alternative, KIUC evaluated undergrounding transmission lines that constituted the highest concentration of bird strikes based on past monitoring (Travers et al. 2020). This alternative would target KIUC's cross-island line, which runs from Port Allen across the interior of the island to Wainiha. To evaluate this alternative, KIUC contracted with Electric Power Engineers, Inc. (EPE) for a detailed assessment of the feasibility of undergrounding three transmission line segments.

- 2.5-mile-long (4-kilometer [km]-long) segment across the Powerline Trail
- 1.0-mile-long (1.6-km-long) segment across the ʻEleʻele Coffee Fields
- 0.5-mile-long (0.8-km-long) segment across Lāwaʻi Valley

In its June 11, 2015, report entitled *Assessment of Opportunities for Minimizing Adverse Effects to Seabirds: Wainiha – Port Allen 69 kV Double Circuit Transmission Line*, EPE concluded that while undergrounding the cross-island line segments would eliminate the potential for covered seabird collisions in those areas, it would be very difficult and prohibitively expensive to construct and maintain. In addition, when line failures did occur, they would be very difficult to locate and repair, and this would result in extended circuit outages that increases the risk of a system failure with wide-ranging adverse consequences.

EPE calculated the following costs to move underground the three powerline segments considered, in 2019 dollars.

- The cost to underground the Powerline Trail segment (2.5 miles [4 km]) would be approximately $27 million. The underground route would be approximately twice the length of the overhead route. The cost amounts to approximately $10.9 million per existing overhead alignment mile and $7.2 million per new underground alignment mile.
- The cost to underground the ʻEleʻele Coffee Fields segment (1.0 mile [1.6 km]) would be approximately $6.5 million.
- The cost to underground the Lāwaʻi Valley segment (0.5 mile [0.8 km]) would be approximately $6.3 million or approximately $12.5 million per mile.

Using the per-mile costs noted above, EPE extrapolated the costs to underground all the cross-island line from the Port Allen Generating Station to Wainiha. EPE estimated that undergrounding all 47 miles (75.6 km) of the cross-island line would cost a minimum of $188 million in 2019 dollars, and that the cost could easily be more than twice that amount (over $378 million). The costs to underground powerlines can be highly variable, depending on terrain, access, geological conditions, and physical obstacles such as roads and bodies of water. This cost is prohibitively high given that KIUC's utility operating income for 2019 was approximately $154.9 million and operating expenses over the same time period were approximately $142.9 million (Kauaʻi Island Utility Cooperative 2020). Furthermore, moving underground one 47-mile (75.6-km) line would leave the majority of KIUC's existing overhead electrical powerlines in place. Based on this analysis, KIUC determined that it would infeasible and cost prohibitive to reduce take of the covered birds by moving underground substantial segments of even some of KIUC's high-risk powerlines that cause take.

8.3 Extensive Tree Planting

This alternative would involve extensive tree planting in areas with exposed powerlines, especially in any high-strike locations along perimeter lines. The trees, once tall enough, would shield the powerlines and reduce the risk and incidence of covered species strikes. Fast-growing tall trees, most of which would be invasive, would be most appropriate.

KIUC considered this alternative but determined that extensive tree planting is not a viable alternative. This alternative was not selected because:

- Many interior powerlines are elevated above the existing tree line, even using alternative tree species.
- Vegetation and powerlines are often incompatible, in terms of the cost to maintain powerline clearance and the risk associated with trees falling on the lines, especially during storms. Increasing vegetation biomass immediately adjacent to powerlines would increase the cost of vegetation maintenance and increase the risk of powerline failure during storms.
- Land on either side of the powerlines where trees would need to be planted and maintained is mostly privately owned. It would be infeasible to negotiate with thousands of individual landowners to plant and maintain additional trees on their property.
- Planting tall trees in some areas can have unacceptable visual impacts. While taller trees would shield powerlines from viewsheds, taller trees can also block desirable views of the mountains or ocean from homeowners or recreationalists.

KIUC attempted to promote the ideas to private landowners, including programs to supply plant materials appropriate for the purpose, but was largely rejected by the landowners. Landowners and their neighbors were primarily concerned about the loss of views of the ocean from more and taller trees.

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Chapter 9
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9.10 Chapter 10, *Glossary*

U.S. Fish and Wildlife Service and National Marine Fisheries Service. 2016. *Habitat Conservation Planning and Incidental Take Permit Processing Handbook*.

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Chapter 10
Glossary of Terms

active breeding burrow—determined when an adult bird is either observed or when signs of bird presence are documented during the breeding season (e.g., feathers, guano, digging).

adaptive management—a method for examining alternative strategies for meeting measurable biological goals and objectives, and then if necessary, adjusting future conservation management actions according to what is learned (65 *Federal Register* 106 35242–35257, June 1, 2000). Not a strategy to address changed circumstances, but a strategy to address uncertainty associated with an HCP's conservation program, particularly where there is uncertainty posing a significant risk to covered species.

adult—life stage in which a species has reached sexual maturity.

avoidance measures—actions that aim to eliminate all potential take of a covered species, or impacts to a covered species.

baseline conditions—conditions surrounding the presence and/or status of a species or its habitat that exists within the plan area prior to implementation of an HCP.

biological goals—an overarching component of an HCP conservation strategy meant to define what the HCP intends to accomplish for wildlife conservation. Biological goals are descriptive, open-ended, and often broad statements of desired future conditions that convey a purpose, but do not define measurable units. Biological goals lay the foundation from which all conservation activities arise.

biological objectives—the steps that outline how an applicant will achieve biological goals; they provide direction for monitoring; they are specific, measurable, achievable, result-oriented and time fixed.

changed circumstances—changes in circumstances affecting a species or the geographic area covered by the KIUC HCP that can reasonably be anticipated during the permit term and that can reasonably be planned for (e.g., new species listings, or a fire or other natural catastrophic event in areas prone to such events). By identifying a specific response to each changed circumstance, the costs of implementing the response, and the funding assurances for those responses in the HCP, it is possible to facilitate adjustments to the HCP's conservation program without having to amend the HCP. Treated as part of the HCP's operating conservation program.

circuit—completed path for electric current from source to point of use and back.

climate—the average weather over many years.

climate change—a statistically significant change in the state of the climate or its variability that persists for an extended period, typically for decades or longer.

colony—area where birds nest and breed in proximity as a group, often sharing communal behaviors for the benefit of the entire group. The size of the colony can vary from just a few breeding pairs to hundreds or thousands of birds depending on the species and availability of resources, including suitable nest sites and takeoff/landing zones.

communication wire—a wire that delivers information by currents of various frequencies. Telephone conversations, photographs, sound and television broadcasts, and statistical data for computer centers are transmitted through communication wire.

compliance monitoring—process used to verify that KIUC is conforming to permit terms and conditions, including correct implementation of the HCP. Also known as implementation monitoring.

conservation measures—describe the specific actions that KIUC will implement to achieve the objectives in support of the HCP's goals. May be any of the avoidance, minimization, or mitigation actions taken to meet the goals and objectives of the HCP.

conservation sites—specific parcels on Kauaʻi with occupied or suitable breeding habitat for the covered seabird species where some of the HCP's conservation measures will be undertaken.

conservation strategy—the HCP's overall and unified approach for achieving the biological goals and objectives.

construction—making or forming a structure by combining or arranging various parts or elements to serve a particular purpose.

covered activities—the projects or ongoing activities that have the potential to take the covered species for which KIUC is requesting incidental take authorization.

covered seabird—The species are Newell's shearwater (ʻaʻo), Hawaiian petrel (ʻuaʻu), and the Hawaiian distinct population segment of band-rumped storm-petrel (ʻakēʻakē).

covered species—the species covered by this HCP. The species are Newell's shearwater (ʻaʻo), Hawaiian petrel (ʻuaʻu), the Hawaiian distinct population segment of band-rumped storm-petrel (ʻakēʻakē), Hawaiian stilt (aeʻo), Hawaiian duck (koloa maoli), Hawaiian coot (ʻalae keʻokeʻo), Hawaiian common gallinule (ʻalae ʻula), Hawaiian goose (nēnē), and the Central North Pacific distinct population segment of green sea turtle (honu).

covered waterbird—the species are Hawaiian stilt (aeʻo), Hawaiian duck (koloa maoli), Hawaiian coot (ʻalae keʻokeʻo), Hawaiian common gallinule (ʻalae ʻula), and Hawaiian goose (nēnē).

crippling bias—the proportion of birds colliding with powerlines that manage to fly or glide beyond the search corridor before dying. This term is only relevant for monitoring techniques in which the number of injuries or mortalities are estimated through underline searches for dead and injured birds.

crippling rate—the proportion of birds colliding with powerlines that subsequently die due to their injuries. Referred to in Chapter 5 as "mortality rate" for powerline strikes.

distribution wire—the electrical wire that delivers power to neighborhoods, businesses, and other facilities in towns and cities from transmission wire. The voltage of distribution wire is typically 13,000 volts or 13 kilovolts.

effectiveness monitoring—used to determine if KIUC is achieving the stated biological goals and objectives of the HCP. It provides the evaluation of whether the effect of implementing the HCP's conservation program is consistent with the assumptions and predictions made when the HCP was developed and approved.

endangered species—a native species, subspecies, variety of organism, or distinct population segment (DPS) which is in danger of becoming extinct throughout all or a significant portion of its range (16 U.S. Government Code 1532[6]).

enhance—the manipulation of the physical, chemical, or biological characteristics of a land cover type to heighten, intensify, or improve one or more specific existing ecological function(s). Enhancement results in the gain of selected existing ecological function(s), but may also lead to a decline in other ecological function(s).

facility—structure built, installed, or established to serve a particular purpose.

fallout—a phenomenon primarily affecting young seabirds (petrels and shearwaters) that leave their nest for the first time but can also affect adults(e.g., presence of unshielded lights, particularly near breeding colonies). These seabirds use natural lighting such as moonlight to navigate out to sea where they spend their time feeding. They can become disoriented by artificial lighting (e.g., streetlights, building lights) and circle lights repeatedly, become exhausted, and often grounded as a result or collide with structures in the process. Grounded seabirds can suffer injury, starvation, predation, or collision (e.g., with vehicles). Seabirds that collide in flight with structures are commonly injured or killed.

fallout season—September 15th to December 15th, when the majority of Newell's shearwater ('a'o), Hawaiian petrel ('ua'u) are fledging from their burrows.

fledging—the act of leaving the nest/burrow for the first time and migrating to the ocean to begin foraging. After fledging, seabirds will not return to their natal burrow until they are 2–5 years old. See also **sub-adults.**

fledgling—a young bird, typically with fully developed wing muscles and feathers, that leaves the nest for good and can survive away from the nest.

full cutoff shielded fixture—full cutoff shielded fixtures are light fixtures that have no direct uplight (no light emitted above horizontal). These fixtures prevent light from shining upwards by enclosing the bulb and directing it downward. A full cutoff shield also requires luminaries to comply with the glare requirement limiting intensity of light from the luminaire in the region between 80 and 90 degrees.

grounded—a bird on the ground in locations where they normally would not be found, usually because of attraction and disorientation by artificial lights or structure collisions. These birds are unable to get off the ground again naturally. This a term typically used for the covered seabirds.

habitat conservation plan (HCP)— A habitat conservation plan (HCP) must accompany an application for a federal incidental take permit and an application for a state incidental take license. An HCP details, without limitation, all applicant proposed enforceable commitments including take avoidance, minimization, and mitigation actions, and monitoring and ensured funding commitments.

harass—is a component of the definition of "take" under the federal ESA (16 USC 1532). Pursuant to USFWS ESA implementing regulations, *harass* is defined as intentional or negligent acts or omissions that create the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt essential behavioral patterns including, but not limited to, breeding, feeding, or sheltering (50 CFR 17.3).

harm—under the federal ESA, *harm* includes significant habitat modification or degradation where it kills or injures wildlife by significantly impairing essential behavioral patterns including, but not limited to, breeding, feeding, or sheltering (50 CFR 17.3).

hatchling—a young animal that has recently come out of its egg. All the covered species emerge from eggs and may be referred to as a "hatchling", but in the KIUC HCP this term is used with reference to green sea turtle (honu).

hurricane—an intense tropical weather system with well-defined circulation and maximum sustained winds of 74 mph (64 knots) or higher.

immediate grounding rate—the proportion of birds colliding with powerlines that are grounded within the search corridor (inverse of crippling rate) or assumed to have lost flight and hit the ground in unsearchable areas.

impact—the effects that covered activities have on the covered species.

impact of the taking—the impacts that result from the taking of the covered species, and described in terms of context, intensity, and duration of the impact. Context is the setting in which the impact of the take analysis occurs and includes consideration of other threats to covered species. Duration of the impact encompasses both current and probable future conditions and trends spanning the entire duration of the requested take. The impact of the taking should be described relative to a species reproduction, numbers, and distribution. The impact of the taking must not appreciably reduce the likelihood of survival and recovery of the species.

inactive burrow—no sign (e.g., bird presence, feathers, guano, digging) that the burrow has been visited during a breeding season.

incidental take—any take otherwise prohibited if such take is incidental to and not the purpose of the carrying out of an otherwise lawful activity (16 USC 1539(a)(1)(B); 50 CFR 17.3).

incidental take license (ITL)—the incidental take license (ITL) is the tool used by the State to authorize incidental take that occurs because of otherwise legal activities (HRS 195D-4(g)). This licensing document must be accompanied with an approved HCP. All qualifying private, non-federal entities, can request an ITL.

incidental take permit (ITP)—pursuant to Section 10(a)(1)(B) of the Endangered Species Act (ESA) of 1973, a permit can be issued by USFWS to non-federal entities, allowing incidental take of an endangered or threatened species when the take is incidental to, and is not the purpose of, carrying out an otherwise lawful activity. This permitting document must be accompanied with an approved HCP.

invasive species—a species that is non-native to the ecosystem and whose introduction causes or is likely to cause economic or environmental harm or harm to human health (Executive Order 13112).

Kona storm—the term was originally applied to the slow-moving subtropical cyclones that occasionally enter the Hawaiian area. Increasingly, this term is now applied by the local public to any widespread rainstorm accompanied by winds from a direction other than that of the trade winds. Kona storms are cool winter storms associated with a southward shift in the mid-latitude jet stream. They are most common during the late fall, winter, and spring and are associated with cold air over the central Pacific Ocean. They bring cloudy wet conditions to the western and southwestern sides of the island.

Kona weather—usually the warmest days in the Hawaiian Islands, when the trade winds, which come from cooler latitudes, fail and air stagnates over the heated islands.

light attraction—disorientation in nocturnal seabirds or green sea turtle (honu) hatchlings caused by attraction toward artificial lighting.

light disorientation—altered behavior in hatchling green sea turtles (honu) that are disoriented by an artificial light source and do not migrate directly to the ocean after emerging from their nest.

land cover type—the dominant feature of the land surface discernible from aerial photographs and defined by vegetation, water, or human uses.

major amendments—changes in the HCP that may affect the impact analysis or conservation strategy. Major amendments require submittal to USFWS and DOFAW of a written application and implementation of all permit processing procedures applicable to an original federal ITP and State ITL.

massif—a block of the earth's crust bounded by faults and shifted to form peaks of a mountain range.

maximum extent practicable—pursuant to section 10 of the ESA, the USFWS must determine that the combination of minimization and mitigation in the HCP leaves no remaining impacts of the taking on the species that could be further mitigated or minimized. Therefore, all impacts of the taking must be either fully offset, or if an applicant cannot fully offset the impacts of the taking, they must demonstrate to the USFWS' satisfaction that it is not practicable to carry out any additional minimization or mitigation.

metapopulation—a group of partially isolated populations belonging to the same species that are connected by pathways of immigration and emigration. Exchange of individuals occurs between such populations, enabling recolonization of sites from which the species has recently become extirpated.

minimization measures—within the context of the HCP, minimization is related to the impacts of the proposed covered activities on the species to be covered. In other words, minimization measures comprise actions that will reduce the impacts of the taking that have been identified during development of the HCP.

minimization efficacy—the desired or intended results from minimization projects on KIUC infrastructure.

minor modifications—changes to the HCP that do not increase the levels of authorized incidental take and do materially modify the scope or nature of activities or actions covered by the federal ITP and State ITL in terms of their effect on the covered species.

monitoring—the systematic surveillance or sampling of air, water, soil, and biota to observe and study the environment, and to derive knowledge from this process. The processes and activities that need to take place to characterize and monitor the quality of the environment or effectiveness of a project.

net benefit—abbreviated reference to "net conservation benefit", a requirement under Hawai'i state law for HCPs to mitigate commensurate for the requested take plus additional mitigation to ensure the likelihood of the survival and recovery of the species in the wild.

nonnative species—species that is not native to the ecosystems in Kaua'i.

"no surprises assurances"—assurances to permit holders that if unforeseen circumstances arise, the USFWS will not require more land, water, or money or additional restrictions on the use of land, water, or other natural resources beyond the level stated in the HCP without the consent of the KIUC (16 CFR 17.22((b)(5); 17.32(b)(5)). This assurance applies as long as KIUC is implementing the terms and conditions of the HCP properly and applies only with respect to species adequately covered by the conservation plan. See also **unforeseen circumstances**. For purposes of this definition, the term "adequately covered" means that a proposed conservation plan has satisfied the permit issuance criteria under Section 10(2)(B) of the ESA for the species covered by the HCP and listed on the ITP, if issued. See 50 CFR 17.3.

open water—aquatic habitats such as lakes, reservoirs, water-treatment ponds, sloughs, and ponds (including percolation and stock ponds) that do not support emergent vegetation.

operation—the fact or condition of a structure being linked to the take of covered species. For powerlines, the wires are operational once they are in place, but those wire do not need to be energized or functional. Streetlights are only operational when the lights are on.

permit area—the geographic area where the ITP applies. It includes the areas under the control of the KIUC where covered activities will occur. The permit area must be delineated in the ITP and be included within the Plan Area of the HCP.

permit term—the period over which KIUC is authorized to incidentally take the covered species in conjunction with implementing the HCP. The permit term for this HCP is 50 years.

Plan Area—the specific geographic area where covered activities and conservation measures described in the KIUC HCP will occur. The KIUC HCP Plan Area covers the full geographic extent of Kaua'i.

predator control—the act of controlling animals defined as predators via a variety of techniques.

predator eradication—complete removal of predators from within a predator exclusion fence.

predator exclusion fence—a fence specially designed to exclude all mammalian predators on Kaua'i from entry, including nonnative rats, feral cats, and ungulates. See **ungulate fence**.

population—a group of individuals of the same species inhabiting a given geographic area, among which mature individuals reproduce or are likely to reproduce. Ecological interactions and genetic exchange are more likely among individuals within a population than among individuals of separate populations of the same species.

powerline—overhead electrical wires strung between supporting structure, including poles, towers, lattice structures, and H-frames. The KIUC HCP covers transmission wires, distribution wires, and communication wires, and associate supporting structures.

range—the geographic area a species currently or historically occupied.

recovery—the process by which the decline of an endangered or threatened species is arrested or reversed or threats to its survival neutralized so that its long-term survival in nature can be ensured. Recovery entails actions to achieve the conservation and survival of a species (U.S. Fish and Wildlife Service and National Marine Fisheries Service 2016), including actions to prevent any further erosion of a population's viability and genetic integrity, as well as actions to restore or establish environmental conditions that enable a species to persist (i.e., the long-term occurrence of a species through the full range of environmental variation). Implementation of an HCP may not impede the ability of a covered species to recover.

reproductive success rate—number of covered seabird burrows that fledged a chick divided by the number of burrows that were confirmed breeding and where an outcome could be determined.

Save Our Shearwaters (SOS)—the SOS Program operates year-round on Kauaʻi rescuing and rehabilitating native Hawaiian birds and the Hawaiian hoary bat. SOS focuses on the rescue and rehabilitation of Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu).

seabird—a bird that frequents coastal waters and the open ocean.

social attraction—a colony creation technique whereby seabirds are attracted to an area to initiate breeding by playing recordings of other seabirds of the same species and installing artificial burrows. This is an effective technique due to the colonial nature of seabirds.

strike reduction—the amount of decrease in avian powerline collisions between the unminimized state and the post-minimization state (e.g., after bird flight diverters are installed).

sub-adult—birds 2–5 years old who have not reached sexual maturity.

suitable habitat—habitat that may be unoccupied or historically or currently occupied that exhibits the characteristics necessary to support a given species. Suitable habitat is used as a criterion for conservation site selection.

take authorizations—the permits that authorize take of species, in this case the federal ITP issued by the USFWS and the state ITL issued by the State of Hawaiʻi Department of Land and Natural Resources, Division of Forestry and Wildlife.

take—under the federal ESA, the term *take* means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect listed species or to attempt to engage in any such conduct (16 USC 1532; 50 CFR 17.3). Under the Hawaiʻi statutes, *take* is defined similarly to the federal ESA as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect endangered or threatened species of aquatic life or wildlife, or to cut, collect, uproot, destroy, injure, or possess endangered or threatened species of aquatic life or land plants, or to attempt to engage in any such conduct.

threatened species—Any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. 16 USC 1532(20).

transmission wire—the electrical wire that delivers power from substations to distribution wire. The voltage of transmission wire is typically 100,000 volts or 100 kilovolts.

triggers—qualitative or quantities thresholds, which can include established schedule milestones, that if not met will initiate adaptive management.

tropical storm—an organized system of strong thunderstorms with a defined circulation (i.e. tropical cyclone) and maximum sustained winds of 39 to 73 mph (62.8 to 117.5 kph).

under-build—distribution wires built on the same pole as transmission wires are always mounted underneath the transmission wires.

ungulate fence—a fence designed to keep out hoofed mammals. On Kauaʻi, existing ungulates that may trample burrows and seabird habitat, or predate on nesting seabirds include feral pigs and goats and deer.

unoccupied habitat—habitat that exhibits all the constituent elements necessary for a species, but which surveys have determined is not currently occupied by that species. The lack of individuals or populations in the habitat is assumed to be the result of reduced numbers or distribution of the species such that some habitat areas are unused. It is possible that these areas would be used if species numbers, or distribution were greater. See also **suitable habitat**.

unforeseen circumstances—changes in circumstances affecting a covered species or geographic area covered by the KIUC HCP that could not reasonably have been anticipated by the plan developers and the USFWS at the time of the HCP's development, and that result in a substantial and adverse change in the status of a covered species. Under the state permit, this refers to changes affecting one or more species, habitat, or the geographic area covered by a conservation plan that could not reasonably have been anticipated at the time of plan development, and that result in a substantial adverse change in the status of one or more covered species.

viable metapopulation—an estimated number of individuals within a metapopulation to persist with high probability in the long term measured by its distribution, population size, age structure, growth rate, and additional demographic variables (e.g., age/cohort survivorship, reproductive success). For the purposes of this HCP 2,500 breeding pairs, and 10,000 individuals, is considered a viable metapopulation.

waterbird—a bird that is found in a variety of wetland habitats including freshwater marshes and ponds, coastal estuaries and ponds, artificial reservoirs, kalo or taro (*Colacasia esculenta*) loʻi or patches, irrigation ditches, sewage treatment ponds, and, in some cases, montane streams and marshlands.

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Chapter 11
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