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Revised Draft
Habitat Conservation Plan for Honua‘ula (Wailea 670) Kīhei, Maui

Submitted to

U.S. Fish and Wildlife Service

and

Hawai‘i Department of Land and Natural Resources

Applicant

Honua‘ula Partners, LLC

Prepared by

SWCA Environmental Consultants

April 2016

REVISED DRAFT
HABITAT CONSERVATION PLAN FOR
HONUAʻULA (WAILEA 670)
KĪHEI, MAUI

Submitted to

U.S. Fish and Wildlife Service
300 Ala Moana Boulevard, Room 3-122
Honolulu, Hawaiʻi 96850

and

Hawaiʻi Department of Land and Natural Resources
1151 Punchbowl Street, Room 325
Honolulu, Hawaiʻi 96813

Applicant

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April 11, 2016

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1.1. Introduction

Honuaʻula Partners, LLC proposes to construct a master-planned community (hereafter the "project") encompassing diverse residential opportunities, commercial and retail mixed uses, on-site recreational amenities, integrated bicycle and pedestrian networks, parks, and open space. Honuaʻula's master-planned community will also feature a golf amenity, as well as a 134-acre (53-hectare [ha]) Native Plant Preservation Area (NPPA) and other areas dedicated to the preservation of native plants and archaeological features. As discussed herein, Honuaʻula has undergone significant public review and comment over the past 14 years in regard to this project. Honuaʻula has been approved for urban development since 1994 and has received all discretionary land use approvals for residential, limited commercial, and golf course uses.

Activities occurring on Honuaʻula's proposed property over the life of the project may result in the incidental take of three federally listed endangered species: Blackburn's sphinx moth (*Manduca blackburni*), ʻāwikiwiki (*Canavalia pubescens*), and Hawaiian goose or nēnē (*Branta sandwichensis*). Honuaʻula's project will result in permanent habitat loss for the endangered Blackburn's sphinx moth because host plants of this moth occur on the property. Although all known living ʻāwikiwiki plants on the property will be protected, construction and operation of the project may result in take of seeds or take of new recruits previously not recorded. Post-construction activities associated with the proposed golf amenity could attract nēnē, resulting in the potential for incidental take of this species. Additionally, two species that are proposed endangered—assimulans yellow-faced bee (*Hylaeus assimulans*) and anthricinan yellow-faced bee (*Hylaeus anthracinus*)—have the potential to be impacted by the proposed project because their preferred floral resources, mainly ʻilima (*Sida fallax*), could be removed or disturbed. These five species (three endangered and two proposed endangered) are hereafter collectively referred to as the "Covered Species."

Implementation of avoidance and minimization measures is expected to avoid any negative impacts on five additional endangered or threatened species that could be attracted to the site during or after construction. These species are the Hawaiian stilt (*Himantopus mexicanus knudseni*), Hawaiian duck (*Anas wyvilliana*), Hawaiian coot (*Fulica alai*), Hawaiian petrel (*Pterodroma sandwichensis*), Hawaiian Hoary bat (*Lasiurus cinereus semotus*), and Newell's shearwater (*Puffinus auricularis newelli*). Although no impact is anticipated and no take is requested for these species, avoidance and minimization measures for these species are included in this habitat conservation plan (HCP).

This HCP seeks to offset the potential impact of the project on the five Covered Species with measures that protect and provide a net benefit to the species island-wide and statewide. The applicant, Honuaʻula, anticipates a 15-year build-out period starting in 2016 throughout which this HCP will be in effect. The HCP also covers post-construction maintenance, management, and operations of the development and golf amenity. Therefore, Honuaʻula seeks a 30-year incidental take permit (ITP) in accordance with Section 10(a)(1)(B) of the federal Endangered Species Act (ESA) of 1973, as amended, and an incidental take license (ITL) in accordance with Chapter 195-D of the Hawaiʻi Revised Statutes (HRS). These permits are issued by the U.S. Fish and Wildlife Service (USFWS) and the State Department of Land and Natural Resources (DLNR), respectively. This HCP supports the issuance of these permits, and describes how Honuaʻula will avoid, minimize, mitigate, and monitor the incidental take of threatened and endangered species that may occur during construction and operation of the proposed project. The general and species-specific mitigation measures Honuaʻula is proposing are intended to increase knowledge of

the species' biology and distribution, enhance populations, or restore degraded native habitat on-site (Table 1). Mitigation measures will provide a net benefit to the species as required under state law. These mitigation measures will be provided in addition to general minimization and mitigation measures, and comprise the principal mitigation measures that will be implemented to offset the requested take of Covered Species.

This HCP, when approved, will fulfill the requirements for an ITP in accordance with Section 10(a)(1)(B) of the federal ESA of 1973, as amended, and an ITL in accordance with Chapter 195-D of the HRS.

Table 1. Mitigation Summary

Native Plant Preservation Area
1. Perpetual on-site conservation easement of 134 acres (54 ha). The easement will meet the approval of the USFWS and the Hawai'i Division of Forestry and Wildlife (DOFAW) before groundbreaking.
2. Weed control including manual, chemical, and mechanical removal. Tree tobacco will not be removed, unless required by USFWS and DOFAW.
3. Control of rats.
4. Enhancement and maintenance of native plant community through propagation and outplanting.
5. Establishment of an 8-foot ungulate fence around the entire NPPA before groundbreaking and ungulate removal before groundbreaking.
6. Maintenance of 0% cover of all non-native species within a 15-foot (5-meter [m]) buffer around listed plant species (e.g., 'āwikiwiki, and outplanted *Colubrina oppositifolia* and *Hibiscus brackenridgei*).
7. Maintenance of less than 40% cover of non-grass invasive weeds in a 112-acre (45-ha) core area (part of the NPPA; see section 7.5.1). Target plant species include koa haole (*Leucaena leucocephala*), lantana (*Lantana camara*), and cow pea (*Macroptilium lathyroides*). Kiawe (*Prosopis pallida*) will remain in place to reduce the potential for increased grass cover.
8. Maintenance of less than 10% cover of non-native grasses in the 112-acre (45-ha) core area. Target grasses include buffelgrass (*Cenchrus ciliaris*), guinea grass (*Urochloa maxima*), and other fire-prone alien grasses.
9. The project includes unpaved trails for maintenance and access to cultural sites, not exceeding 1% of the acreage of the NPPA, and informational signs.
10. The area is designed to preserve Blackburn's sphinx moth's habitat, 'āwikiwiki, and other native vegetation, and will also provide protection to cultural sites present on-site.
11. 'Āwikiwiki is a short-lived perennial vine that is easy to propagate but may be difficult to outplant. Enhancement of this species will be accomplished by seed scattering and experimentation with outplanting technologies. Between years 10 and 15, an annual average of 50 'āwikiwiki plants will be present in the NPPA, with an annual range between 0 and 500 plants. After year 15, the annual average, based on 5-year intervals, will be 50 plants. This population will no longer require outplantings to maintain stable and increasing cover trend, and will be maintained in perpetuity.
Kanaio and Auwahi
1. At each of these two sites, 500 individual 'aiea (*Nothocestrum* spp.) seedlings will be outplanted, for a total of 1,000 'aiea seedlings. Planting will coincide with the timing of on-site mitigation. This will further offset the loss of larval food plants (host plants) for Blackburn's sphinx moths at the property.
Endowment
1. Maintenance of the NPPA will continue in perpetuity through the establishment of an endowment. The endowment will be managed by a conservation organization, entity, or management board that will be selected prior to issuance of the permit. Habitat in the NPPA will be managed under the supervision of Honua'ula (or its successors or assigns) during the first 15 years of the permit term. Thereafter, habitat management will be implemented under the supervision of a conservation organization to be agreed upon and named before the permit is issued. The endowment funding the mitigation costs will be fully funded before construction begins.
Nēnē
1. Funding of $30,000 to DLNR will be provided for the protection of nēnē.

1.2. Applicant

The property was acquired in 2000 by California-based WCPT/GW Land Associates, LCC, which was later succeeded by Honuaʻula Partners, LLC, a successor-in-interest to WCPT/GW Land Associates, and the current owner of the property. When acquired, the subject property was designated for development as Project District 9 in the *Kīhei-Mākena Community Plan*, zoned for two 18-hole golf courses and limited support uses, and designated Urban by the State Land Use Commission. The applicant's intention from the beginning of this process has been to develop the property consistent with the provisions provided for in the *Kīhei-Mākena Community Plan*. The applicant initiated a Change in Zoning application with the County of Maui in the fall of 2000, and received a recommendation for approval and transmittal to the Maui County Council (Council) from the Maui Planning Commission (MPC) in October 2001. The applicant initiated hearings with the Council in January 2002, received a recommendation for approval with conditions from the Council Land Use Committee in November 2007, and final project district zoning approval from the Council in March 2008. Then Mayor Charmaine Tavares signed the legislation into law on April 8, 2008.

Subsequent to final zoning approval, the applicant has initiated compliance with the conditions of approval consistent with the provisions of Project District Zoning Ordinance 19.90A. These actions include initiation of an environmental impact statement (EIS) and Phase II zoning application. The accepting authority for the EIS is the MPC, and Phase II zoning approval will be issued by the MPC.

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1.3. Regulatory Context

1.3.1. Federal Endangered Species Act

The federal ESA (16 United States Code [USC] 1531–1544) protects wildlife and plant species that have been listed as threatened or endangered. It is designed to conserve the ecosystem on which the species depend. Candidate species, which may be listed in the near future, are not afforded protection under the ESA until they are formally listed as endangered or threatened.

Section 9, and rules promulgated under Section 4(d), of the ESA prohibits the unauthorized take of any endangered or threatened species of wildlife listed under the ESA. Under the ESA, the term *take* means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect species listed as endangered or threatened, or to attempt to engage in any such conduct. As defined in regulations, the term *harm* means an act that actually kills or injures wildlife; it may include significant habitat modification or degradation, which actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering (50 Code of Federal Regulations [CFR] 17.3). The rules define *harass* to mean an intentional or negligent act or omission that creates the likelihood of injury to wildlife by annoying it to such an extent, as to significantly disrupt normal behavior patterns, which include, but are not limited to, breeding, feeding, or sheltering (50 CFR 17.3).

By issuing an ITP under Section 10, the USFWS may permit, under certain terms and conditions, any take otherwise prohibited by Section 9, or a rule under Section 4(d) of the ESA if such take is incidental to the carrying out of an otherwise lawful activity ("incidental take"). To apply for an ITP, an applicant must develop and fund a USFWS-approved HCP to minimize and mitigate the effects of the incidental take. Such take may be permitted, provided the following ITP issuance criteria of ESA Section 10(a)(2)(B), 50 CFR 17.22(b)(2), and 50 CFR 17.32(b)(2) are met:

- The taking will be incidental.
- The applicant will, to the maximum extent practicable, minimize and mitigate the impacts of such taking.
- The applicant will ensure that adequate funding for the HCP and procedures to deal with unforeseen circumstances will be provided.
- The taking will not appreciably reduce the likelihood of the survival and recovery of the species in the wild.
- Other necessary or appropriate measures required by the Secretary of the Interior, if any, will be met.

To obtain an ITP, an applicant must prepare a supporting HCP that provides the following information described in ESA Sections 10(a)(2)(A) and (B), 50 CFR 17.22(b)(1), and 50 CFR 17.32(b)(1):

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

The *Habitat Conservation Planning and Incidental Take Permit Processing Handbook* (the HCP Handbook), published by the USFWS and the National Oceanic and Atmospheric Administration National Marine Fisheries Service (NOAA NMFS) in November 1996, provides additional policy guidance concerning the preparation and content of HCPs. The USFWS and the NOAA NMFS published an addendum to the HCP Handbook on June 1, 2000 (USFWS and NOAA NMFS 2000). This addendum, also known as the "Five Point Policy," provides clarifying guidance for 1) applicants applying for an ITP and 2) agencies issuing ITPs under ESA Section 10. The five components addressed in the Five-Point Policy are discussed briefly below:

- **Biological Goals and Objectives:** HCPs must include biological goals (broad guiding principles for the conservation program and the rationale behind the minimization and mitigation strategies) and biological objectives (the measurable targets for achieving the biological goals). These goals and objectives must be based on the best scientific information available, and they are used to guide conservation strategies for species covered by the HCP.
- **Adaptive Management:** The Five-Point Policy encourages the development of adaptive management plans as part of the HCP process under certain circumstances. Adaptive management is an integrated method for addressing biological uncertainty and devising alternative strategies for meeting biological goals and objectives. An adaptive management strategy is essential for HCPs that would otherwise pose a significant risk to the Covered Species due to significant information gaps.

- **Monitoring:** Monitoring is a mandatory element of all HCPs under the Five-Point Policy. For this reason, an HCP must provide for monitoring programs to gauge the effectiveness of the HCP in meeting the biological goals and objectives and to verify that the terms and conditions of the HCP are being properly implemented.
- **Permit Duration:** Regulations provide several factors that are used to determine the duration of an ITP, including the duration of the applicant's proposed activities and the expected positive and negative effects on Covered Species associated with the proposed duration (50 CFR 17.32 and 222.307). Under the Five-Point Policy, the USFWS also will consider the level of scientific and commercial data underlying the proposed operational program of the HCP, the length of time necessary to implement and achieve the benefits of the program, and the extent to which the program incorporates adaptive management strategies.
- **Public Participation:** Under the Five-Point Policy guidance, the USFWS announced its intent to expand public participation in the HCP process to provide greater opportunity for the public to assess, review, and analyze HCPs and associated documentation (e.g., National Environmental Policy Act [NEPA] review). As part of this effort, the USFWS has expanded the public review process for most HCPs from a 30-day comment period to a 60-day period.

1.3.2. Federal National Environmental Policy Act

Issuance of an ITP is a federal action subject to compliance with NEPA (42 USC 4371 et seq.). The purpose of NEPA is to promote agency analysis and public disclosure of the environmental issues surrounding a proposed federal action to reach a decision that reflects NEPA's mandate to strive for balance between human activity and the natural world. The scope of NEPA goes beyond that of the ESA by considering the impact of a federal action on non-wildlife resources, such as water quality, air quality and cultural resources. The USFWS will prepare and provide for public review an environmental assessment (EA) to evaluate the potential environmental impacts of issuing an ITP and approving the implementation of the proposed Honuaʻula HCP. The purpose of the EA is to determine if ITP issuance and HCP implementation will significantly affect the quality of the human environment. If the USFWS determines significant impacts are likely to occur, a comprehensive EIS for the proposed action will be prepared and distributed for public review; otherwise, a finding of no significant impact (FONSI) will be issued. The USFWS will not make a decision on ITP issuance until after the NEPA process is complete.

1.3.3. Federal Migratory Bird Treaty Act

The federally listed birds addressed in this HCP (the nēnē as well as the four listed waterbird species) are also protected under the Migratory Bird Treaty Act (MBTA) of 1918, as amended (16 USC 703-712). The MBTA prohibits the take of migratory birds. A list of birds protected under MBTA-implementing regulations is provided at 50 CFR 10.13. Unless permitted by regulations, under the MBTA it is unlawful to pursue, hunt, take, capture or kill; attempt to take, capture or kill; possess, offer to or sell, barter, purchase, deliver or cause to be shipped, exported, imported, transported, carried or received any migratory bird, part, nest, egg or product.

The MBTA provides no process for authorizing incidental take of MBTA-protected birds. However, if the HCP is approved and USFWS issues an ITP to the applicant, the terms and conditions of that ITP will also constitute a Special Purpose Permit under 50 CFR 21.27 for the take of the nēnē under the MBTA. Therefore, subject to the terms and conditions to be specified in the ITP, if issued, any such take of nēnē also will not be in violation of the MBTA. However, because the MBTA provides for no incidental take authorization, other MBTA-protected birds that are not protected by the ESA and that may be adversely affected by the proposed project will not be covered by any take authorization.

1.3.4. Federal National Historic Preservation Act

USFWS issuance of an ITP under ESA Section 10(a)(1)(B) is considered an "undertaking" covered by the Advisory Council on Historic Preservation and must comply with Section 106 of the National Historic Preservation Act (NHPA) (16 USC 470-470b, 470c-470n and 36 CFR 800). The *undertaking* is defined as the land-use activity that may proceed once an ITP is issued to an applicant. Section 106 requires USFWS to assess and determine the potential effects on historic properties that would result from the proposed undertaking and to develop measures to avoid or mitigate any adverse effects. Accordingly, USFWS must consult with the Advisory Council on Historic Preservation, the State Historic Preservation Officer (SHPO), affected tribes, the applicant, and other interested parties, and make a good-faith effort to consider and incorporate their comments into project planning.

The USFWS will determine the "area of potential effects" associated with the proposed undertaking, which is usually defined as the geographic area where the undertaking may directly or indirectly change the character or use of historic properties included in or eligible for the National Register of Historic Places. The USFWS generally interprets the area of potential effects as the specific location where incidental take may occur and where ground-disturbing activities may affect historic properties. The USFWS, in consultation with the State Historic Preservation Division (SHPD), must make a reasonable and good-faith effort to identify undiscovered historic properties. The USFWS also determines the extent of any archeological investigations that may be required; the cost of NHPA compliance, however, rests with the applicant.

Extensive archaeological and cultural resources surveys and impact studies have been conducted for the project, and Honuaʻula Partners, LLC has consulted with SHPD. A cultural preservation plan is being created for the property, and a final Archaeological Inventory Survey has been submitted for approval by the State Historic Preservation Division.

1.3.5. Hawai'i Revised Statutes, Chapter 195D

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

To qualify for an ITL, the following must occur (language adapted from HRS 195D-4(g)):

- The applicant minimizes and mitigates the impacts of the incidental take to the maximum extent practicable (i.e., implements an HCP).
- The applicant guarantees that adequate funding for the HCP will be provided.
- The applicant posts a bond; provides an irrevocable letter of credit, insurance, or surety bond; or provides other similar financial tools, including depositing a sum of money in the endangered species trust fund created by HRS 195D-31, or provides other means approved by the BLNR, adequate to ensure monitoring of the species by the state and to ensure that the applicant takes all actions necessary to minimize and mitigate the impacts of the incidental take.
- The plan increases the likelihood that the species will survive and recover.

- The plan takes into consideration the full range of the species on the island so that cumulative impacts associated with the incidental take can be adequately assessed.
- The activity permitted and facilitated by the license to incidentally take a species does not involve the use of submerged lands, mining, or blasting.
- The cumulative impact of the activity, which is permitted and facilitated by the license, provides net environmental benefits.
- The incidental take is not likely to cause the loss of genetic representation of an affected population of any endangered, threatened, proposed, or candidate plant species.

HRS 195D-4(i) directs the DLNR to work cooperatively with federal agencies in concurrently processing HCPs, ITLs, and ITPs. Section 195D-21 deals specifically with HCPs, and its provisions are similar to those in federal regulations. According to this section, HCPs submitted in support of an ITL application shall do the following:

- Identify the geographic area encompassed by the HCP; the ecosystems, natural communities, or habitat types in the plan area that are the focus of the plan; and the endangered, threatened, proposed, and candidate species known or reasonably expected to be present in those ecosystems, natural communities, or habitat types in the plan area.
- Describe the activities contemplated to be undertaken in the plan area with sufficient detail to allow the department to evaluate the impact of the activities on the particular ecosystems, natural communities, or habitat types in the plan area that are the focus of the plan.
- Identify the steps that will be taken to minimize and mitigate all negative impacts, including, without limitation, the impact of any authorized incidental take, with consideration of the full range of the species on the island so that cumulative impacts associated with the incidental take can be adequately assessed; and identify the funding that will be available to implement those steps.
- Identify those measures or actions to be undertaken to protect, maintain, restore, or enhance the ecosystems, natural communities, or habitat types in the plan area; a schedule for implementation of the measures or actions; and an adequate funding source to ensure that the actions or measures, including monitoring, are undertaken in accordance with the schedule.
- Be consistent with the goals and objectives of any approved recovery plan for any endangered species or threatened species known or reasonably expected to occur in the ecosystems, natural communities, or habitat types in the plan area.
- Provide reasonable certainty that the ecosystems, natural communities, or habitat types will be maintained in the plan area throughout the life of the plan in sufficient quality, distribution, and extent to support in the plan area those species typically associated with the ecosystems, natural communities, or habitat types, including any endangered, threatened, proposed, and candidate species known or reasonably expected to be present in the ecosystems, natural communities, or habitat types in the plan area.
- Contain objective, measurable goals, the achievement of which will contribute significantly to the protection, maintenance, restoration, or enhancement of the ecosystems, natural communities, or habitat types; time frames within which the goals are to be achieved; provisions for monitoring (such as field sampling techniques), including periodic monitoring by representatives of the department or the ESRC, or both; and provisions for evaluating progress achieving the goals quantitatively and qualitatively.

- Provide for an adaptive management strategy that specifies the actions to be taken periodically if the plan is not achieving its goals.

In addition to the above requirements, all HCPs and their actions authorized under the HCP should be designed to result in an overall net benefit to the threatened and endangered species in Hawaiʻi (HRS 195D-30).

Section 195D-25 provides for the creation of the ESRC, which is composed of biological experts, representatives of relevant federal and state agencies (e.g., USFWS, U.S. Geological Survey [USGS], and DLNR), and appropriate governmental and non-governmental members. The ESRC serves as a consultant to the DLNR and BLNR on matters relating to endangered, threatened, proposed, and candidate species. ESRC reviews all applications for HCPs and makes recommendations to the DLNR and BLNR on whether they should be approved, amended, or rejected.

Duties of the ESRC include reviewing all applications for HCPs, Safe Harbor Agreements, and ITLs, and making recommendations to the DLNR and the BLNR on whether they should be approved, amended, or rejected; reviewing all existing HCPs, Safe Harbor Agreements and ITLs annually to ensure compliance, and making recommendations for any necessary changes; and considering and recommending appropriate incentives to encourage landowners to voluntarily engage in efforts that restore and conserve endangered, threatened, proposed, and candidate species. Hence, the ESRC plays a significant role in the HCP planning process. The applicant, Honuaʻula, provided a pre-HCP introductory presentation to the ESRC on December 6, 2010. The first draft of the HCP was presented to the ESRC on March 12, 2013, after an ESRC site visit on March 8, 2013. The HCP was deferred pending resolution of issues related to archeological surveys of the site. The revised proposed project was introduced to the ESRC in an update presented on October 21, 2015.

Following preparation of the proposed HCP, the HCP and the application must be made available for public review and comment no fewer than 60 days before approval. If the DLNR approves the HCP, participants in the HCP (e.g., the ITL holder) must submit an annual report to DLNR within 90 days of each fiscal year ending June 30, as further detailed in section 8 below; this report must include a description of activities and accomplishments, analysis of the problems and issues encountered in meeting or failing to meet the objectives set forth in the HCP, areas needing technical advice, status of funding, and plans and management objectives for the next fiscal year (HRS 195D-21).

1.3.6. Hawai‘i Revised Statutes, Chapter 343

HRS Chapter 343 (Environmental Impact Statements) was developed to establish a system of environmental review that will ensure that environmental concerns are given appropriate consideration in decision making along with economic and technical considerations (HRS 343-1). A state EIS was prepared for Honuaʻula (PBR Hawaiʻi 2010, 2012), because the project involves the following:

- Extension of Piʻilani Highway from Wailea Ike Drive to Kaukahi Street, a portion of which will be on right-of-way (ROW) owned by the State of Hawaiʻi.
- Possible development of an on-site wastewater treatment facility.

The Maui County Planning Department submitted the EIS preparation notice (EISPN) to the State of Hawaiʻi Office of Environmental Quality Control (OEQC) on February 23, 2009. Notice of the availability of the EISPN was published in the March 8, 2009, edition of the OEQC's *The Environmental Notice* (OEQC 2009a). The public comment period for the EISPN began March 8, 2009 and ended April, 7, 2009.

The Maui County Planning Department subsequently submitted an EA/EISPN to OEQC on September 18, 2009. Notice of the availability of the EA/EISPN was published in the October 8, 2009 edition of the OEQC's *The Environmental Notice* (OEQC 2009b). The official public comment period on the EA/EISPN was from October 8, 2009 to November 7, 2009; however, Honuaʻula Partners, LLC voluntarily extended the comment period until November 17, 2009, to allow all consulted parties ample time to provide comments.

Subsequent to the EA/EISPN public comment period, Maui County Planning Department submitted the draft EIS to OEQC on April 13, 2010. Notice of the availability of the draft EIS was published in the April 23, 2010 edition of OEQC's *The Environmental Notice* (OEQC 2010). The official 45-day public comment period on the draft EIS was from April 23, 2010, to June 7, 2010; however, as a courtesy to those that requested more time to review the draft EIS, Honuaʻula Partners, LLC again voluntarily extended the comment period on the draft EIS until June 30, 2010. The Maui County Planning Department approved the final EIS on July 24, 2012 (PBR Hawaiʻi 2012). On October 5, 2012, the Sierra Club and Maui Unite filed an action in the Second Circuit Court, Civil No. 12-1-0800(2), challenging the sufficiency of the final EIS. That challenge, and issues raised in negotiations following that challenge, has resulted in revisions to the proposed project, some of which are reflected in this HCP.

1.4. Project Description

1.4.1. Project History

The first EIS approved for development of the property was published by PBR Hawaiʻi in 1988. In 1992, the *Kīhei-Mākena Community Plan* amendment and final EIS were approved as Project District 9 in the *Kīhei-Mākena Community Plan* and in Chapter 19.90A, Maui County Code (MCC). In 1993, project district zoning approval was received for the entire 670-acre (270-ha) property. In 1994, the State Land Use Commission issued its decision and order approving urban designation for the property. Following project redesign, the Maui County Council approved Bills 21 and 22 in December 2007 providing for conditional project district zoning for all 670 acres (270 ha) allowing for residential, limited commercial, golf course, and open space zoning.

1.4.2. Project Design and Components

Honuaʻula will be a master-planned community in the Kīhei-Mākena region of Maui adjacent to Wailea Resort (Figure 1). The project will encompass diverse residential opportunities, commercial and retail mixed uses, on-site recreational amenities, integrated bicycle and pedestrian networks, parks, and open space. Honuaʻula will also feature a golf amenity and related facilities, as well as a 134-acre (54-ha) NPPA and other areas dedicated to the preservation of native plants and archaeological features (Figure 2). The project will not contain any open water features. As discussed herein, Honuaʻula has been planned and has undergone significant public review and comment for over 14 years. More significantly, Honuaʻula has been approved for urban development since 1994 and has received all discretionary land use approvals for residential, limited commercial, and golf course uses, with the exception of Phase II approval.

Honuaʻula will provide homes priced for a range of consumer groups, including workforce affordable homes in compliance with Chapter 2.96, MCC (Residential Workforce Housing Policy). It will reflect community values and feature distinctive architecture to create a unique and compelling community in context with the Kīhei-Mākena region. This cohesive approach will integrate natural and human-made boundaries and landmarks to craft a sense of place within a defined community. In addition, a principal

design and planning goal is to preserve defining features of Honuaʻula, such as the topography and views, as much as possible.

1.4.3. Covered Activities

This HCP, and associated federal and state incidental take authorizations to be issued by the USFWS and DLNR, will cover and provide authorization for incidental take resulting from the following activities, which will occur as part of the project. These are subject to any requirements or restrictions described in this HCP or the incidental take authorization documents:

- Grading and earth moving.
- Installation and construction of infrastructure.
- Construction of homes and facilities.
- Installation of landscaping.
- Driving and biking on the property by employees, contractors, and public on established roadways, sidewalks, and paths in accordance with posted speed limits.
- Operation, maintenance, and management of all constructed facilities.
- Operation, maintenance, and management of the golf amenity.
- General property operation and management of maintenance facilities, including landscape maintenance.
- Implementation of the conservation measures outlined in this HCP.

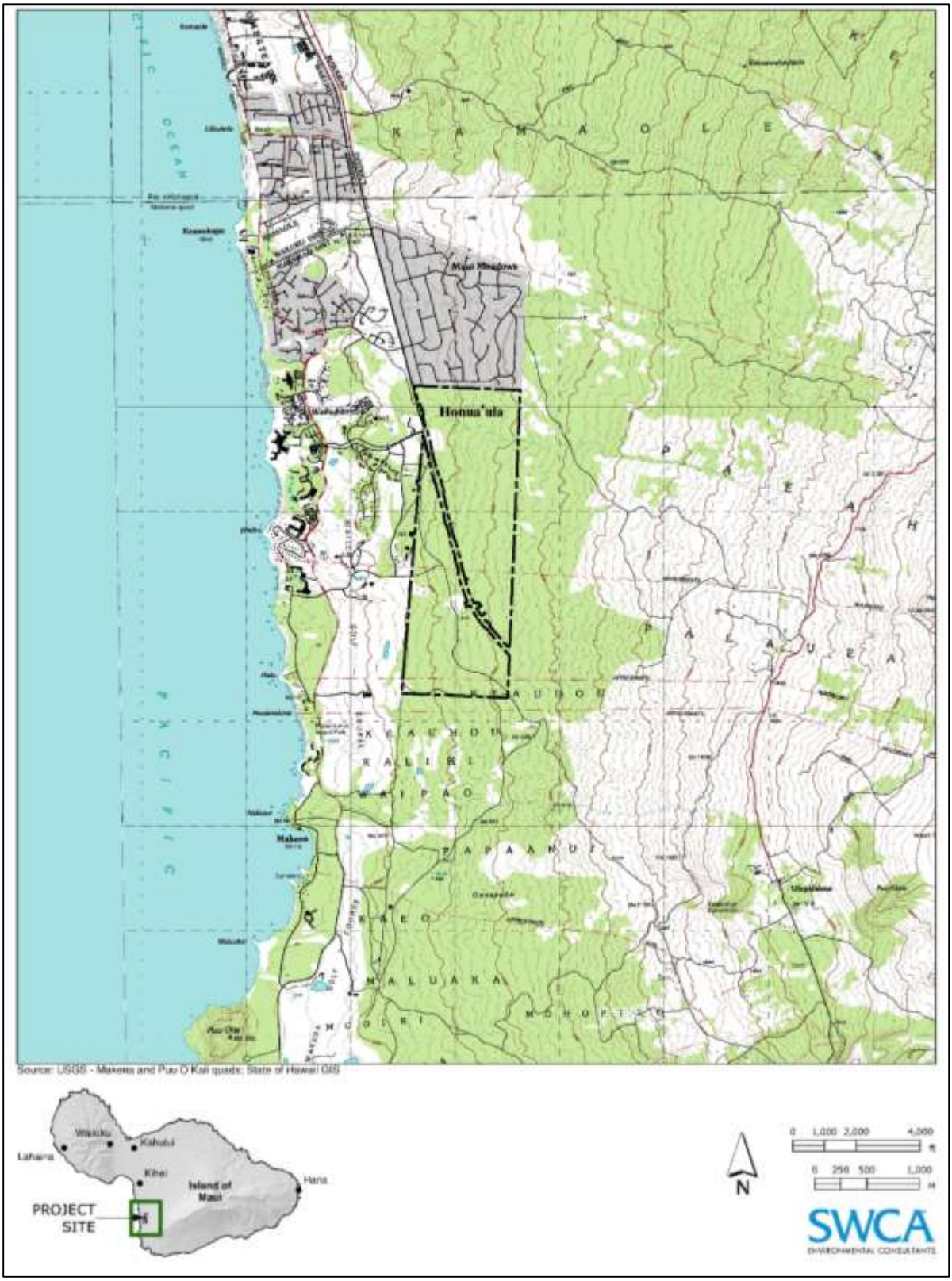

Figure 1. Project site (property).

Figure 2. Revised conceptual project layout.

1.4.4. Purpose and Need for Honuaʻula Project

The purpose and intent of the Honuaʻula project are to implement the Project District 9 ordinance (Chapter 19.90A, MCC) governing the property, which establishes permissible land uses and appropriate standards of development for a residential community consisting of single-family and multi-family dwellings complemented with village mixed uses and all integrated with a golf amenity and other recreational amenities. As planned, Honuaʻula is consistent with the residential, commercial, and recreational uses in the *Kīhei-Mākena Community Plan*, which has been affirmed through a community-based process. Consistent with the *Kīhei-Mākena Community Plan* and Chapter 19.90A, MCC, Honuaʻula will do the following:

- Provide a mix of single- and multi-family housing types for a range of consumer groups.
- Emphasize community development with single- and multi-family units complemented with village mixed uses and commercial uses primarily serving the residents of the community.
- Integrate a golf amenity, which may consist of a putting and short course comprising a series of holes that can be played as part of a nine-hole short course, and other recreational amenities with the different uses in Honuaʻula.
- Integrate community-oriented parks with pedestrian and bicycle recreation ways.
- Incorporate buffer zones between residential areas and the Piʻilani Highway extension corridor.
- Provide a site for future public use in anticipation of need (PBR Hawaiʻi 2010).

The need for the project stems from a substantial unmet demand for housing, including workforce housing, in the Kīhei-Mākena region over the coming two decades. Demand for new residential units in the Kīhei-Mākena region is projected to range from 7,000 to over 10,000 units over the next 22 years. Excluding Honuaʻula, a total of approximately 5,160 units are either currently unsold or planned in the region, resulting in a projected regional shortfall of 1,840–5,686 units. Therefore, Honuaʻula, with its housing units priced for a range of consumer groups, will serve to satisfy the unmet demand for housing in the Kīhei-Mākena region (Hallstrom 2009).

The Honuaʻula project is also needed for the significant economic benefits it will provide. The project is expected to infuse more than 1 billion dollars in capital investment into the Maui economy and create thousands of jobs during the projected 15-year construction and build-out period. After construction, the project will provide hundreds of permanent jobs and contribute over 1.5 million dollars in annual property tax revenue to the County of Maui. Positive economic contributions by the creation of Honuaʻula will include the following (numbers are approximate):

- $1.2 billion of direct capital investment in the Maui economy during the build-out period.
- 9,537 "worker years" of direct on-site employment during the build-out period.
- $480 million in employee wages paid out during the build-out period.
- 518 jobs (382 directly related to on-site activities and 136 related to indirect off-site activities) after the build-out period.
- $19 million in annual wages from the on- and off-site jobs after the build-out period.
- $513.9 million (nearly $40 million annually) in discretionary expenditures into the Maui economy by Honuaʻula residents and guests during the build-out period.

- $77 million annually in discretionary expenditures into the Maui economy by Honuaʻula residents and guests after the build-out period.
- $41.8 million in net tax revenue benefit (taxes less costs) to the County of Maui during the build-out period.
- $1.6 million in annual net tax revenue benefit (taxes less costs) to the County of Maui after the build-out period.
- $97 million in net tax revenue benefit (taxes less costs) to the State of Hawaiʻi during the build-out period.
- $1.5 million in annual net tax revenue benefit (taxes less costs) to the State of Hawaiʻi after the build-out period.

Furthermore, if developed, the Honuaʻula project will contribute significantly to the provision of public services by providing $5 million to the County for the development of the South Maui Community Park, $3.45 million to the Department of Education, 2 acres (0.8 ha) of land to the creation of a fire station, and $550,000 to the county for the development of a police station.

2. DESCRIPTION OF HABITAT CONSERVATION PLAN

2.1. Purpose of this Habitat Conservation Plan

Activities occurring on Honua'ula's proposed property over the life of the project may result in the incidental take of three federally listed endangered species—Blackburn's sphinx moth, 'āwikiwiki, and Hawaiian goose or nēnē. Additionally, two species that are proposed endangered—assimulans yellow-faced bee and anthricinan yellow-faced bee—have the potential to be impacted by the proposed project (Table 2). These five species (three endangered and two proposed endangered) are hereafter collectively referred to as the "Covered Species."

The project will result in permanent habitat loss for the endangered Blackburn's sphinx moth because host plants of this moth occur on the property. Although all known living 'āwikiwiki plants on the property will be protected, construction and operation of the project may result in take of seeds or take of new recruits previously not recorded. Post-construction activities associated with the proposed golf amenity could attract nēnē, resulting in the potential for incidental take of this species. Finally, the two yellow-faced bee species (*Hylaeus* spp.), which are currently proposed for listing as endangered, could be impacted because their preferred floral resources, 'ilima, could be removed or disturbed.

In addition, implementation of avoidance and minimization measures is expected to avoid any negative impacts on six additional endangered or threatened species that could be attracted to the site during or after construction. These species are the Hawaiian stilt, Hawaiian duck, Hawaiian coot, Hawaiian petrel, Hawaiian hoary bat, and Newell's shearwater (see Table 2). Although no impact is anticipated and no take is requested for these species, avoidance and minimization measures for these species are included in this HCP.

Table 2. Federal and/or State Listed Species Addressed in this Habitat Conservation Plan

Scientific Name	Common, Hawaiian Name(s)	Date Listed	Status*
Covered Species			
Manduca blackburni	Blackburn's sphinx moth	02/01/2000	E
Branta sandwichensis	Hawaiian goose, nēnē	03/11/1967	E
Canavalia pubescens	'Āwikiwiki	06/27/2013	E
Hylaeus assimulans	Assimulans yellow-faced bee	Not applicable	PE
Hylaeus anthracinus	Anthricinan yellow-faced bee	Not applicable	PE
No Take Requested			
Pterodroma sandwichensis	Hawaiian petrel	03/11/1967	E
Puffinus auricularis newelli	Newell's shearwater, 'a'o	10/28/1975	T
Anas wyvilliana	Hawaiian duck, koloa maoli	03/11/1967	E
Himantopus mexicanus knudseni	Hawaiian stilt, ae'o	10/13/1970	E
Fulica americana alai	Hawaiian coot, 'ala ke'oke'o	10/13/1970	E
Asio flammeus sandwichensis†	Hawaiian short-eared owl, pueo	–	–
Lasiurus cinereus semotus	Hawaiian hoary bat, 'ope'ape'a	10/13/1970	E

*E = Federally endangered; T = Federally threatened; PE = Proposed endangered (Federal)

†The Hawaiian short-eared owl is not a federally listed endangered species. Only O'ahu Island populations of the short-eared owl are listed as endangered by the State of Hawai'i.

These species are protected under the ESA, as amended. Because of the documented presence of these species at or near the property and the anticipated take in connection with construction and operation of the proposed project, the Honuaʻula Partners LLC has filed an application for an ITP in accordance with Section 10(a)(1)(B) of the ESA and an ITL pursuant to HRS Chapter 195-D. This HCP has been prepared to fulfill application requirements for these permits. Upon issuance of the ITL and ITP and compliance with any conditions contained therein, Honuaʻula Partners LLC will be authorized to take or clear habitat for the Covered Species in the property, in connection with the otherwise lawful construction and operation of the proposed project.

The purpose of this HCP is to address the following:

- To make the most supportable determinations as to the potential impact that the development could have on the listed species.
- To discuss alternatives to the proposed development and its design, in terms of these impacts.
- To propose appropriate efforts to minimize, mitigate, and monitor these potential impacts to the maximum extent practicable.
- To ensure funding for the completion of these efforts.
- To provide for adaptive management and adjustment of the above measures as determined during implementation of the HCP.

2.2. Scope and Term

This HCP seeks to offset the potential impact of the proposed project on the Covered Species with measures that protect and provide a net benefit to the species island-wide and statewide. Honuaʻula Partners LLC anticipates a 15-year build-out starting in 2016 throughout which this HCP will be in effect. The HCP will also cover post-construction maintenance, management, and operations of the development and golf course. Therefore, the applicant seeks a 30-year ITP and ITL. The ITP and ITL will be issued to take effect at the initiation of construction, during and after which anticipated impacts are expected.

No substantive scientific information regarding the population biology (e.g. distribution and abundance, density, population genetics) of Blackburn's sphinx moth on Maui exists for use in calculating potential take at Honuaʻula. Similar difficulties prevent direct calculation of potential take of ʻāwikiwiki and yellow-faced bees. Therefore, in accordance with the HCP Handbook (Chapter 3, Sections B.2.b. and C.1), a habitat-based approach to quantify take is employed to design on-site and off-site mitigation measures.

2.3. Surveys and Resources

The following sources were used in the preparation of this HCP. Many of these documents cite additional relevant studies:

- EIS and appendices for Wailea 670 (PBR Hawaiʻi 1988)
- Draft EIS and appendices for Honuaʻula (PBR Hawaiʻi 2010)
- Final EIS and appendices for Honuaʻula (PBR Hawaiʻi 2012)
- Ground water resources assessments
- Marine water quality assessment

- Marine environmental assessments
- Golf course best management practices
- *Botanical Survey of Honuaʻula (Wailea 670), Kīhei, Maui* (SWCA 2010a)
- *Botanical Survey of Alternate Water Line Alignments to Honuaʻula* (SWCA 2009)
- *Wildlife Survey of Honuaʻula (Wailea 670), Kīhei, Maui* (SWCA 2010b)
- *Terrestrial Flora and Fauna Survey of the Honuaula (Wailea 670) Water System* (SWCA 2010c)
- *Wildlife Survey of Alternate Water Line Alignments to Honuaʻula* (SWCA 2010d)
- *Honuaʻula (Wailea 670) Conservation and Stewardship Plan, Kihei, Maui* (SWCA 2010e)
- *2013 Survey of* Canavalia pubescens *at Honuaʻula (Wailea 670*) (SWCA 2013)
- *2015 Survey of* Canavalia pubescens *at Honuaʻula (Wailea 670*) (SWCA 2015)
- Tree tobacco surveys at Honuaʻula in 2013 and 2014
- Archaeological inventory surveys
- Cultural impact assessments
- Cultural resources preservation plan
- Archaeological preservation and mitigation plan

3. ENVIRONMENTAL SETTING

3.1. Location, Vicinity, and Climate

The Honuaʻula property encompasses a rectangular area of 670 acres (270 ha) on the southeastern slope of Mt. Haleakalā. The property includes portions of Paeahu, Palauea, and Keauhou Ahupuaʻa, Maui, between 295 and 804 feet (90 and 245 m) in elevation (see Figure 1). Local climatic conditions at the property are characteristic for the dry, sunny, and warm, leeward Kīhei-Mākena coast. Average monthly temperatures in the region range from 71.7 degrees Fahrenheit (°F) (January) to 78.5°F (August) (Western Regional Climate Center 2005). The area is arid, with mean annual precipitation ranging from 16 to 20 inches (406 to 508 millimeters) throughout the region (Maui County Data Book 2008). Northeast trade winds prevail approximately 80%–85% of the time averaging 10–15 miles per hour (mph) during the afternoons, with slightly lighter winds in the mornings and nights. Southerly Kona winds occur most commonly between October and April (Maui County Data Book 2008).

3.2. Topography and Geology

Approximately 495 acres (200 ha) of land in the northern three-quarters of the Honuaʻula property are underlain by older lava flows of the Kula Volcanic Series (ranging from 13,000 to 950,000 years old) (Figure 3). Weathering of lavas led to the formation of a thin layer of soil over the northern portion. Soil depths average 30–50 centimeters (cm) below surface, in areas where bedrock is not exposed (personal communication, M. Dega, Scientific Consulting Services [SCS], 10/02/2014). Approximately 170 acres (70 ha) of younger lava of the Hana Volcanic Series (between 5,000 and 13,000 years old) make up the southern quarter of the property (see Figure 3). The southern lava flows have not undergone extensive weathering. This southern area is characterized by an extremely rough surface composed of broken ʻaʻā

lava blocks called "clinker" with little or no soil accumulation (PBR Hawaiʻi 1988). The soils and lavas covering the property, and the drainage gulches that run across the land, strongly influence the nature of the vegetation that grows there. Altenberg (2010) describes it as follows: "'Aʻā habitat consists of microsites of soil scattered among clinker lava."

3.3. Soils

The USDA Natural Resources Conservation Service, Soil Survey of the Islands of Kauaʻi, Oʻahu, Maui, Molokaʻi, and Lānaʻi (Foote et al. 1972) classifies the soils at the property into four soil types of two soil associations: Keawakapu-Mākena association and Kamaʻole-Oanapuka association. The Natural Resources Conservation Service designates the four on-site soil types as follows:

1) Mākena Loam, stony complex, 3%–15% slopes (MXC) occurs on the lower leeward slopes of Haleakalā, between Mākena and Kamaʻole. It consists of Mākena Loam and Stony Land. Stony Land occurs on low ridges and makes up 30%–60% of the complex. Mākena Loam occurs as gently sloping areas between the low ridges of Stony Land. On the Mākena part of the complex, permeability is moderately slow, runoff is slow to medium, and the erosion hazard is slight to moderate. The available water capacity is approximately 1.8 inches per foot of soil. On the Stony Land part, permeability is very rapid, and there is no erosion hazard. The Mākena part is in capability classification Vis, non-irrigated; stony land part is in capability classification VIIs, non-irrigated.
2) Keawakapu, extremely stony silty clay loam (KNXD) occurs on low uplands. This soil series consists of well-drained, extremely stony soils. These soils developed in volcanic ash. Permeability is moderate. Runoff is slow to medium, and the erosion hazard is slight to moderate. Capability classification is Vis, non-irrigated.
3) Oanapuka very stony silt loam, 7%–25% slopes (OAD) occurs on the lower uplands. This soil series consists of well-drained, very stony soils. These soils developed in volcanic ash and material derived from cinders. Permeability is moderately rapid. Runoff is slow, and the erosion hazard is slight to moderate. Capability classification is Vis, non-irrigated.
4) Very Stony Land (rVS) consists of young ʻaʻā lava that has a thin covering of volcanic ash that locally extends deep into cracks and depressions. The slope ranges from 7% to 30%.

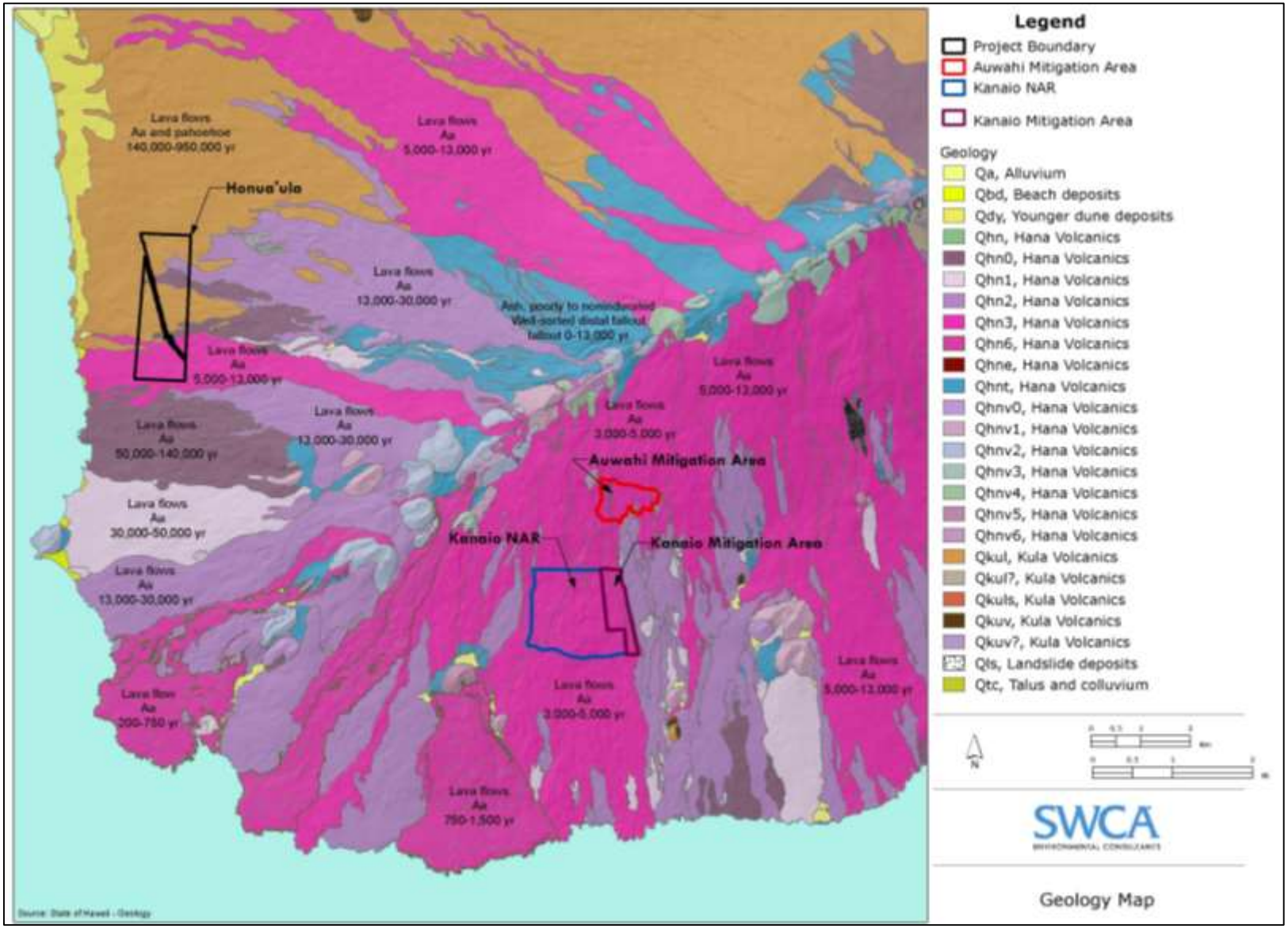

Figure 3. Geologic map of the property (project boundary) and vicinity.

3.4. Hydrology, Drainage, and Water Resources

3.4.1. Surface Water

Hydrological processes in Hawaiʻi are highly dependent on the climatic and geological features, and streamflow is influenced by rainfall and wind patterns. The semi-arid area in which the property is located receives on average an annual rainfall of 18 inches (457 millimeters). Because of the relatively dry conditions at and above the area, gulches traversing the property fill with runoff only during, and briefly following, heavy rainfall events. No perennial streams exist in the property.

3.4.2. Flooding

The Flood Insurance Rate Map prepared by the Federal Emergency Management Agency's National Flood Insurance Program depicts flood hazard zones throughout the state, and classifies lands into four zones depending on the expectation of flood inundation. Most of the property is in flood zone C, which is outside of the 500-year floodplain in an area of minimal flooding.

3.4.3. Groundwater

The property and the wells that will supply the project are in the Kamaʻole Aquifer System, an area delineated and regulated by the State Commission on Water Resource Management. This system comprises a wedge-shaped area of approximately 89 square miles (230 square kilometers [km^2]), with its base along an 11-mile stretch of shoreline from Waiakoa Gulch on the north to Cape Kinaʻu on the south, and its apex at the top of Haleakalā. Based on drilled wells and by geophysical soundings, groundwater in the Kamaʻole Aquifer exists as a basal lens from the shoreline as far inland as the 1,700-foot (518-m) contour (Tom Nance Water Resources Engineers 2010).

3.5. Environmental Contaminants

A phase I environmental site assessment was conducted for Honuaʻula by LandAmerica Assessment Corporation (2007). This assessment included a site reconnaissance as well as research and interviews with representatives of the public, property ownership, site manager, and regulatory agencies. The environmental site assessment did not reveal any evidence of recognized environmental conditions in connection with the property, nor did it find any upgradient sites of potential concern to the property based on review of a database report from Environmental Data Resources for the property and surrounding areas (LandAmerica Assessment Corporation 2007).

3.6. Land Use Designations

Under The State Land Use Law (Act 187), HRS Chapter 205, all lands and waters in the state are classified into one of four districts: Agriculture, Rural, Conservation, and Urban. In addition, land use is dictated by the land use ordinance from the city and county.

The state land use for the property is classified as Urban; the property falls in the county and community plan zoning Project District 9, and does not fall in the special management area.

3.7. Flora

3.7.1. Surveys Conducted

Botanical surveys for the project were first conducted by SWCA in March 2008 and in May 2009 (SWCA 2009, 2010a). Follow-up surveys for ʻāwikiwiki were conducted by SWCA in April 2013 (SWCA 2013), December 2013, and April 2015 (SWCA 2015). Several preceding surveys have been conducted at the property since 1988 (Char and Linney 1988; Char 1993, 2004; SWCA 2006; Altenberg 2007). Most botanical surveys are qualitative descriptions of vegetation and list species observed during relative brief survey periods. The 2008 and 2009 SWCA surveys comprise a thorough quantitative assessment of the property's vegetation, during a period following a wet winter season, which was considered to be the time during which plant abundance is greatest (SWCA 2010a). Nonetheless, vegetation is dependent on dynamic environmental conditions, particularly rainfall and grazing pressure, and may fluctuate seasonally and change over time. Although specific plant diversity and abundances may change, the characterization of the vegetation types is more constant.

Char and Linney (1988) recorded 132 plant species, including 21 native species. They recommended protection of a small area in the southwestern corner of the property where they found ʻāwikiwiki and other uncommon native plants; however, unknown persons subsequently bulldozed the area, and all of these plants were lost. SWCA recorded 146 plant species in the property in 2008 and 2009. Of these, 26 species are native to the Hawaiian Islands, 14 of these endemic. The remaining 120 plant species are introduced non-native species.

Altenberg (2007) found 20 native plants, including 12 endemic species, and identified four native species not previously recorded by Char and Linney (1988) or Char (1993, 2004). These are pua kala (*Argemone glauca*), alena (*Boerhavia repens*), ʻakoko (*Euphorbia celastroides* var. *lorifolia*), and ʻānunu (*Sicyos pachycarpus*). However, Char and Linney (1988) and Char (1993, 2004) reported five species not found later by Altenberg (2007): maidenhair fern (*Adiantum capillus-veneris*), pellaea (*Pellaea ternifolia*), kākonakona (*Panicum torridum*), pōpolo (*Solanum americanum*), and alena (*Boerhavia repens*). Altenberg (2007) suggested that Honuaʻula contains much of the third-largest contiguous area of wiliwili (*Erythrina sandwicensis*) habitat on Maui and recommended the southwestern 110 acres (45 ha) be protected for its ecological value.

Char and Linney (1988) divided the vegetation on the property into three distinct vegetation types: 1) kiawe/buffelgrass pasturelands, 2) gully vegetation, and 3) scrub vegetation. More recent data from the USGS's Gap Analysis Program (USGS 2006) classifies land cover in the property largely as Open Kiawe Forest and Shrubland (alien grasses), Uncharacterized Open-Sparse Vegetation, with small patches of Alien Grassland and Alien Forest (Figure 4). SWCA (2010a) described three distinct vegetation types in the property: kiawe-buffelgrass grassland, mixed kiawe-wiliwili shrubland, and gulch vegetation (Figure 5), similar to the three categories described by Char and Linney (1988).

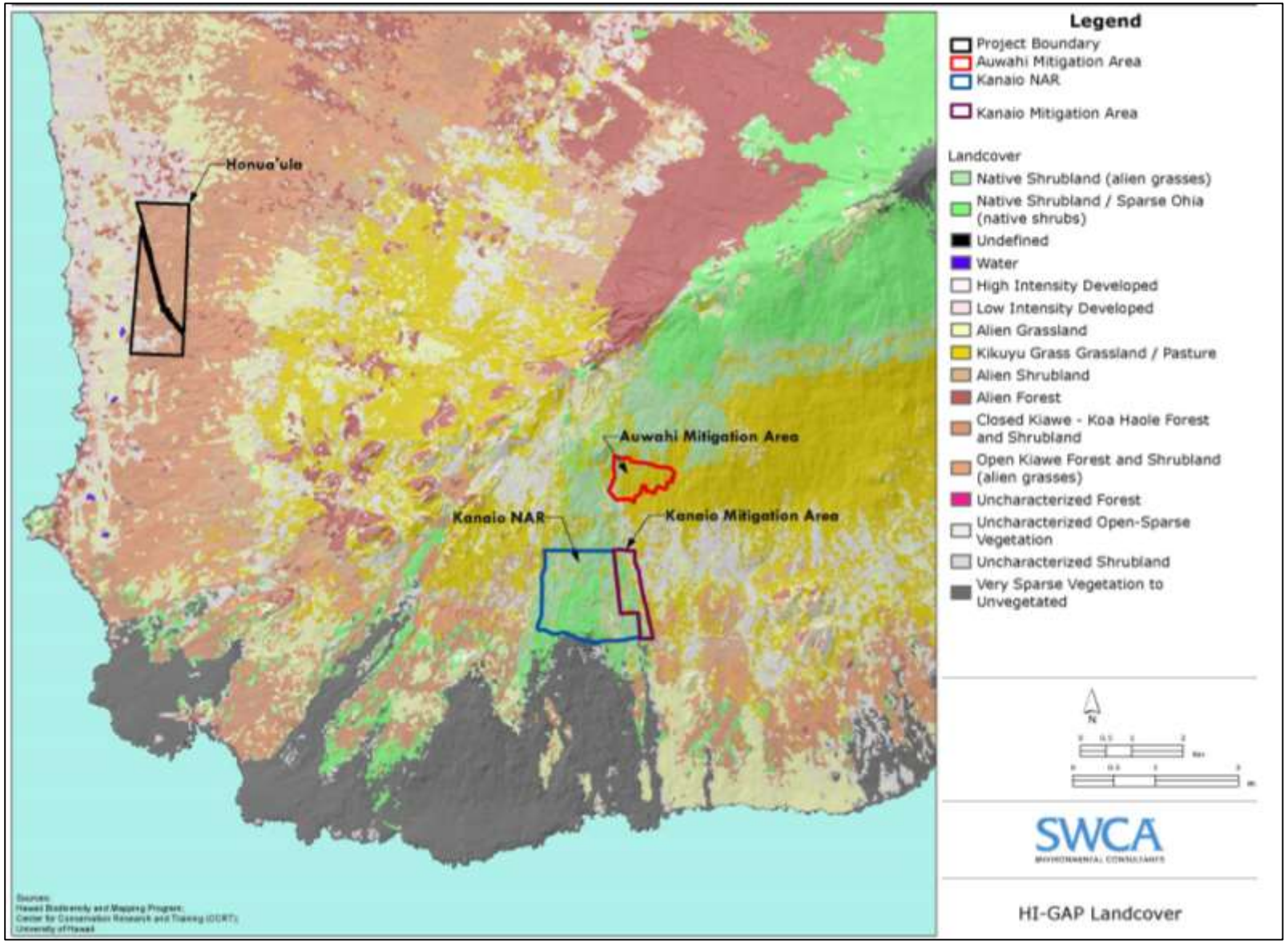

Figure 4. Hawai'i U.S. Geological Service's Gap Analysis Program data in and near the property (project boundary).

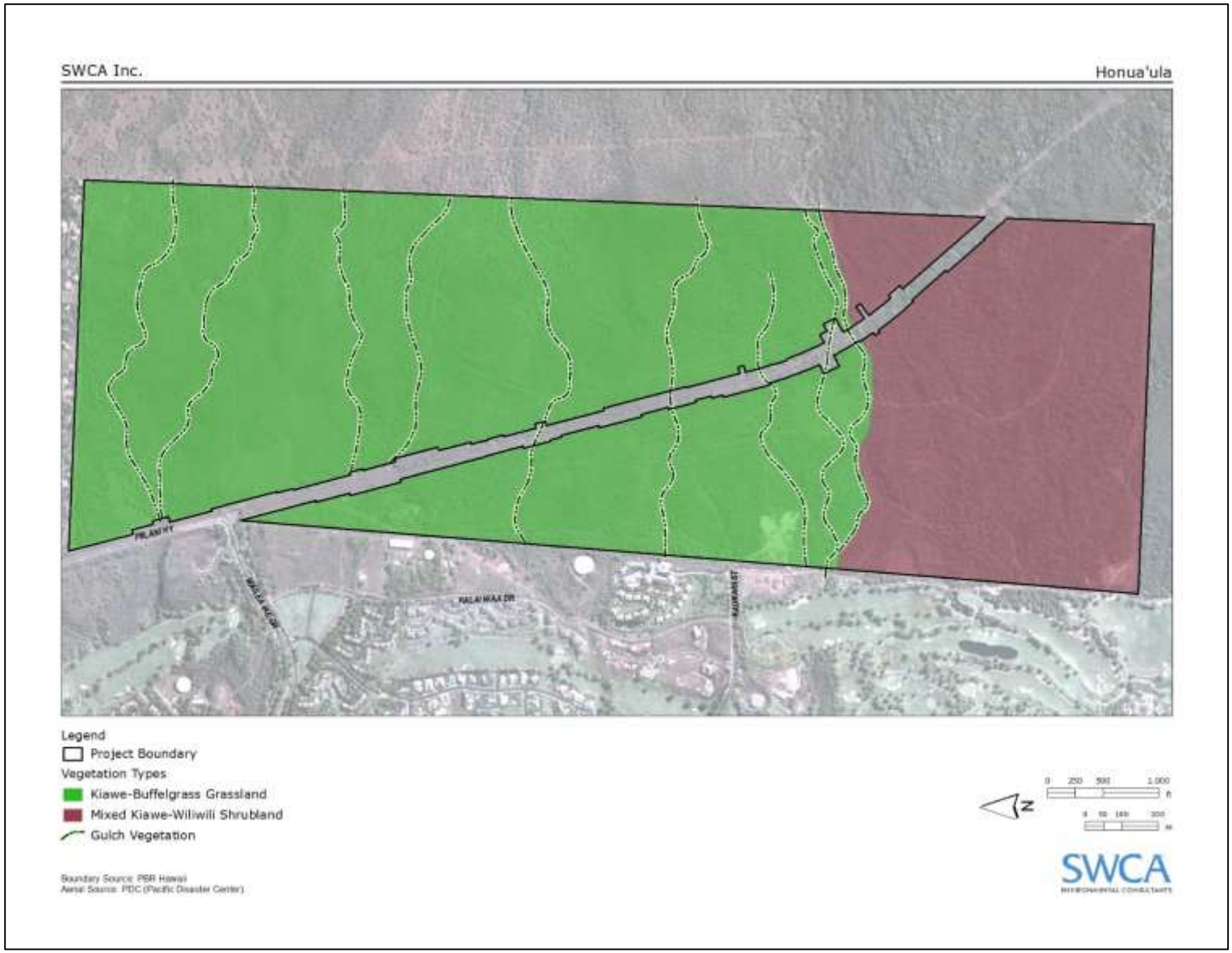

Figure 5. Vegetation types in the property (project boundary).

Approximately 75% of the northern portion of the property is characterized by an extensive grassland comprising primarily kiawe and buffelgrass (SWCA 2010a). Guinea grass, natal redtop (*Melinis repens*), and sour grass (*Digitaria insularis*) were also scattered throughout the northern portion of the property. Other plants found in this area include mostly invasive aliens, most notably koa haole, lantana (*Lantana camara*), partridge pea (*Chamaecrista nictitans*), and cow pea. The area has been disturbed throughout by numerous jeep trails and unrestricted grazing by axis deer (*Axis axis*). Some open areas that appeared to be heavily grazed were devoid of buffelgrass but contained the native shrubs ʻilima (*Sida fallax*) and hoary abutilon (*Abutilon incanum*), and the introduced golden crown-beard (*Verbesina encelioides*). The vast expanse of kiawe-buffelgrass in the northern three quarters of the property is bisected from east to west by several gulches that carry flood waters to the sea during and briefly after heavy rainfall events. These intermittent gulches vary in depth and are shaded by their steep walls, providing relatively cool and moist conditions, resulting in a unique vegetation type. Three species of ferns including maidenhair fern, sword fern (*Nephrolepis multiflora*), and the endemic ʻiwaʻiwa fern (*Doryopteris decipiens*) were found in the shaded rocky outcrops and crevices in the gulches.

Native pili grass (*Heteropogon contortus*) was found in more open and sunny locations around the gulches. Other species found in the gulches include tree tobacco (*Nicotiana glauca*), wiliwili, lantana, partridge pea, golden crown-beard, ʻilima, hoary abutilon, koa haole, indigo (*Indigofera suffruticosa*), ʻuhaloa (*Waltheria indica*), and lion's ear (*Leonotis nepetifolia*). Remnant mixed kiawe-wiliwili shrubland was limited to the southern ʻaʻā lava flow in the southern quarter of property (see Figure 5). Scattered groves of wiliwili and kiawe trees co-dominated the upper story. Native shrubs, such as ʻilima and maiapilo (*Capparis sandwichiana*), and the native vine ʻānunu, were represented in the understory. Ground vegetation in these and all areas was dominated by introduced shrubs, introduced grasses, and introduced vines and herbaceous species. Lantana, found throughout the mixed kiawe-wiliwili shrubland, showed signs of dieback. Guinea grass found on the property, although abundant, was grazed to stubble, probably by axis deer.

SWCA conducted a thorough, quantitative assessment of the vegetation on the property, including gathering spatially explicit information on native species and their distribution. Figure 6 illustrates the distribution of native plant species on the property by count according to the surveys conducted in 2008. Table 3 below lists native plant species recorded on the property by SWCA (2010a). Table 4 lists the occurrence of adult and seedling native plants identified on the property by SWCA in 2008 (SWCA 2010a). A detailed report of the analysis and findings can be found in Appendix 1.

In addition, surveys were done by SWCA for off-site areas impacted by creation and/or improvements of waterlines, but no significant findings were reported in terms of sensitive or listed native species (SWCA 2009, 2010c). The proposed off-site areas were surveyed by Xamanek Researches (1994), and no sensitive or native species were documented.

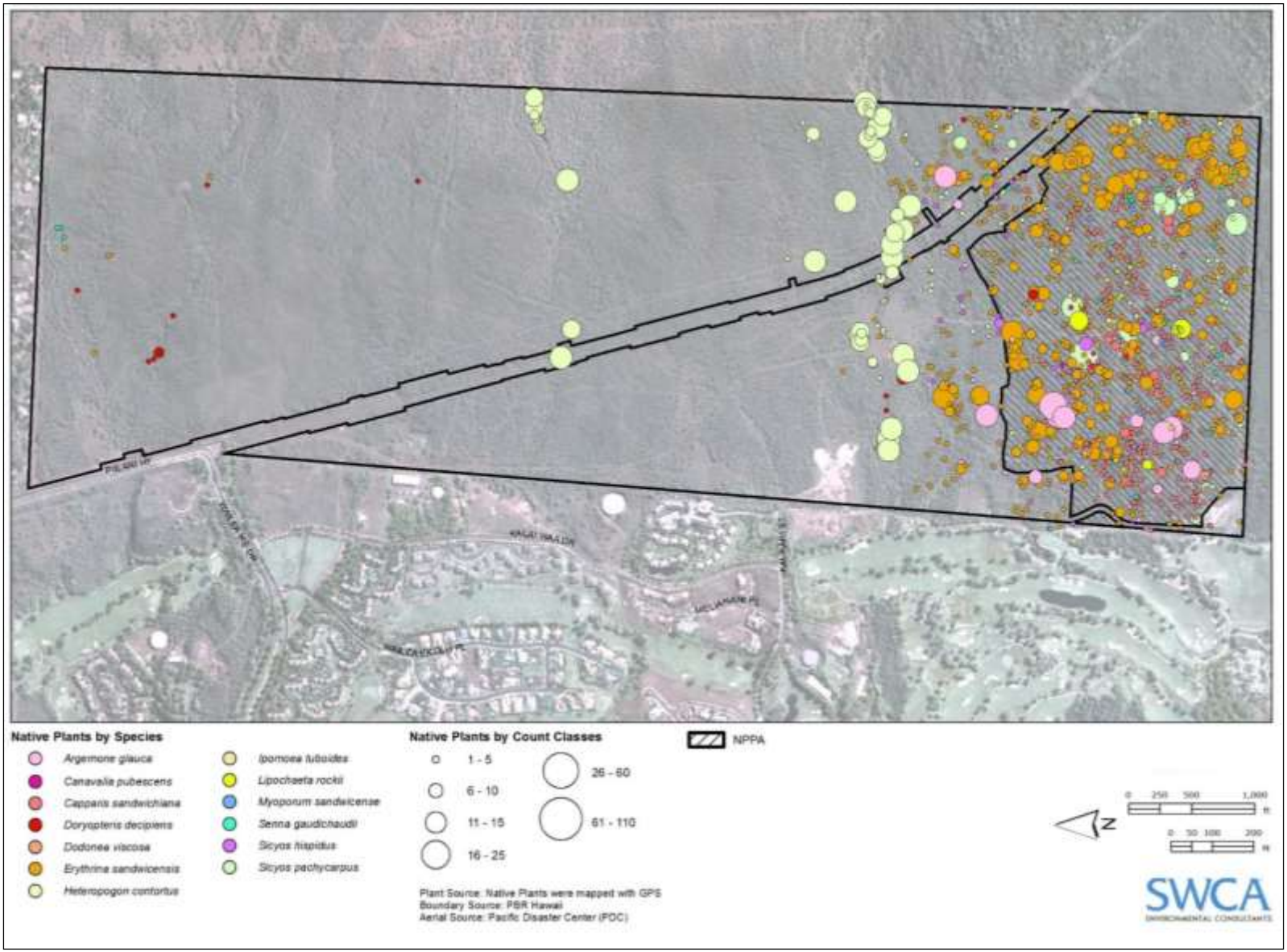

Figure 6. Native plant count classes in the property, from SWCA (2010a).

Table 3. Native Plants Reported from the Property Arranged in Order of their Relative Importance

Species	Status	Hawaiian or Common Name	Family
Group 1			
Lipochaeta rockii	E	nehe	Asteraceae
Canavalia pubescens	E	ʻāwikiwiki	Fabaceae
Erythrina sandwicensis	E	wiliwili	Fabaceae
Capparis sandwichiana	E	maiapilo	Capparaceae
Senna gaudichaudii	I	kolomona	Leguminoceae
Sicyos hispidus	E	ʻānunu	Cucurbitaceae
Sicyos pachycarpus	E	ʻānunu	Cucurbitaceae
Euphorbia celastroides var. *lorifolia**	E	ʻakoko	Euphorbiaceae
Argemone glauca	E	pua kala	Papavaraceae
Group 2			
Myoporum sandwicense	E	naio	Myoporaceae
Panicum torridum	E	kakonakona	Poaceae
Heteropogon contortus	E	pili	Poaceae
Ipomoea tuboides	E	ipomea	Convolvulaceae
Boerhavia herbstii	E	alena	Nyctaginaceae
Doryopteris decipiens	E	ʻiwaʻiwa	Pteridaceae
Plumbago zeylanica	E	ʻilieʻe	Plumbaginaceae
Group 3			
Dodonaea viscosa	I	ʻaʻaliʻi	Sapindaceae
Sida fallax	I	ʻilima	Malvaceae
Boerhavia sp.	I	alena	Nyctaginaceae
Abutilon incanum	I	hoary abutilon	Malvaceae
Ipomoea indica	I	koali awahia	Convolvulaceae
Waltheria indica	I	ʻuhaloa	Malvaceae
Pellaea ternifolia	I	pellaea	Pteridaceae
Adiantum capillus-veneris	I	maidenhair fern	Pteridaceae

Source: SWCA (2010a).

Notes: Group 1 = endemic (E) and indigenous (I) plants uncommon in the property as well as elsewhere in the state, and/or of significance to life stages of the endangered Blackburn sphinx moth; Group 2 = relatively common endemic species throughout Hawaiʻi Group 3 = relatively common native species throughout Hawaiʻi.

* A single stunted ʻakoko was found in the project area in 2006; however, the plant was found to be dead in the late summer of 2007, and was not found at all during the 2008 surveys. Therefore, it is not considered in further plant density analysis for the purpose of defining boundaries of the native plant preserve.

Based on the observed distribution and composition of native plants in the property, it is apparent that the southern ʻaʻā lava flow, which is partially demarcated by the stone wall that runs mauka makai across the northern margin of the flow, is a remnant native dry shrubland (Gagne and Cuddihy 1999). Many have

stated that native dry forests and dry shrublands are among the most endangered ecosystems in Hawaiʻi, and as some believe, in the world (Rock 1913; Noss and Peters 1995; Bruegmann 1996; Allen 2000; Cabin et al. 2000, 2001; Medeiros 2006, Altenberg 2007, 2010). Like many areas in the state, however, the intrinsic ecological significance of this remnant native habitat was not recognized until recently. Previous biological surveys of the property dating back to the mid-1980s have failed to note this, and no government efforts were ever undertaken to protect this area as a remnant native dry forest. As it passed through numerous public zoning and entitlement processes over the years, the land was converted to urban district and approved for development without expressed concern from any county, state, or federal agency that the property was of any interest or biological significance. The southern portion of the property was not recognized as containing components of a native dry shrubland ecosystem until the recent work of SWCA (2006) and Altenberg (2007). However, the property's condition is most accurately described as degraded, particularly the northern 500 acres (202 ha). As previously noted, the property is designated Urban and zoned as Project District 9, and it has been slated for development since at least 1988. It has been subject to historic disturbances by wartime training maneuvers and uncontrolled grazing by feral ungulates, and it is crisscrossed by bulldozed access roads.

Table 4. A Comparison of the Number of Native Plants and Seedlings Observed in the Entire Honuaʻula Property and the Remnant Mixed Kiawe-Wiliwili Shrubland in the Southern Portion of the Property

Species (Hawaiian name)	Number of Points			Number of Seedlings			Number of Adults			Total Numbers Observed		
	KW	Prop	NPPA	KW	Prop	NPPA	KW	Prop	NPPA	KW	Prop	NPPA
Argemone glauca (pua kala)	26	26	13	247	247	173	165	165	131	412	412	304
Canavalia pubescens ('āwikiwiki)	5	5	5	0	0	0	5	5	5	5	5	5
Capparis sandwichiana (maiapilo)	311	312	307	14	14	14	548	549	529	562	563	543
Dodonaea viscosa (ʻaʻaliʻi)	7	7	6	0	0	0	16	16	14	16	16	14
Doryopteris decipiens (ʻiwaʻiwa)	2	14	1	0	2	0	7	52	6	7	54	6
Erythrina sandwicensis (wiliwili)	546	569	405	334	341	289	2105	2137	1702	2439	2478	1991
Heteropogon contortus (pili)	0	66	0	0	384	0	0	1109	0	0	1493	0
Ipomoea tuboides (ipomea)	5	5	4	0	0	0	5	5	4	5	5	4
Lipochaeta rockii (nehe)	24	24	24	56	56	56	45	45	45	101	101	101
Myoporum sandwicense (naio)	17	17	16	0	0	0	21	21	19	21	21	19
Senna gaudichaudii (kolomona)	28	32	25	1	5	1	36	38	33	37	43	34
Sicyos hispidus (ʻānunu)	48	49	24	5	5	5	107	108	56	112	113	61
Sicyos pachycarpus (ʻānunu)	101	102	72	313	313	294	289	290	237	602	603	531

Notes: Prop = entire Honuaʻula Property, KW = kiawe-wiliwili shrubland, NPPA = Native Plant Preservation Area.

Source: Adapted from SWCA (2010a)

3.7.2. Covered Plant Species

3.7.2.1. ʻĀWIKIWIKI

ʻĀwikiwiki first became a candidate for listing in 1997 and was listed as endangered in June 2013. Five ʻāwikiwiki individuals were found in the property by SWCA in 2008 (SWCA 2010a). During the March 2013 ESRC meeting, several members expressed concern that ʻāwikiwiki may occur elsewhere on the property given that the survey was conducted several years ago. SWCA resurveyed portions of the ʻaʻā lava flow in April 2013 to update the current distribution of ʻāwikiwiki in the property. None of the five ʻāwikiwiki individuals recorded during 2008 were alive during the April 2013 survey. However, a single live seedling was observed adjacent to one of the dead adults, and seeds were seen under several plants. Two additional dead plants (and associated seeds) that were not recorded during the 2008 survey were observed (SWCA 2013). In December 2013, an additional five ʻāwikiwiki individuals were recorded along the western boundary of the property. In April 2015, nine individuals were observed in the NPPA, of which eight were living during the survey. All of the individuals were seen in the immediate vicinity of previously recorded sites, except one individual along the northwest boundary of the NPPA (SWCA 2015).

In addition to the individuals recorded during SWCA surveys and consultation, Maui Cultural Lands volunteers have identified additional sites and individual plants on the property. Based on volunteer efforts, Maui Cultural Lands reported five sites on the property containing 19 plants in June 2014. A map showing ʻāwikiwiki that have been sighted by volunteers is included in Appendix 2.

All living ʻāwikiwiki plants observed by SWCA between 2008 and 2015 are in the NPPA (perpetual preservation easement), and will therefore be protected. However, additional locations containing ʻāwikiwiki plants have been observed (see Appendix 2). It is possible that ʻāwikiwiki seeds occur outside of the NPPA, and new plants could germinate after heavy rains. Therefore, it is assumed that plants and seeds may occur outside of the proposed NPPA, and ʻāwikiwiki is included as a Covered Species. A final, detailed survey for ʻāwikiwiki will be performed before the HCP is finalized, and pre-construction surveys are included in the HCP as a measure to adequately assess impacts to ʻāwikiwiki, and to assure incidental take does not exceed authorized take. No other federal- or State of Hawaiʻi–listed threatened or endangered plant species have been found on the property (Char and Linney 1988; Char 1993, 2004; SWCA 2006; Altenberg 2007, SWCA 2010a).

Population, Biology, and Distribution of ʻĀwikiwiki. ʻĀwikiwiki is a perennial climbing liana with pubescent, trifoliate leaves. The flowers occur in clusters of 8–20, and are typical of pea-like plants, usually colored a dark red, pink, or purple with a white spot and streaking at the base of the petals. Seed pods are 12–18 cm long (5–7 inches) and contain large brown to reddish brown seeds. Currently ʻāwikiwiki is uncommon, and is found only in open, dry sites such as open lava fields, kiawe thickets, and dry forests at 15–540 m (49–1,770 feet) in elevation on leeward East Maui. Historically, it was also known to occur on Niʻihau, Kauaʻi, and Lānaʻi (Wagner et al. 1990; USFWS 2010, 2012).

Current Threats to ʻĀwikiwiki. The remaining populations of ʻāwikiwiki on Maui are threatened by feral goats and axis deer that directly predate the plants, and degrade and destroy habitat by destroying native plants and disrupting topsoil, leading to erosion and establishment of introduced and invasive species. Additional threats may include drought, fire, and competition from invasive plant species. Because of anticipated increased impacts resulting from an increasing deer population, ʻāwikiwiki is believed to be in decline.

Occurrence of ʻĀwikiwiki on Maui and at the Property. The current remaining population on Maui is estimated at 200 individuals (USFWS 2012), in four scattered populations on East Maui, most of which are located on state lands: Keokea and Puʻu o Kali, Papaka Kai, southeast Pohakea, and Honuaʻula. Most of these individuals occur at Puʻu o Kali. All ʻāwikiwiki individuals formerly found in the ʻAhihi-Kinaʻu Natural Area Reserve (NAR) on Maui were destroyed by feral goats by the end of 2010. Five individual ʻāwikiwiki were found in the ʻaʻā portion of the property by SWCA in 2008. All ʻāwikiwiki were flowering and fruiting during the survey. The plants appeared to be healthy with no signs of damage or disease (SWCA 2010a). Following the extensive drought in October 2010, ʻāwikiwiki stems at Honuaʻula were dry and leafless; however, seeds in pods were abundantly present on the desiccated vines. No ʻāwikiwiki seedlings were observed in pre- and post-drought reconnaissance surveys conducted by SWCA in the fall of 2010 and spring of 2011. None of the adult ʻāwikiwiki individuals recorded during the 2008 SWCA survey were alive during a survey conducted by SWCA in April 2013. However, a single live seedling was observed adjacent to one of the dead adults, and seeds were seen on the ground under several plants. Two additional dead plants (and associated seeds) not recorded during the 2008 survey were also observed in the NPPA in 2013 (SWCA 2013). Five additional live ʻāwikiwiki individuals were observed by SWCA near the western boundary of the property in December 2013. In April 2015, a follow-up survey was conducted in the southern ʻaʻā lava flow portion of the Honuaʻula property (SWCA 2015). During the April 2015 survey, SWCA did not observe any ʻāwikiwiki individuals in the surveyed areas outside the NPPA. Nine individuals were observed in the NPPA, of which eight were living during the survey. All of the individuals were seen in the immediate vicinity of previously recorded sites, except one individual along the northwest boundary of the NPPA. Considering the relative short-lived natural history of the species, the distribution of ʻāwikiwiki changes over time, and in response to rainfall events and grazing pressure from axis deer.

3.8. Fauna

3.8.1. Surveys Conducted

Wildlife surveys of the property were conducted by SWCA in 2008 and 2009 (SWCA 2010b). The results of the primary wildlife survey by SWCA is provided in Appendix 10. Several preceding wildlife surveys have been conducted at the property since 1988 (Bruner 1988, 1993, 2004), in conjunction with above-mentioned botanical surveys. During these surveys, no native birds, mammals, or invertebrates were observed on the property (Bruner 1988, 1993, 2004).

3.8.2. Non-Listed Wildlife Species

3.8.2.1. BIRDS

Bruner (1988, 1993, 2004) found no substantial changes in the abundance or composition of alien bird species on the property between his surveys, encompassing a span of 16 years. In his most recent survey, Bruner (2004) found house finch (*Haemorhous mexicanus*), Japanese white-eye (*Zosterops japonicus*), black francolin (*Francolinus francolinus*), and zebra dove (*Geopelia striata*) to be the most abundant birds on the property. In May and September 2008, SWCA recorded 16 species of introduced birds on the property (Table 5). The most abundant alien birds during these surveys were Japanese white-eye, nutmeg manikin (*Lonchura punctulata*), zebra dove, and northern cardinal (*Cardinalis cardinalis*). Along the southern border of the property, African silverbill (*Lonchura cantans*) and red-crested cardinal (*Paroaria coronata*) were more common (SWCA 2010b). SWCA (2010b) recorded four alien bird species that were not recorded by Bruner (1988, 1993, and 2004): cattle egret (*Bubulcus ibis*), mourning dove (*Zenaida macroura*), chestnut munias (*Lonchura atricapilla*), and Erckel's francolin (*Francolinus erckelii*). The francolin recording was based on an auditory observation. This species has never before been recorded in

Maui, and this observation may represent a misidentification. These four alien bird were relatively rare during SWCA's 2008 surveys. In addition, surveys were done by SWCA for off-site areas impacted by creation and/or improvements of waterlines, but no significant findings were reported in terms of sensitive or listed native species (SWCA 2010c, 2010d). Additional surveys were conducted by Xamanek Researches (1994), and no sensitive or native species were documented.

Besides the Hawaiian short-eared owl, or pueo (*Asio flammeus sandwichensis*), the only resident native bird detected on the property is the cosmopolitan black-crowned night-heron, or auku'u (*Nycticorax nycticorax*). One black-crowned night-heron was observed flying across the property (SWCA 2010b). Visiting migratory species were seen on the property during chance, or opportunistic sightings. SWCA biologists have seen Pacific golden-plovers (*Pluvialis fulva*) on several occasions during the winter months on lawns and golf courses adjacent to the property, and Bruner (1988) recorded one Pacific golden-plover during his February 1988 survey of the property. One northern harrier (*Circus cyaneus*), which is not commonly sighted in the Hawaiian Islands, was seen flying over the property in 2006 by an SWCA biologist (SWCA 2010b).

Although seabirds spend most of their time over the ocean, they nest on land, and may fly over the property to and from their nesting sites, or in search of fresh water or thermals. Non-listed seabirds that may be seen flying over the property include the great frigatebird (*Fregata minor*) and tropicbirds (*Phaeton* spp.).

Table 5. Bird Species and Relative Abundance Observed on the Honua'ula Property during SWCA's Bird Surveys in May and September 2008

Species	Common Name	Status	Birds per Point Count (n = 30)	Abundance Rank
Asio flammeus sandwichensis	Pueo	N	x	–
Bubulcus ibis	Cattle egret	I	x	–
Zenaida macroura	Mourning dove	I	0.03	12
Francolinus erckelii	Erckel's francolin	I	0.03	12
Francolinus pondicerianus	Gray francolin	I	0.23	9
Francolinus francolinus	Black francolin	I	0.73	5
Streptopelia chinensis	Spotted dove	I	0.30	7
Geopelia striata	Zebra dove	I	1.70	3
Tyto alba	Barn owl	I	x	–
Zosterops japonicus	Japanese white eye	I	3.50	1
Mimus polyglottos	Common mockingbird	I	0.03	12
Acridotheres tristis	Common myna	I	0.07	11
Cardinalis cardinalis	Northern cardinal	I	1.3	4
Carpodacus mexicanus	House finch	I	0.23	9
Lonchura punctulata	Nutmeg mannikin	I	3.03	2
Lonchura atricapilla	Chestnut munia	I	x	–
Lonchura cantans	African silverbill	I	0.67	6

Source: SWCA (2010b)

Notes: I = introduced, N = native, x= observed outside point counts.

Hawaiian Short-Eared Owl or Pueo

Population, Biology, and Distribution of Pueo. The Hawaiian short-eared owl is an endemic subspecies of the nearly cosmopolitan short-eared owl (*Asio flammeus*). This is the only extant owl native to Hawaiʻi and is found on all the main islands from sea level to 8,000 feet (2,450 m). The Hawaiian short-eared owl is listed by the State of Hawaiʻi as endangered on the Island of Oʻahu, but it is not listed on Maui. Unlike most owls, Hawaiian short-eared owls are active during the day (Mostello 1996; Mitchell et al. 2005), though nocturnal or crepuscular activity has also been documented (Mostello 1996). Hawaiian short-eared owls are commonly seen hovering or soaring over open areas (Mitchell et al. 2005).

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

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

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

Hawaiian short-eared owls nest on the ground. Little is known about their breeding biology, but nests have been found throughout the year. Nests are constructed by females and consist of simple scrapes in the ground lined with grasses and feather down. Females perform all incubating and brooding, and males feed females and defend nests. The young may leave the nest on foot before they are able to fly and depend on their parents for approximately 2 months (Mitchell et al. 2005).

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

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

Occurrence of Pueo on Maui and at the Property. Six pueo have been observed on the property over the course of SWCA's wildlife surveys (2010b) and associated field trips (Figure 7). Twelve barn owls (*Tyto alba*) and six other unidentified owls have been sighted in the kiawe-buffelgrass grasslands in the northern portion of the property. No pueo or barn owls have been sighted in the southern kiawe-wiliwili shrubland, and no owl nests were found anywhere on the property. Bruner (1988, 1993, and 2004) did not record any pueo in the property during any of his surveys.

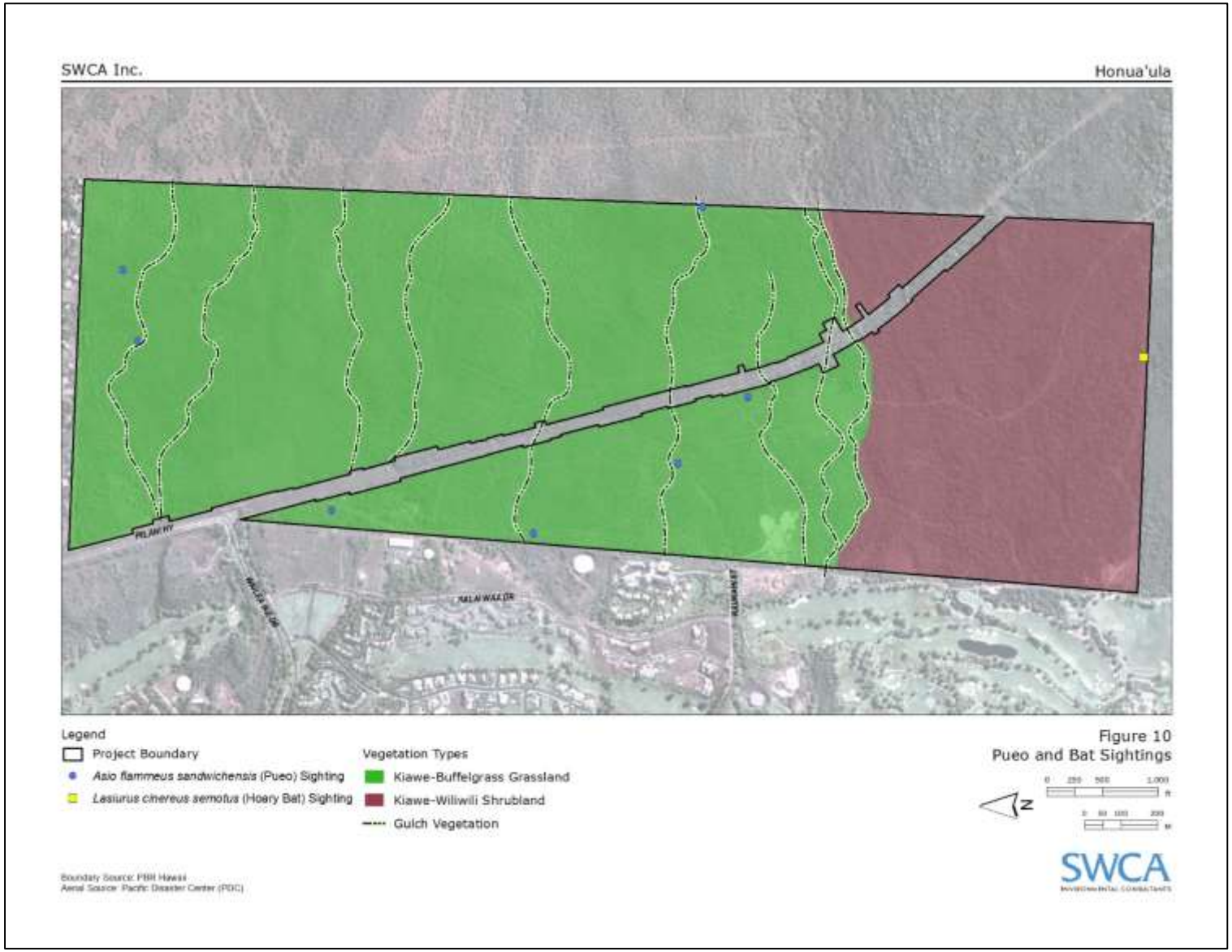

Figure 7. Owl and bat sightings in the property (project boundary), from SWCA (2010a).

3.8.2.2. HERPETOFAUNA

No native land reptiles or amphibians occur in Hawaiʻi (McKeown 1996). Geckos (Gekkonidae) were heard calling by SWCA (2010b) on the property and along jeep roads on the southern border of the property, but were not seen. No skinks (Scincidae) or amphibians have been recorded at the property.

3.8.2.3. MAMMALS

Historically, the property has been exposed to cattle (*Bos taurus*) grazing. Feral goats (*Capra hircus*) and axis deer have had unrestricted access to the property and pose a serious threat to the native plant species and the integrity of the remnant mixed kiawe-wiliwili shrubland. Recently, Honuaʻula Partners, LLC constructed a cattle fence preventing cattle from entering the kiawe-wiliwili shrubland in the southern portion of the property, but cattle are still occasionally grazed in the northern portion of the property and more regularly east of the property on lands owned by ʻUlupalakua Ranch. SWCA (2010b) did not record the presence or evidence of cattle, but following their survey, cattle were allowed to graze in the northern kiawe-buffelgrass lands on the property. Small herds of 4–30 axis deer were commonly seen during surveys of the property (SWCA 2010b), and deer scat, tracks, and evidence of buck rubs (rubbing of antlers on trees) were commonly seen. Deer have also been recorded on the property by Bruner (1988, 1993, 2004). Although goats have been reported on the property, none were observed during any of the surveys. Mongoose have been recorded on the property by Bruner (1988, 1993, 2004), and have more recently been observed on the property by SWCA biologists. Other small mammals, including cats, rats, and mice (*Mus musculus*), are likely present on the property because of its proximity to the Maui Meadows subdivision and the Wailea Resort (see Figure 1). The fact that small mammals have not been recorded on the property may be because of their nocturnal, secretive, and cryptic nature. Rodent remains have been detected in owl pellets found on the property.

3.8.3. Listed Wildlife Species with No Requested Take

None of the four endangered Hawaiian waterbird species or the two endangered seabird species are known to occur in the property, and no suitable habitat for these species exists there. However, these six species may be attracted to portions of the property (USFWS 1995) following construction. Although no water features are planned for the golf amenity, the waterbirds may be attracted to features associated with the golf amenity, and juvenile seabirds may be attracted and disoriented by lights on the property. The Hawaiian hoary bat has been observed only once at the property (SWCA 2010b), and low numbers of bats, if any, may use trees in the property for roosting and/or pupping.

3.8.3.1. HAWAIIAN HOARY BAT

Population, Biology, and Distribution of the Hoary Bat. The Hawaiian hoary bat is the only native land mammal present in the Hawaiian archipelago. It is a sub-species of the hoary bat (*Lasiurus cinereus*), which occurs across much of North and South America. Males and females have a wingspan of approximately 0.3 m (1 foot), although females are typically larger and heavier than males, weighing on average 17.9 grams (0.6 ounce). Males average 14.2 grams (0.5 ounce). Both sexes have a coat of brown and gray fur. Individual hairs are tipped or frosted with white (Mitchell et al. 2005; Jacobs 1993).

The Hawaiian hoary bat has been recorded on Kauaʻi, Oʻahu, Molokaʻi, Maui, and Hawaiʻi, but little historical population estimates or information exist for this subspecies. Recent population estimates for all islands in the state have ranged from hundreds to a few thousand bats (Menard 2001). The Hawaiian

hoary bat is believed to occur primarily below an elevation of 1,220 m (4,000 feet). This subspecies has been recorded between sea level and approximately 2,760 m (9,050 feet) in elevation on Maui, with most records occurring at or below approximately 628 m (2,060 feet), although research has shown some degree of altitudinal movement over seasons (USFWS 1998; Gorresen et al. 2013).

Hawaiian hoary bats roost in native and non-native vegetation from 1 to 9 m (3 to 29 feet) above ground level. They have been observed roosting in ʻōhiʻa (*Metrosideros polymorpha*), hala (*Pandanus tectorius*), coconut palms (*Cocos nucifera*), ironwood (*Casuarina equisetifolia*), kukui (*Aleurites moluccana*), kiawe tree, avocado (*Persea americana*), mango (*Mangifera indica*), shower trees (*Cassia javanica*), pūkiawe (*Leptecophylla tameiameiae*), and fern clumps; they are also suspected to roost in eucalyptus (*Eucalyptus* spp.) and Sugi pine (*Cryptomeria japonica*) stands. The species has been rarely observed using lava tubes, cracks in rocks, or human-made structures for roosting. While roosting during the day, Hawaiian hoary bats are solitary, although mothers and pups roost together (USFWS 1998; Kawailoa Wind Power 2014).

A preliminary study (November 2004 to August 2008) of a small sample of Hawaiian hoary bats (n = 28) on the Island of Hawaiʻi had a mean, estimated, short-term (3–13 calendar days) core use area of 25.5 ha (63.0 acres) (Bonaccorso et al. 2015). The size of home ranges and core areas varied widely among individuals. Core areas included feeding ranges that were actively defended, especially by males, against conspecifics. Female core ranges overlapped with male ranges. Hawaiian hoary bats typically feed along a line of trees, forest edges, or roads, and a typical feeding range stretches approximately 275 m (902 feet). Hawaiian hoary bats will spend 20–30 minutes hunting in a feeding range before moving on to another (Bonaccorso 2011).

It is suspected that breeding primarily occurs between May and October (Gorresen et al. 2013). Lactating females have been documented from June to August, indicating that this is the period when non-volant young are most likely to be present. Breeding has been documented on the Islands of Hawaiʻi and Kauaʻi, as well as a singular observation on Oʻahu (Baldwin 1950; Kepler and Scott 1990; Menard 2001; Kawailoa Power, LLC. 2014). Seasonal changes in the abundance of Hawaiian hoary bats at different elevations indicate that altitudinal movements occur on the Island of Hawaiʻi. During the breeding period (May through October), Hawaiian hoary bat occurrences increase in the lowlands and decrease at high elevation habitats. In the winter, bat occurrences increase in high elevation areas (above 1,525 m [5,000 feet]) from January through March (Bonaccorso 2011; Menard 2001; Gorresen et al. 2013). It is not known whether bats observed on other islands breed locally or only visit these islands during non-breeding periods.

Hawaiian hoary bats feed on a variety of native and non-native night-flying insects, including moths, beetles, crickets, mosquitoes, and termites (Whitaker and Tomich 1983). They appear to prefer moths ranging from 16 to 20 mm (0.60 to 0.89 inch) in size (Bellwood and Fullard 1984; Fullard 2001). Koa moths (*Scotorythra paludicola*), which are endemic to the Hawaiian Islands and use koa (*Acacia koa*) as a host plant (Haines et al. 2009), are frequently targeted as a food source (personal communication, Gorresen, 2013). Microchiroptera bats like the Hawaiian hoary bat locate their prey using echolocation. Typical peak frequency for echolocation hunting behavior occurs at 27.8 kilohertz, whereas social calls are recorded at a peak frequency of 9.6 kilohertz (Bellwood and Fullard 1984). Water courses and edges (e.g., coastlines and forest-pasture boundaries) appear to be important foraging areas (Brooks and Ford 2005; Francl et al. 2004; Grindal et al. 1999; Menzel et al. 2002; Morris 2008). In addition, the Hawaiian hoary bat is attracted to insects that congregate near lights (Bellwood and Fullard 1984; Mitchell et al. 2005; USFWS 1998). They begin foraging either just before or after sunset, depending on the time of year (Mitchell et al. 2005; USFWS 1998; Jacobs 1993).

Current Threats to the Hoary Bat. Little is known regarding threats to the Hawaiian hoary bat. The presumed decline of the species may be due to the decrease in canopy cover during historic times (Tomich 1986; Nowak 1994), in particular the severe deforestation on Oʻahu in the early nineteenth century (Tomich 1986). The main observed mortality of the Hawaiian hoary bat in Hawaiʻi has been from bats snagging on barbed wire and colliding with wind turbines. The extent of the impact of barbed wire fences is unknown, because most are not checked regularly. The extent of mortality at wind farms is well documented because intensive monitoring is carried out to document such fatalities. Other threats may include pesticide use, which in the past has impacted federally listed bat species (Clark et al. 1978), and the introduction of non-native species such as introduced invertebrates, which alter the possible prey composition, and coqui frogs (*Eleutherodactylus* spp.), which have the capacity to attain very high densities (Beard et al. 2009) resulting in reductions of total insect biomass (Bernard 2011).

Occurrence of the Hoary Bat on Maui and at the Property. On Maui, the Hawaiian hoary bat is believed to occur primarily in moist, forested areas, although little is known about its exact distribution and habitat use on the island. Surveys for endangered Hawaiian hoary bats were conducted at the property between 1830 and 0000 from September 19 to 21, 2008, by SWCA biologists. These surveys were conducted under ideal weather conditions using night vision goggles (Morovison PVS-7 Ultra) and an Anabat detector (Titley Electronics, NSW Australia). SWCA biologists sighted a single Hawaiian hoary bat at the southern boundary of the property flying seaward at 18:44 hours during a point-count survey on September 19, 2008 (see Figure 7). Echolocation calls from this individual were simultaneously recorded on the Anabat detector. No other sightings of bats have been made at the property outside of the 2008 surveys.

3.8.3.2. HAWAIIAN PETREL

Population, Biology, and Distribution of Hawaiian Petrels. Hawaiian petrel was once abundant on all main Hawaiian Islands except Niʻihau (Mitchell et al. 2005). The population was most recently estimated to be approximately 20,000, with 4,000–5,000 breeding pairs (Mitchell et al. 2005). Today, Hawaiian petrels continue to breed in high-elevation colonies on Maui, Hawaiʻi, Kauaʻi, and Lānaʻi (Richardson and Woodside 1954; Simons and Hodges 1998; Telfer et al. 1987). Radar studies conducted in 2002 also suggest that breeding may occur on Molokaʻi (Day and Cooper 2002). It is believed that breeding no longer occurs on Oʻahu (Harrison 1990).

Survey work at a recently re-discovered Hawaiian petrel colony on Lānaʻi, which had been previously thought to be extirpated, indicates that thousands of birds are present, rather than hundreds of birds as first assumed; and that the size of the breeding colony approaches that at Haleakalā, Maui, where as many as 1,000 pairs have been thought to nest annually (Mitchell et al. 2005; Tetra Tech EC, Inc. 2008a, 2008b). Hawaiian petrels are nocturnal and subsist primarily on squid, fish, and crustaceans caught near the sea surface. Unlike shearwaters, Hawaiian petrels are not known to dive or swim below the surface (Pitman 1986). Foraging may take place thousands of kilometers from their home islands during both breeding and non-breeding seasons (Spear et al. 1995). In fact, recent studies conducted using satellites and transmitters attached to Hawaiian petrels have shown that they can range across more than 6,200 miles (10,000 km) during 2-week foraging expeditions (Adams 2008).

Hawaiian petrels are active in their nesting colonies for approximately 8 months each year. The birds are long-lived (approximately 30 years) and return to the same nesting burrows each year between March and April. Present-day Hawaiian petrel colonies are typically located at high elevations above 2,500 meters (8,200 feet). The types of habitats used for nesting are very diverse and range from xeric habitats with little or no vegetation, such as at Haleakalā National Park on Maui, to wet forests dominated by ʻōhiʻa with uluhe fern (*Dicranopteris linearis*) understory as those found on Kauaʻi (Mitchell et al. 2005). Females lay only one egg per year, which is incubated alternately by both parents for approximately 55

days. Eggs hatch in June or July, after which both adults fly to sea to feed and return to feed the nestling. The fledged young depart for sea in October and November. Adult birds do not breed until age 6 and may not breed every year, but pre-breeding and non-breeding birds nevertheless return to the colony each year to socialize.

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

Ungulates can indirectly affect nesting seabirds by overgrazing and trampling vegetation, as well as facilitating erosion. Climatic events such as El Niño can also impact the reproductive success of seabirds (Hodges and Nagata 2001). Other threats include occasional mortality from collisions with power lines, fences, and other structures near breeding sites or from attraction to bright lights. Juvenile birds are sometimes grounded when they become disoriented by lights on their nocturnal first flight from inland breeding sites to the ocean. A few, mostly juvenile, Hawaiian petrels have landed in brightly lighted areas at scattered locations on Maui most years. The problem is much smaller than the one involving Newell's shearwaters, and Simons and Hodges (1998) conclude that it is probably not a threat to remaining populations.

Occurrence of Hawaiian Petrels on Maui and at the Property. Haleakalā supports the largest known nesting colony of Hawaiian petrels (USFWS 2005a; Hodges and Nagata 2001). Approximately 1,000 known nests are in the crater of the dormant shield volcano, with the highest concentration on the western rim between 2,400 and 3,055 m (7,875 and 10,020 feet) in elevation. This population estimate may be an underestimate according to Cooper and Day (2003). The highest densities of nests (15–30 burrows per hectare) occur in Haleakalā National Park. Predator trapping is conducted year-round to reduce predation pressure on these burrows. Lower densities of nesting burrows occur elsewhere in the crater and beyond the park boundaries, but these are currently not actively managed (Hodges and Nagata 2001). Radar studies indicate that most of the petrels flying inland toward their nesting sites on Haleakalā choose a flight path that may minimize their overland flight, and the number of birds recorded flying over Mākena were relatively low (Cooper and Day 2003).

3.8.3.3. NEWELL'S SHEARWATER

Population, Biology, and Distribution of Newell's Shearwater. The Newell's shearwater is an endemic Hawaiian sub-species of the nominate species Townsend's shearwater (*Puffinus a. auricularis*) of the eastern Pacific. The Newell's shearwater is considered "Highly Imperiled" in the *Seabird Conservation Plan, Pacific Region* (USFWS 2005b) and in the *Waterbird Conservation for the Americas: The North American Waterbird Conservation Plan, Version 1* (Kushlan et al. 2002). Species identified as "Highly Imperiled" have suffered significant population declines and have either low populations or some other high risk factor.

The most recent population estimate of Newell's shearwater on the Hawaiian Islands was approximately 84,000 birds, with a possible range of 57,000–115,000 birds (Ainley et al. 1997b). The largest breeding population of Newell's shearwater occurs on Kaua'i (Telfer et al. 1987; Day and Cooper 1995; Ainley et

al. 1995, 1997b; Day et al. 2003). Breeding also occurs on Hawai'i Island (Reynolds and Richotte 1997; Reynolds et al. 1997; Day et al. 2003a) and almost certainly occurs on Moloka'i (Pratt 1988; Day and Cooper 2002). Recent radar studies suggest the species may also nest on O'ahu (Day and Cooper 2008).

Newell's shearwaters typically nest on steep slopes vegetated by uluhe fern undergrowth and scattered 'ōhi'a trees. Currently, most Newell's shearwater colonies are found from 525 to 3,900 feet (160 to 1,200 m) above mean sea level, often in isolated locations and/or on slopes greater than 65 degrees (Ainley et al. 1997b). The birds nest in short burrows excavated into crumbly volcanic rock and ground, usually under dense vegetation and at the base of trees. A single egg is laid in the burrow, and one adult bird incubates the egg while the second adult goes to sea to feed. Once the chick has hatched and is large enough to withstand the cool temperatures of the mountains, both parents go to sea and return irregularly to feed the chick. The closely related Manx shearwater (*Puffinus puffinus*) is fed every 1.2–1.3 days (Ainley et al. 1997b). Newell's shearwaters arrive at and leave their burrows during darkness, and birds are seldom seen near land during daylight hours. During the day, adults remain either in their burrows or at sea some distance from land.

First breeding occurs at approximately 6 years of age, after which breeding pairs produce one egg in a given year. A high rate of non-breeding is found among experienced adults that occupy breeding colonies during the summer breeding season, similar to some other seabird species (Ainley et al. 2001). No specific data exist on longevity for this species, but other shearwaters may reach 30 years of age or more (e.g., Bradley et al. 1989; del Hoyo et al. 1992).

The Newell's shearwater breeding season begins in April, when birds return to prospect for nest sites. A pre-laying exodus follows in late April and possibly May; egg-laying begins in the first 2 weeks of June and likely continues through the early part of July. Pairs produce one egg, and the average incubation period is thought to be approximately 51 days (Telfer 1986). The fledging period is approximately 90 days, and most fledging takes place in October and November, with a few birds still fledging into December (SOS unpublished data).

Current Threats to Newell's Shearwater. Radar studies on Kaua'i show a 63% decrease in detections of shearwaters between 1993 and 2001 (Day et al. 2003). It was presumed that the decrease in detections corresponded to an actual decrease in population, rather than simply a shift in areas used for breeding. Declines in Newell's shearwater populations are attributed to loss of nesting habitat, predation by introduced mammals (mongoose, feral cats, rats, and feral pigs) at nesting sites, and fallout of juvenile birds associated with disorientation from urban lighting (Ainley et al. 1997b; Mitchell et al. 2005; Hays and Conant 2007).

Occurrence of Newell's Shearwater on Maui and at the Property. The Newell's shearwater was first discovered on Maui when several birds of the species were taken to Mr. M. Newell by Hawaiians in 1894 (Sincock and Swedberg 1969). In 1931, Peters (1931) considered the species extinct. According to Munro (1944), any possible remnant colonies would be located on Kaua'i, which was the only major island from which mongoose were absent; however, in 1954, an adult Newell's shearwater was recovered from a sugar mill in 'Aiea, O'ahu (Richardson 1955). Sincock and Swedberg (1969) were the first to reconfirm breeding on Kaua'i. There is no indisputable evidence of Newell's shearwater nesting on Maui (Ainley et al. 1997b). In 1983, one live bird was found near Peahi Reservoir in eastern Maui on July 13, 1983 (Pyle 1983). Further evidence comes from a very small number of grounded juveniles during the fall fledging season on Maui, but it is unclear whether these fledged from Maui or if these were individuals from other islands that were attracted by coastal lights. On average, one fledgling is found on the island per year (Cooper and Day 2003). Radar observations further suggest that small numbers of Newell's shearwater may be nesting inland in eastern and western Maui (Cooper and Day 2003), but more study is needed to

unequivocally confirm the presence of breeding Newell's shearwater on Maui. No Newell's shearwaters were observed at the property during any of the surveys.

3.8.3.4. HAWAIIAN STILT

Population, Biology, and Distribution of the Hawaiian Stilt. The Hawaiian stilt is a non-migratory endemic subspecies of the black-necked stilt (*Himantopus mexicanus mexicanus*). The black-necked stilt occurs in the western and southern portions of North America, southward through Central America, West Indies, to southern South America and also the Hawaiian Archipelago (Robinson et al. 1999). Hawaiian stilt and black-necked stilt are part of a super-species complex of stilts found in various parts of the world (Pratt et al. 1987; Robinson et al. 1999). The *U.S. Pacific Islands Regional Shorebird Conservation Plan* considers the Hawaiian stilt as highly imperiled because of its low population level (Engilis and Naughton 2004). Over the past 25 years, the Hawaiian stilt population has shown a general upward trend statewide. Annual summer and winter counts have shown variability from year to year. This fluctuation can be attributed to winter rainfall and variation in reproductive success (Engilis and Pratt 1993; USFWS 2005a). The state population size has recently fluctuated between 1,200 and 1,500 individuals with a 5-year average of 1,350 birds (USFWS 2005a). Adult and juvenile dispersal has been observed both intra- and inter-island in the state (Reed et al. 1998).

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

Hawaiian stilts favor open wetland habitats with minimal vegetative cover and water depths of less than 9.4 inches (24 cm), as well as tidal mudflats (Robinson et al. 1999). Stilts feed on small fish, crabs, polychaete worms, terrestrial and aquatic insects, and tadpoles (Robinson et al. 1999; Rauzon and Drigot 2002). Hawaiian stilts tend to be opportunistic users of ephemeral wetlands to exploit the seasonal abundance of food (Berger 1972; USFWS 2005a). Hawaiian stilts nest from mid-February through late August, with variable peak nesting from year to year (Robinson et al. 1999). Nesting sites for stilts consist of simple scrapes on low relief islands in and/or adjacent to ponds. Clutch size averages four eggs (Hawaiʻi Audubon Society 2005; USFWS 2005a).

Current Threats to the Hawaiian Stilt. The most important causes of decline of the Hawaiian stilt and other Hawaiian waterbirds is the loss of wetland habitat and predation by introduced animals. Barn owls and the endemic Hawaiian short-eared owl are known predators of adult stilts and possibly their young (Robinson et al. 1999; USFWS 2005a). Known predators of eggs, nestlings, and/or young stilts include small Indian mongoose, feral cat, rats, feral and domestic dogs, black-crowned night-heron, cattle egret, common myna (*Acridotheres tristis*), ruddy turnstone (*Arenaria interpres*), laughing gull (*Leucophaeus atricilla*), American bullfrog (*Rana catesbeiana*), and large fish (Robinson et al. 1999; USFWS 2005a). A study conducted at the Kiʻi Unit of the James Campbell NWR between 2003 and 2004 attributed 45% of stilt chick losses to bullfrog predation over the two breeding periods (USFWS unpublished data). The Kiʻi Unit has ongoing control programs for mongoose, feral cats, rats, cane toads (*Bufo marinus*), and bullfrogs (personal communication, Silbernagle, USFWS, 06/12/2012). Other factors that have contributed to population declines in Hawaiian stilts include altered hydrology, alteration of habitat by invasive non-native plants, disease, and possibly environmental contaminants (USFWS 2005a). Although

the Hawaiian stilt is considered imperiled, it is believed to have high recovery potential with a moderate degree of threat.

Occurrence of Hawaiian Stilt on Maui and at the Property. The Maui population of Hawaiian stilts has ranged between approximately 250 and 530 birds, and is largely supported by Maui's two large coastal wetlands: Kealia and Kanahā. The most important nesting habitat is at Kealia, and small numbers of stilts also frequent aquaculture facilities on the island (USFWS 2005a). Stilts are highly mobile, and monthly counts indicate that birds move freely between wetlands, likely in search of optimal foraging habitat (Ueoka 1997). Point-count surveys were conducted by SWCA biologists on May 27–29 and September 19–21, 2008. Twenty-eight (28) point-count stations were established throughout the property in all habitat types. No Hawaiian stilts were observed at the property during any of the surveys.

3.8.3.5. HAWAIIAN COOT

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

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

Coots are usually found on the coastal plain of islands and prefer freshwater ponds or wetlands, brackish wetlands, and human-made impoundments. They prefer open water that is less than 11.8 inches (30 cm) deep for foraging. Preferred nesting habitat has open water with emergent aquatic vegetation or heavy stands of grass (Schwartz and Schwartz 1949; Brisbin et al. 2002; USFWS 2005a). Nesting occurs mostly from March through September, with opportunistic nesting occurring year-round depending on rainfall. Hawaiian coots will construct floating nests of aquatic vegetation, semi-floating nests attached to emergent vegetation, or nests in clumps of wetland vegetation (Brisbin et al. 2002; USFWS 2005a). False nests are also sometimes constructed and used for resting or as brooding platforms (USFWS 2005a). Coots feed on seeds, roots, and leaves of aquatic and terrestrial plants, freshwater snails, crustaceans, tadpoles of bullfrogs and marine toads, small fish, and aquatic and terrestrial insects (Schwartz and Schwartz 1949; Brisbin et al. 2002).

Current Threats to the Hawaiian Coot. Similar to the other listed waterbirds, the recovery of the Hawaiian coot is limited by habitat loss and degradation (USFWS 2005a). According to the USFWS *Draft Revised Recovery Plan for Hawaiian Waterbirds, Second Draft of Second Revision* (2005a) the Hawaiian coot has a high potential for recovery and a low degree of threats. Introduced feral cats, feral and domestic dogs, and mongoose are the main predators of adult and young Hawaiian coots (Brisbin et al. 2002; Winter 2003). Other predators of young coots include black-crowned night-heron, cattle egret, and large fish. Coots are susceptible to avian botulism (*Clostridium botulinum*) outbreaks in the Hawaiian Islands (Brisbin et al. 2002).

Occurrence of the Hawaiian Coot on Maui and at the Property. The population of Hawaiian coot on Maui has fluctuated between approximately 200 and 600 birds, with the largest concentrations found at Kanahā

and Kealia ponds. The species is highly mobile, and individuals move frequently between these wetlands (USFWS 2005a). Point-count surveys were conducted by SWCA biologists on May 27–29 and September 19–21, 2008. Twenty-eight (28) point-count stations were established throughout the property in all habitat types. No Hawaiian coots were observed at the property during any of the surveys.

3.8.3.6. HAWAIIAN DUCK

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

The historical range of the Hawaiian duck includes all the main Hawaiian Islands, except for the Islands of Lānaʻi and Kahoʻolawe. Hawaiian ducks are strong flyers and usually fly at low altitudes. Intra-island movement has been recorded, where they may move between ephemeral wetlands or disperse to montane areas during the breeding season (Engilis et al. 2002). Hawaiian ducks also fly inter-island and have been documented flying regularly between Niʻihau and Kauaʻi in response to above-normal precipitation and the flooding and drying of Niʻihau's ephemeral wetlands (USFWS 2005a). Hawaiian ducks occur in aquatic habitats up to an altitude of 10,000 feet (3,048 m) in elevation (Uyehara et al. 2007). The only naturally occurring population of Hawaiian duck exists on Kauaʻi, with reintroduced populations on Oʻahu, Hawaiʻi, and Maui (Pratt et al. 1987; Engilis et al. 2002; Hawaiʻi Audubon Society 2005).

Hawaiian ducks are closely related to mallards (Browne et al. 1993). Because of this close genetic relationship, Hawaiian ducks will readily hybridize with mallards, and allozyme data indicate there has been extensive hybridization between Hawaiian duck and feral mallards on Oʻahu, with the near disappearance of Hawaiian duck alleles from the population on the island (Browne et al. 1993). Uyehara et al. (2007) found a predominance of hybrids on Oʻahu, and samples collected by Browne et al. (1993) from ducks and eggs at the Kiʻi Unit of the James Campbell NWR found mallard genotypes. In 2005, a peak count of 141 Hawaiian duck x mallard hybrids was recorded on the Kiʻi Unit of the James Campbell NWR (USFWS unpublished data). Populations on Maui are also suspected to largely consist of Hawaiian duck x mallard hybrids. Estimated Hawaiian duck hybrid counts on these islands are 300 and 50 birds, respectively (Engilis et al. 2002; USFWS 2005a). The current wild population of pure Hawaiian ducks is estimated at approximately 2,200 birds. Approximately 200 pure individuals occur on the Island of Hawaiʻi, and the remainder resides on Kauaʻi. Because of similarities between the species, it can be difficult to distinguish between pure Hawaiian ducks, feral hen mallards, and hybrids during field studies. Habitat types used by the Hawaiian duck include natural and human-made lowland wetlands, flooded grasslands, river valleys, mountain streams, montane pools, forest swamplands, aquaculture ponds, and agricultural areas (Engilis et al. 2002; Hawaiʻi Audubon Society 2005; USFWS 2005a). The James Campbell NWR provides suitable habitat for foraging, resting, pair formation, and breeding (Engilis et al. 2002). No suitable habitat for Hawaiian duck occurs on the Honuaʻula property.

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

Current Threats to the Hawaiian Duck. Loss of habitat and hybridization with mallards are the largest threats to the Hawaiian duck. In addition, Hawaiian ducks are predated by mongoose, feral cats, feral dogs, and possibly rats (Engilis et al. 2002). Black-crowned night-heron, largemouth bass (*Micropterus salmoides*), and bullfrog have also been observed taking ducklings (Engilis et al. 2002). Avian diseases are another threat to Hawaiian ducks, with outbreaks of avian botulism occurring annually throughout the state. In 1983, cases of adult and duckling mortality on Oʻahu were attributed to aspergillosis and salmonella (Engilis et al. 2002).

Occurrence of the Hawaiian Duck on Maui and at the Property. The Maui population of Hawaiian duck was estimated in 2004 at fewer than 20 birds, which occur primarily at Kanahā pond. This small breeding population is a result of a release of fewer than 12 captive individuals, which was conducted by the State of Hawaiʻi in 1989. Hybridization with feral mallards does occur on Maui, and hybrids are likely to outnumber Hawaiian ducks (USFWS 2005a). Point-count surveys were conducted by SWCA biologists on May 27–29 and September 19–21, 2008. Twenty-eight (28) point-count stations were established throughout the property in all habitat types. No Hawaiian ducks were observed at the property during any of the surveys.

3.8.4. Covered Animal Species

3.8.4.1. BLACKBURN'S SPHINX MOTH

Population, Biology, and Distribution of Blackburn's Sphinx Moth. The Blackburn's sphinx moth is one of Hawaiʻi's largest insects with a wingspan of up to 12 cm. It is closely related to the North American tomato hornworm (*Manduca quinquemaculata*), with which it has been confused in the past. The two species differ substantially in biology and are geographically distinct. Riotte (1986) demonstrated that Blackburn's sphinx moth is a distinct species, native to the Hawaiian Islands, and these findings are accepted as valid to date. Relatively little research has been conducted on this species; therefore, there is a paucity of information on its biology, habitat associations, and population status. The Blackburn's sphinx moth is the first listed insect species in Hawaiʻi.

The Blackburn's sphinx moth is currently found in topographically diverse landscapes and in areas with low to very high levels of non-native vegetation. The primary constituent elements (PCEs) required by Blackburn's sphinx moth larvae for foraging, sheltering, and maturation are the two documented host plant species in the genus *Nothocestrum* (*N. latifolium* and *N. breviflorum*), both of which themselves are proposed or listed endangered species. At lower elevations, moth larvae are found most often on the non-native tree tobacco (*Nicotiana glauca*), but has also been found on commercial tobacco (*Nicotiana tabacum*), eggplant (*Solanum melongena*), tomato (*Solanum lycopersicum* var. *cerasiforme*) (USFWS 2005c), and the indigenous pōpolo (*Solanum americanum*). PCEs required by Blackburn's sphinx moth adults for foraging, sheltering, dispersal, breeding, and egg production that occur on the property are native nectar-supplying plants mostly with a long, tubular calyx. Adult moths have been observed feeding on the native morning glory (*Ipomoea indica*) and hala pepe (*Pleomele auwahiensis*), but they are expected to feed on a range of potential host plants that possess characteristics of adaptation to moth pollination, including a tubular calyx, light coloration, nocturnal anthesis (opening at night), or strong fragrance. Possible native adult host plants include maiapilo, ʻilieʻe (*Plumbago zeylanica*), but non-native plants, including tree tobacco, may be used by adult moths for feeding.

Minimum development time from egg to adult is reported as 56 days (Williams 1947), but VanGelder and Conant (1998) reported an average development time of 75.9 days based on data collected on moths reared in captivity. Information on adult longevity is not available, but Sphingid moths like the Blackburn's sphinx moth, generally have a longer lifespan than most moths, thanks to their ability to feed from a variety of sources, rather than relying on stored fat reserves. Captive moths in a study by

VanGelder and Conant (1998) did not live longer than 12 days as an adult. They also did not observe adult moths feeding or attempting to feed on morning glory flowers, or artificial flowers. Despite this apparent lack of feeding, these moths successfully reproduced. Larvae descend from their host plant or tree and search for suitable soil before pupating. They may remain dormant in the soil for up to 1 year (personal communication, Rubinoff, University of Hawaiʻi, 05/12/2012), as is common with congeneric species.

No estimates exist for Blackburn's sphinx moth population numbers, but the species is believed to have been in decline over the past 100 years (USFWS 2005c). After an effort led by Bishop Museum staff to find the species in the late 1970s, it was considered extinct (Gagné and Howarth 1985), until 1984, when a population was discovered on Maui (Riotte 1986). The Blackburn's sphinx moth was once known from all of the Hawaiian Islands, but currently is restricted to Maui, Kahoʻolawe, and Hawaiʻi. The decline and disappearance from several islands have been attributed to habitat loss and fragmentation from urban and agricultural development, increased wildfire frequency, invasion by non-native invasive weeds, impacts from ungulate grazing, direct impacts on the moth from non-native parasitoid flies and wasps, and insect predators.

Current Threats to Blackburn's Sphinx Moth. The Blackburn's sphinx moth recovery plan (USFWS 2005c) cites a number of factors contributing to the species' continued decline. However, the magnitude and importance to limiting recovery of the species are unknown at this time. Dry and mesic forests are believed to play an important role in the moth's seasonal foraging and sheltering needs (USFWS 2005c), and based on this assumption, the moth's range has declined approximately 82% since human arrival on the islands. The PCEs required by Blackburn's sphinx moth larvae for foraging, sheltering, maturation, and dispersal include two documented host plant species in the genus *Nothocestrum* (*N. latifolium* and *N. breviflorum*), which are presently listed as endangered. Habitat loss and fragmentation exacerbate the impact of decreased nectar availability during drought, causing further threat to future viability of population (USFWS 2005c).

Alien arthropods are believed to be a major threat to the Blackburn's sphinx moth through predation, parasitism, and direct competition. The main suspected predators include a number of ant (Formicidae) species that are known to impact other native arthropods, or are known predators of Lepidoptera elsewhere in their introduced range. Ants are not believed to be a native component of native Hawaiian fauna (Wilson 1996), and presently at least 50 species of invasive ants have become established in Hawaiʻi (Plentovich et al. 2010). Many ants are generalists, and can be particular destructive to native insular biota because of their high densities, recruitment behavior, and aggressiveness (Reimer 1993). The Blackburn's sphinx moth recovery plan (USFWS 2005c) lists the following ant species as presenting a threat to the moth: *Pheidole megacephala*, *Iridomyrmex humilis*, *Anoplolepis gracilipes*, *Solenopsis geminata*, *S. papuana*, and *Ochetellus glaber*.

Parasites introduced either intentionally or accidentally are believed to be a major factor limiting recruitment of the Blackburn's sphinx moth. Because of the relative rarity of the moth, the impact of parasitoids has not been quantified, but introduced parasitic Braconid and Ichneumonid wasps and Tachinid flies have an abundance of hosts, and are considered a potentially major threat (USFWS 2005c). A number of species of parasitic wasps in the Trichogrammatidae family are established in Hawaiʻi, including *Trichogramma* species were found to have parasitized 70% of eggs in a study by Williams (1947), and 8.8% of eggs in VanGelder and Conant's (1998) study. Although the impact of these wasps is most likely density dependent, the abundance of alternative hosts may enable extinction of the Blackburn's sphinx moth as part of the broader host base (Nafus 1993). Two parasitic Tachinid flies (*Chaetogaedia monticola*, and *Lespesia archippivora*) have been purposefully introduced to control army worms. Both species are known to parasitize a variety of lepidopteran species, including sphinx moths, and both are known to occur on Maui and Hawaiʻi (Nishida 1997).

Occurrence of Blackburn's Sphinx Moth on Maui and at the Property. Neither *N. latifolium* nor *N. breviflorum*, which are considered to be a PCE required by Blackburn's sphinx moth larvae for foraging, sheltering, maturation, and dispersal, occurs on the property or would likely survive if propagated on the property, due to constraints related to rainfall and elevation.

PCEs required by Blackburn's sphinx moth adults for foraging, sheltering, dispersing, breeding, and egg producing that occur on the property are native nectar-supplying plants, including morning glory (*Ipomoea* spp.), maiapilo, and ʻilieʻe. Another adult host plant may include hala pepe (USFWS 2005c); however, this species is not found on the property. The vegetation communities that support these plants—dry and mesic areas between the elevations of sea level and 1,525 m (5,000 feet) that receive between 25 and 250 cm (10 and 100 inches) of annual precipitation—are also considered important elements in the recovery of the species by the USFWS (2003a).

Surveys for endangered Blackburn's sphinx moths were conducted in the property on March 13, 2008, May 27–29, 2008, and November 11, 2008. The March and May surveys were conducted by Bishop Museum Entomologist David Preston, Ph.D. and Betsy Gagné, M.S. of the Hawaiʻi DOFAW, accompanied by SWCA Biologist John Ford, M.S. and USFWS Biologist James Kwon. These surveys focused on host plants used by the various life stages of Blackburn's sphinx moth that are known to occur in the property. Leaves and stems were examined carefully for the presence or sign of moths, including frass (fecal matter), cut stems and leaves, and eggs. Sign attributed to larval Lepidoptera (cut stems, chewed leaves, and frass) was found on tree tobacco in the kiawe-wiliwili shrubland habitat by Dr. Preston during the 2008 surveys (Figure 8). Three Blackburn's sphinx moth caterpillars were observed on tree tobacco during the 2008 surveys. The occurrence of Blackburn's sphinx moth larvae was much lower compared to that of the non-native white-lined sphinx moth (*Hyles lineata*) and the non-native oleander hawk moth (*Daphnis nerii*) found at Kanaio and Kahului by Van Gelder and Conant (1998).

VanGelder and Conant (1998) reported oleander hawk moth larvae on tree tobacco at Kanahā, Kahului, and white-lined sphinx moth larvae on tree tobacco at KNGTA lands. Vangelder and Conant (1998) report that oleander hawk moth feeding damage "appeared different" from that of Blackburn's sphinx moth, but they did not specify how to distinguish the two. Despite this reported difference in appearance, the report raises to question the technique of using leaf damage as an indication of Blackburn's sphinx moth activity, unless leaf damage can be distinguished. It also questions the identity of eggs found in areas where multiple species occur.

SWCA has photo-documented oleander hawk moth larvae on tree tobacco on Maui, Kim and Forest Starr have photo-documented the pink-spotted hawk moth (*Agrius cingulate*) feeding on tree tobacco (personal communication, Starr and Starr, 04/03/2012), and Heather Eijzenga has documented white-lined sphinx moth feeding on tree tobacco on ʻAleʻale off Kahoʻolawe (personal communication, Eijzenga, Pacific Cooperative Studies Unite, University of Hawaiʻi at Mānoa, 04/18/2012). These non-native species are polyphagous. There are nine genera and twelve species of Sphingid moths in Hawaiʻi. In addition, a multitude of additional organisms, including other lepidopterans, cause leaf and stem damage on tree tobacco, and using leaf and stem damage alone is an inaccurate assessment of Blackburn's sphinx moth activity. Dr. Daniel Rubinoff insists that cut leaf stems and leaves cannot be used as a definitive sign of Blackburn's sphinx moth presence (personal communication, Rubinoff, College of Tropical Agriculture and Human Resources, University of Hawaiʻi, January 26 and April 26, 2011). It should therefore not be presumed that the large number of "signs" found at Honuaʻula are all attributable to Blackburn's sphinx moth.

In December 2013 and January 2014, SWCA conducted a survey for tree tobacco in the property to obtain data on the extent and density of Blackburn's sphinx moth food plants outside of the NPPA. Survey transects were spaced 50 m apart in the northern portion of the property, and 20 m apart in the southern

portion outside of the NPPA, where denser vegetation required closer spacing of transects. In total, 12 individual tree tobacco plants were found in seven locations on the property, outside of the proposed NPPA (see Figure 8). These plants were inspected for Blackburn's sphinx moth larvae, and none were found. Density and distribution of tree tobacco are very susceptible to rain and drought cycles; therefore, these survey data are used as an index of tree tobacco abundance.

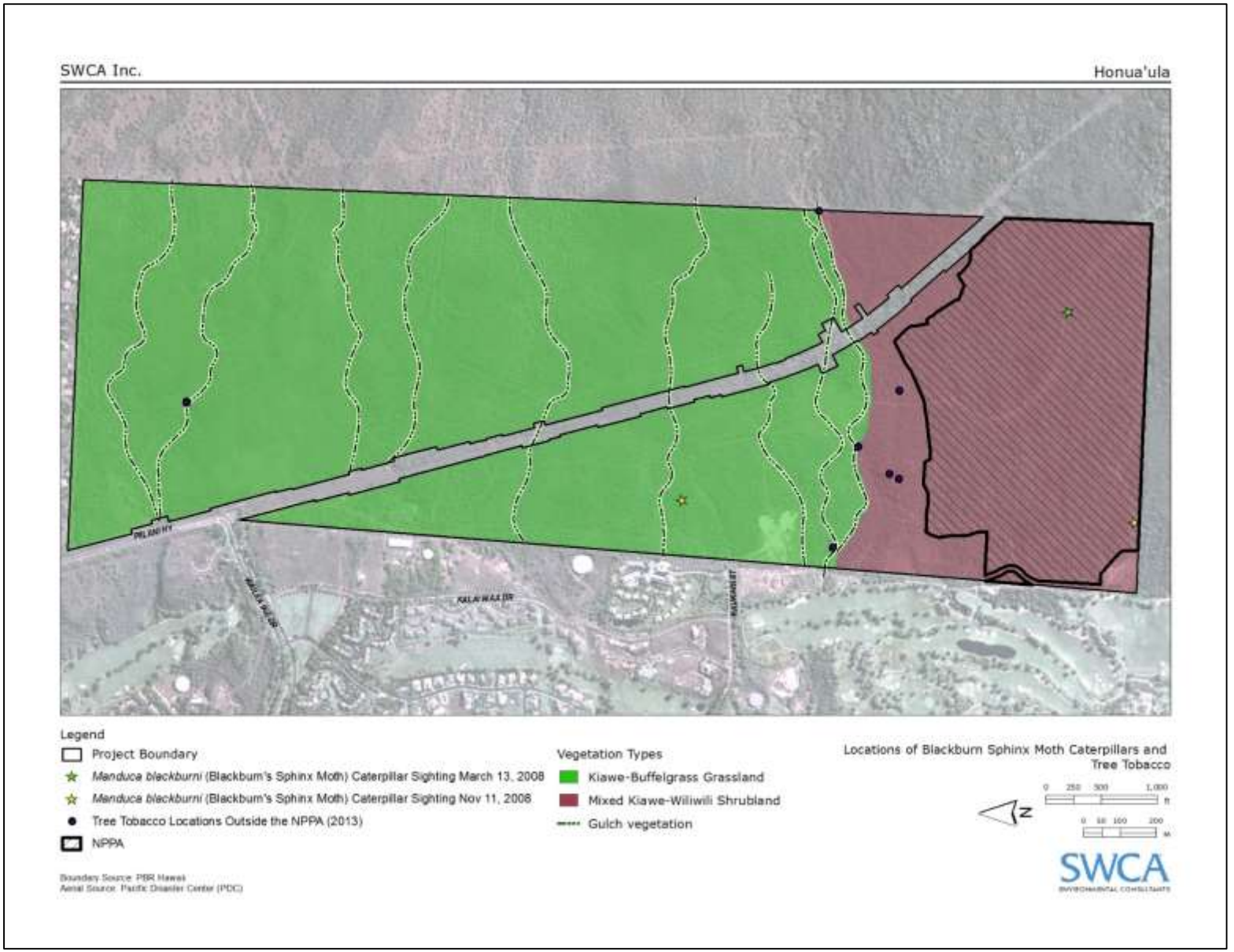

Figure 8. Locations of Blackburn's sphinx moth caterpillars and tree tobacco in the property (project boundary).

3.8.4.2. NĒNĒ

Population, Biology, and Distribution of Nēnē. The nēnē is a medium-sized goose with a black head and nape contrasting a yellow-buff check and neck. The species' overall length is 63–69 cm (25–26 inches) (Hawai'i Audubon Society 2005). The nēnē is adapted to a terrestrial and largely non-migratory lifestyle in the Hawaiian Islands, with negligible dependence on freshwater habitat. Compared to the related Canada goose (*Branta canadensis*), nēnē wings are reduced by approximately 16% in size, and their flight capability is comparatively weak. Nonetheless, the nēnē is capable of both inter-island and high altitude flight (Miller 1937; Banko et al. 1999).

After nearly becoming extinct in the 1940s and 1950s, the nēnē population slowly has been rebuilt through captive-breeding programs. Wild populations of nēnē occur on Hawai'i, Maui, and Kaua'i. The USFWS estimated that in the early part of the last decade, the nēnē population numbered 1,300 individuals (USFWS 2004). The primary release site on Maui is at Haleakalā National Park on East Maui, where 511 nēnē were released between 1962 and 2003.

Since 1995, most of the Maui releases have been from a release pen in the Hana'ula region of West Maui in an effort to establish a second population on Maui on this part of the island (personal communication, F. Duvall, Maui DOFAW). Since 1994, 104 nēnē have been released at Hana'ula, and 18 have been released at Haleakalā (USFWS 2004). An effort to move approximately 300 nēnē off areas adjacent to airport runways on Kaua'i is underway, and as of May 2012, approximately 30 birds have been moved into pens at Haleakalā Ranch.

The nēnē has an extended breeding season, with eggs reported from all months except May, June, and July, although most birds in the wild nest during the rainy (winter) season between October and March (Banko et al. 1999, Kear and Berger 1980). Nēnē nest on the ground in a shallow scrape in the dense shade of a shrub or other vegetation. A clutch typically contains three to five eggs, and incubation lasts for 29–31 days. The female incubates the eggs, with the male standing guard nearby, often from an elevated location. Once hatched, the young remain in the nest for 1–2 days (Banko et al. 1999). Fledging of captive birds occurs at 10–12 weeks, but may occur later in the wild. During molt, adults are flightless for a period of 4–6 weeks. Molt occurs after hatching of eggs, such that the adults generally attain their flight feathers at about the same time as their offspring. When flightless, goslings and adults are extremely vulnerable to predators such as dogs, cats, and mongoose. From June to September, family groups join others in post-breeding aggregations (flocks), often far from nesting areas.

Nēnē occupy various habitat types ranging from beach strand, shrubland, and grassland to lava rock, at elevations ranging from coastal lowlands to alpine areas (Banko 1988; Banko et al. 1999). Nēnē eat plant material, and the composition of their diet depends largely on the vegetative composition of their surrounding habitats. They appear to be opportunistic in their choice of food plants as long as the plants meet their nutritional demands (Banko et al. 1999; Woog and Black 2001).

Current Threats to Nēnē. Current threats to nēnē include predation by non-native mammals, exposure in high-elevation habitats, insufficient nutritional resources for both breeding females and goslings, a lack of lowland habitat, human-caused disturbance and mortality (road mortality, disturbance by hikers, etc.), behavioral problems related to captive propagation, and inbreeding depression (USFWS 2004). Predators of nēnē eggs and goslings include dogs, cats, rats, and mongoose. Dogs and mongoose are also responsible for most of the known cases of adult predation (USFWS 2004). Nēnē have also been negatively impacted by human recreational activities (e.g., hikers and hunters), and a number have been struck by vehicles. Nēnē may be attracted to golf courses, especially when water features are present, and become exposed to higher chances of interactions with humans. They may become subject to accidental strikes by golf balls, to harassment, or to being intentionally killed. Adult birds, but especially chicks, are

vulnerable to being struck by golf carts, trucks, and mowers (personal communication, Medeiros, DOFAW, and Swindle, USFWS). In recent years, at least six nēnē have been inadvertently struck and killed by golf balls, and at least one has been intentionally killed on a golf course on Maui (USFWS 2004; personal communication, Medeiros, DOFAW).

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

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

Occurrence of Nēnē on Maui and at the Property. The first captive nēnē to be reintroduced to Maui were 30 birds that were bred by the Wildfowl and Wetlands Trust in Slimbridge, England, and five birds from the Pōhakuloa propagation project on Hawai'i. These birds were released in Haleakalā Crater at Haleakalā National Park on July 26, 1962 (Walker 1969). Besides Haleakalā, nēnē have been reported from the Kahikinui, Kīhei, Kula, Lāhainā, Olinda, Wailuku, and West Maui areas. The Maui population of nēnē in 2002 was estimated at 336 (USFWS 2004). Nēnē were not observed during any of the surveys on the property.

3.8.4.3. YELLOW-FACED BEES (*HYLAEUS* SPP.)

Seven species of yellow-faced bees in the genus *Hylaeus* (family Colletidae), including assimulans yellow-faced bee and anthricinan yellow-faced bee, were proposed for listing as endangered in September 2015 (USFWS 2015). Assimulans yellow-faced bee and anthricinan yellow-faced bee had been previously listed as candidate species. The assimulans yellow-faced bee and anthricinan yellow-faced bee possess the general structure of other hymenopterans (bees, wasps, ants) and resemble small wasps in appearance.

Population, Biology, and Distribution of the Assimulans Yellow-Faced Bee and Anthricinan Yellow-Faced Bee. These two species of yellow-faced bees occur in coastal and lowland dry areas on Maui up to 2,000 feet (610 m) in elevation. They are both ground-nesting solitary bees that require relatively dry conditions (USFWS 2013a, 2013b). Nests are constructed in existing natural cavities in coral rubble, under bark, or rocks. The adult bees feed on flower nectar, whereas the larvae eat pollen and nectar collected by the adult female. The primary host plant of the assimulans yellow-faced bee and anthricinan yellow-faced bee is 'ilima (USFWS 2013a, 2013b). All Hawaiian yellow-faced bees are believed to almost exclusively visit native plants. Much of the life history of these species remains unknown.

Current Threats to Assimulans yellow-faced bee and Anthricinan yellow-faced bee. Destruction, degradation, and loss of coastal and lowland habitat as a result of development, fire, invasive species, and recreational activities are primary threats to Hawaiian yellow-faced bees. Predation by yellow-jacket wasps (*Vespula pensylvanica*) and ants further threatens these species. Yellow-faced bees also face competition from non-native pollinators such as the honey bee (*Apis mellifera*) (Magnacca 2007). Genetic bottlenecks, random demographic fluctuations, and localized catastrophes make the species vulnerable to extinction (Daly and Magnacca 2003; Magnacca 2007).

Occurrence of Assimulans yellow-faced bee and Anthricinan yellow-faced bee on Maui and at the Property. On Maui, the assimulans yellow-faced bee was recorded at two sites (Lahainaluna and Waikapū). It may also occur in other inaccessible portions of West Maui (USFWS 2013b). The anthricinan yellow-faced bee has been recently recorded at Wailuku Sand Hills, Kanaio NAR, and Manawainui Gulch (USFWS 2013a).

Research entomologist and *Hylaeus* expert Karl Magnacca surveyed the property for a 1-day survey in May 2011. Because of the conditions during the survey, it was not possible to conclude whether yellow-faced bees were present without further surveys; therefore, the presence of the assimulans yellow-faced bee and anthricinan yellow-faced bees in the property is assumed based on the property's location, presence of ʻilima, and because the assimulans yellow-faced bee has been recorded on nearby sites. Anthricinan yellow-faced bees were observed visiting the flowers of several native species that occur on the property, including ʻilima, pua kala, naio (*Myoporum sandwicense*) (USFWS 2011a).

4. BIOLOGICAL GOALS AND OBJECTIVES

The final addendum to the *Handbook for Habitat Conservation Planning and Incidental Take Permitting Process* (USFWS and NOAA NMFS 2000) is a five-point policy guidance for the HCP process. The addendum outlines the importance of defining biological goals. These broad, guiding principles clarify the purpose and direction of an HCP's operating conservation program. Biological objectives are also integral to the HCP process to achieve the different components of the biological goals. The objectives are more measurable than the goals and may include species or habitat indicator, location, action, quantity/state, and timeframe needed to meet the objective (USFWS and NOAA NMFS 2000).

Honuaʻula Partners, LLC has met with local representatives of the USFWS and Hawaiʻi DLNR to discuss potential adverse impacts to the five Covered Species, measures to practicably avoid and minimize the potential for adverse impacts to all listed species, and biological goals and objectives. Where the potential for impacts is unavoidable, this HCP provides means to minimize and mitigate any adverse impacts to the listed species that may occur, and to provide a net conservation benefit.

Based on ongoing surveys conducted in the property, as well as records of species known to exist at adjacent areas, the proposed project is expected to directly or indirectly impact Covered Species Blackburn's sphinx moth, ʻāwikiwiki, and nēnē. It may attract Hawaiian stilt, Hawaiian coot, Hawaiian duck, Newell's shearwater, and Hawaiian petrel. All potential impacts to Hawaiian hoary bat can be avoided.

Specific biological goals and accompanying biological objectives of this HCP are as follows:

1. Avoid direct impacts from construction activities on the Hawaiian hoary bat, Newell's shearwater, and Hawaiian petrel.
    a. Develop and implement best management practices (BMPs) to avoid harm to the Hawaiian hoary bat, Newell's shearwater, and Hawaiian petrel.
    b. Provide endangered species awareness training to all construction personnel.
    c. Deploy construction monitors to prevent harm to the Hawaiian hoary bat.

2. Minimize, to the maximum extent practicable, impacts from construction activities on Blackburn's sphinx moth and ʻāwikiwiki.
    a. Develop and implement best management practices (BMPs) to minimize harm to the Covered Species.
    b. Provide endangered species awareness training to all construction personnel.
    c. Deploy construction monitors to minimize harm to the Covered Species.

3. Avoid impacts of post-construction operations on Hawaiian stilt, Hawaiian coot, Hawaiian duck, Newell's shearwater, and Hawaiian petrel.
    a. Develop and implement BMPs for operations to prevent harm to the Hawaiian stilt, Hawaiian coot, Hawaiian duck, Newell's shearwater, and Hawaiian petrel.
    b. Provide endangered species awareness training to all employees.
    c. Develop and implement a program to educate golfers about endangered species present at the golf amenity, and about measures to avoid harm to the listed waterbird species.
    d. Develop and implement a program to avoid light-induced attraction of seabirds to the property through selection and installation of appropriate lighting fixtures and adherence to appropriate dark sky lighting provisions.

1. Minimize, to the maximum extent practicable, impacts from post-construction operations on nēnē, ʻāwikiwiki, yellow-faced bees, and Blackburn's sphinx moth.
    a. Develop and implement BMPs for operations to prevent harm to Covered Species.

   b. Provide endangered species awareness training to all employees.
   c. Develop and implement a program to educate golfers about endangered species present at the golf amenity, and about measures to avoid harm to nēnē.

2. Provide a net conservation benefit for the recovery of the Blackburn's sphinx moth, ʻāwikiwiki, yellow-faced bees, and nēnē, pursuant to HRS Chapter 195D.
   a. Adhere to goals of existing recovery plans for the species, considering the most recent updated information and goals.
   b. Implement specific measures to manage and protect habitat for the Blackburn's sphinx moth, ʻāwikiwiki, and yellow-faced bees within a Native Plant Preservation Area.
   c. Provide offsite planting of native host plants for the Blackburn's sphinx moth.
   d. Protect existing population of nēnē through predator control measures

3. Maintain as much of the present onsite population of ʻāwikiwiki on the property, as practicable.
   a. Provide an onsite easement containing as much of the present onsite ʻāwikiwiki population as practicable.

5. ALTERNATIVES

5.1. No Action ("no build") Alternative

The no action alternative would occur if the USFWS and DLNR fail to issue an ITP and ITL for the project. This would result in a "no build" alternative that would mean the Honuaʻula community would not be constructed, and the property would remain vacant. There would be no master-planned community embracing "smart growth" principles, such as diverse residential opportunities, village mixed uses, on-site recreational amenities, and integrated bicycle and pedestrian networks. Honuaʻula Partners, LLC is a business entity created for this sole purpose; therefore, a "no build" alternative is contrary to the Honuaʻula Partners, LLC's fundamental purpose and objective. Moreover, the vision for Project District 9 would not be realized, and decisions regarding the use of the property for residential, recreational, and commercial uses previously made by the State Land Use Commission, the Maui Planning Commission, and the Maui County Council would not be implemented. In addition, under the no-build alternative, many of the conditions of zoning under County of Maui Ordinance No. 3554 that benefit the entire region would not be implemented. Likewise, the no-build alternative would deprive the state, county, and general public of the significant economic benefits associated with Honuaʻula, and the range of mitigation measures proposed in this HCP for the protection and recovery of Covered Species would not be implemented. Lastly, the projected increasing demand for housing for a range of consumer groups in the Kīhei-Mākena region would remain unmet.

5.2. Alternative Preserve Layout

Additional sizes for the NPPA (22 acres, 40 acres, and 80 acres) were considered. The initially evaluated site layout included a 22-acre native plant preserve along with 26 acres of a native plant conservation area. During the evaluation process, it was determined that much of the native plant conservation area was too fragmented and too small or narrow to effectively protect the natural resources it contained. The effective preservation of 22 acres of on-site Blackburn's sphinx moth habitat was deemed to be difficult to manage and ineffective. For the native plants, the 22-acre area was not located or sized adequately to address an appropriate cross section of plants or density and was therefore enlarged to address this concern as well.

A 40-acre preserve layout was selected for the project, but in an effort to avoid impacts to archeological features that were described by Perzinski et al. 2014 and Hodara et al. 2014, and which were not previously described in Sinoto et al. 2012, the project layout was revised, resulting in a 134-acre NPPA. This in turn, also reduced impacts to natural resources, including the Covered Species.

6. POTENTIAL IMPACTS

6.1. Estimating Project-Related Impacts

6.1.1. Blackburn's Sphinx Moth

Currently available scientific information regarding the population biology (e.g., distribution and abundance, density, population genetics) of Blackburn's sphinx moth on Maui is insufficient for use in calculating potential take at Honuaʻula. Furthermore, abundance of both host plants and individual moths varies on a temporal scale, complicating quantification of potential take. Direct take of adult moths, larvae, eggs, and pupae will be largely avoided following USFWS guidelines (Appendix 3), and requested take is limited to permanent habitat loss for the Blackburn's sphinx moth. Therefore, in accordance with the HCP Handbook (Chapter 3, Sections B.2.b. and C.1), a habitat-based approach is employed to quantify take and to design on-site and off-site mitigation measures.

Vegetation across the 670-acre (270-ha) property is not homogenous and is well delineated by three primary vegetation types: kiawe-buffelgrass grassland, gulch vegetation, and a mixed kiawe-wiliwili shrubland (SWCA 2010a). The mixed kiawe-wiliwili shrubland is delineated by the younger Hana Volcanic flow in the southern 190-acre portion of the property (see Figures 3 and 5). Most plants believed to be native host species for adult Blackburn's sphinx moths, including maiapilo, morning glory (*Ipomoea spp.*), and ʻilieʻe, are confined to this southernmost portion of the property (see Figure 6), and all evidence of Blackburn's sphinx moth larval presence and all but one larvae sightings occurred in this southern portion of the property.

The total take of Blackburn's sphinx moth habitat resulting from the construction of Honuaʻula is expected to total 299 acres (121 ha). To minimize project impacts to the Blackburn's sphinx moth and as part of the on-site mitigation (see section 7.3.1 for details) a perpetual conservation easement of 134 acres (54 ha) for a NPPA will be preserved in the kiawe-wiliwili shrubland. No take of Blackburn's sphinx moth or moth habitat is expected to occur in this area.

Tree tobacco has been recognized as the premier larval food supply at the property for the Blackburn's sphinx moth. In December 2013 and January 2014, SWCA conducted a survey for tree tobacco in the property to obtain data on the extent and density of Blackburn's sphinx moth food plants outside the NPPA. Survey transects were spaced 50 m apart in the northern portion of the property, and 20 m apart in the southern portion outside the NPPA. In total, 12 individual tree tobacco plants were found in seven locations on the property, outside the proposed NPPA (see Figure 8). This constitutes an estimate of impacts to larval food source as a result of development of the property.

6.1.2. ʻĀwikiwiki

ʻĀwikiwiki plants recorded on the property (Figure 9) will be protected in the NPPA, as described in section 7.3.1. Although all known living ʻāwikiwiki plants on the property will be protected, construction and operation of the project may result in take of seeds or take of new recruits previously not recorded.

In addition to individual plants, the protection of endangered "land plants" under HRS 195D-2 also includes seeds. A seed bank consists of ungerminated, viable seeds present on or in the soil or associated litter (Leck et al. 1989; Baskin and Baskin 2001). Very few seed bank and seed longevity studies have been conducted for Hawaiian species, and it is not known how long ʻāwikiwiki seeds can remain viable on the surface, in the soil, or within the ʻaʻā lava. The hard-coated seeds have the potential to persist on the surface, in the soil, or within the ʻaʻā lava for lengthy dry periods (Thompson 2000; Thompson et al. 2003). Conversely, ʻāwikiwiki seeds are large and therefore are more likely to suffer predation than smaller seeds (Thompson and Grime 1979). Over 65 Fabaceae species have been identified as having a persistent seed bank, which means seeds remain viable in the seed bank until at least the second germination season (i.e., over 1 year) (Baskin and Baskin 2001).

It is difficult to calculate potential take of the seed bank due to the lack of available scientific information regarding the seed bank of ʻāwikiwiki and difficulties with observing and counting seeds in ʻaʻā lava. Given that ʻāwikiwiki has no specialized means of seed dispersal, it is not likely that extensive natural seed dispersal of this species is occurring on the property, limiting the number of sites at which the plant or seeds may be found. During the most recent survey, the number of seeds observed near living or dead individuals ranged from 0 to over 250 (SWCA 2013, 2015). For this HCP, it is assumed that an average of 25 ʻāwikiwiki seeds occur per ʻāwikiwiki site (n = 20; range 0–250).

Take of ʻāwikiwiki is estimated based on 4 potential ʻāwikiwiki sites (new recruits or unrecorded) containing a total of 25 viable ʻāwikiwiki seeds per site. These impacts will be mitigated through implementation of mitigation measures described in section 7.3 and 7.4.

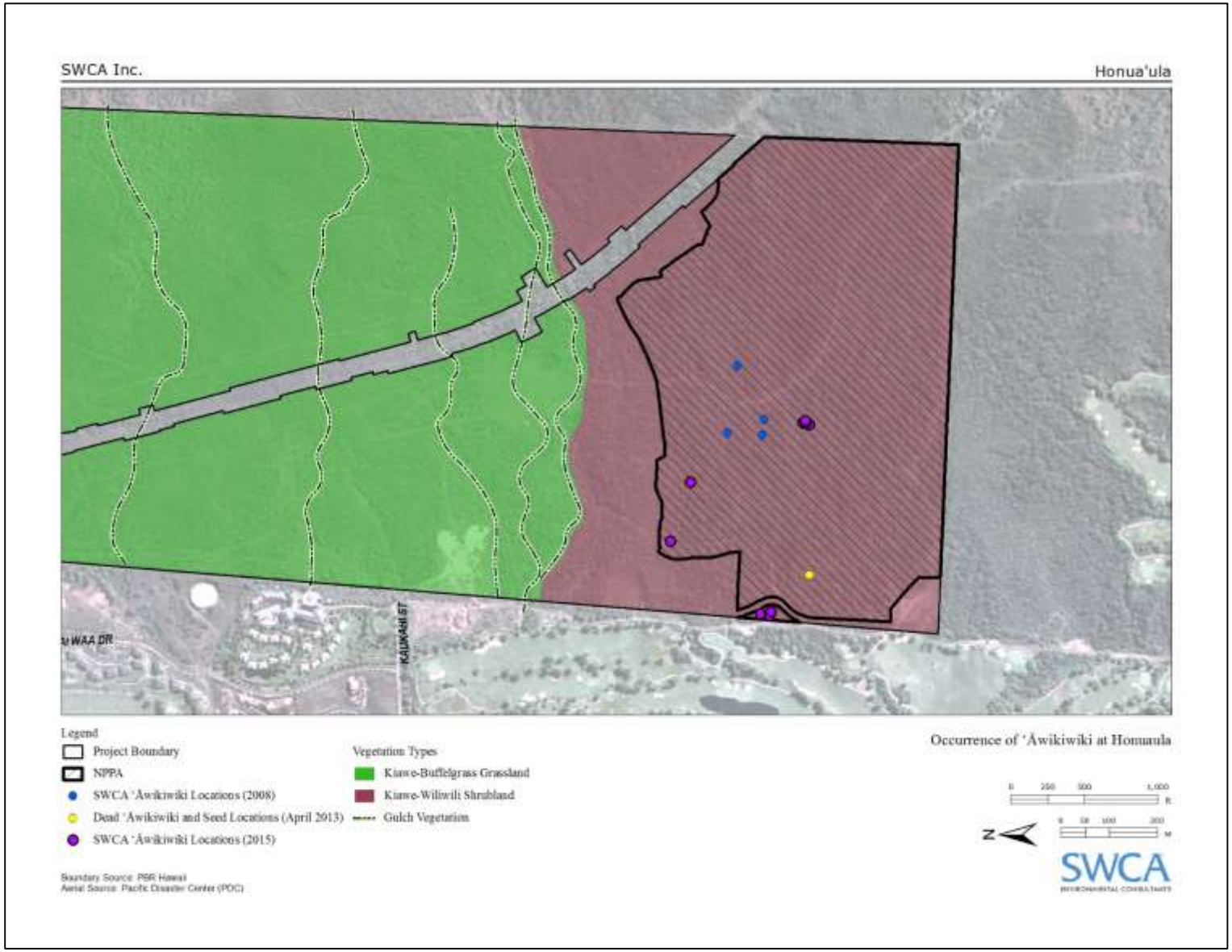

Figure 9. Occurrence of āwikiwiki (*Canavalia pubescens*) in the property (project boundary).

6.1.3. Nēnē

6.1.3.1. DIRECT TAKE

Nēnē are currently not found at or near the property (SWCA 2010b), and the nearest populations occur at Haleakalā National Park, and West Maui (USFWS 2005a). There have been nēnē sightings in Kīhei, Maʻalaea, and ʻUlupalakua, and the property's location in between these sites puts it in a hypothetical flight path between these sites. However, construction activities are not expected to attract nēnē to the property, and therefore no direct take is anticipated for this species during the construction phase.

The creation of golf greens and lawns on the property may attract nēnē. A variety of human activities may lead to direct take of nēnē, including disturbance caused by hikers, hunters, and other outdoor recreational activities, and harm caused by vehicles and golf balls (USFWS 2005a; personal communication, Swindle, USFWS). There is anecdotal information about incidents involving injury to or death of nēnē on golf courses, but there are no quantitative data on which to base a take estimate. In addition, incidents resulting in disturbance or take of nēnē are not always documented or reported, and cause of mortality is often undetermined (personal communication, Medeiros, DOFAW). Golf balls struck nēnē on at least six occasions between 1992 and 1994 at Volcano Golf Course and Country Club, Hawaiʻi. Five birds died as a result and a sixth one died as a result of predation as it lingered overnight with its stricken mate (Banko et al. 1999). This golf course is close to a core population of nēnē at Hawaiʻi Volcanoes National Park. In addition, there is one report of nēnē intentionally killed by golfers on Maui in 1997.

Agency biologists estimate that approximately 1–3 incidents occur per year across the 50 golf courses on the islands of Kauaʻi, Maui, and Hawaiʻi (personal communication, Swindle, USFWS; Creps DOFAW; and Polhemus, formerly DOFAW), but Maui nēnē biologist for DOFAW on Maui, John Medeiros, estimates that the number of incidents resulting in take on the 14 golf courses on Maui averages between 1 and 3 per year, fluctuating greatly between years. Currently, there are no reports of nēnē in the Mākena-Wailea area (personal communication, Medeiros, DOFAW), indicating a low likelihood of nēnē becoming attracted to or even established on the property. However, Haleakalā Ranch, in cooperation with USFWS and DOFAW, is constructing a release pen southeast of Manawainui gulch at 2,625 feet in elevation in the Waiopae area, at which nēnē will be released in the near future (Haleakalā Ranch et al. 2009). This is expected to increase the nēnē population on Maui and locally, to bring nēnē closer to the property, and to increase the likelihood of nēnē sightings at or near the property. How much this likelihood will increase is unknown. Although females remain near their natal sites, in general, whereas males disperse, reasons for fluctuations in dispersal are relatively unstudied.

In addition, released females are less philopatric than wild ones (Woog 2000). Nēnē are most vulnerable to take during nesting activities. Eggs and chicks can be struck by trucks, golf carts, and mowers, or nest failure can occur as a result of predation. Adults are more aggressive when breeding, which leads to increased interaction with humans around the breeding site. Measures will be implemented to avoid nesting on the property (section 7.1); however, if the nēnē population increases near the property, nesting may not be entirely avoidable in the future. Nēnē are generalist feeders; are known to feed on a variety of native and non-native berries, sedges, and grasses; and are attracted to mowed turf. They will nest under a variety of shrubs, including the native pūkiawe, aʻaliʻi (*Dodonaea viscosa*), and ʻōhelo (*Vaccinium reticulatum*), and the non-native Christmas berry (*Schinus terebinthifolius*), lantana, and ironwood (Banko et al. 1999). Currently, nēnē nest on two to three of Maui's 14 golf courses every year (personal communication, Medeiros, DOFAW).

For direct take estimates, based on information and assumptions presented above, an incident rate of 0.125 nēnē/year/golf course is estimated. The property is not currently close to existing nēnē habitat, the

golf amenity will not contain water features, and extensive golf amenity operation minimization measures will be implemented. Nevertheless, an incidental take risk of 0.125 nēnē per year is assumed.

6.1.3.2. INDIRECT TAKE

Honuaʻula will implement management strategies aimed at preventing the creation of an attractive nuisance, in particular, conditions favorable for nēnē nesting. Therefore, nēnē are most likely to visit the golf greens at the property during non-breeding periods (May through July) or at the end of their breeding period when the adults and young may travel as family groups. Nēnē are highly territorial during the breeding season (Banko et al. 1999), and males are likely to be defending nesting territories while the females are incubating. Upon hatching, both parents attend to heavily dependent young; adult nēnē also molt while in the latter part of their breeding period and are therefore flightless for 4–6 weeks (USFWS 2004a). These adults attain their flight feathers at about the same time as their goslings (USFWS 2004a). Consequently, such birds are more likely to visit the property only when goslings have already fledged.

Indirect take to account for loss of dependent young will be assessed for adult nēnē only when mortality occurs during the breeding season (August to April). Adults found during the months of October through March will be assumed to have had a 60% chance of having been actively breeding because 60% of the population has been recorded to breed in any given year (Banko et al. 1999). Adult nēnē mortality that occurs outside the peak breeding season (April, August, and September) will be assumed to have had a 25% chance of breeding. Male and female nēnē care for their young fairly equally, so indirect take is assessed equally to the direct take of any male or female adult nēnē found during the breeding season. Because breeding nēnē are not expected to visit the property before their young fledge, the number of young possibly affected by loss of an adult is based on the average number of fledglings produced per pair (studies indicate that the average number of fledglings produced annually per pair of nēnē is 0.3 [Hu 1998]).

Based on these assumptions, as indicated in Table 6, the amount of indirect take assessed for each direct take of an adult nēnē during the months of October through March is 0.18. The amount of indirect take assessed for each direct take of an adult bird during the remainder of the breeding season is 0.08.

Table 6. Calculation of Indirect Take of Nēnē

Nēnē	Season	No. Fledglings per Pair (A)	Likelihood of Breeding (B)	Indirect (A × B)
Adult, any gender	October–March	0.3	0.60	0.18
Adult, any gender	April, August, and September	0.3	0.25	0.08
Adult, any gender	May–July	–	0.00	0.00
Immature	All year	–	0.00	0.00

6.1.3.3. ESTIMATED TOTAL TAKE FOR NĒNĒ

Direct take estimates based on current and future projections of nēnē mortality on golf courses is low. In addition, the actual number of incidents per year fluctuates significantly (personal communication, Medeiros, DOFAW).

Nēnē are not expected to be attracted to the golf greens every year, particularly in their current population status and distribution. However, the population of nēnē on Maui is expected to expand, which may increase the likelihood of the species occurring at Honuaʻula. Therefore risk of incidental take of nēnē is only anticipated to be present after golf amenity creation, but the take request will cover the full permit term of 30 years.

The estimated direct take incidental to property construction and operations is 3.75 birds (0.125 × 30 years). Indirect take associated with these nēnē is 0.6 (0.18 per take); therefore, the total estimated take is 4.35 nēnē. Requested and expected take is summarized below in Table 7.

Table 7. Nēnē Expected Take and Requested Take

Tier	Timeline	Direct	Indirect	Total
Expected take	Annual average	0.125	0.02	0.145
	Project life (30 years)	3.750	0.60	4.350
Requested take	Project life limit	4.000	1.00	5.000

The current population of nēnē statewide is estimated at 1,300 individuals with 315 birds occurring on Maui (DOFAW unpublished data 2003). The rates of take estimated for nēnē are not expected to significantly affect the species. Avoidance and minimization measures will most likely altogether prevent any take of nēnē that may incidentally visit the property. The proposed mitigation measures will therefore contribute to the species' recovery in absence of take, or provide a net conservation benefit in case of incidental take. For this reason, no significant adverse impacts to the species' overall populations, and no significant cumulative impacts to the species, are anticipated.

6.1.4. Yellow-Faced Bees (Hylaeus spp.)

Similar to the Blackburn's sphinx moth, currently available scientific information regarding the population biology (e.g., distribution and abundance, density, and population genetics) of yellow-faced bees on Maui is insufficient for use in calculating potential take at Honuaʻula. Abundance of both host plants and individual bees varies on a temporal scale, complicating quantification of potential take. The primary host plant of the assimulans yellow-faced bee and anthricinan yellow-faced bee is ʻilima (USFWS 2013a, 2013b), which is found on the property. Both species are assumed to be present in the kiawe-wiliwili shrubland portion of the property, which is where host plants are found. Therefore, the requested take will be based on loss of 56 acres (23 ha) of habitat, as calculated for Blackburn's sphinx moth in section 6.1.1.

6.2. Cumulative Impacts to Listed Species

Presently only one ITP has been issued for Blackburn's sphinx moth. Auwahi Wind Farm has obtained a 25-year permit under ESA Section 10(a)(1)(B) and HRS 195D for the permanent take of 0.3 acre (0.12 ha) of degraded habitat with some native species, and an additional 27.7 acres (11 ha) of degraded habitat (Tetra Tech EC, Inc 2012).

No ITPs have been issued for ʻāwikiwiki. The USFWS estimates that the current population is approximately 200 individuals on East Maui. The requested take associated with this project represents 2% of the population. The proposed project proposes mitigation measures that would provide a contribution to the overall success of this species; therefore, cumulative impacts would not be significant.

No ITPs have been issued for either yellow-faced bee species, and no population estimates are available.

Three ESA Section 10(a)(1)(B) permits for nēnē have been issued through HCPs on the Island of Maui (Table 8). Additional take has been authorized for various other smaller projects and federal projects. Take has also been authorized through two Safe Harbor Agreements on Maui (see Table 8). Under a Safe Harbor Agreement, property owners voluntarily undertake management activities on their property to enhance, restore, or maintain habitat benefiting species listed under the ESA. These agreements assure property owners they will not be subjected to increased property use restrictions if their efforts attract listed species to their property or increase the numbers or distribution of listed species already on their property. The USFWS issues the applicant a permit that authorizes any necessary future incidental take through Section 10(a)(1)(A) of the ESA. Accordingly, all impacts associated with these Section 10 permits have been mitigated in accordance with the statute.

Authorized take of nēnē is documented at several locations on Maui (see Table 8). Between 2006 and 2014, Kaheawa Wind Power LLC has documented observed direct take of 17 full-grown nēnē at Kaheawa Wind Power, and one nēnē at Kaheawa Wind Power II (Kaheawa Wind Power 2014). Since 2005, two nēnē fatalities have been documented at Piʻiholo Ranch, whereas 48 nēnē have been released at Piʻiholo Ranch (DOFAW 2008). Other developments on Maui with the potential to have cumulative impacts to nēnē include developments that decrease nesting and foraging habitat, as well as golf courses that may attract nēnē to the area, increasing their vulnerability to vehicular collisions or golf ball strikes (USFWS 2005a).

Proposed mitigation measures for nēnē at Honuaʻula are expected to more than offset the anticipated take and will contribute to the species' recovery by providing a net conservation benefit, as required by state law. Similar measures are expected for other future developments on Maui with the potential to impact nēnē. For this reason, the cumulative impact of take authorized for Honuaʻula combined with previously and future authorized take is not expected to result in a significant cumulative impact to the species.

At a broader scale, Honuaʻula represents one of many development projects that may be expected to occur on the Island of Maui. Some of the causes of decline of the Covered Species, including habitat reduction and fragmentation, may be on the rise due to continued real estate development on Maui, and will likely continue increasing in the future. Even when conducted in compliance with all applicable local, state, and federal environmental regulations, there is the potential for cumulative impacts to occur from these projects if take is not readily apparent. By implementing this HCP, Honuaʻula will ensure that the net effects of this project will contribute to the recovery of the Covered species. Currently, the areas of dry to mesic scrub and forest habitats below 5,000 feet (1,525 m) that are or could be used by the Blackburn's sphinx moth consist of approximately 367,161 acres (148,588 ha) (USFWS 2005a). The 56 acres expected to be lost as a result of development of Honuaʻula represent approximately 0.015% of the presently available or occupied habitat.

Table 8. Habitat Conservation Plans and Safe Harbor Agreements for Nēnē

Permittee	Permit Duration	Location	No. of Permitted Take Over Permit Duration
Habitat Conservation Plan Permits			
Kaheawa Pastures Wind Energy Facility	01/30/2006–01/30/2026	Māʻalaea, Maui	60
Kaheawa Wind Power II	01/04/2012–01/04/2032	Māʻalaea, Maui	30
Auwahi Wind Farm	01/31/2012–01/31/2037	Auwahi, Maui	5
Safe Harbor Agreement Permits			
Molokai Programmatic Safe Harbor Agreement for Nēnē	04/07/2003–04/07/2053	Island Wide, Molokaʻi	Various
Puʻu O Hoku Ranch – Nēnē Reintroduction	08/22/2001–08/22/2008	Cape Halawa, Molokaʻi	> 0
Umikoa Ranch	12/05/2001–12/05/2051	Umikoa Ranch, Hawaiʻi	> 0
Piʻiholo Ranch	09/21/2004–09/21/2054	Makawao, Maui	> 0

6.3. Assessment of Impact on Critical Habitat

Critical habitat is a term used and defined in the ESA. Critical habitat is a specific geographic area that contains features essential for the conservation of a threatened or endangered species. The purpose of designating critical habitat is not to set aside these areas for conservation, but to ensure that federal actions do not destroy or adversely modify critical habitat. Private actions are generally not directly affected by critical habitat designation.

The property does not currently contain critical habitat for any listed species. However, on June 11, 2012, USFWS published a proposed rule to list 38 species on Molokaʻi, Lānaʻi, and Maui as endangered and to designate critical habitat for 135 species on Molokaʻi, Lānaʻi, Maui, and Kahoʻolawe, under the ESA of 1973, as amended (USFWS 2012). In addition to designating critical habitat for those species that are proposed for listing as "endangered" under this rule, USFWS also proposes to designate critical habitat for 11 additional species that are already listed, but do not yet have designated critical habitat. Further, USFWS is proposing to revise critical habitat for 85 species that are already listed as threatened or endangered on the four aforementioned Hawaiian Islands. USFWS uses an ecosystem-based approach to the proposed designation and/or revision of critical habitat under this proposed rule in an effort to conserve habitat units that the USFWS has determined to be essential to the conservation of multiple species. The proposed critical habitat includes areas currently occupied by listed species, and areas that are currently unoccupied, as well as areas for which no previous records exist. The proposed critical habitat is not finalized until a final rule containing the critical habitat boundaries has been published in the *Federal Register*.

The proposed critical habitat designation totals 271,062 acres (106,695 ha) on Molokaʻi, Lānaʻi, Kahoʻolawe, and Maui. Forty-seven (47) percent of the area being proposed as critical habitat on those islands is currently already designated as critical habitat. In effect, the proposed rule would result in more than doubling the area of critical habitat currently designated on Maui, and would cover approximately 40% of the land area on the island, 45% of which is privately owned.

Almost 154 acres (62 ha) of the proposed Maui-Lowland-Dry Unit 3, which totals 1,098 acres (444 ha), is located in the Honua'ula property (Figure 10; spatial data obtained from USFWS: personal communication Dawn Bruns, August 2012). Almost all of the land in proposed Maui-Lowland-Dry Unit 3 that is not part of the property is land owned by ʻUlupalakua Ranch, and is being considered for exclusion from critical habitat by USFWS. Maui-Lowland-Dry Unit 3 is proposed designated critical habitat for 19 species: ʻāwikiwiki, *Alectryon micrococcus, Bidens micrantha* ssp. *kalealaha, Bonamia menziesii, Canavalia pubescens, Cenchrus agrimonioides, Colubrina oppositifolia, Ctenitis squamigera, Flueggea neowawraea, Hibiscus brackenridgei, Melanthera kamolensis, Melicope adscendens, Melicope mucronulata, Neraudia sericea, Nototrichium humile, Santalum haleakalae* var. *lanaiense, Sesbania tomentosa, Solanum incompletum, Spermolepis hawaiiensis,* and *Zanthoxylum hawaiiense*. Of these 19 species, only ʻāwikiwiki (section 3.7.1) has been recorded at the property (Char and Linney 1988; Char 1993, 2004; SWCA 2006, 2009a; Altenberg 2007).

Approximately 119 acres (48 ha) (approximately 75%) of the proposed critical habitat in the Honuaʻula property will be protected within the NPPA. Additionally, this HCP will implement measures that benefit some of the 19 listed species with proposed designated critical habitat in Maui-Lowland-Dry Unit 3. The relative paucity of PCEs for most of the species for which critical habitat is proposed at the Honuaʻula property, combined with the absence of 18 of the 19 species for which Maui-Lowland-Dry Unit 3 is proposed, significantly limits the potential contribution of the Honuaʻula property to the recovery of these species in the long term.

As stated in 50 CFR 424.12(b), PCEs are to be determined for each species when designating critical habitat. The proposed rule, published in the *Federal Register* on June 11, 2012, uses an ecosystem-based approach to determining PCEs, and contains for each critical habitat unit "physical or biological features essential to the conservation of those individual species that occupy that particular unit, or areas essential for the conservation of those species identified that do not presently occupy that particular unit" (USFWS 2012:34473). These physical and biological features present in the ecosystems are considered to provide the necessary PCEs for each species in the proposed rule (USFWS 2012:34527). For the 19 species in Maui-Lowland-Dry Unit 3, these physical and biological features include an elevation range of less than 3,300 feet, annual precipitation of less than 50 inches, and substrates including weathered silty loams to stony clay, rocky ledges, and little-weathered lava. These general features are found in most of the southern and western flanks of Haleakalā below 3,300 feet and southern and western west Maui.

The physical and biological features pertaining to Maui-Lowland-Dry Unit 3 also include canopy genera: *Diospyros, Myoporum, Pleomele, Santalum,* and *Sapindus;* subcanopy species: *Euphorbia, Dodonaea, Leptecophylla, Osteomeles, Psydrax, Scaevola,* and *Wikstroemia;* and understory genera: *Alyxia, Artemisia, Bidens, Chenopodium, Nephrolepis, Peperomia,* and *Sicyos.* Although these are generally not uncommon Hawaiian genera, only one of the canopy genera (*Myoporum*), one of the subcanopy genera (*Dodonaea*), and one of the understory genera (*Sicyos*) in the list of PCEs are found in the property. None of these genera are particularly common in the property, or can be considered representative of the features or vegetation of the property. In 2008, SWCA found 16 aʻaliʻi in seven locations, 21 naio in 17 locations, and 113 ʻānunu (*Sicyos hispidus*) at 49 locations (SWCA 2010a).

The proposed project will result in a net conservation benefit to the one species with occupied habitat at property: ʻāwikiwiki. The 134-acre NPPA will be managed to remove threats to the species and improve

habitat conditions, and the population of the species itself will be enhanced through propagation and outplanting. Under current conditions, the few ʻāwikiwiki plants at the property are under threat from ungulates, competition from invasive species, and fire, making local recovery potential for the species very low without the measures proposed in this HCP.

Likewise, the proposed critical habitat for ʻāwikiwiki and the additional 18 species not occupying the area will receive more conservation benefit from the proposed on-site mitigation program (section 7.3.1 and 7.4.1) than it would in absence of the project. The loss of approximately 35 acres of this proposed critical habitat will be offset by protection and enhancement, in perpetuity, of 134 acres on-site, located in the proposed Maui-Lowland-Dry Unit 3. As noted in this HCP, the on-site mitigation involves a perpetual on-site conservation easement; weed control, including manual, chemical, and mechanical removal; control of pest animal species, including rats; enhancement of native plant species through propagation and outplanting; exclusion of ungulates; and interpretive trails and informational signs. The mitigation plan will provide for 15 years of funding for habitat improvements, followed by ongoing, perpetual funding for maintenance of the on-site mitigation site (i.e., the NPPA). Therefore, the impacts to approximately 35 acres of proposed lowland dry critical habitat will be offset at a better-than-2:1 ratio, as recommended by USFWS (personal communication, Dawn Bruns)

To further benefit species for which Maui-Lowland-Dry Unit 3 is proposed, a number of these species will be included in the outplanting effort at the NPPA, where appropriate. In addition to ʻāwikiwiki, outplantings may include *Bidens micrantha* ssp. *kalealaha, Bonamia menziesii, Cenchrus agrimonioides, Colubrina oppositifolia, Hibiscus brackenridgei, Neraudia sericea, Sesbania tomentosa, Solanum incompletum,* and *Spermolepis hawaiiensis* to enhance or establish populations of these species at the NPPA. Based on biological restrictions, *Ctenitis squamigera, Melanthera kamolensis, Melicope mucronulat,* and *Nototrichium humile* are not appropriate for planting in these areas, and will not be included in the outplantings. The NPPA does not provide habitat to support successful protection and conservation of *Flueggea neowawraea, Alectryon macrococcus, Melicope adscendens, Zanthoxylum hawaiiense,* and *Santalum haleakalae* var. *lanaiense*; therefore, these species are also not included in the outplantings at the NPPA.

As noted in the proposed rule, the Secretary may exclude an area from critical habitat based on economic impacts, impacts to national security, or any other relevant impacts (USFWS 2012). The Secretary can consider the existence of conservation agreements, other land management plans, and voluntary partnerships with federal, private, state, and tribal entities when making decisions under Section 4(b)(2) of the ESA. When considering the benefits of exclusion, USFWS considers factors such as whether exclusion of a specific area is likely to result in conservation; the continuation, strengthening, or encouragement of partnerships; or the implementation of a management plan that provides equal to or more conservation than a critical habitat designation would provide. In evaluating the existence of a conservation plan when considering the benefits of exclusion, USFWS considers a variety of factors, including whether the plan is finalized, how it provides for the conservation of the essential physical or biological features, whether there is a reasonable expectation that the conservation management strategies and actions contained in a management plan are likely to be implemented into the future, whether the conservation strategies in the plan are likely to be effective, and whether the plan contains a monitoring program or adaptive management to ensure that the conservation measures are effective and can be adapted in the future in response to new information.

The proposed rule includes a number of areas considered for exclusion from critical habitat designation on the basis of existing voluntary conservation agreements and management plans, including a HCP, to benefit conservation of the affected species and their habitat. Given the benefits of the conservation measures and mitigation plan proposed in this HCP, and the limited resources for most of the 19 species at the property, as defined in the proposed rule, the area covered by the HCP may be considered for

exclusion. In all, the proposed project in this HCP will provide a net conservation benefit to the proposed critical habitat and the species for which its designation has been proposed and that can be successfully planted in the NPPA.

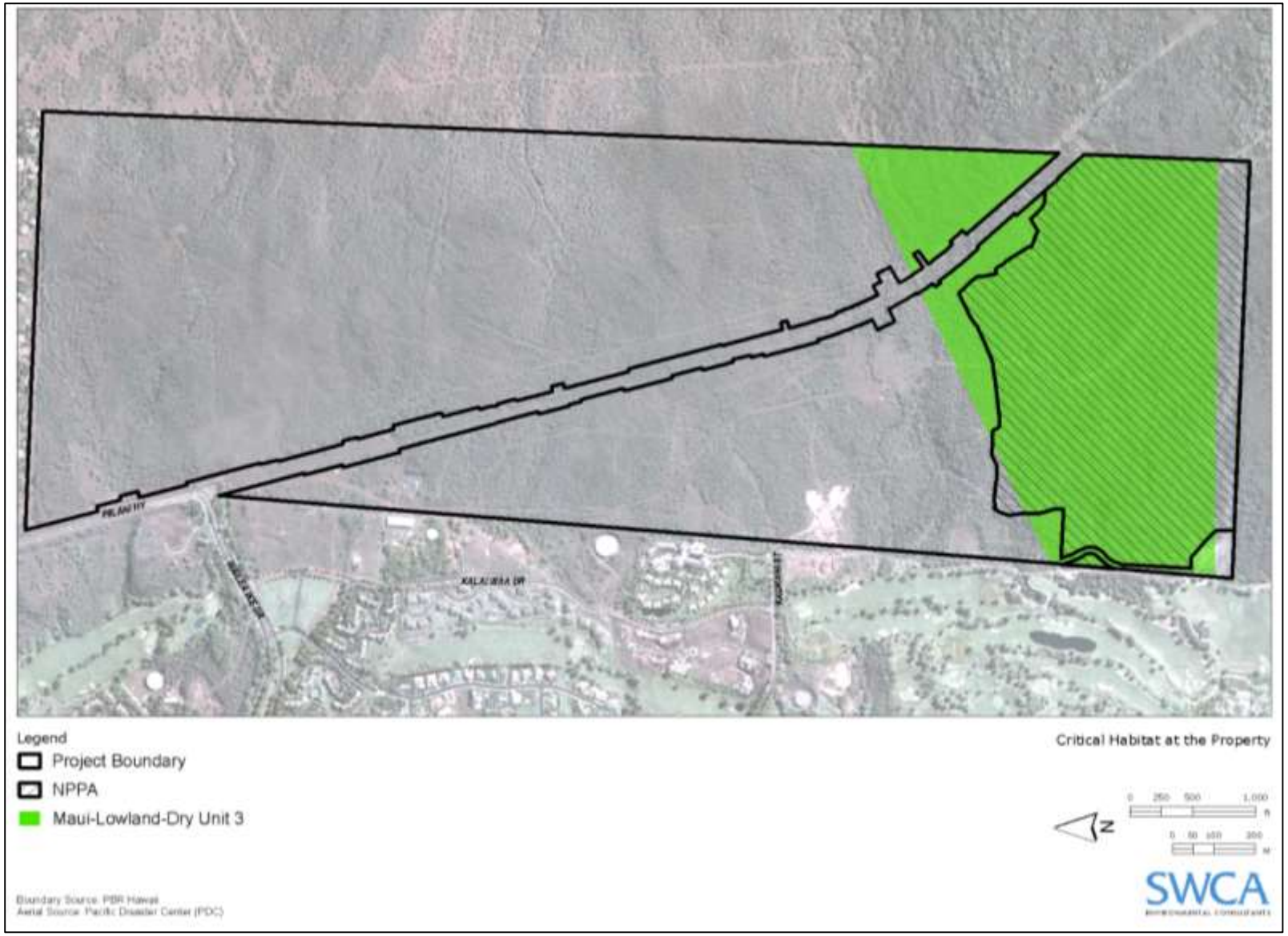

Figure 10. Proposed critical habitat in the property (project boundary).

7. AVOIDANCE AND MINIMIZATION, AND MITIGATION MEASURES

7.1. General Avoidance and Minimization Measures

The analysis of project design alternatives supports the conclusion that the proposed action (that is, the proposed Honuaʻula project) is preferred after consideration of financial feasibility and all impacts on the human and natural environment. Complete avoidance of risk to the Covered Species is impossible under the proposed action. Therefore, Honuaʻula Partners, LLC has incorporated a number of measures to minimize the risk of impacts to Covered Species. Additional measures are included to avoid and minimize risks to other wildlife species that may otherwise be adversely impacted by the project, to minimize impacts on the human environment, and to minimize any impacts to species included in this HCP, but for which take is not requested. General measures apply to both construction and post-construction activities, and additional measures for activities associated with construction and post-construction operations are specified. These measures are discussed in the following sections.

7.1.1. Natural Resources Manager

A natural resources manager will be hired as recommended in the *Honuaʻula Native Plant Conservation Plan* (SWCA 2010e). DOFAW and USFWS will approve the criteria and qualifications for the position, but Honuaʻula Partners, LLC will hire the natural resources manager. Performance of this person will be evaluated against the approved HCP. The natural resources manager's responsibilities will include conducting public outreach, supporting plant restoration and propagation efforts, conducting scientific research, controlling and eradicating invasive species from plant preservation and conservation areas, and implementing the goals and objectives of the *Honuaʻula (Wailea 670) Conservation and Stewardship Plan, Kihei, Maui* (SWCA 2010e). The appointed person will also oversee implementation of other avoidance and minimization measures described in this section during construction and post-construction operations. The natural resources manager will work cooperatively with government and non-governmental organizations, including the Maui Invasive Species Committee, Leeward Haleakalā Watershed Alliance, DLNR, and other organizations.

The natural resources manager will be hired before mitigation measures are implemented and before any major construction activities begin, and he or she will be responsible for designing and implementing any necessary protocols to avoid and minimize impacts to any of the Covered Species. This position will remain filled for the life of the project.

The responsibilities of the natural resources manager as specified in this HCP include the following:

- Coordinate response to injured or deceased wildlife at the property (section 7.1.2).
- Conduct surveys before, during, and after construction for āwikiwiki, Blackburn's sphinx moth, Hawaiian short-eared owls, and Hawaiian hoary bat (section 7.2).
- Keep track of presence and activity of Covered Species at the property (section 7.2).
- Ensure golf amenity marshalls and starters receive training in identification of Covered Species, and in measures to avoid and minimize harm to these Covered Species (section 7.1.2, 7.3.5).
- Develop a fire plan in consultation with USFWS, DLNR, and other entities as appropriate (section 7.5.3).

- Implement a monitoring program in consultation with USFWS, DLNR, and other entities as appropriate, and submit annual reports to DOFAW and USFWS (section 8.2).
- Develop a public education and outreach program (section 7.5.3). This will consist of a golf amenity component, to be completed before the start of golf amenity operation; a general local community and general public at large component; and an endangered species awareness component (section 7.1.2). The general education and outreach component will include sponsoring service trips to assist with management activities, field trips for island students, and development of interpretive signs to encourage public cooperation and discourage trespassing through the NPPA.
- Ensure succession of management of the on-site mitigation site (i.e., the NPPA), should the assigned manager or organization cease to exist or otherwise become unavailable to manage and execute the mitigation measures. This includes coordination with a cultural advisory group, set forth in the forthcoming cultural resource and preservation plan and the historic preservation plan.

7.1.2. Endangered Species Education Program

An endangered species education program will be conducted for all regular on-site staff. The program will be long term, ongoing, and updated as necessary. Staff will be trained to identify listed and non-listed native wildlife species that may be found on-site, to record observations of species protected by the ESA, HRS Chapter 195, and/or MBTA, and to take appropriate steps when and if injured or deceased wildlife is found (Appendix 4).

As part of their safety training, temporary employees, contractors, and any others that may drive project roads will be educated as to project road speed limits, the possible presence of injured or deceased wildlife on roads, and the possibility of nēnē and Hawaiian short-eared owls on roads. These types of personnel will be instructed to contact the natural resources manager immediately if they detect any injured or deceased wildlife on-site.

7.2. Construction Phase Avoidance and Minimization Measures

7.2.1. Endangered Species Construction Contract Provisions (Including BMPs)

Honuaʻula Partners, LLC will develop provisions and restrictions, which will be based on the BMPs described in the HCP, to avoid and minimize impacts to Covered Species. These provisions and restrictions will apply to all construction activities planned for areas in which Covered Species may occur. These provisions will be inserted into construction contracts for these activities.

7.2.2. Pre-Construction Wildlife Surveys

The natural resources manager will conduct surveys of any areas that will be subject to large-scale construction activities, such as mass-grading. The main focus of these surveys will be on āwikiwiki, Blackburn's sphinx moths, and Hawaiian short-eared owls. Surveys will be of sufficient scope and duration to detect these species, and survey protocols will be review by the agencies before any ground-breaking activities.

Potential larval host plants for the Blackburn's sphinx moth, including tree tobacco and other plants in the Solanaceae family, will carefully be examined before removal. The natural resource manager will assure the steps outlined in the most recent USFWS guidelines (Appendix 3, as updated via adaptive management) for avoiding Blackburn's sphinx moth take are followed (see also section 7.3.7).
The Hawaiian short-eared owl, which is not listed as threatened or endangered on the island of Maui, has been observed at the property, and may roost or even nest in low vegetation or nest on the ground in the property. Because Hawaiian short-eared owls breed year-round, it is not possible to time vegetation clearing activities to avoid potential for conflict with nesting by this species. The natural resources manager will conduct systematic surveys to detect any Hawaiian short-eared owl nesting activity. Vegetation clearing will be suspended within 300 feet (91 m) of any area where distraction displays, vocalizations, or other indications of nesting by adult Hawaiian short-eared owls are seen or heard, and resumed when it is apparent that the young have fledged or other confirmation that nesting is no longer occurring.

7.2.3. Fencing

The entire perimeter of the property has already been fenced to exclude cattle from the kiawe-wiliwili shrubland. This fence will be replaced along the western, eastern, and northern boundaries with an ungulate-proof fence to effectively exclude non-native axis deer, goats, as well as cattle from further damaging native plants. The fence will be constructed by the permit holder using corrosion-resistant galvanized steel materials, and will be approximately 8 feet in height with mesh size of no more than 6 inches. All ungulates will be removed from the property using humane methods, as described in the *Animal Management Plan for Honuaʻula* (SWCA 2010e). Temporary fences will be erected around the conservation areas (see section 7.5.2) to prevent any construction-related impacts to native plants and cultural sites in these areas. Where appropriate, this will include the use of silt fencing to limit sediment runoff from upslope construction areas. The entire perimeter of the NPPA will be fenced before construction. All fencing will be inspected on a daily basis and repaired when necessary.

7.2.4. Best Management Practices

Honuaʻula Partners, LLC will implement BMPs to ensure that construction activities do not harm any Covered Species at the property, and to minimize erosion and sedimentation runoff. These measures include those outlined in the transportation management plan by Austin, Tsutsumi, and Associates Inc. (2009) and approved by both the County of Maui and Hawaiʻi Department of Transportation, and measures recommended by the USFWS (April 08, 2009) with regard to minimizing impacts to natural resources (Appendix 5). These measures include the following:

- Erecting signs to delineate parking areas, speed limits, disposal sites, etc.
- Carefully selecting a staff parking area at a sufficient distance from the on-site NPPA and plant conservation areas to minimize potential impacts to resources and wildlife protected in those areas.
- Establishing a speed limit of 15 miles per hour (mph) for all vehicular traffic at the property to limit strike hazard to Covered Species, in particular nēnē and short-eared owls.
- Limiting outdoor lighting to the period outside of fledging season for the endangered Hawaiian petrel and Newell's shearwaters, which falls between September 15 and December 15. In compliance with State Department of Health regulations, construction can only be performed between 7:00 a.m. and 6:00 p.m., Monday through Friday, and between 9:00 a.m. and 6:00 p.m. on Saturdays (Austin, Tsutsumi and Associates, Inc, 2009). Therefore, no nighttime construction will be performed. All outdoor lights will be shielded.

- Establishing appropriate buffer zones around any candidate, proposed, threatened, or endangered species found at the property during the pre-construction surveys, until threat to the species no longer exists.
- Installing sediment barriers such as silt fencing along the bottom of a slope and downgradient of a disturbed area, especially in areas upslope of the NPPA and plant conservation areas.
- If listed species, in particular nēnē, are attracted to construction sites, work within 100 feet of the animal will cease until the animal(s) leave on their own accord. The local DOFAW office will be notified.

7.3. Operation Phase Avoidance and Minimization Measures

7.3.1. Roadways (Speed Limit)

Permanent speed limits will be posted throughout the property to minimize collision with Covered Species and other native wildlife. In addition, speed bumps will be installed on roadways wherever necessary to ensure compliance with posted speed limits. Speed limits across the property will be 15 mph. If one or more nēnē do become present on the property, specific signs signaling their presence along roads will be installed.

7.3.2. Seabirds: Lighting

External lighting at the property and its associated buildings and facilities are subject to Maui County Code Title 20, Chapter 35, regulating outdoor lighting standards. This chapter prohibits the use of broad-spectrum mercury vapor lights, and mandates that lights are either fully shielded, or imposes usage restrictions on lights that may be partially shielded. These conditions are intended to minimize fallout of juvenile seabirds.

In addition, external light at the property will be designed to ensure that light attraction to seabirds is minimized. External lighting associated with the proposed development, including parking areas, accent lighting, and external building illumination, will follow existing recommendations from USFWS (Appendix 6) and will be of the following types: shielded lights, cut-off luminaries, or indirect lighting. External lighting and utility structures will be minimized and shielded to such an extent that attraction and fallout of seabirds are unlikely to occur. This includes all lighting on private homes.

7.3.3. Management and Maintenance

Regular management and maintenance activities at the property are not expected to result in any adverse impacts to Covered Species. However, the following steps will be taken to further ensure the minimization and avoidance of impacts:

- The natural resources manager will notify management and maintenance personnel of the location of any nests or individuals of Covered Species, and will provide guidelines on avoiding impacts to these species.
- All management and maintenance staff will be required to attend the endangered species training, described above, on an annual basis.

- Management and maintenance staff will report all activity and presence of Covered Species at the property to the natural resources manager.

7.3.4. Owners and Residents (Covenants, Conditions, and Restrictions)

To assure compliance with conditions associated with lighting, leash laws, landscaping, and others that may affect Covered Species, Honuaʻula Partners, LLC will include provisions in the project covenants, conditions, and restrictions addressing these issues. The eventual management of the project by a master association and individual homeowner associations will undertake enforcement of the management plan.

7.3.5. Golf Amenity Operations

Concerns with regard to attraction of nēnē and waterbirds and subsequent impacts on these species are primarily related to golf amenity features. Because the golf amenity will not contain any permanent water features, attraction of waterbirds to the property is not expected; however, any measures described below to minimize harm to nēnē will also be applied to other waterbirds if, for unforeseen reasons, they do become attracted to features associated with the golf amenity.

- All management and golf amenity maintenance staff will be required to attend the endangered species training annually.
- The natural resources manager will ensure that golf management receives training in identification of Covered Species, and in measures to avoid and minimize harm to the Covered Species. This will include measures in response to injured or dead Covered Species, non-harmful means to encourage Covered Species to leave areas in which they are at risk of harm, or measures to discourage them from occupying such areas. This training will be in addition to the regular required endangered species education.
- If Covered Species are observed or anticipated, due to presence at nearby properties, at the golf amenity, the natural resources manager will brief the golf amenity personnel on the status of these species at the golf amenity, and provide instructions on appropriate measures to minimize or avoid harm to these species.
- When Covered Species are observed or anticipated at the golf amenity, the golf amenity starter will inform every golfer about the presence of the Covered Species. Each golfer will receive a briefing including information about the protected status of the Covered Species under the ESA and HRS Chapter 195D, the necessity of taking measures to avoid harm to the species, and about any golf amenity rules that apply to these situations.
- If Covered Species are observed foraging, transiting, or even nesting at areas of the golf amenity, the natural resources manager, marshal, or starter will temporarily halt play in that location until the animals have relocated.
- If any dead or injured Covered Species is found on the golf amenity, a wildlife recovery and response protocol will be implemented. This protocol will be developed with consultation of USFWS and DLNR, and a draft is included in Appendix 4.
- An endangered species education program will be developed for the golf amenity. Features that may be included in this education program are brochures or placards to be issued to each golfer, and educational materials such as informational panels or posters will be placed at the pro shop or an educational kiosk. An educational program is anticipated to be very effective, because this will be a private golf amenity, and most users will be regulars and residents of the development.

- Users of the golf amenity will be instructed to contact the starter or marshall on duty when Covered Species are observed on the golf amenity, or when there are any concerns regarding Covered Species.

7.3.6. Avoidance Measures for the Hawaiian Hoary Bat

Trees 15 feet or more in height will not be cleared for construction between June 1 and September 15 when non-volant Hawaiian hoary bat juveniles may be present at the property, pursuant to recent USFWS guidance based on available literature and data (Bonaccorso et al 2015; DOFAW 2015). The natural resources manager or other qualified wildlife biologist will monitor for bats before vegetation clearing to further ensure no impacts to juvenile bats will occur.

Any fences built for the project will have a barbless top-strand of wire to prevent entanglements of the Hawaiian hoary bat on barbed wire.

7.3.7. Minimization Measures for Direct Take of Blackburn's Sphinx Moths

To minimize direct take of Blackburn's sphinx moths, Honuaʻula Partners, LLC will follow the USFWS protocol (see Appendix 3) for the removal of tree tobacco. This includes measures such as checking trees for sign of larvae, leaving trees with larvae or sign of larvae for 30 days, cutting trees without sign or larvae at ground level, and leaving the root ball and soil in the surrounding 30-foot (10-m) radius for a period of 1 year before ground disturbance. Checking trees for presence or sign of larvae will be overseen by the natural resource manager or other delegated personnel trained by the natural resource manager.

Impacts to Blackburn's sphinx moths resulting from light attraction at Honuaʻula are not considered likely. Moths are known to be attracted to lights, and light attraction may cause the moth to strike an object or otherwise fall to the ground where it could be exposed to predation or other stressors. USFWS has acknowledged that quality of darkness may be a factor in adult Blackburn's sphinx moth behavior, but this issue was not taken into account when critical habitat was designated due to a lack of prior studies of the issue (USFWS 2003a). Flight-to-light distances of Sphingid moths have been shown to be less than 33 feet (10 m), and the effective radius of a 125-watt mercury vapor light is a mere 9 feet (3 m) (Frank 2006). The short flight-to-light distance along with a very low density of moths result in a very low expected risk of light impacts to Blackburn's sphinx moths at Honuaʻula. Furthermore, the property is located in an urban area that already has a high level of ambient lighting. This minimizes the chances of light attraction for moths by reducing flight-to-light behavior (Frank 1988, 2006). This would significantly dilute the effect of additional lights installed at the property. Nonetheless, potential impacts will be avoided by reducing light pollution as recommended by the USFWS for avoidance of light impacts to seabirds. In addition, light fixtures will be placed away from areas in which moths may become trapped and tightly sealed to avoid entrance of moths as recommended by Frank (2006).

External lighting at the property and its associated buildings and facilities are subject to Maui County Code Title 20, Chapter 35, regulating outdoor lighting standards. This chapter prohibits the use of broad-spectrum mercury vapor lights, and mandates that lights are either fully shielded, or imposes usage restrictions on lights that may be partially shielded.

In the area between the Site 200 wall and the NPPA, Honuaʻula Partners, LLC will implement the provisions of Lighting Zone 1 (LZ-1) of the dark sky model light ordinance (Appendix 7).

7.4. Selection of Mitigation Measures

Honuaʻula Partners, LLC coordinated with biologists from USFWS, DOFAW, SWCA, and members of the ESRC to identify and select appropriate mitigation measures to compensate for the potential incidental take of two federal and/or state-listed species during construction or operations at the Honuaʻula property. In addition, mitigation is designed to ensure USFWS and DOFAW permit issuance criteria are met. The criteria used for determining the most appropriate mitigation measures are as follows:

1. The level of mitigation should (at least) be commensurate with the currently anticipated take.
2. Mitigation should be species specific and, to the extent practicable, location or island specific.
3. Mitigation measures should be practicable and capable of being done given currently available technology and information.
4. Mitigation measures should have measurable goals and objectives that allow success to be assessed.
5. Mitigation measures should be flexible to adjust to changes in the level of take according to new information during project operation.
6. Mitigation measures should be consistent with or otherwise advance the strategies of the respective species' draft or approved recovery plans.
7. Mitigation measures that serve to directly "replace" individuals that may be taken (e.g., by improving breeding success or adult and juvenile survival) are preferred, although efforts to improve the knowledge base for poorly documented species also have merit, particularly when the information to be gained can benefit future efforts to improve survival and productivity.
8. Off-site mitigation measures of resources located on otherwise unprotected private land are preferred over those on public land, and sites on state land are preferred by USFWS over those on federal land.
9. Measures to decrease the level of take resulting from a private activity unrelated to the project are generally considered the responsibility of the other party and are not preferred as mitigation.
10. Alternate or supplemental mitigation measures should be identified for future implementation if the level of take is found to be higher (or lower) as a result of monitoring.

Federally and/or state-listed species considered to have potential to be incidentally taken during the life of the project are the Blackburn's sphinx moth, nēnē, and ʻāwikiwiki, as well as the proposed listed assimulans yellow-faced bee and anthricinan yellow-faced bee. The mitigation proposed to compensate for impacts to these species is based on anticipated levels of incidental take as determined through on-site surveys, off-site information gathering, and modeling. The primary goal of the proposed mitigation measure is to directly offset habitat lost at the property, and increase populations of the Covered Species to aid their recovery. Combined, the on-site and off-site mitigation measures will provide a net ecological benefit, as required by Chapter 195-D, HRS.

7.5. On-Site Mitigation Plan

This plan addresses general mitigation measures designed to minimize and offset loss of habitat and loss of components of the native communities at the property as a result of construction and operation of the project, in addition to the required mitigation measures for take of, or loss of habitat for, the Covered Species. The compensatory mitigation plan includes establishment of an on-site NPPA, and an off-site mitigation plan. Budgeted costs are estimates and are not necessarily fixed. The applicant, Honuaʻula, will provide the required conservation measures in full, even if the actual costs are greater than anticipated. The goals, objectives, and commitments in this HCP will be met by Honuaʻula.

7.5.1. Native Plant Preservation Area

Honuaʻula Partners, LLC will establish a perpetual on-site conservation easement over an area of approximately 134 acres (54 ha) in the remnant kiawe-wiliwili shrubland (Figure 11), which will encompass all known historic locations of nehe (*Lipochaeta rockii*) plants as well as ʻāwikiwiki plants found by SWCA at the property (see Table 4). Impacts to the Blackburn's sphinx moth and to both yellow-faced bee species, and the loss of approximately 56 acres (23 ha) of habitat for these species are offset through establishment and management of the 134-acre (54-ha) NPPA. This more than satisfies the 2:1 mitigation ratio required by USFWS (personal communication, Dawn Bruns, USFWS). Outplanting or seeding and management of ʻāwikiwiki in the NPPA will offset any take of this species.

The easement will be approved by DOFAW and USFWS, and will be in place before the ITL and ITP are issued. The scope of the NPPA will be set forth in an agreement between Honuaʻula Partners, LLC and the county that shall include the following: 1) a commitment from Honuaʻula Partners, LLC, its successors, and permitted assigns to protect and preserve the NPPA for the protection of native Hawaiian plants; 2) use of the NPPA will be confined to activities consistent with the purpose and intent of the NPPA; and 3) no development other than fences and interpretive trails will be allowed in the NPPA. Interpretive trails will be minimal in size, and shall not consist of imported materials or hardened surfaces, and care will be taken to minimize impacts to native plants during establishment of trails. Existing jeep roads will be used to the maximum extent practicable. Trail surface area will not exceed 1% of the total area of the NPPA.

Title to the NPPA will be held by Honua'ula Partners, LLC, its successors, and permitted assigns, or will be conveyed to a land trust that holds other conservation easements. The grantee and the easement will be drafted to meet the approval of USFWS and DOFAW. The easements shall provide USFWS with a third-party right-of-enforcement prior to groundbreaking. Access to the area will be permitted pursuant to an established schedule specified in the conservation or preservation plans to organizations on Maui dedicated to the preservation of native plants, to restoring and perpetuating native species, and to engaging in needed research. These organizations may enter the NPPA at reasonable times for cultural and educational purposes only.

The entire NPPA will be enclosed by an 8-foot-tall deer-proof fence with barbless double-strand top wire. The fence construction and ungulate removal from the entire NPPA will be completed before construction. Vegetation enhancement activities will be initiated once ungulates have been removed.

The NPPA will consist of a 112-acre (45-ha) core area, surrounded by a 22-acre (9-ha) conservation buffer area, per USFWS request (personal communication, Dawn Bruns, USFWS). Although the entire 134-acre (54-ha) NPPA will be protected and enhanced, the USFWS has required that a 112-acre (45-ha) area (Figure 11) be established in the NPPA for the protection and enhancement of threatened and endangered species. In the core area, more stringent enhancement and maintenance measures are

implemented, and listed species will only be introduced to this core area. This is to ensure the measures of success set forth for the core area are met.

In the core area of the NPPA, management measures will include the following:

- Maintenance of 0% cover of all non-native species within a 15-foot (5-m) buffer around listed plant species (e.g., ʻāwikiwiki, and outplanted *Colubrina oppositifolia* and *Hibiscus brackenridgei*). In order to measure percentage cover, an observer will stand at the edge of the plant's extent at ordinal directions (north, south, east, and west) and visually estimate cover of species within 5 m.
- Maintenance of less than 40% cover of non-grass invasive weeds in the remainder of the core area. This does not include kiawe. Target plant species include koa haole, lantana, and cow pea. Kiawe will remain in place to reduce the potential for increased grass cover, and a plan will be developed for gradual replacement of kiawe canopy cover with native species. Tree tobacco will also not be removed from the NPPA (unless directed to do so by USFWS and DOFAW) because this plant is a recognized host plant for the Blackburn's sphinx moth. USFWS and DOFAW may establish a maximum stem count to limit the abundance of tree tobacco in the NPPA. To assess cover of non-native species in the core area, a systematic sampling design will be used. Transects will be spaced 50 m apart, extending in the west-to-east direction (mauka to makai). At 50-m intervals along each transect, 10-m^2 permanent sampling plots will be established and marked with an identification number. Percent cover of vegetation will be visually estimated in each plot and identified to the narrowest taxonomic level possible. To specifically assess grass cover and potential fire threat, between 20-40 0.5-m^2 quadrats (PVC reference frames) will be randomly placed in each 10-m^2 permanent sampling plot. In each quadrat, an observer will visually estimate cover of each grass species present. Substrate (soil, rock, litter, etc.) will also be recorded in the quadrats..
- Maintenance of less than 10% cover of non-native grasses in the remainder of the core area to reduce fire risk and enhance recruitment of native plant species. Target grasses include buffelgrass, guinea grass, and other fire-prone alien grasses. Percentage cover of non-native grasses will be estimated in the same plots using the same methodology described above.
- Early detection and removal of incipient weeds (i.e., recently introduced).
- Outplanting of listed species with proposed critical habitat in the NPPA, as appropriate (see section 6.3).
- Broadcast of ʻāwikiwiki seeds (collected from the property before grading and construction) in the core area.
- Outplanting of other native dry forest plant species. This may include native host plants for the Blackburn's sphinx moth. The PCEs for Blackburn's sphinx moth larvae, ʻaiea (*Nothocestrum* spp.), will be considered for propagation and outplanting in the core area. The outcome of this effort is unknown because the property lies at lower elevation than the distribution reported for the species (Wagner et al. 1999).
- Control of rats, which limit recruitment of native plants through browsing and seed predation, using appropriate bait stations and/or traps in a grid system. Methods will be developed through consultation with U.S. Department of Agriculture Animal Damage Control, USFWS, and DLNR. State Department of Health BMPs will be implemented. Rat control will be implemented before outplanting of any listed species.
- If any portion of the NPPA is burned at any time after initiation of construction at the property, intensive restoration will be initiated in the burned area within 1 month.

Throughout the remainder of the NPPA, management measures will include the following:

- Early detection and removal of incipient weeds.
- Maintenance of less than 40% cover of non-grass invasive weeds in the remainder of the NPPA. This does not include kiawe. Target plant species include koa haole, lantana, and cow pea. Kiawe will remain in place to reduce the potential for increased grass cover. Tree tobacco will also not be removed from the NPPA (unless directed to do so by USFWS and DOFAW) because this plant is a recognized host plant for the Blackburn's sphinx moth. USFWS and DOFAW may establish a maximum stem count to limit the abundance of tree tobacco in the NPPA. To assess cover of non-native species in the remainder of the NPPA, a stratified random sampling design will be used. Two strata will be established: one above 150 m in elevation, and one below 150 m in elevation. In each stratum, five randomized, 10-m^2 permanent sampling plots will be selected and marked with an identification number. Percent cover of vegetation will be estimated in each plot. To specifically assess grass cover and potential fire threat, between 20-40 0.5-m^2 quadrats (PVC reference frames) will be randomly placed in each 10-m^2 permanent sampling plot. In each quadrat, an observer will visually estimate cover of each grass species present. Substrate (soil, rock, litter, etc.) will also be recorded in the quadrats.
- Maintenance of less than 10% cover of non-native grasses. Target grasses include buffelgrass, guinea grass, and other fire-prone alien grasses. Percentage cover of non-native grasses will be estimated in the same permanent plots using the same methodology described above.
- Outplanting of native dry forest plant species, as appropriate.

Weed control in the NPPA may include manual, mechanical, or chemical control methods, or a combination of these methods. Restricted pesticide use will be performed or overseen by a licensed applicator, and in coordination with applicable government conservation agencies as required by the label. Specific management details will be identified by the natural resources manager during the initial stage of program implementation.

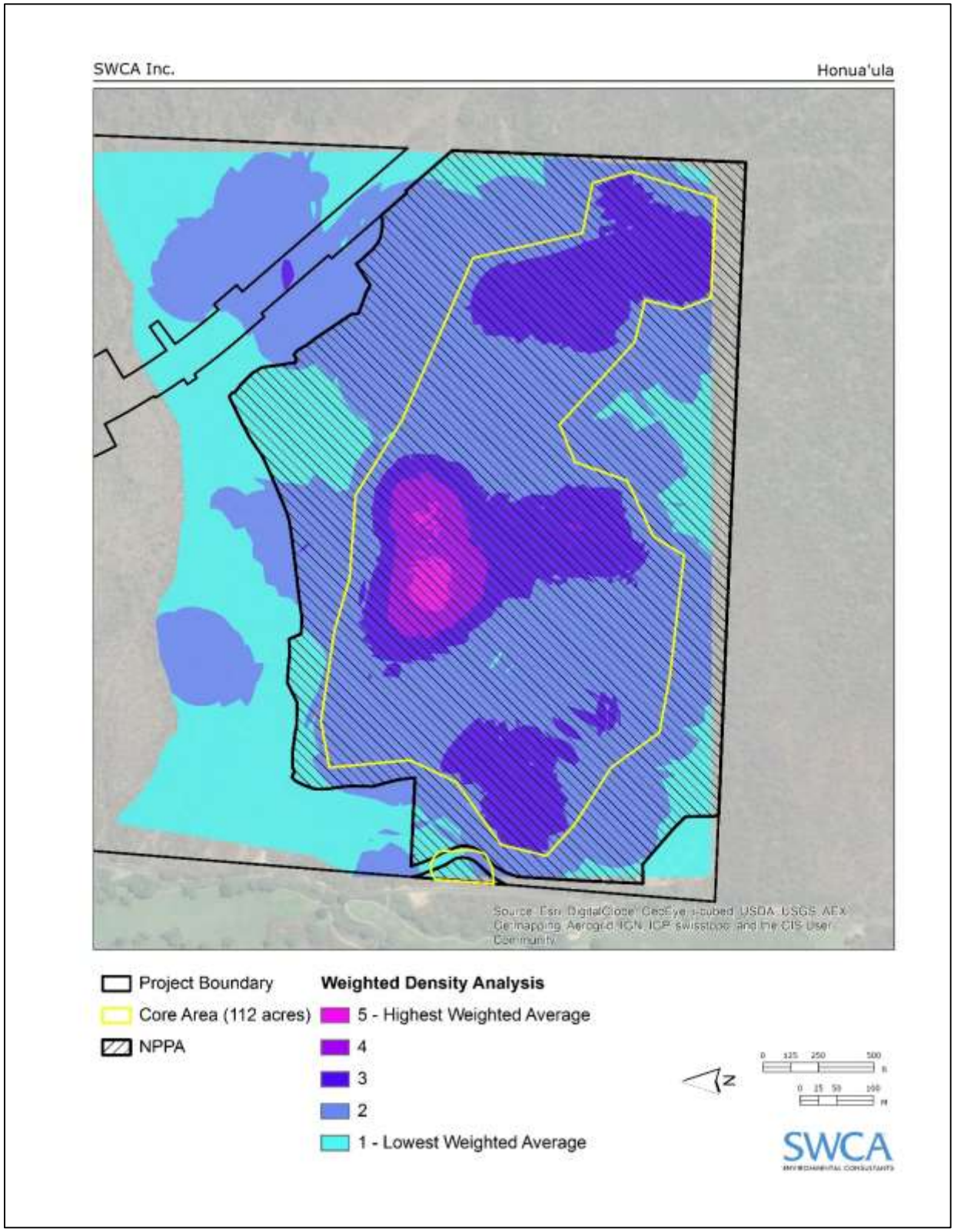

Figure 11. Proposed core area in native plant preservation area.

7.5.2. Plant Conservation Areas

In addition to the NPPA described above, plant conservation areas will be located throughout the property adjacent to both the golf amenity and the NPPA. The areas will include 1) all the existing natural gulches throughout the property, 2) ungraded conservation areas in which existing native plants will be protected and which will be managed as natural areas, and 3) areas containing naturalized landscape and in which existing native vegetation will be conserved or enhanced. These areas combined will add an additional conservation area of approximately 108 acres (44 ha) in which existing native plants will be protected. Management strategies employed for these plant conservation areas may include measures listed above for the NPPA.

7.5.3. Native Plant Conservation Plan

Honuaʻula Partners, LLC will implement a management plan based on SWCA's forthcoming Honuaʻula native plant conservation plan and based on what is described in the conservation and stewardship plan in the final EIS (PBR Hawaiʻi 2012). The purpose of the conservation and stewardship plan was to identify measures to be taken to avoid and minimize impacts including establishment and management of a perpetual on-site native plant preservation easement. The goals and main elements of this plan have been incorporated into this HCP. The management plan will be revised and finalized before the start of construction based on agency and public comments on this HCP to assure consistency between the two documents. The *Honuaʻula Native Plant Conservation Plan* (NPCP) may be updated if adaptive management is implemented under the provisions of this HCP. The goals of the NPCP are to preserve elements of the remnant kiawe-wiliwili shrubland, as much as possible, and to protect native plants and animals in the immediate area affected by construction of the proposed Honuaʻula community. The secondary goals of the NPCP are to cooperate with researchers in furthering the science of native plant propagation, provide education and outreach opportunities, and enhance the natural beauty of the proposed Honuaʻula project. NPCP objectives, some of which have been described above as part of the avoidance and minimization strategy and in the description of the on-site NPPA and plant conservation areas, include the following:

- Establish a position for an on-site natural resources manager (section 7.1.1.1).
- Construct a deer fence around the eastern and southern boundaries of the 670-acre (270-ha) property (section 7.2.3).
- Remove all ungulates from in the entire property (section 7.2.3).
- Control noxious invasive plants (sections 7.5.1 and 7.5.2).
- Protect and propagate native plants from local seed stocks (sections 7.5.1 and 7.5.2).
- Attempt to propagate native host plants for Blackburn's sphinx moth in the NPPA (section 7.5.1)
- Develop a fire control plan (natural resources manager in consultation with USFWS, DLNR, and other entities as appropriate). The purpose of this plan is protection of the NPPA and the plant conservation areas from fire damage. This plan will be in place before ungulates are removed from the property.
- Control non-native seed predators to the maximum extent practicable.
- Implement a monitoring program (natural resources manager in consultation with USFWS, DLNR, and other entities as appropriate). The purpose of this monitoring will be to accurately establish a baseline to evaluate efficacy of management activities, and to identify threats to the NPPA. The monitoring plan will also cover future monitoring requirements.

- Landscape the property with native plants from local seed stock.
- Honua'ula Partners, LLC will attempt to involve a wide range of stakeholders in the management of the NPPA. The natural resources manager will work with the University of Hawaii, Maui Invasive Species Council, Leeward Haleakalā Watershed Alliance, state DLNR, and others, as appropriate, to conduct detailed scientific inventories and monitoring programs to develop an accurate baseline and ongoing monitoring to evaluate the efficacy of management activities and identify imminent threats to the preserve. Honua'ula will make an effort to continually disseminate useful information to all stakeholders.
- Develop a public education and outreach program (natural resources manager) (section 7.1.2). This will include sponsoring service trips to assist with management activities, field trips for island students, and development of interpretive signs to encourage public cooperation and discourage trespassing through the NPPA.

Stewardship in the context of traditional Hawaiian uses was focused on survival of the inhabitants in a subsistence economy. However, in the present day, preservation of resources is approached from a conservation, educational, cultural, historic, and recreational perspective. Stewardship, therefore, integrates preservation of archeological resources and conservation of natural resources, so future generations can appreciate the historic subsistence communities, and adaptability of the historic residents, as well as see remnants of native dry shrubland. This plan focuses specifically on management actions to enhance and conserve native plants in the property. Preservation of cultural resources will be addressed in the forthcoming native plant historic preservation plan and cultural resource preservation plan, which will be complementary to this plan.

7.6. Blackburn's Sphinx Moth Off-Site Mitigation Measures

Impacts to the Blackburn's sphinx moth and the approximately 56 acres (23 ha) of its habitat are offset through implementation of an on-site mitigation plan incorporating the 134-acre (54-ha) NPPA. This is more than sufficient to satisfy the 2:1 mitigation requirement from USFWS (personal communication, Dawn Bruns, USFWS). However, because success of on-site outplanting of ʻaiea is uncertain, additional compensation of loss of larval food plants for the Blackburn's sphinx moth, consisting of approximately 21 tree tobacco plants, based on a property-wide survey, will be accomplished by off-site outplanting of ʻaiea. This off-site mitigation plan has been designed in consultation with USFWS, DLNR, Dr. Art Medeiros, Andrea Buckman (Leeward Haleakalā Watershed Restoration Partnership), Dr. Dan Rubinoff (Lepidopterist, UH Mānoa), and facilitated with the cooperation of Mr. Sumner Erdman (ʻUlupalakua Ranch). The off-site mitigation component of this plan consists of a one-time planting of 1,000 ʻaiea seedlings, at an average density of 10 trees per acre. Some watering and management will be implemented to assure successful establishment of these trees. Half (500) of these seedlings will be planted at the Kanaio mitigation site, and half (500) will be planted at Auwahi (Figure 12). The planting will coincide with the start of the on-site mitigation measures at the NPPA. At least 100 of the planted trees will be alive after 10 years, at both sites combined. Planting will start before construction.

The assessment of suitable off-site mitigation sites has focused on areas with similar geology as the property in areas where outplanting of native larval host plants (i.e., *Nothocestrum*) is feasible.

7.6.1.1. KANAIO

After close consultation with the federal and state wildlife agencies, a privately owned, protected parcel was identified as particularly high-quality Blackburn's sphinx moth habitat, due to the abundance of both native larval host plants (i.e., *Nothocestrum*) and adult host plants (see Figure 12). This mitigation site is

adjacent to the eastern border of Kanaio NAR, which is considered to be the main stronghold for the Blackburn's sphinx moth on Maui, hosting the core population on that island (USFWS 2005c; Conant and VanGelder 1998). The mitigation site is within the 8-foot-tall deer fence currently protecting Kanaio NAR.

The *Kanaio mitigation site* is considered by USFWS (Dawn Bruns, in maps recently provided to SWCA; USFWS 2005c), USGS (Medeiros et al. 1993; and USGS GAP Analysis maps), and VanGelder and Conant (1998) as a premier example of the native dry forest habitat, which has been reported to have the highest densities of Blackburn's sphinx moth on Maui (citations above). Interest in the area was sparked in 1984 after the rediscovery of Blackburn's sphinx moth in this area, eventually leading to the establishment of the NAR (personal communication, Betsy Gagne, NARS Staff DOFAW, May 2, 2011). The ʻaiea planting area is rich in full stature hala pepe and ʻaiea trees, tree tobacco, and many native host plants that are consider PCEs for Blackburn's sphinx moth habitat (Medeiros et al. 1993; LeGrande Biological Surveys 2011).

Established in 1990, the Kanaio NAR south of the property encompasses 876 acres (354 ha). The reserve is between 1,100 and 2,780 feet (335 and 850 m) in elevation on leeward East Maui. The substratum at Kanaio is similar to the southern portion of Honuaʻula and consists of broken ʻaʻā lavas estimated to be less than 10,000 years old (Medeiros et al. 1993). Soils are ʻaʻā flows and very stony lands on a gently sloping (< 15%) topography with trench-like channels formed by lava flows when the area was formed. Climate conditions are similar to the property, with arid, windswept conditions and an annual rainfall of approximately 30 inches (750 mm). Most of the precipitation comes from periodic Kona storms between October and March (DLNR 2003).

The vegetation at Kanaio can be classified into four different communities, largely determined by the underlying geologic substrate and degree of past disturbance: 1) groves of native trees, 2) native shrublands, 3) lava fields with sparse vegetation, and 4) areas dominated by an assemblage of non-native grasses, shrubs, and herbs. In the native groves, the reserve contains representatives of three native vegetation types: ʻaʻaliʻi (*Dodonaea*) lowland shrublands, lama (*Diospyros*) forest, and wiliwili (*Erythrina*) forest. Although they are highly disturbed and altered, these groves are among the best examples of Hawaiian dry forest left in the state, and they are an important component of Hawaiʻi's overall remaining biodiversity (DLNR 2003).

The proposed Kanaio ʻaiea planting area (see Figure 12) is on the same substrate as Kanaio NAR and has been included in the 8-foot-tall deer fence protecting Kanaio NAR. Medeiros et al. (1993) and SWCA found a total of 171 species of plants at the off-site ʻaiea planting area, 40% of which are native to the Hawaiian Islands (19 indigenous species and 49 endemic species). In contrast, the Honuaʻula property harbors 146 species of plants overall, of which 27% are native (26 indigenous species and 14 endemic species). Refer to the table in Appendix 8 for comparison of plant species found at the mitigation site and the property. The vegetation includes all of the elements of the native dry shrubland that are found at the property, including a similar suite of adult host plants for the Blackburn's sphinx moth, and the larval host plant tree tobacco, as well as ʻaiea. Densities of wiliwili appear to be patchy, but similar to those at the property. Price et al. (2007) assigned values of 'medium' to 'high' habitat quality for wiliwili in the area encompassing Kanaio and the proposed ʻaiea planting area on his habitat quality maps, based on bioclimatic data. The USGS GAP classifies much of the proposed ʻaiea planting area at Kanaio as Native shrubland (alien grasses and Native shrubland (Native shrubs), with some patches of Kikuyu grassland/Pasture and Uncharacterized shrubland (see Figure 4). The Biodiversity Summary and Habitat Quality Assessment by The Nature Conservancy shows the western half of the proposed mitigation site as Threatened Native Ecosystem, and the eastern half as Rapidly Degrading Ecosystem (Figure 13).

The native forests on both the Honuaʻula property and Kanaio have undergone degradation from decades of disturbance, leading to modification of the original habitat. Most notable is the removal of the understory vegetation as a result of grazing and ungulate trampling, which has led to a change in temperature, moisture, and soil chemistry (Medeiros et al. 1993). As a result, there has been poor recruitment of the native trees. Tree tobacco is present at Kanaio, and along with the native ʻaiea, it serves as habitat for the larvae of the Blackburn's sphinx moth (VanGelder and Conant 1998). Outplanting of ʻaiea will assist in the recovery of Blackburn's sphinx moth habitat now that the area has been protected from ungulates.

7.6.1.2. AUWAHI

The ʻaiea planting area at Auwahi is part of a large, 5,400-acre (2,185-ha) stand of diverse, native dryland forest. The botanist Joseph Rock (1913) described the Auwahi dryland forest on Maui as one of the richest botanical regions in the archipelago. Since then, ungulates (cattle, deer, and pigs), wildland fires, and invasive plants, especially kikuyu grass (*Cenchrus clandestinus*), have degraded this dryland forest. The substratum in this area is similar to that of Honuaʻula and Kanaio, consisting of broken ʻaʻā lava on relatively young lava flows, less than 10,000 years old. Presumably the rough substrate helped protect it from ungulate browsing and fire, resulting in a higher remaining native plant and tree density (Medeiros et al. 1998). Auwahi contains very high native tree diversity, with 50 dryland species, including ʻaiea (*Nothocestrum* spp.) and wiliwili, which is still quite common throughout lower Auwahi (Medeiros et al. 2009). Furthermore, it provides reliable habitat for the Blackburn's sphinx moth and some native birds, including the ʻapapane (*Himatione sanguinea*), amakihi (*Hemignathus virens*), pueo (*Asio flammeus*), and rarely the ʻiʻiwi (*Vestiaria coccinea*).

The USGS GAP classifies the land cover at Auwahi largely as Kikuyu Grass Grassland/ Pasture, with some NS: Native Shrubland (alien grasses), indicating the prevalence of the kikuyu grass understory (USGS 2006). According to the Biodiversity Summary and Habitat Quality Assessment by The Nature Conservancy, the area is characterized as Rapidly Degrading Ecosystem.

The first integrated restoration of Auwahi forest began in 1997 with an interagency effort at the 10-acre Auwahi I enclosure (USGS 2006). The area was fenced and ungulates were excluded. By 2000, kikuyu grass was virtually eliminated from the enclosure with herbicide (1% glyphosate), and its cover was reduced to 2%. Since 2000, volunteer outplanting trips were organized to plant quick growing native plant species, especially ʻaʻaliʻi, to create microhabitat through shade and leaf litter and deter establishment of non-native species such as grasses and *Bocconia frutescens* (Papaveraceae). Natural reproduction of native species was first observed in 2002. After 10 years of restoration, 28 native species were naturally reproducing within the enclosure. In 2009, a much larger enclosure was built at Auwahi, protecting approximately 190 acres of dryland forest, and encompassing the first two Auwahi enclosures (see Figure 12). Aside from being an unprecedented dryland forest restoration potential, this project will also provide opportunities to study limitations and threats to Hawaiian dryland forests.

7.6.2. Measures of Success

Success of the on- and off-site mitigation efforts for the Covered Species will be determined as follows:

Honuaʻula On-Site NPPA

- A 134-acre conservation easement has been established at Honuaʻula before permits were issued, and its active management plan has been implemented.
- An 8-foot-tall ungulate fence has been established around the entire NPPA before construction.

- Ungulates are not present in the site before construction and ungulate-exclusion is maintained in perpetuity.
- Maintain 0% cover of all non-native species within a 15-foot (5-m) buffer around listed plant species (e.g., ʻāwikiwiki, and outplanted *Colubrina oppositifolia* and *Hibiscus brackenridgei*).
- Maintain less than 40% cover of non-grass invasive weeds in the remainder of the core area. Target plant species include koa haole, lantana, and cow pea. Kiawe will remain in place to reduce the potential for increased grass cover.
- Maintain less than 10% cover of non-native grasses in the remainder of the core area. Target grasses include buffelgrass, guinea grass, and other fire-prone alien grasses.
- Between years 10 and 15, an annual average of 50 mature ʻāwikiwiki plants will be present at the NPPA, with an annual range between 0 and 500 plants. After year 15, the annual average, based on 5-year intervals, will be 50 plants. This population will no longer require outplantings to maintain stable and increasing cover trend, and will be maintained in perpetuity.
- No more than 1% of the area is impacted by hiking trail development.
- Lights near the NPPA are shielded so they are not directly visible from in the NPPA.
- Reduction of rat densities, and minimization of rat impacts to recruitment and survival of native plants in the NPPA.
- Outplanting of ʻaiea has been attempted in the NPPA.

Kanaio and Auwahi

- A minimum of 500 ʻaiea plants are propagated and outplanted at each of the mitigation sites within 10 years of initiation of construction, for a total of 1,000 outplanted seedlings. Planting will start prior to construction.

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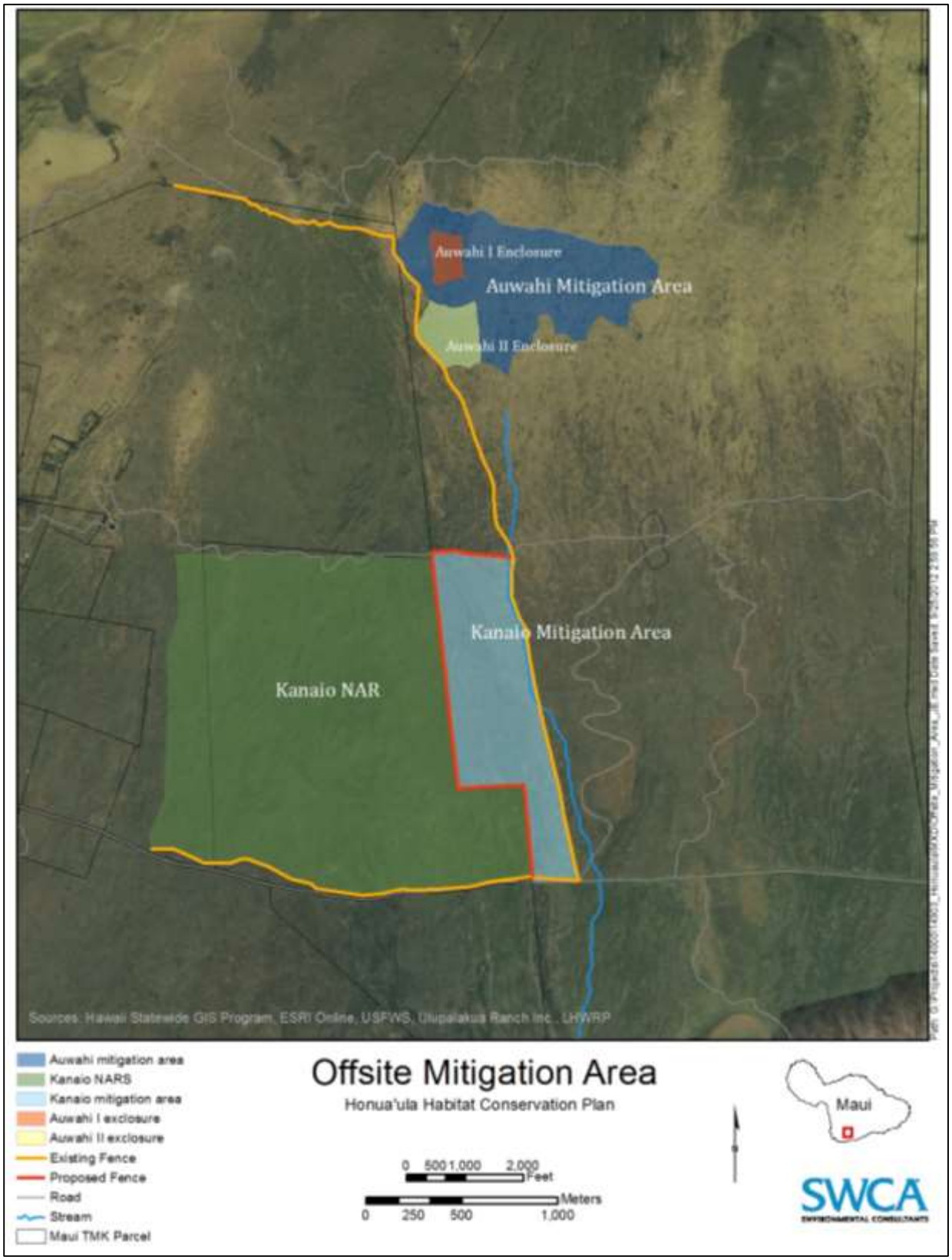

Figure 12. Off-site mitigation sites.

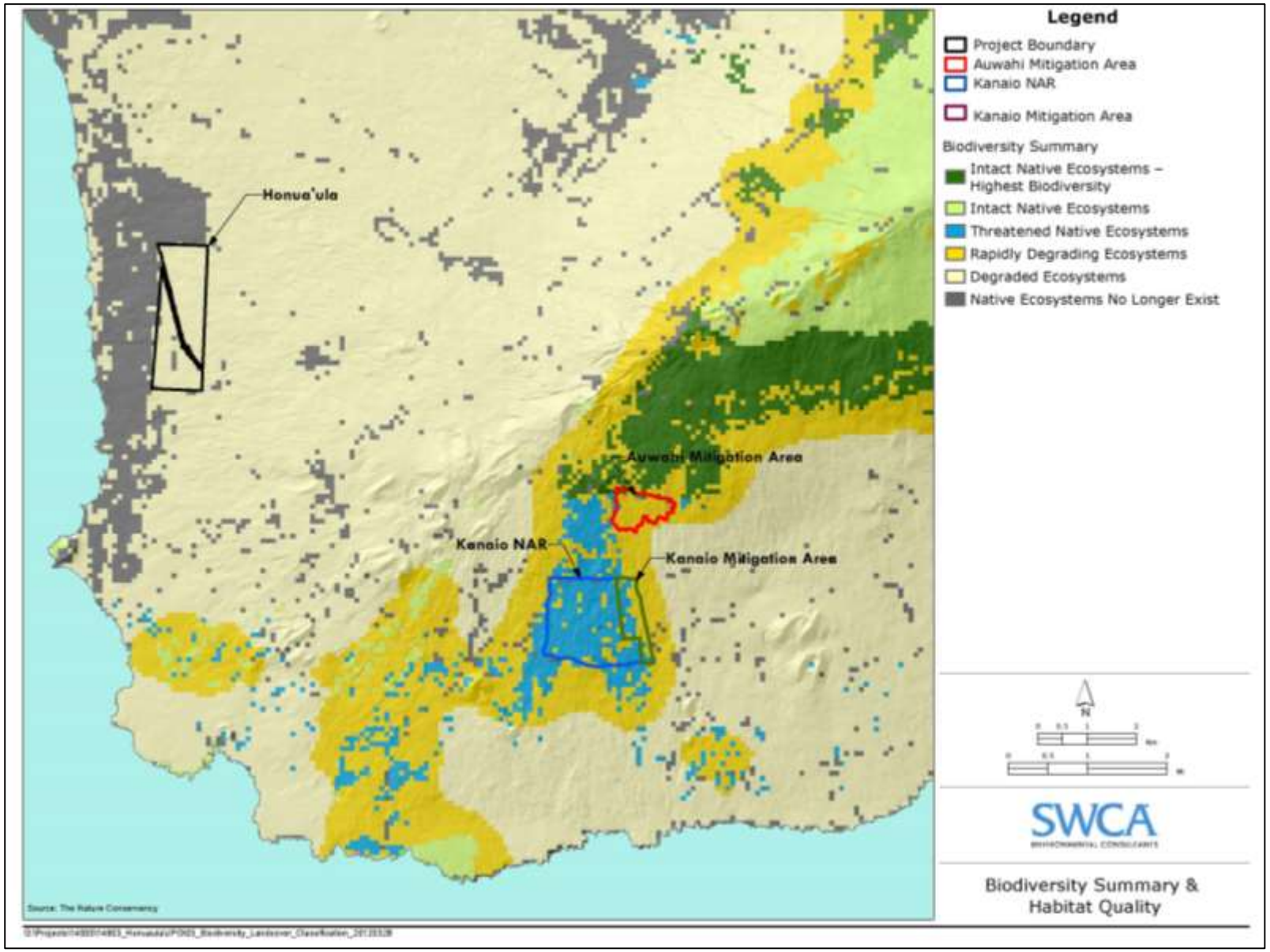

Figure 13. The Nature Conservancy Biodiversity Landcover Classification in and near the property (project boundary).

7.7. Nēnē Mitigation

The nēnē mitigation described below was developed with the intention of providing a net ecological benefit to the species in alignment with state and federal species recovery goals. Honuaʻula Partners, LLC will provide support for nēnē population protection and enhancement or nēnē propagation and release, which may include translocation.

The estimated cost for each proposed measure is presented in Appendix 9. All proposed measures are intended to promote the recovery of the species in portions of its historic range.

7.7.1. Nēnē Mitigation Measures

As a result of the emergency declaration by Governor Abercrombie in 2011 to move several hundred nēnē from Kauaʻi, the conservation needs for this species have shifted. DOFAW and USFWS have agreed to provide a mitigation project description for this HCP. The text below serves only as an example of potential proposed mitigation. Honuaʻula Partners, LLC will provide funding of $30,000 to DLNR or other assigned agency or fiduciary before completion of the golf amenity for the protection of nēnē, sufficient to achieve net benefit to the species as required in HRS Chapter 195D. This includes funding toward staffing operations, maintenance, and/or predator control.

Mitigation measures are intended to provide a net benefit to the species in alignment with state and federal species recovery goals; to promote the recovery of the species in portions of its historic range; and to contribute to an increase in adult or juvenile survival and/or increased productivity (average number of fledglings per pair) at the mitigation site(s).

Mitigation for nēnē will take into account the expected direct and indirect take of the species for the life of the project, as well as any loss of productivity that might occur. Mitigation for any direct take of adults and direct or indirect take of goslings or fledglings will be provided through replacement by adults and possibly fledglings. However, when adults are replaced by fledglings, the survival rate of fledglings to adulthood will be taken into account in determining the number of fledglings needed to offset expected levels of take of adult birds.

7.7.2. Measures of Success

Mitigation for nēnē will be considered successful and complete following full funding as agreed upon with Honuaʻula, Partners, LLC, DLNR, and USFWS.

8. IMPLEMENTATION

8.1. HCP Administration

Honuaʻula will administer this HCP with guidance from USFWS and DLNR. Other experts may be consulted as needed, including biologists from other agencies (e.g., USGS), conservation organizations, consultants, and academia. HCP-related issues may also be brought before the ESRC for formal consideration when deemed appropriate by Honuaʻula Partners, LLC, or DLNR.

Honuaʻula Partners, LLC will meet at least annually with USFWS and DLNR. Additional meetings and conferences may be called by any of the parties at any time to address immediate concerns. The purpose of the regular meetings will be to evaluate the efficacy of monitoring methods, compare the results of monitoring to the estimated take, evaluate the success of mitigation, and develop recommendations for future monitoring and mitigation. Regular meetings will also provide opportunities to consider the need for adaptive management measures. In addition, Honuaʻula Partners, LLC will meet annually with the ESRC to provide updates of monitoring, mitigation, and adaptive management, and to solicit input and recommendations for future efforts. ESRC may request additional meetings at any time to address immediate questions or concerns.

8.2. Monitoring and Reporting

The monitoring program in this HCP addresses both monitoring of impacts and tracking the success of mitigation measures. All monitoring activities on-site and off-site will be coordinated by the natural resources manager, with the aid of trained staff as appropriate. The monitoring of impacts associated with the construction of the site is closely linked to the surveys designed to minimize or avoid these impacts.

On-site construction monitoring will include the following:

- Pre-construction wildlife surveys. If Covered Species or other listed wildlife are found in the construction area, the area will be treated as described in Chapter 7 and will be monitored until the Covered Species or other listed wildlife are no longer present.
- Fences constructed around natural areas, including the NPPA, will be inspected regularly, and any impacts to the vegetation and wildlife within will be monitored and reported.
- All potential larval host plants for the Blackburn's sphinx moth will be checked for presence of larvae or eggs as described in section 7.1.1.13. Occupied host plants will be monitored and treated as described in 7.1.1.13.

Post-construction monitoring will include the following:

- Daily monitoring of the golf amenity for presence of nēnē and other listed species. Presence of listed species on the golf amenity will be handled as described in section 7.1.1.11. Any impacts to listed species on the golf amenity will be reported according to section 7.1.1.11 and Appendix 4.
- Personnel, including security personnel, will be trained to look for and recognize listed species covered or discussed in the HCP, including Blackburn's sphinx moth, ʻāwikiwiki, Hawaiian petrel, and Newell's shearwater. This will ensure ongoing monitoring of the property, particularly the most brightly lit areas, for potential fallout of listed species.

Monitoring will be an integral part of this plan to ensure that mitigation goals are met. Monitoring of both on-site and off-site mitigation areas will occur, as follows:

- Integrity of fences will be inspected on a quarterly basis.
- The NPPA will be monitored at least quarterly for the presence of ungulates.
- Success of rodent population suppression at the NPPA will be monitored at regular intervals using traps and/or tracking tunnels.
- Percentage cover of non-native weeds will be monitored on an annual basis.
- Long-term monitoring of mitigation success will include
    - annual average of mature ʻāwikiwiki individuals,
    - survival and the relative number of host plants for Blackburn's sphinx moth, and
    - presence of additional threats to Blackburn's sphinx moth, including ants and *Trichogramma* wasps.

Other specific measures may be added to the monitoring plan as per DLNR or USFWS recommendations.

Honuaʻula Partners, LLC will provide annual reports to DLNR and USFWS by August 31 of each year. Honua'ula Partners, LLC will confer with USFWS and DOFAW following the submittal of the annual report to review the results and discuss future HCP implementation issues. These reports will include information on realized take; implementation and success of avoidance, minimization, and mitigation measures as described in this HCP; and other information as requested by the agencies.

Pursuant to HRS Chapter 195D, DOFAW may conduct independent monitoring tasks during the life of the permit to ensure compliance with the terms and conditions of the HCP and ITL, and all costs associated with compliance monitoring shall be paid by the applicant. USFWS may conduct inspections and monitoring in accordance with the ESA and its implementing regulations (currently codified at 50 CFR 13.47).

8.3. Adaptive Management

According to USFWS policy, adaptive management is defined as a formal, structured approach to dealing with uncertainty in natural resources management, using the experience of management and the results of research as an on-going feedback loop for continuous improvement (USFWS 2000). Adaptive approaches to management recognize that the answers to all management questions are not known and that the information necessary to formulate answers is often unavailable. Adaptive management also includes, by definition, a commitment to change management practices when determined appropriate for the benefit of the Covered Species.

The adaptive management program for this HCP addresses any uncertainties in achieving mitigation goals for the Covered Species. For the most part, mitigation practices as described in this HCP are not expected to require much adaptive management. However, monitoring of implementation and success of minimization and mitigation measures may lead to implementation of adaptive management. Any such changes would require the approval of USFWS and DLNR. This includes the following measures:

- It is uncertain if and how many nēnē will become attracted to and established on the golf amenity. The proposed minimization measures have been designed based on best available information at the time of writing. If, despite these minimization measures, take is trending toward a higher rate than requested for in this HCP, Honuaʻula will consult with DLNR and USFWS about design and implementation of additional or alternative minimization measures. If additional take is anticipated, Honuaʻula Partners, LLC will seek an amendment for authorization of additional take.

- The mitigation measures to compensate nēnē take are expected to be successful within the timeline specified for the measure. If mitigation cannot be accomplished using that measure within the specified timeline, the Applicant may request more time, or alternative mitigation measures may be initiated with approval of USFWS and DLNR.
- The mitigation measures to compensate for take of ʻāwikiwiki are expected to be successful within the timeline specified for the measure. If mitigation cannot be accomplished using these measures within the specified timeline, the Applicant may request more time, or alternative mitigation measures may be initiated with approval of USFWS and DLNR.
- Ungulate removal from the fenced areas is expected to occur within the timeline specified in this HCP. However, due to challenges posed by terrain or vegetation, additional time or resources may be necessary to effectively remove ungulates from the mitigation sites. In such case, the Applicant will notify USFWS and DLNR and seek their concurrence.
- USFWS and DOFAW may decide to direct Honuaʻula Partners, LLC to remove tree tobacco from the NPPA. It may be considered an attractive nuisance should take of Blackburn's sphinx moth be documented on-site. Tree tobacco will only be removed from the NPPA with approval from USFWS and DOFAW, and in accordance with USFWS tree tobacco removal guidelines.
- The USFWS protocol to minimize and avoid impacts to the Blackburn's sphinx moth (see Appendix 3) will be used during construction, and these protocols are expected to be updated as new information becomes available. Updated protocols will be used when appropriate.

After reviewing the annual monitoring report and in consultation with DLNR and USFWS, Honuaʻula Partners, LLC may make additional implement adaptive management changes to the avoidance, minimization, and mitigation measures described in this HCP, if warranted by USFWS, DLNR, or Honuaʻula Partners, LLC to meet the goals set forth in this HCP. Furthermore, if new information becomes available during the life of the permit, this may be used to further improve effectiveness of the measures in this HCP. Nothing in this section authorizes any change that would result in an increase in the amount or nature of the incidental take or increase the impacts of take of Covered Species. If USFWS or DLNR believe that an adaptive management measure is warranted, they may require it to be implemented.

8.4. Funding Plan

Consistent with ESA Section 10 and HRS Chapter 195D, this funding plan has been designed to ensure that all identified mitigation and conservation actions and their associated costs will be funded.

Earlier sections of this HCP describe a habitat conservation program with measures that Honuaʻula Partners, LLC will undertake to monitor, minimize, and mitigate the incidental take of each Covered Species and to provide a net conservation benefit, as measured in biological terms pursuant to HRS Chapter 195D. This section summarizes planning-level estimates of the costs to implement the conservation program, both during and after the permit term, as well as the proposed timing of the funding and the funding assurances. As described in the funding assurances section below, the Honuaʻula Partners, LLC will be responsible for covering all costs.

All cost estimates are derived and summarized from the more detailed cost estimates provided in Appendix 9. Cost estimates are stated in constant 2014 dollar terms.

8.4.1. Habitat Mitigation Costs and Investments

HCP implementation will require investments in habitat preservation, upfront habitat improvements, and ongoing habitat management and monitoring, both during the permit term and after the permit term, as described below:

- Land Costs and Conservation Easements. The HCP proposes an on-site preserve, the NPPA. The developer will secure and dedicate the necessary conservation easement on this area.
- Upfront Land Improvements and Investments. The on-site NPPA will require extensive upfront investments in fencing and ungulate and animal removal. These investments are expected to occur in the first 2 years of HCP implementation and are included in the project development funding.
- Management, Planning, Monitoring, Education, and Replacement. A number of additional, ongoing expenditures will be required on site management, preserve management, fencing replacement, and other tasks required to ensure the HCP conservation goals are met.
- Post-Permit Endowment. Habitat management and monitoring will be required, in perpetuity, beyond the end of the permit term. An endowment sufficient to generate real interest payments (interest over and above inflation) that can cover these ongoing post-permit costs will be required. Under the endowment strategy described in the funding section below, an average, annual, real interest rate of 3.25% is expected.

8.4.2. Funding Strategy

8.4.2.1. SUMMARY OF FUNDING APPROACH

The funding approach is based on the following four key components:

1. Direct developer funding of most of the mitigation requirements upfront, before construction is initiated.
2. Additional funding from secured sources during the permit term.
3. Full funding of the required post-permit endowment by the end of the permit term to fund all post-permit mitigation requirements.
4. Placement of the endowment funding in the endowment program of the National Fish and Wildlife Foundation (NFWF), The Office of Hawaiian Affairs, or other entity approved by DOFAW and USFWS before the permit is issued.

8.4.2.2. FUNDING BY COST COMPONENT

This funding approach includes the following approaches to funding the key cost components described above:

- Upfront Land Improvements and Investments. Funding of 100% of the upfront land improvements and investments before grading begins. This totals $80,000.
- Permit Term Habitat Management and Monitoring Funding. Annual management and monitoring costs will be funded through revenue generated by sales. The total cost for the first 15 years of the permit term is $2,735,000.
- Upfront Endowment Funding. An investment of $1.985 million in a NFWF or other entity approved by DOFAW and USFWS before the permit is issued, endowment account before grading begins, representing 100% of the full post-permit endowment required (2016 dollars). This endowment will provide funding for annual costs after the first 15 years of the permit term.

8.4.2.3. ENDOWMENT PLACEMENT AND RETURNS

To ensure the appropriate management of the endowment funding, the developer will place all endowment funding with the NFWF Impact-Directed Environmental Accounts program, or another agency or entity acceptable to USFWS, DOFAW, and Honua'ula Partners LLC. This program was established to manage endowments for conservation activities. NFWF staff have indicated that the expected, average annual net real interest rate (inflation and investment management costs removed) is in the 3.25%–3.50% range. In other words, barring unexpected market swings, NFWF expects to be able to provide an average annual return of between 3.25% and 3.50% on the mitigation endowments it holds. The lower 3.25 percent rate of return has been applied in this analysis.

8.4.3. Funding Assurances

Upfront funding of the mitigation costs will remove substantial uncertainty associated with the availability of funding. The developer understands that there will be two endowment sufficiency reviews. To the extent that ongoing habitat management and monitoring costs have been higher than expected or the NFWF indicates that a different real interest rate is appropriate, an adjustment to both the endowment funding requirement and the annual assessment will be established. To the extent that additional endowment funding is required, the developer will provide the additional funding before the end of the first 15 years of the permit term. Funding assurances for costs that are not provided up front will be provided by a letter of credit or bond approved by DOFAW and USFWS prior to groundbreaking. This letter of credit or bond will be recertified on an annual basis, for the remaining outstanding mitigation obligations.

8.5. Changed Circumstances Provided for in the Habitat Conservation Plan

Circumstances change or occur during the life of an HCP, and some can be anticipated and planned for. For Honuaʻula, possible changed circumstances that are anticipated and planned for are provided below, along with procedures to provide for these changed circumstances.

1. Global Climate Change Significantly and Negatively Alters Status of the Covered Species

   Global climate change during the life of the project (30 years) has some limited potential to alter the current distribution of the species or the vegetation communities used by the Covered Species through region-wide changes in weather patterns, in sea level, in average temperature, and in levels of precipitation (Intergovernmental Panel on Climate Change 2007). In some instances, climate change may cause populations of Covered Species to decline. Covered Species are likely to be affected through changes in temperature, precipitation, the distribution of their food resources, and possible changes in the vegetation at their preferred nesting habitats. It is unknown how the Blackburn's sphinx moth will be affected by any changes in climate over the life of the permit due to its presumed ability to use non-native habitats. ʻĀwikiwiki may be particularly vulnerable to rising temperatures, decreased rainfall, and increasing fire frequency that may occur as a result of climate change. The distribution of the nēnē's native food resources, particularly at high elevations, may change if climate change alters the range of native plants that they use. Nēnē, however, are also able to use a variety of non-native food resources.

   With climate change, hurricanes or storms may occur with greater intensity (Webster et al. 2005; U.S. Climate Change Science Program 2009), which may increase the risk of damage to established mitigation sites. This is discussed in scenario 4 below. Sea level is predicted to rise approximately 3 feet (1 m) in Hawaiʻi by the end of the twenty-first century (Fletcher 2009).

Given this prediction, any rise in sea level experienced during the life of the project would likely be less than 3 feet (1 m). Because mitigation sites are more than 3 feet (1 m) above sea level, these sites are unlikely to be impacted by sea level rise during the project life.

Precipitation may decline by 5%–10 % in the wet season and increase 5% in the dry season, due to climate change (Giambelluca et al. 2009). This may result in altered hydrology at the mitigation sites. Other mitigation sites may be considered for continued mitigation if the existing sites are no longer considered suitable. The alternate mitigation site will be chosen in consultation with USFWS and DLNR.

Vegetation at the mitigation site may also change with decreased precipitation or increased temperatures and wildfire threat. Although changes are expected to be small over the life of the permit, they are much less predictable in the long term. Should significant changes in vegetation occur and are demonstrated to affect the productivity of the Covered Species, other mitigation sites may be considered for continued mitigation, if deemed necessary, and will be chosen in consultation with and approved by USFWS and DLNR. In all cases, mitigation efforts will remain commensurate with requested take with a net benefit provided to each Covered Species as required by state law.

Any changes in the mitigation measures implemented for any of the Covered Species due to climate change will be performed to meet the objectives outlined in this document. Modifications to the endowment budget during the first 15 years of permit issuance will be made based on the best available information, incorporating anticipated project costs associated with a changing climate. Changes to the mitigation budget would be made with the approval USFWS and DLNR.

2. Disease Outbreaks in Covered Species

Nēnē are not considered to be limited by disease, although omphalitis, an infection of the umbilical stump, has been found to cause mortality in both wild and captive nēnē goslings (USFWS 2004). These geese have also been documented to have been infected with avian pox and avian malaria, but no deaths have been attributed to either disease (USFWS 2004). It is considered possible that the introduction of the West Nile virus may affect the survival of nēnē (USFWS 2004).

Should the prevalence of disease increase dramatically and become identified as a major threat to the survival of these species by DLNR and USFWS, Honuaʻula Partners, LLC will consult with DLNR and USFWS to determine if changes in monitoring, reporting, or mitigation are necessary to provide assistance in documenting or reducing the impact of the disease whether the disease is or is not transmitted by humans or is due to human habitat modification.

Any changes prompted by disease outbreaks in the species covered in the HCP will be performed to achieve mitigation objectives. The endowment budget incorporates funding to enable mitigation objectives to be met in the event of disease outbreaks if mitigation actions have not been fully achieved or unmitigated take remains. Changes to the mitigation budget would be made with the approval USFWS and DLNR.

3. Deleterious Change in Relative Abundance of Non-Native Plant Species, Ungulates, Parasites, or Predators Occurring at the Mitigation Sites for Covered Species

Should the proportion or coverage of non-native plant species, parasites, or predators increase at any mitigation site to a point where it is believed that this change is causing significant habitat degradation or loss of habitat, or significant increases in mortality for the Covered Species, thereby resulting in a measurable decline of the species at the site, Honuaʻula will consult with DLNR and USFWS to determine if measures to prevent the further spread of non-native plants, parasites, or predators are available, practical, and necessary. If no such measures are available,

mitigation measures for the affected Covered Species would be implemented at another site with approval of DLNR and USFWS. Costs for implementing such measures and consequent changes in monitoring, reporting, or mitigation, as deemed appropriate by DLNR and USFWS, are estimated in the mitigation budget in the HCP. These actions will be implemented if mitigation actions have not been fully achieved or if unmitigated take remains.

4. Natural Disasters such as Hurricanes, Severe Storms, and Wildfires

   Natural disasters, including hurricanes, storms, and wildfires, have potential to significantly affect the status of one or more of the Covered Species on Maui and, consequently, alter the relative importance of the incidental take of individuals. Such disasters could also greatly hinder or disrupt mitigation efforts.

   It is not known how nēnē respond to storms or hurricanes. Because nēnē are relatively sedentary, it is presumed likely that individuals of these species would seek available shelter rather than flee when confronted by major storms. Honuaʻula may implement changes in monitoring, reporting, or mitigation to help population recovery or to contribute to rehabilitation of habitat for nēnē following a major storm, if deemed appropriate by DLNR and USFWS. If no such measures are available, mitigation measures may be implemented at another site as determined with DLNR and USFWS. Any such measures and consequent changes in monitoring, reporting, or mitigation, as deemed appropriate by DLNR and USFWS, will be implemented. The endowment budget incorporates funding to enable mitigation objectives to be met in the face of anticipated natural disasters if mitigation actions have not been fully achieved or if unmitigated take remains.

   Wildfires could impact Blackburn's sphinx moths or their habitat by reducing cover of native woody plants and increasing cover of non-native grasses. It is not known how Blackburn's sphinx moths or their habitat respond to storms or hurricanes. However, Honuaʻula will implement changes in monitoring, reporting or mitigation deemed appropriate by DLNR and USFWS if necessary. The endowment budget incorporates funding to enable mitigation objectives to be met in the face of anticipated natural disasters if mitigation actions have not been fully achieved, the natural disaster adversely affects mitigation site habitat, or unmitigated take remains.

   ʻĀwikiwiki could be adversely affected by natural disasters because these disturbance events can destroy vegetation and modify abiotic conditions (e.g., light regimes), creating areas more prone to invasion by non-native plants. Furthermore, these events may cause direct physiological stress on the plants (USFWS 2012).

5. Changes in the Price of Raw Materials and Labor

   Annual reviews will be performed to analyze the costs in the previous year's budget for mitigation expenses and cumulative costs. Annual expenses for subsequent years will be adjusted to meet projected costs based on previous years' expenditures and cumulative spend to date.

6. De-listing of Covered Species

   Should any of the species covered in the HCP be de-listed during the tenure of the permit, it is expected that the mitigation efforts provided by Honuaʻula would have contributed in some part to the de-listing of the species. Therefore, mitigation actions for that species will continue to be performed in accordance with the HCP, unless and until USFWS and DLNR agree that such actions may be discontinued.

7. Listing of One or More Species that Already Occur On-Site

   In the event that one or more species that occur on-site are listed pursuant to the ESA, Honuaʻula Partners, LLC will evaluate the degree to which the species is (or are) at risk of being incidentally taken by project operations. If take of the species appears possible, Honuaʻula will then assess whether the mitigation measures already being implemented provide conservation benefits to the

newly listed species and if any additional measures are needed to provide a net conservation benefit to the species. Honuaʻula Partners, LLC would then seek coverage for the newly listed species under an amendment to the HCP.

Potential remediation measures to address changed circumstances at the project area or mitigation site(s) are anticipated to improve the overall habitat quality and/or health of the Covered Species following recognition of a changed circumstance. However, these activities also have the potential to impact wildlife and their habitat. Potential impacts from the remediation measures are discussed in the HCP EA.

8.6. Changed Circumstances Not Provided for in the Habitat Conservation Plan

If changed circumstances occur that were not provided for in section 8.5, and the HCP is otherwise being properly implemented, USFWS and DLNR will not require any conservation and mitigation measures in addition to those provided for in the HCP without the consent of Honuaʻula Partners, LLC.

8.7. Unforeseen Circumstances and "No Surprises" Policy

Unforeseen circumstances are "changes in circumstance surrounding an HCP that were not or could not be anticipated by HCP participants, DLNR and USFWS that result in a substantial and adverse change in the status of a Covered Species" (USFWS and NMFS 1996). Under the "No Surprises" policy, with a properly implemented HCP (HRS 195D-23), Honuaʻula Partners, LLC will not be required to commit additional land, water, money, or financial compensation, or be subject to additional restrictions on land, water, or other natural resources to respond to such unforeseen circumstances beyond what has been already agreed upon in the HCP, without their consent. For the purposes of this HCP, changes in circumstances not provided for in section 8.4 that substantially alter the status of the Covered Species are considered unforeseen circumstances.

The "No Surprises" policy assurances only apply to species "adequately covered" in the HCP. Species considered to be "adequately covered" are those covered by the HCP that satisfy the permit issuance criteria under HRS 195D-21. The species considered adequately covered in this HCP, and therefore covered by the "No Surprises" policy assurances, include the nēnē and Blackburn's sphinx moth.

In the event that unforeseen circumstances occur during the term of the permit and USFWS and DLNR conclude that any of the Covered Species are being harmed as a result, the agencies may require additional measures of Honuaʻula Partners, LLC where the HCP is being properly implemented only if such measures are limited to modifications of the conservation program for the affected species and maintain the original terms of the HCP to the maximum extent possible. Additional conservation and mitigation measures will not involve the commitment of additional land, water, or financial compensation or additional restrictions on the use of land, water, or other natural resources otherwise available for development or use under the original terms of the HCP without the consent of the applicant.

8.8. Notice of Unforeseen Circumstances

USFWS and DLNR will have the burden of demonstrating that unforeseen circumstances exist, using best available scientific and commercial data. USFWS and DLNR will notify Honuaʻula in writing should USFWS or DLNR believe that any unforeseen circumstance has arisen.

8.9. Permit Duration

The HCP for Honuaʻula is written in anticipation of the issuance of an ITP and ITL to cover the entire project duration of 30 years.

8.10. Amendment Procedure

Different procedures are present that allow for the amendment to the ITL/ITP. However, the cumulative effect of any amendments must not jeopardize any listed species. USFWS and DLNR must be consulted on all proposed amendments, and the amendment procedures are listed below.

8.10.1. Minor Amendments

Informal, minor amendments are permissible without a formal amendment process provided that the change(s) necessitating such amendment(s) does not cause a net adverse effect on any of the Covered Species that is significantly different from the effects considered in the original HCP. Such informal amendments could include routine administrative revisions or changes to surveying or monitoring protocols that do not decrease the level of mitigation or increase take. A request for a minor amendment to the HCP may be made with written notice to USFWS and DLNR. A public review process may be required for the minor amendment. The amendment will be implemented upon receiving concurrence from the agencies.

8.10.2. Formal Amendments

Formal amendments are required when the applicant wishes to significantly modify the project, activity, or conservation program already in place. Formal amendments are required if the change(s) necessitating such amendment(s) could produce a net adverse effect on any of the Covered Species that is significantly different than any of those considered in the original HCP. For example, a formal amendment would be required if the documented level of take exceeds that covered by the HCP's adaptive management program. A formal amendment also would be required if another listed species is found to occur in the project area and could be adversely affected by project activities.

This HCP may be formally amended upon written notification to USFWS and DLNR with the same supporting information that was provided with the original application. The need for a formal amendment must be determined at least 1 year before permit expiration, because a formal amendment may require additional baseline surveys and data collection, additional or modified minimization and/or mitigation measures, and/or additional or modified monitoring protocols. It may also require a supplemental NEPA evaluation and additional public review.

8.11. Renewal and Extension

This HCP proposed by Honuaʻula Partners, LLC may be renewed or extended, and amended if necessary, beyond its initial 30-year term with the approval of USFWS and DLNR. A written request will be submitted to both agencies that will certify that the original information provided is still current and conditions unchanged or that will provide a description of relevant changes to the implementation of the HCP that will take place. Such a request shall be made at least 180 days prior to the conclusion of the permit term. Under federal law, the HCP shall remain valid and in effect while the renewal or extension is being processed, but under State of Hawaiʻi law, the HCP will remain valid and in effect during

processing only if the renewal or extension is processed during the original permit term. The permit may not be renewed for levels of take beyond those authorized by the original permit.

8.12. Other Measures

Issuance criteria under ESA Section 10(a)(2)(B) authorize USFWS to obtain such other assurances as the Secretary may require that the HCP will be implemented. An implementing agreement stipulating the HCP's terms and conditions in contractual form will be signed by all parties (Honuaʻula, USFWS, and DLNR).

9. CONCLUSION

Honuaʻula Partners, LLC looks forward to working with USFWS, DLNR, and the ESRC throughout the approval and long-term implementation of the HCP for the Honuaʻula project. Although the construction of Honuaʻula will aid with closing the gap between demand and availability of housing for a variety of consumer types, construction of the community is not without potential for adverse and unavoidable environmental impacts. Honuaʻula Partners, LLC is committed to making all reasonable efforts to avoid, minimize, mitigate, and compensate for these impacts as evaluated and determined through the HCP process and its adaptive management strategy to provide a net benefit to the species identified in the HCP through a transparent and consultative process with all parties concerned.

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Appendix 1

Appendix 1

BOTANICAL SURVEY OF HONUAʻULA (WAILEA 670), KĪHEI, MAUI

PREPARED FOR

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August 2008
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1.0 INTRODUCTION

1.1 Objectives

SWCA Environmental Consultants (SWCA) was tasked to conduct a botanical survey within the 271 ha (670 ac) Honua'ula (Wailea 670) Property (hereinafter referred to as the 'Property') in Kīhei, Maui. The objectives of the survey were to: 1) describe the vegetation on the Property; 2) document all the plant species found on the Property; and 3) identify and map the location(s) of native plants. This report documents the results of the botanical survey, offers conservation management recommendations, and provides mitigation alternatives to address the Phase I project district zoning conditions promulgated by the Maui County Council. The survey also supports the Environmental Impact Statement (EIS) being prepared for the project by PBR Hawaii, Inc. in accordance with Chapter 343 Hawaii Revised Statutes (HRS). A companion document addressing wildlife and plant-related wildlife issues was prepared by SWCA and is submitted under separate cover (SWCA 2009a). Further documentation will detail the conservation and stewardship plan for the Native Plant Preservation Area and an animal management plan as required by the Maui County Council (SWCA 2009b).

Botanical surveys conducted in support of EIS and environmental assessments (EA) under HRS Chapter 343 are typically qualitative descriptions of vegetation and lists of species observed during brief pedestrian surveys. They are characteristically limited to a single survey rather than repeated seasonal assessments, and rarely the result of rigorous, quantitative research. In the past, greater emphasis was placed upon individual species than the ecosystems in which they occurred. To better address concerns raised by the Maui County Council and members of the public over the presence of native plants within the southern portion of the Property, SWCA set out to conduct a thorough quantitative assessment of site vegetation in order to obtain the best possible understanding of vegetation types and plant species present within the Property.

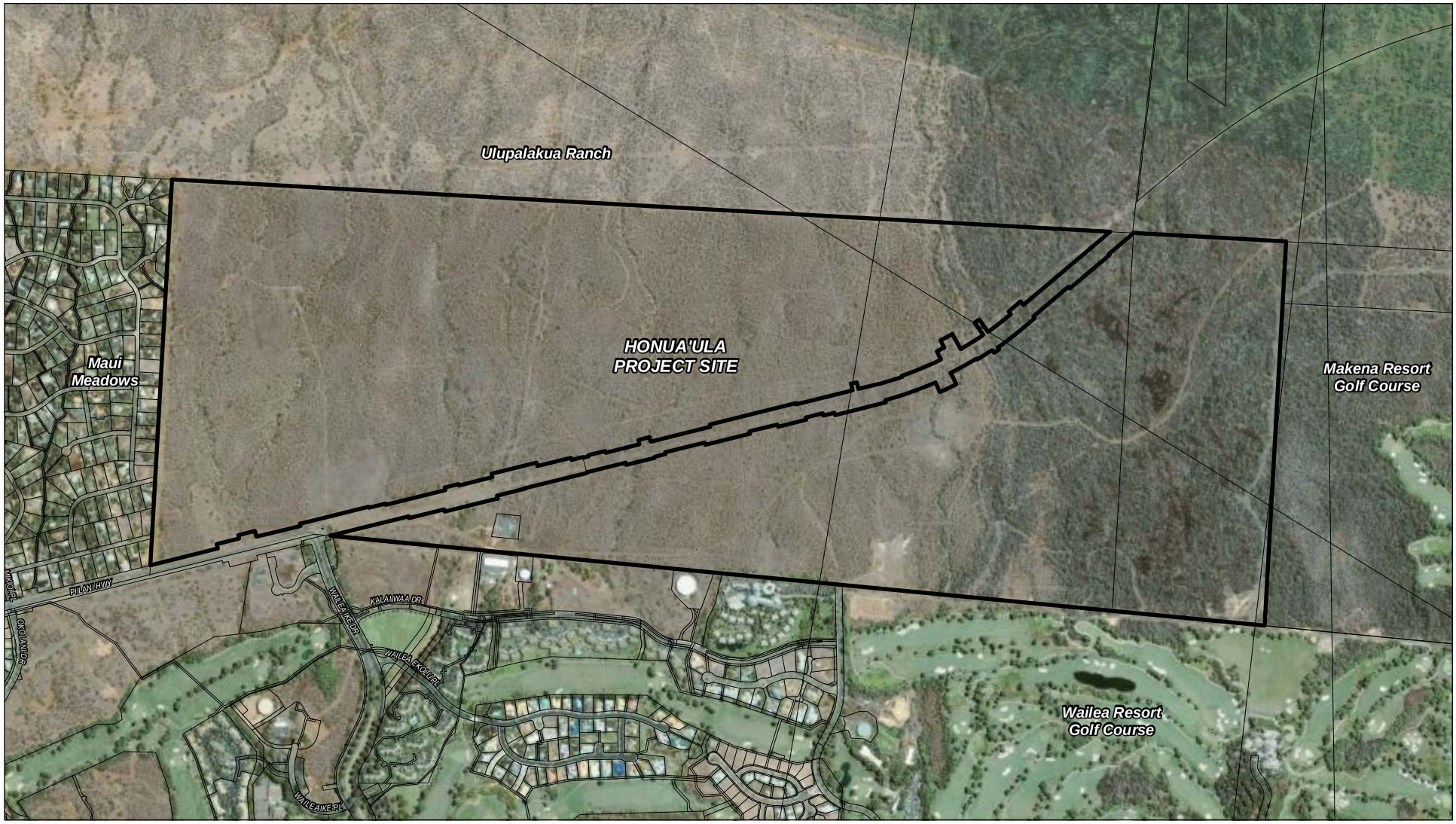
1.2 Project Summary

Honua'ula is a planned mixed-residential community encompassing a rectangular area of 271 ha (670 ac) east of, and adjacent to, the existing Wailea Resort in Kīhei, Maui. It is bounded by the Maui Meadows subdivision to the north, the Makena golf course to the south, the Wailea golf course to the west, and the 'Ulupalakua Ranch to the east (Figure 1). An EIS was first published for the development (then known as Wailea 670) in 1988 (PBR Hawaii 1988). Project district zoning was approved for the entire 271 ha in 1993, and approximately 170 ha (420 ac) was approved for golf course development and accessory uses. The following year, the State Land Use Commission issued a decision and order on urban land use designation. Since 1988, the project has had several owners.

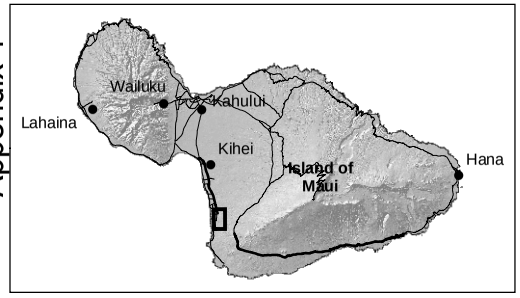
After six years of project revisions by the present owner to accommodate community concerns, the Maui County Council approved Phase I conditional Project District Zoning for 271 ha allowing for residential, limited commercial, golf course, and open space zoning. With this approval, the Maui County Council issued several conditions regarding the conservation of natural resources. Their conditions included the creation of a Native Plant Preservation Area and stewardship plan for the propagation of native dry land forest plants within the Property. The conservation and stewardship plan (SWCA 2009b) incorporates findings, conclusions, and recommendations of this report and a sister report prepared by SWCA on the wildlife resources of the Property.

1.3 Physical Setting

Approximately 200 ha (495 ac) of land in the northern three-quarters of the Honua'ula Property within the Paeahu ahupua'a consists of older lava flows of the Kula Volcanic Series (Figure 2). Older Kula lavas range in age from 140,000 to 950,000 years old, while younger Kula lavas in the central portion of the parcel may be between 13,000 and 30,000 years old (USGS). Weathering of lavas led to the formation of a thin layer of soil over the northern portion. About 70 ha (173 ac) of younger Hana Volcanic Series flows within the Palauea ahupua'a make up the southern quarter of the Property. The southern lava flows are estimated to be between 5,000 and 13,000 years old (Figure 2) and have not undergone extensive weathering.



Appendix 1



Legend

Honua'ula Project Boundary

TMK Parcels

Aerial Source: Microsoft 2009
Boundary and Parcel Source: PBR Hawaii

Figure 1
Aerial Photograph

0 250 500 1,000 ft

0 50 100 200 M

N

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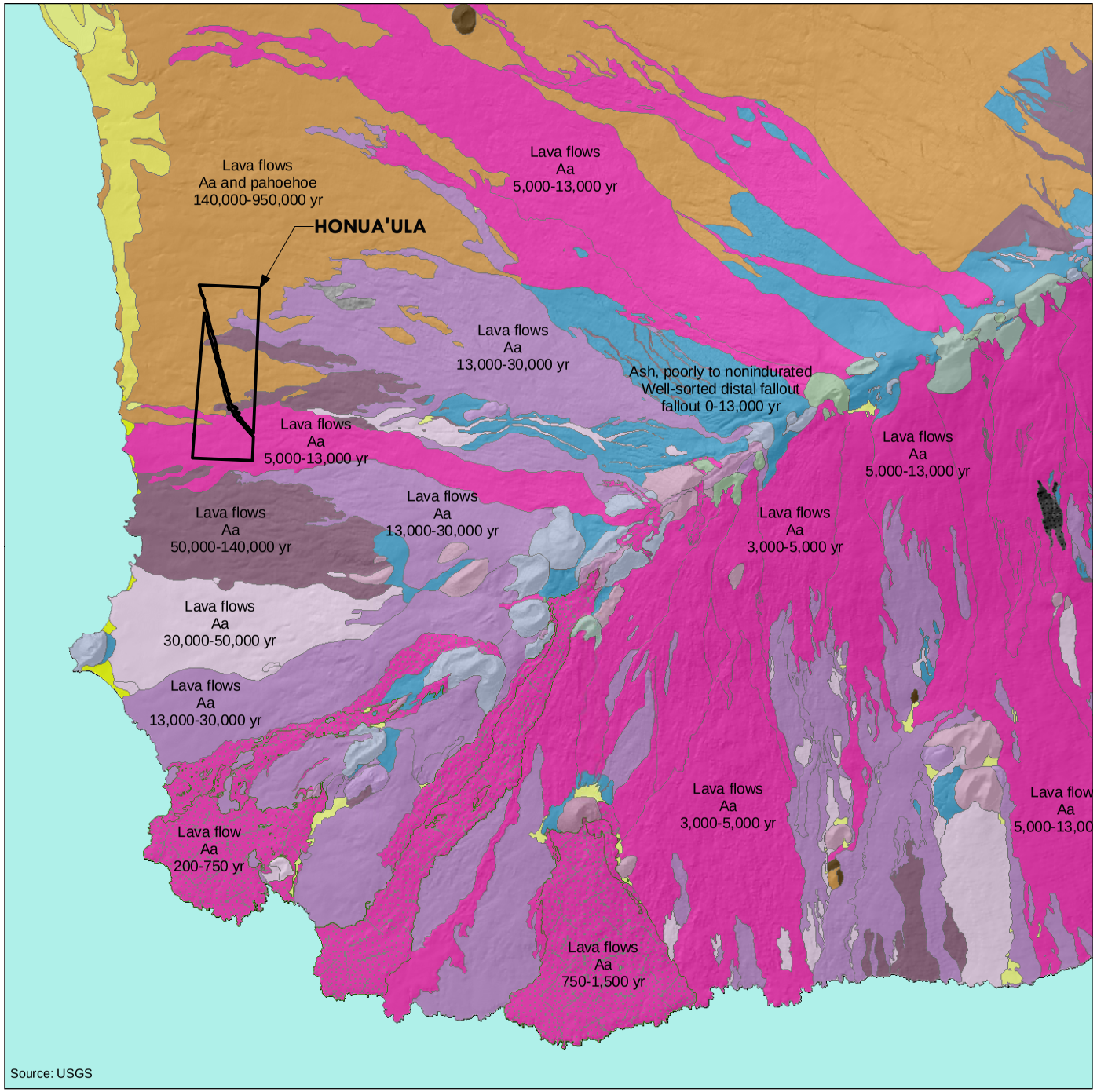

Legend

Project Boundary

Geology

- Qa, Alluvium
- Qbd, Beach deposits
- Qdy, Younger dune deposits
- Qhn, Hana Volcanics
- Qhn0, Hana Volcanics
- Qhn1, Hana Volcanics
- Qhn2, Hana Volcanics
- Qhn2v, Hana Volcanics
- Qhn3, Hana Volcanics
- Qhn6, Hana Volcanics
- Qhne, Hana Volcanics
- Qhnt, Hana Volcanics
- Qhnv0, Hana Volcanics
- Qhnv1, Hana Volcanics
- Qhnv2, Hana Volcanics
- Qhnv3, Hana Volcanics
- Qhnv4, Hana Volcanics
- Qhnv5, Hana Volcanics
- Qhnv6, Hana Volcanics
- Qkui, Kula Volcanics
- Qkul, Kula Volcanics
- Qkul?, Kula Volcanics
- Qkuls, Kula Volcanics
- Qkuv, Kula Volcanics
- Qkuv?, Kula Volcanics
- Qls, Landslide deposits
- Qtc, Talus and colluvium

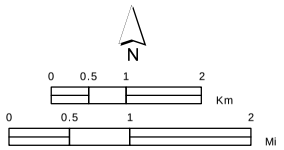

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Figure 2
Geology Map

Appendix 1

This area is characterized by an extremely rough surface composed of broken ʻaʻā lava blocks called clinker with little or no soil accumulation (PBR Hawaii 1988). The terrain slopes gently at about 12% in an east to west direction across the Property. Steeply sloping ridges and gulches dissect the parcel, particularly in the north. The soils and lavas covering the Property, and the drainage gulches that run across the land, strongly influence the nature of the vegetation that grows there.

1.4 Literature Review

At one time, Rock (1913) suggested that lowland dry and mesic forests in Hawaiʻi had more native tree species than any other area in the state. Since then, however, native lowland dry forests have been degraded by non-native herbivores and invaded by alien shrubs and grasses (Wagner, et al. 1999). True native dry forests are acknowledged to be the rarest native plant community within the main Hawaiian Islands (Bruegmann 1996) and the nation (Noss and Peters 1995). Bruegmann (1996) estimated that over 90 percent of Hawaiʻi's native dry forest habitats have been severely fragmented and degraded. Williams (1990) and Cabin et al. (2000a, 2000b) summarized the causative factors of this loss citing pre-contact fire and deforestation, non-native ungulate grazing, alien species invasions, and conversion of forests for agricultural, urban, and military uses.

During the Second World War, the military used lands in Kīhei for training and maneuvers (P. Erdman, Ulupalakua Ranch, pers. comm.). Activities within and adjacent to the Property included a Navy Underwater Demolition Team (UDT) training base at Kamaole, an Army camp at Makena, and amphibious assault training exercises by the Marine Corps. Jeep roads were bulldozed inland and cross-country movement by armored vehicles and troops were conducted. Following 1945, the area was returned to open pasture. Periodic bulldozing of the highway easement connecting Kīhei to ʻUlupalakua by the State of Hawaiʻi, grazing pressure from axis deer (*Axis axis*) and feral goats (*Capra hircus*), and unauthorized *kiawe* (*Prosopis pallida*) logging have caused further disturbance to the area.

Char and Linney (1988) conducted the first botanical survey within the Property area. They observed 132 plant species in three distinct vegetation types: *kiawe* (*Prosopis pallida*)/buffelgrass (*Cenchrus ciliaris*) pasturelands, gully vegetation, and scrub vegetation. Twenty-one of the 132 plant species they observed are native to Hawaiʻi. The remaining 111 are non-native species. They found no threatened or endangered plant species within the Property. However, they identified one candidate species, *ʻāwikiwiki* (*Canavalia pubescens*), and several uncommon native species on the site including *nehe* (*Lipochaeta rockii*), *ʻānunu* vine (*Sicyos hispidus*), *maiapilo* (*Capparis sandwichiana*), and *kolomona* (*Senna gaudichaudii*). Char and Linney (1988) recommended that a small area in the southwestern corner of the Property where they found *ʻāwikiwiki* (*C. pubescens*) and representatives of other uncommon native plants be left intact. However, sometime prior to 1996, unknown persons bulldozed the area and the plants were lost.

The *nehe* plants (*Lipochaeta rockii*) reported from the Property have a distinct leaf shape (A.C. Medeiros, USGS, pers. comm.); however, the current Manual of Flowering Plants of Hawaii (Wagner et al. 1999) did not find sufficient scientific evidence to recognize it as a distinct variety or subspecies. Herbst (Bishop Museum, pers. comm.) suggested that it might easily hybridize with other plants of the same species.

Recently, Altenberg (2007) drew attention to the southern portion of the Property which he claimed to be among the best examples of a remnant native lowland dry forest remaining on Maui. He suggested that Honua'ula "contains most of the 3rd largest contiguous area of *wiliwili* (*Erythrina sandwicensis*) habitat on Maui, approximately 110 acres in the southern 1/6 of the property" (Altenberg 2007). Altenberg recommended that an area of approximately 45 ha (110 ac) be preserved for its ecological significance. He found 20 native plant species (including 12 endemic species) concentrated in the southern one third of the Property. Four of the native species he observed - *pua kala* (*Argemone glauca*), *alena* (*Boerhavia herbstii*), *ʻakoko* (*Chamaecyse celastroides* var*. lorifolia*), and *ʻānunu* (*Sicyos pachycarpus*) - had not been reported by Char and Linney (1988) or Char (1993, 2004). Char and Linney (1988) and Char (1993, 2004) reported five species within the Property that were not found by Altenberg (2007): maidenhair fern (*Adiantum capillus-veneris*), *pellaea* (*Pellaea ternifolia*), *kakonakona* (*Panicum torridum*), *Solanum americanum* (*popolo*) and *alena* (*Boerhavia repens*).

Gagne and Cuddihy (1999) noted that native dry forest communities occur on all of the main islands at 300-1,500 m (984-4,921 ft) in elevation, especially on leeward aspects or in the rain shadows of mountains. Precipitation is between 500-2,000 mm (17-79 in) annually, and is usually concentrated between November and March. Gagne and Cuddihy (1999) noted that lowland dry forests usually "grade into lowland dry grasslands or shrub lands below 300 m elevation…" The semi-arid Honua'ula Property lies between 90-245 m (295-804 ft) elevation, and is estimated to receive about 300 mm (12 in) of precipitation annually. Hence, the southern portion of the Property may be described more accurately as a highly disturbed, remnant native coastal dry shrubland (sensu Gagne and Cuddihy 1999) in which *wiliwili* (*Erythrina sandwicensis*) has become a common inhabitant. Medeiros (USGS, pers. comm.) suggested that mature *wiliwili* (*Erythrina sandwicensis*) trees may be found throughout southeastern Maui, often in abundance and greater densities than those encountered in the Property. Altenberg (2007) identified eight *wiliwili* (*E. sandwicensis*) forests in southeast Maui including Kanaio, Pu'u o Kali, Honua'ula / Wailea 670, Makena, La Perouse, Kaupo, Lualailua, and Waikapu.

The recent US Geological Survey GAP Analysis Program (Figure 3) maps classified landcover within the Property as largely "XT: open kiawe forest and shrubland (alien grasses)", "Y: uncharacterized open-sparse vegetation", with small patches of "XG: alien grassland" and "XT: alien forest". Price et al. (2007) recently developed methods using bioclimatic data to map habitat quality for and range of two widespread plant species including *wiliwili* (*Erythrina sandwicensis*) and two rare plant species throughout the Hawaiian Islands. The area encompassed by the Property appears on these maps as 'medium' to 'low' habitat quality for *wiliwili* (*E. sandwicensis*) (Price et al. 2007). However, numerous areas in southeastern Maui located between Pu'u Ola'i and Kaupo outside the Property did appear as having 'high' habitat characteristics on the maps prepared by Price et al (2007).

2.0 METHODS

Spatially explicit information on the composition and structure of plant communities within the Property is needed to meet the survey objectives, especially if data are to be used to make conservation, management and long-term monitoring and ecological research recommendations for the Property. However, the relatively small Property and the nature of the understory vegetation prevent the effective application of remote sensing technologies typically used in vegetation mapping. Therefore, SWCA botanists developed a sampling method to meet all three study objectives. High resolution field sampling techniques were designed based upon previous reconnaissance surveys conducted by SWCA, cooperating government, and other scientists on March 6-8, 13-15, 24-26, 2006; January 4-5, February 24-26, and October 18, 2007.

2.1 Field Surveys

A modified one-dimensional line transect method of plot-less sampling (Barbour et al. 1987) was employed by SWCA botanists across the entire Property. Linear transects were established at regular 20 m (65.6 ft) intervals across the remnant mixed *kiawe-wiliwili* shrubland in the southern portion of the Property, and at regular 50 m (164 ft) intervals across the entire northern portion of the Property (Figure 4). Transects in the northern portion of the Property were placed 50 m apart because, compared to the southern rugged 'a'ā lava flow with scrub vegetation, the northern 200 ha (495 acres) of Property is open pastureland and is known to harbor fewer native plant species (Char and Linney, 1988 and Altenberg 2007). The advantages of plot-less sampling are: 1) a sample plot does not need to be established, saving time; and 2) elimination of subjective error associated with the sample plot boundaries. This method also allowed us to sweep the entire project site to record more native plants than would have been found through sample plots and/or quadrats.

Transects were pre-established on an 800 × 1200 m (0.5 × 0.75 mi) map-overlay with ARC GIS software developed by Environmental Science Research Insititute (ESRI), and pre-loaded into Trimble GeoXT (Pocket PC) Global Positioning System (GPS) units with Terrasync 2.4 GPS software. Field surveys for this study were conducted within the southern 70 ha (173 acres) of scrub vegetation on March 8-10, 2008 and March 29-31, 2008, by botanists Shahin Ansari, Ph.D., Maya LeGrande, M.S., Ane Bakutis, M.S., Hina Kneuble, M.S., Talia Portner, B.S., Tiffany Thair, (M.S. candidate), and GIS Analyst Ryan Taira, B.A.

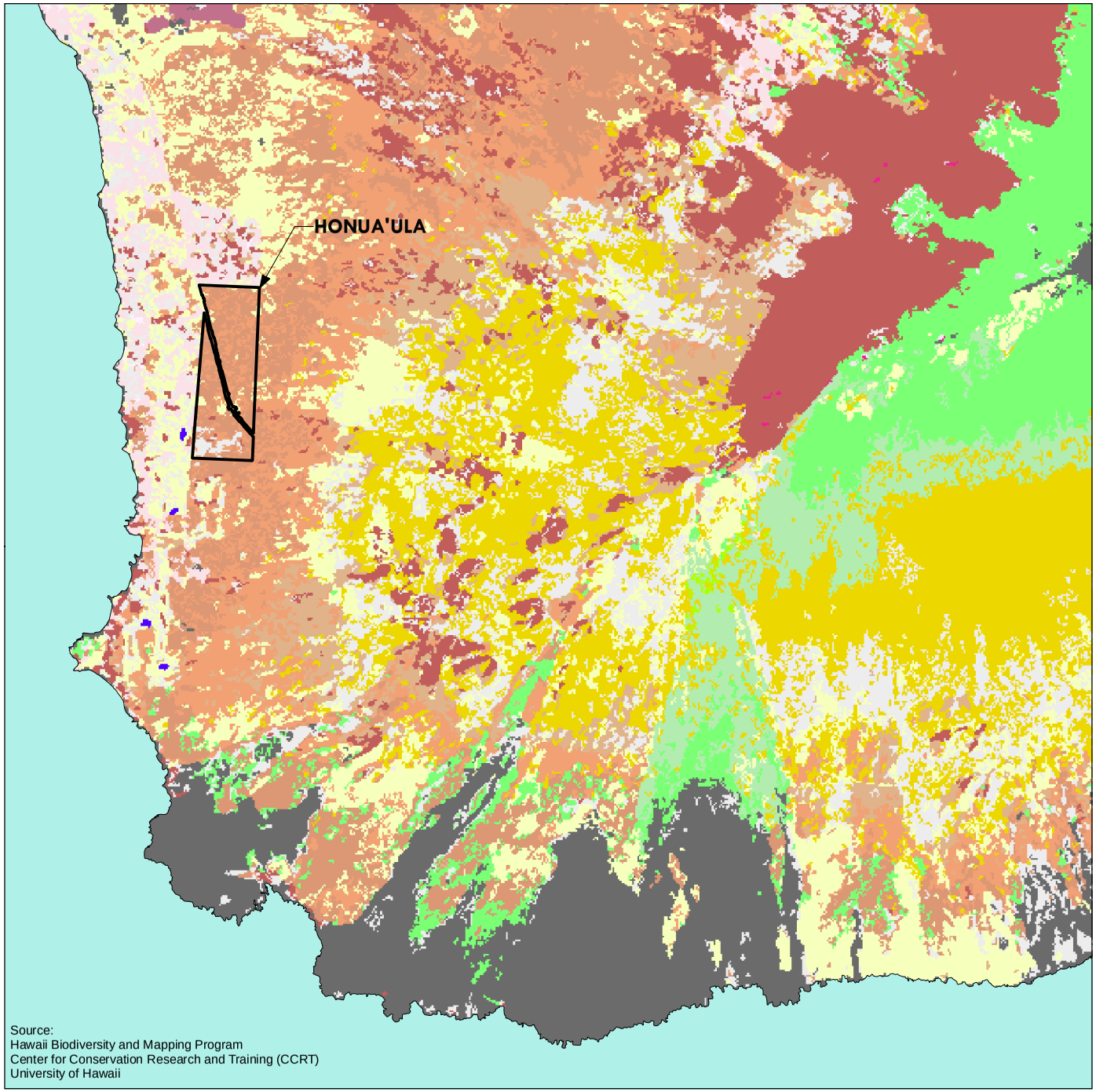

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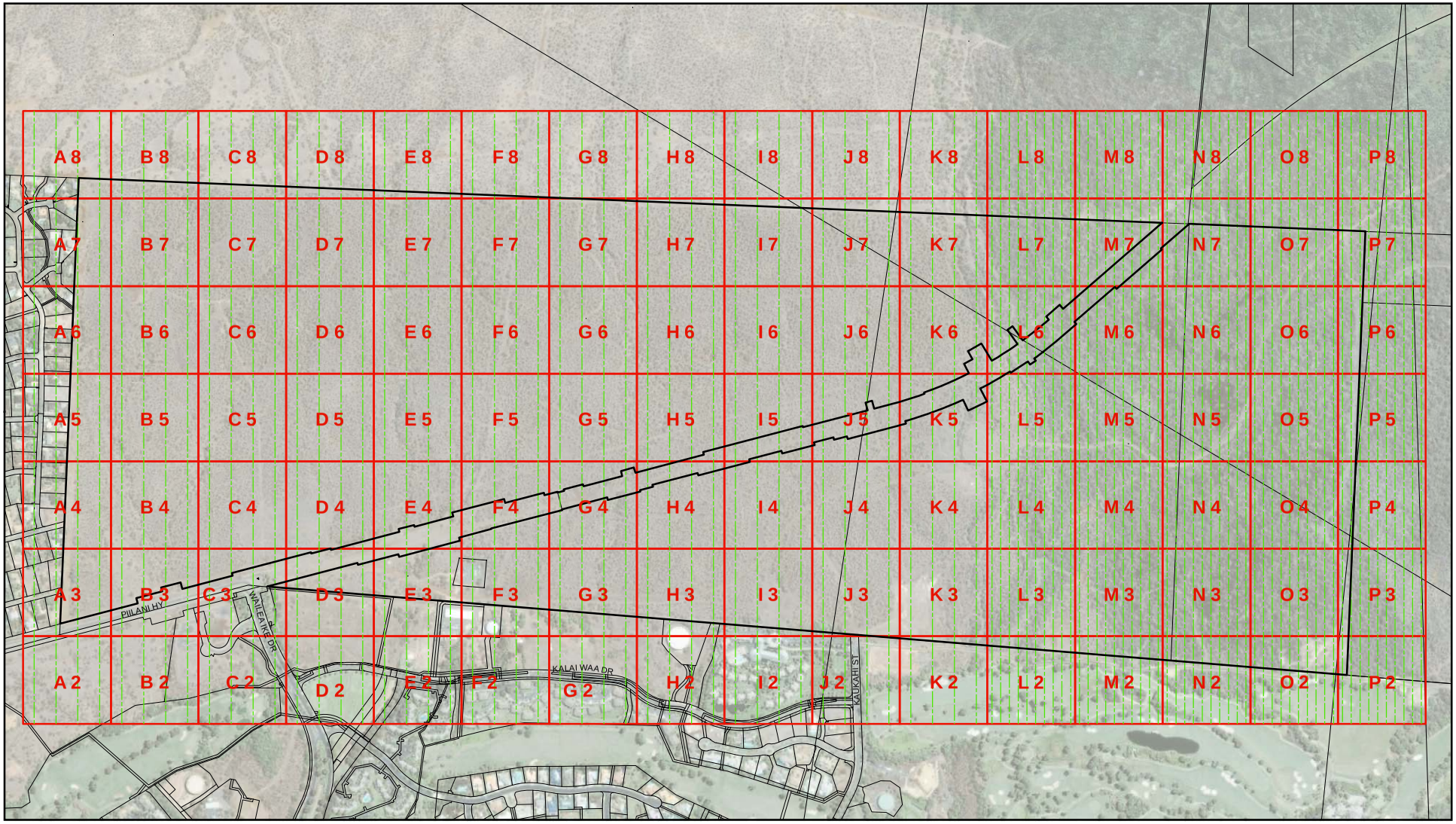
Figure 3
HI-GAP Landcover

Appendix 1



Appendix 1

Legend

- Transects
- Parcels
- Project Boundary
- 200 Meter Grid

Figure 4
Grid and Transects Map

0 250 500 1,000 ft

N

0 50 100 200 M

Parcel and Boundary Source: PBR Hawaii

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The northern portion of the Property was surveyed by the team on May 27- 29, 2008. Three two-person teams concurrently walked abreast along adjacent transects. Each team was responsible for locating and mapping native plants 10 m (33 ft) on either side of each transect. At each plant feature, 10 to 15 data points were collected and averaged to produce a single GPS point. GPS data was collected along transects using Wide Area Augmentation System (WAAS) for real time differential GPS (DGPS). At the end of each transect, the botanists moved to adjacent transects to continue their search until all transects were surveyed. Mapping was conducted at an approximate rate of 0.4 km/ hr (0.25 miles/ hr). Surveys commenced at the southeastern corner of the Property (grid P8) and proceeded to the south-west corner (grid P2; Figure 4). The entire length of each transect was surveyed, totaling 78,500 m (48.7 mi) across the Property.

A single GPS point was collected at the center of each discrete patch of vines, herbaceous and small shrub species. Herbs, shrubs, and vines less than 15 cm (6 inch) tall that were not flowering or fruiting were considered seedlings. For each patch, the botanists documented the phenology, number of individuals (seedlings and adults), aerial diameter of the patch (m), presence/ absence of signs of herbivory (such as chewed leaves or stems, scraping of the leaf surface), damage (broken off branches) and/or disease (wilting, yellowing of the whole or part of the plant). If patches were very large (> 5 m² or 54 ft²), a GPS point was collected every 5 m^2. Where multiple *wiliwili* trees (*E. sandwicensis*) were found with overlapping canopies, a single GPS point was collected at the approximate center of the grove of trees. Botanists also noted the aerial canopy diameter and the number of seedlings/ juveniles and adult plants within a grove. Large tree species with trunks less than 15 cm (6 inch) in diameter were regarded as juveniles.

Hoary abutilon (*Abutilon incanum), koali awahia* (*Ipomoea indica*)*, 'ilima (Sida fallax), popolo* (*Solanum americanum*), *'ilie'e* (*Plumbago zeylanica*), *alena* (*Boerhavia* spp.), and *'uhaloa* (*Waltheria indica*) were abundant and widespread indigenous (versus endemic) species common throughout the southern 'a'ā lava flow. Therefore, individuals of these species were not mapped. This is consistent with the methods of Altenberg (2007).

2.2 Mapping and Data Analysis

GPS field data was post-processed with GPS Pathfinder Office software and used to differentially correct to a Continuously Operating Reference Station (CORS). Most features were accurate to sub-meter precision. Data was exported in ESRI ArcGIS to shape file format in NAD 83 (Cors 96) UTM Zone 4 meters using WGS 84 to NAD 83_4 transformation. ESRI ArcView 9.2 software was used for digital mapping.

To better visualize the distribution of native plant species, a graduated circle map was created showing the distribution of all species based on the number of plants mapped at each location (GPS point). Circles of different color represent different species, the size of the circle reflects the number of individuals mapped at each location and assigned to one of six count classes; 1-5, 6-10, 11-15, 16-25, 26-60, and 61-110 individuals. While the graduated circle map is informative, a more effective way to find the greatest concentration of the native plant resources is to map the densities of each species.

Vegetation density maps were created using kernel density which is based on the quadratic kernel function described in Silverman (1986). The 26 native species known to occur in the Property were arranged in order of their relative importance by the project botanists and only the top eight endemic and indigenous plant species that are uncommon within the Property and elsewhere in the State were included in the GIS density analysis (Table 1). Density of these selected eight native plant species was evaluated as a means of identifying suitable boundaries for a Native Plant Preservation Area within a portion of the Property based upon their greatest concentration.

Using the ArcView GIS Spatial Analyst extension, SWCA converted species count classes of the eight species to density (number of species/acre) classes. These resulting density maps allow comparison of native plants on the same spatial scale. However, density maps for these species varied greatly from 0-57 plants per acre for *wiliwili* (*Erythrina sandwicensis*) to 0-1 plant per acre for *'āwikiwiki* (*Canavalia pubescens*). Therefore, the maps were further standardized by reclassifying the densities for the species to a common scale where nine (9) represented the highest density for each species and one (1) represented lowest. The reclassified density maps

were then overlaid with a percent weight assigned to each. Each species was assigned a different weight by the project botanists based on their relative botanical importance throughout the State and Property (Table 2). The density maps and the overlay analysis were developed using 100 m (328 ft) resolution to define specific and contiguous preservation areas that protect the greatest concentration of rare native plant species within the Property.

Table 1. Native plants reported from the Property arranged in order of their relative importance by project botanists. *Group 1 = endemic (E) and indigenous (I) plants uncommon within the Property as well as elsewhere in the State, and/or of significance to life stages of the endangered Blackburn sphinx moth (Manduca blackburni); Group 2 = relatively common endemic species throughout Hawai'i, Group 3 = relatively common native (indigenous) species throughout Hawai'i.*

Species	Status	Hawaiian Name	Family
GROUP 1			
Lipochaeta rockii	E	*nehe*	Asteraceae
Canavalia pubescens	E	*paunu*	Fabaceae
Erythrina sandwicensis	E	*wiliwili*	Fabaceae
Capparis sandwichiana	E	*maiapilo*	Capparaceae
Senna gaudichaudii	I	*kolomona*	Fabaceae
Sicyos hispidus	E	*'ānunu*	Cucurbitaceae
Sicyos pachycarpus	E	*'ānunu*	Cucurbitaceae
Chamaesyce celastroides var. *lorifolia**	E	*'akoko*	Euphorbiaceae
Argemone glauca	E	*pua kala*	Papaveraceae
GROUP 2			
Myoporum sandwicense	E	*naio*	Myoporaceae
Panicum torridum	E	*kakonakona*	Poaceae
Heteropogon contortus	E	*pili*	Poaceae
Ipomoea tuboides	E	*ipomea*	Convolvulaceae
Boerhavia herbstii	E	*alena*	Nyctaginaceae
Doryopteris decipiens	E	*'iwa'iwa*	Adiantaceae
Plumbago zeylanica	E	*'ilie'e*	Plumbaginaceae
GROUP 3			
Dodonaea viscosa	I	*'a'ali'i*	Sapindaceae
Sida fallax	I	*'ilima*	Malvaceae
Boerhavia spp.**	I	*alena*	Nyctaginaceae
Abutilon incanum	I	hoary abutilon	Malvaceae
Ipomoea indica	I	*koali awahia*	Convolvulaceae
Waltheria indica	I	*'uhaloa*	Sterculiaceae
Pellaea ternifolia	I	*pellaea*	Adiantaceae
Adiantum capillus-veneris	I	maidenhair fern	Pteridaceae
Solanum americanum	I	*popolo*	Solanaceae

** A single stunted akoko was found within the Property in 2006; however, the plant was found to be dead in the late summer of 2007, and was not found at all during the 2008 surveys. Therefore, it is not considered in further plant density analysis for the purpose of defining boundaries of the native plant preserve.*
*** Two indigenous species of Boerhavia (repens and acutifolia) were reported within the Property during the SWCA surveys. Char and Linney (1988) and Char (1993, 2004) also found B. repens within the Property.*

2.3 Regional Assessment of *Wiliwili* Abundance

A low-altitude qualitative aerial survey of southeast Maui was conducted by biologists Robert Kinzie, Ph.D., John Ford, M.S., and GIS Analyst Ryan Taira, B.A. on July 11, 2008 to identify and photograph other areas where *wiliwili* (*Erythrina sandvicensis*) is common. During summer months, *wiliwili* (*E. sandwicensis*) trees drop their leaves and are easy to identify from the air. The aerial survey began at Kahului International Airport and extended along the Kīhei coast over undeveloped lands between 300-450 m (980-1500 ft) elevation toward the southeast to Lualailua, at altitudes ranging from 15-150 m (50-500 ft) above ground level (AGL).

Still photos and videos of *wiliwili* (*E. sandwicensis*) were collected with a SONY DCR-SR100 digital video camera with a Carl Zeiss® Vario-Sonnar® T lens. Still photos were also taken with a Pentax Optio W30 digital camera with a Pentax 6.3mm lens. *Wiliwili* (*E. sandwicensis*) trees within the Pu'u O Kali Preserve, Honua'ula, adjacent 'Ulupalakua Ranch and Makena Resort lands, Makena State Park, lands east of Pu'u Olai, Ahihi-Kinau, Kanaio, and Lualailua were photographed.

Table 2. Percent weight assigned for the eight species selected for density analysis; *based on their relative botanical importance throughout the State and the Honua'ula Project site.*

Species	Common Name	Percent Weight
Lipochaeta rockii (E)	*nehe*	16
Canavalia pubescens (E)	*paunu*	15
Erythrina sandwicensis (E)	*wiliwili*	14
Capparis sandwichiana (E)	*maiapilo*	13
Senna gaudichaudii (I)	*kolomona*	12
Sicyos hispidus (E)	*'ānunu*	11
Sicyos pachycarpus (E)	*'ānunu*	10
Argemone glauca (E)	*pua kala*	9

3.0 RESULTS

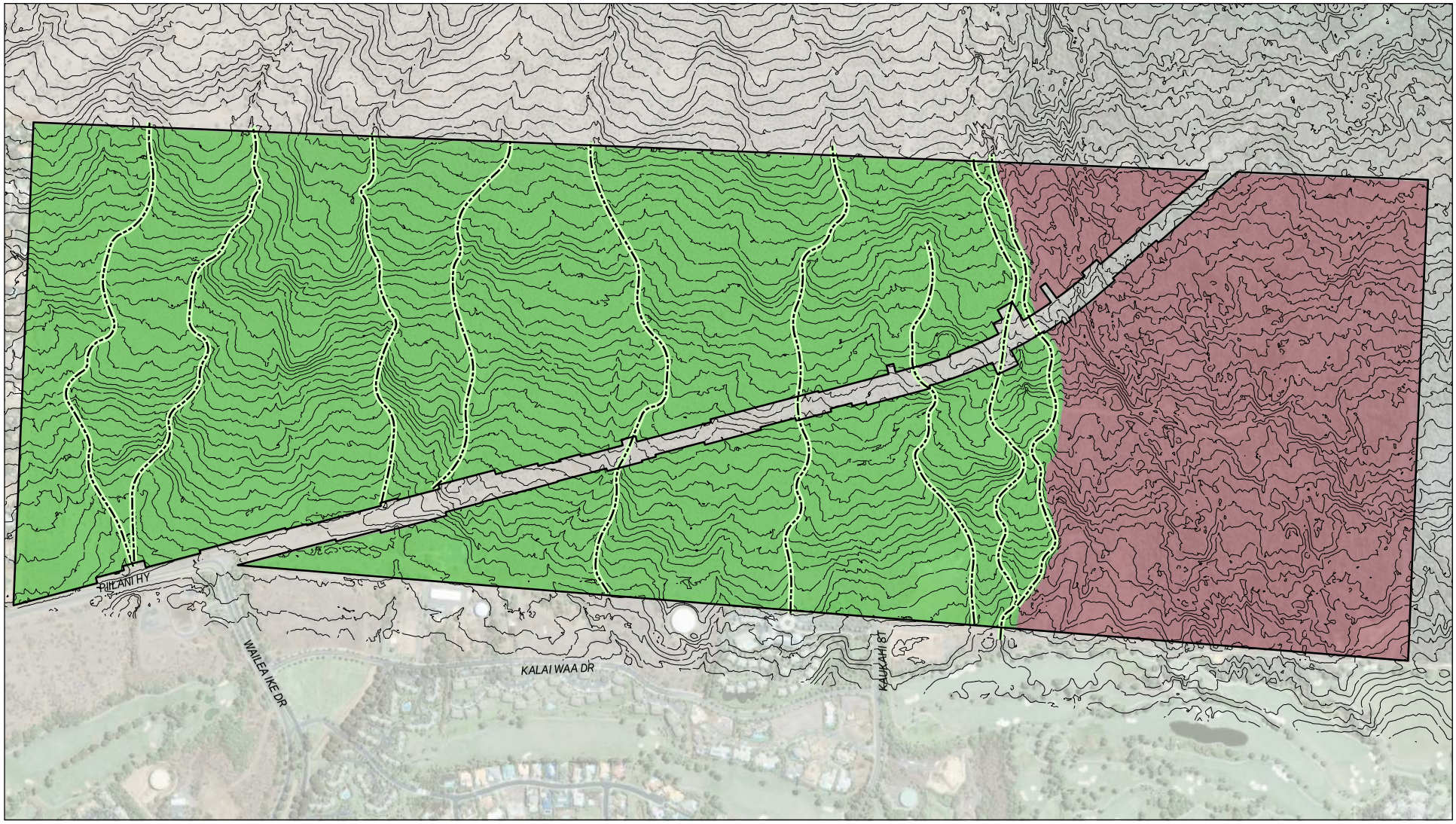
A complete list of all plants found within the site is provided in Appendix A. *Portulaca* sp. nov. was reported by Char and Linney (1988); however, it is not included in Appendix A because the species level was never determined and no known collections were made by Char and Linney (1988). All the native plant species described from the Property are known to occur elsewhere on Maui and the main Hawaiian Islands. Only the unique leaf form of Rock's *nehe* (*Lipochaeta rockii*) appears to be limited to the Property. Table 3 illustrates the occurrence of adult and seedling native plants within the Property.

Table 3. A comparison of the number of native plants and seedlings observed within the entire Honua'ula Property and the remnant mixed kiawe-wiliwili shrubland in the southern portion of the Property. *Prop = entire Honua'ula Property, KW = kiawe-wiliwili shrubland.*

Species (Hawaiian name)	Number of Points		Number of Seedlings		Number of Adults		Total Numbers Observed	
	KW	Prop	KW	Prop	KW	Prop	KW	Prop
Argemone glauca (pua kala)	26	26	247	247	165	165	412	412
Canavalia pubescens ('āwikiwiki)	5	5	0	0	5	5	5	5
Capparis sandwichiana (maiapilo)	311	312	14	14	548	549	562	563
Dodonea viscosa ('a'ali'i)	7	7	0	0	16	16	16	16
Doryopteris decipiens ('iwa'iwa)	2	14	0	2	7	52	7	54
Erythrina sandwicensis (wiliwili)	546	569	334	341	2105	2137	2439	2478
Heteropogon contortus (pili)	0	66	0	384	0	1109	0	1493
Ipomoea tuboides (ipomea)	5	5	0	0	5	5	5	5
Lipochaeta rockii (nehe)	24	24	56	56	45	45	101	101
Myoporum sandwicense (naio)	17	17	0	0	21	21	21	21
Senna gaudichaudii (kolomona)	28	32	1	5	36	38	37	43
Sicyos hispidus ('ānunu)	48	49	5	5	107	108	112	113
Sicyos pachycarpus ('ānunu)	101	102	313	313	289	290	602	603

3.1 Vegetation

Similar to the vegetation categories described by Char and Linney (1988), SWCA found three distinct vegetation types within the Property (see Figure 5). Each of these is described in the following paragraphs. Figure 6 illustrates the percent of introduced and native plants reported from each of the three predominant vegetation types.



Legend
- Project Boundary

Vegetation Types
- Kiawe-buffel Grass Grassland
- Kiawe-wiliwili Shrubland
- Gulch Vegetation

Appendix 1

Figure 5
Vegetation Types

0 250 500 1,000 ft
0 50 100 200 M
N

Boundary Source: PBR Hawaii
Aerial Source: Microsoft 2009

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3.1.1 *Kiawe*-Buffelgrass Grassland

About 75% of the northern portion of the project parcel is characterized by an extensive grassland comprised primarily of *kiawe* (*Prosopis pallida*) *and* buffelgrass (*Cenchrus ciliaris*). There is scattered evidence that trespassers may be logging *kiawe* (*P. pallida*) trees for charcoal in this area. Guinea grass (*Urochloa maxima*), natal redtop (*Rhynchelytrum repens*), and sour grass (*Digitaria insularis*) are also scattered throughout the northern portion of the Property. Other plants found here include the invasive *koa haole* (*Leucaena leucocephala*), lantana (*Lantana camara*), partridge pea (*Chamaecrista nictitans*) and cow pea (*Macroptilium lathyroides*).

The area has been disturbed throughout by numerous jeep trails and unrestricted grazing by axis deer. Some open areas that appeared to be heavily grazed were devoid of buffelgrass (*Cenchrus ciliaris*), but contained the native shrubs *'ilima* (*Sida fallax*) and hoary abutilon (*Abutilon incanum*), and the introduced golden crown beard (*Verbesina encelioides*).

3.1.2 Gulch Vegetation

The vast expanse of *kiawe*-buffelgrass in the northern three quarters of the Property is bisected from east to west by several gulches that carry flood waters to the sea (Figure 5). These intermittent gulches vary in depth and are characterized by patches of exposed bedrock. The gulches are shaded by their steep walls providing relatively cool and moist conditions. Three species of ferns including maidenhair fern (*Adiantum capillus-veneris*), sword fern (*Nephrolepis multiflora*), and the endemic *'iwa'iwa* fern (*Doryopteris decipiens*) were found in the shaded rocky outcrops and crevices within the gulches. Native *Pili* grass (*Heteropogon contortus*) was found in more open and sunny locations. Other species found within the gulches include tree tobacco (*Nicotiana glauca*), *wiliwili* (*Erythrina sandwicensis*), lantana (*Lantana camara*), partridge pea (*Chamaecrista nictitans*), golden crownbeard (*Verbesina encelioides*), *'ilima* (*Sida fallax*), hoary abutilon (*Abutilon incanum*), *koa haole* (*Leucaena leucocephala*), indigo (*Indigofera suffruticosa*), *'uhaloa* (*Waltheria indica*) and lion's ear (*Leonotis nepetifolia*).

3.1.3 Mixed *Kiawe*-*Wiliwili* Shrubland

Remnant mixed *kiawe-wiliwili* shrubland was limited to the southern 'a'ā lava flow in the southern quarter of Property (Figure 5). Scattered groves of large-stature *wiliwili* (*Erythrina sandwicensis*) and *kiawe* trees co-dominated the upper story. Native shrubs, such as *'ilima* (*Sida fallax*) and *maiapilo* (*Capparis sandwichiana*), and the native vine *'ānunu* (*Sicyos pachycarpus*), were represented in the understory. Introduced shrubs, introduced grasses, and introduced vines and herbaceous species dominated the ground vegetation. Lantana (*Lantana camara*), found throughout the mixed *kiawe-wiliwili* shrubland, showed signs of dieback. Although abundant, the guinea grass (*Urochloa maxima*) found on the site was grazed to stubble, probably by axis deer.

3.2 Endangered, Threatened, and Candidate Endangered Species of Plants

No Federal or State of Hawai'i listed threatened, or endangered plant species were found in the Property. Over a period of time, Altenberg (2007) collected roughly 15 GPS points for *'āwikiwiki* vines (*Canavalia pubescens*) within the *kiawe-wiliwili* shrubland during his hikes across the Honua'ula parcel. It is unknown how many of his GPS points represent duplicate occurrences of the same plant. The U.S. Fish and Wildlife Service (2009) reported "a few individuals at Palauea-Keahou" [including the Property] based upon information received from Altenburg (2007) and Hank Oppenheimer (Plant Extinction Prevention Program, pers. comm.). During this study, the project botanists found only five (5) individual *'āwikiwiki* (*C. pubescens*) plants on the Property. All *'āwikiwiki* (*C. pubescens*) were flowering and fruiting at the time of the survey; however, no seedlings were detected. The plants appeared to be healthy with no signs of damage or disease.

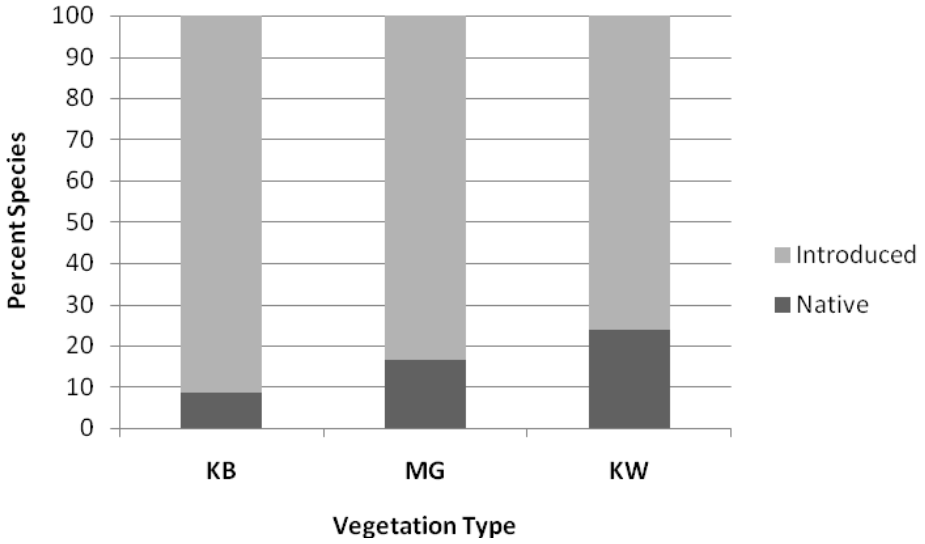

Figure 6. ***Percent of native and introduced plant species found in each of the three predominant vegetation types within the Property.*** *Data is pooled across all plant species (n= 146) observed by Char and Linney (1988), Altenberg (2007) and SWCA (this study). KB = Kiawe-buffelgrass grassland (n= 105, 9 natives and 96 introduced), MG = mixed gulch vegetation (n= 66, 11 natives and 55 introduced), KW = kiawe-wiliwili shrubland (n= 106, 26 natives and 80 introduced).*

3.3 Distribution and Abundance of Native Plant Species

In all, 146 plant species have been identified within the Property, 26 of which are native, 14 of these endemic. The remaining 120 plant species are introduced non-native species. Of the 26 native species reported in previous surveys (Char and Linney 1988, Altenberg 2007), we found 21 during this study. We did not observe *Panicum torridum*, *Boerhavia herbstii*, *Adiantum capillus-veneris*, *Chamaesyce celastroides* and *Pallaea ternifolia* during our surveys. Figure 7 illustrates the location of native plants within the Property, and Figure 8 illustrates the distribution of native plant species within the Property by count.

As previously mentioned, hoary abutilon (*Abutilon incanum), koali awahia* (*Ipomoea indica*), *'ilima (Sida fallax), popolo* (*Solanum americanum*), *'ilie'e* (*Plumbago zeylanica*), *alena* (*Boerhavia* spp.), and *'uhaloa* (*Waltheria indica*) were abundant and widespread throughout the *kiawe-wiliwili* shrubland, and therefore were not mapped since it was not feasible to collect GPS data for each individual plant. Aside from these species and *'āwikiwiki* (*Canavalia pubescens*), which is discussed above and at length in Section 4.0, descriptions of the remaining native plants found on the Property appear below. Individual fact sheets, including photographs and distribution maps, of the native plants mapped by SWCA are found in Appendix B in alphabetical order by species name.

SWCA botanists found 412 *pua kala* (*Argemone glauca*) in 26 locations within the Property, all of which were limited to the southern 'a'ā portion of the Property (Table 3, Figure 8). Most clusters averaged 16 individuals, most of which were seedlings (60%). Clusters ranged from one to 39 m^2 with the average being 4 m^2 (n= 26 clusters). The majority of clusters occurred in the southwestern portion of the *kiawe-wiliwili* shrubland, usually in relatively open, sunny locations of the lava flow. All plants of this species we observed were flowering at the time of the surveys.

Maiapilo (*Capparis sandwichiana*) is a common shrub throughout the understory of the remnant mixed *kiawe-wiliwili* shrubland. We found 563 *maiapilo* during the survey and all but one individual was located in the southern 'a'ā portion of the Property (Table 3, Figure 8). Most clusters ranged from one to five individuals; 11 were larger, consisting of six to 10 individuals.

Appendix 1

Legend

- Project Boundary
- Native Plant Points

Figure 7
Native Plant Occurrences

0 250 500 1,000 ft

0 50 100 200 M

N

Native Plant Source: Trimble GeoXT GPS
Boundary Source: PBR Hawaii
Aerial Source: Microsoft 2009

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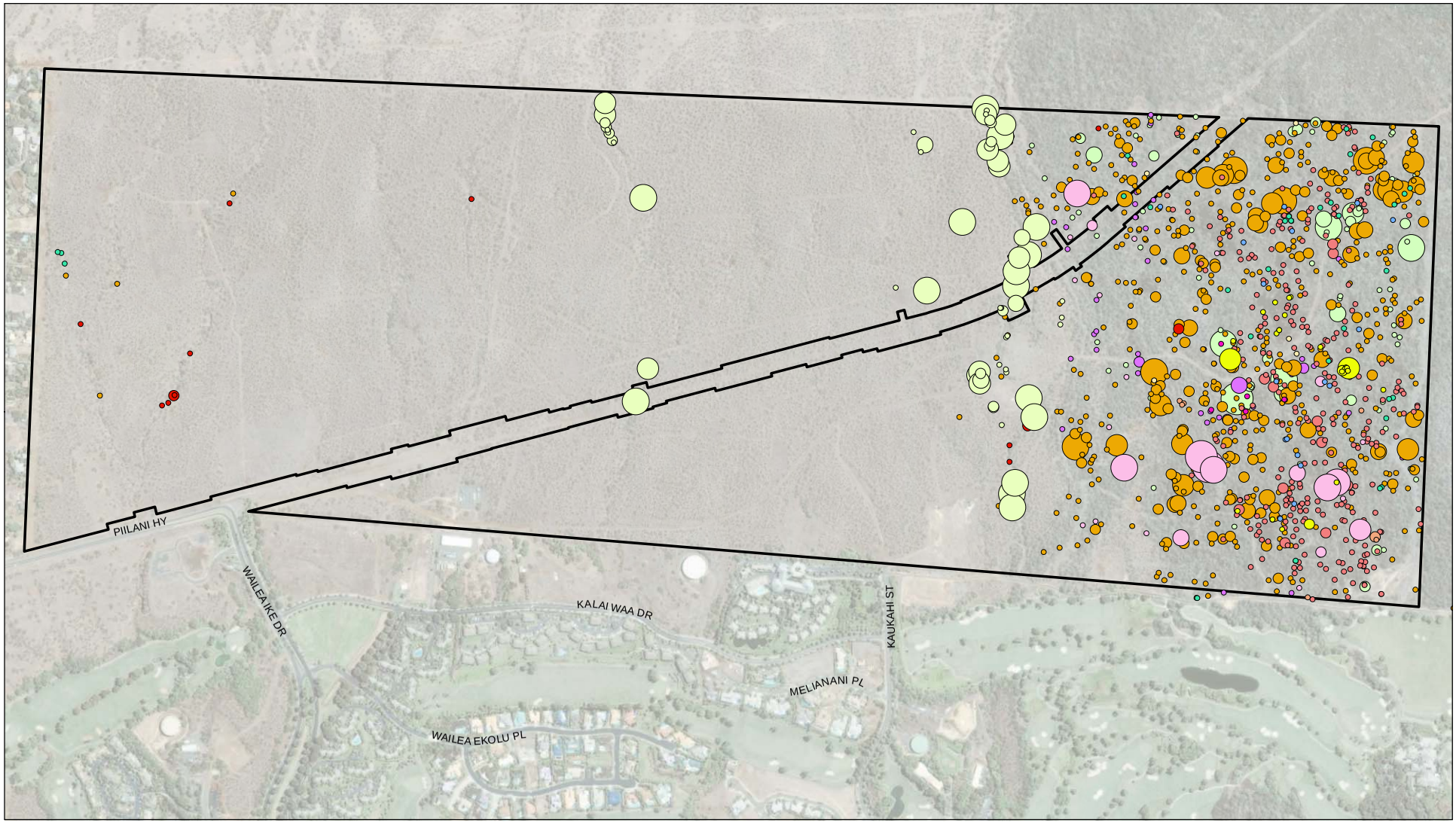

Appendix 1

Native Plants by Species

- *Argemone glauca*
- *Canavalia pubescens*
- *Capparis sandwichiana*
- *Doryopteris decipiens*
- *Dodonea viscosa*
- *Erythrina sandwicensis*
- *Heteropogon contortus*
- *Ipomoea tuboides*
- *Lipochaeta rockii*
- *Myoporum sandwicense*
- *Senna gaudichaudii*
- *Sicyos hispidus*
- *Sicyos pachycarpus*

Native Plants by Count Classes

- 1 - 5
- 6 - 10
- 11 - 15
- 16 - 25
- 26 - 60
- 61 - 110

Plant Source: Native Plants were mapped with GPS
Boundary Source: PBR Hawaii
Aerial Source: Microsoft 2009

Figure 8
Native Plant Count Classes

N

0 250 500 1,000 ft

0 50 100 200 M

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These large clusters were found primarily in the southern portion of the *kiawe-wiliwili* shrubland. The aerial cover of the largest cluster was 531 m^2, others ranged from one to 314 m^2 (average cover of 17 m^2). Several *maiapilo* clusters were flowering and fruiting, but the frequency of seedlings was low (2.5%). About 20% of the plants showed mild to heavy signs of insect herbivory where the epidermis (upper layer of the leaves) appeared to be scraped away.

We observed 16 *'a'ali'i* (*Dodonaea viscosa*) shrubs in seven locations, all limited to the southwestern corner of the *kiawe-wiliwili* shrubland (Figure 8). Six of the seven locations had one to four individuals while the largest cluster was comprised of six individuals. Average cover of *'a'ali'i* was about 26 m^2 where the aerial cover of two clusters were 79 m^2 each and the remaining five ranged from one to 20 m^2. One plant was observed fruiting and no seedlings were observed in the vicinity of the adult shrubs. All plants were healthy with no detectable signs of damage, disease, or herbivory.

Fifty-four *'iwa'iwa* (*Doryopteris decipiens*) ferns were distributed at about 14 locations within the Property (Figure 8). Of these, only seven individuals were found within the *kiawe-wiliwili* shrubland; the others occurred in the drainage gulches within the northern portion of the Property. The number of individuals within a cluster ranged from one to 16, the majority of which were adults (96%). Some plants showed signs of dehydration; most plants in the largest cluster (16 individuals) were very dry. Aerial cover of the largest cluster was approximately 7 m^2 while the others ranged from one to 3 m^2.

Wiliwili (*Erythrina sandwicensis*) was the most common native tree species in the southern 'a'ā lava flow (Table 3, Figure 8). We mapped 2,476 individuals distributed throughout the Property. The majority (2439 individuals) were limited to the *kiawe-wiliwili* shrubland in groves of various sizes. The largest groves (>15 individuals) tended to be located in the eastern portion of the *kiawe-wiliwili* shrubland. The number of adult *wiliwili* (*E. sandwicensis*) trees was greater (86%) than seedlings and juveniles (Table 3). Most *wiliwili* trees showed some form of damage, primarily from the Erythrina gall wasp (*Quadristichus erythrinae* Kim) and the seed eating bruchid beetle (*Specularius impressithorax* Pic). Additional information on the *wiliwili* (*E. sandwicensis*) within the Property can be found in Table 4.

Table 4. Number of wiliwili (Erythrina sandwicensis) groves on the project site. *Grove size is categorized by the number of individual trees in the grove. Range and average canopy cover is measured in m^2.*

Number of Trees in Grove	Number of Groves	Range in Grove Canopy Cover (min-max) (m^2)	Mean Canopy Cover of the Grove (m^2) (+/- 1 S.E.)	Median Grove Canopy Cover (m^2)
1 to 5	417	0.8 - 1589.6	94.1	38.5
6 to 10	107	28.3 – 2862	523.5	254.3
11 to 15	28	12.6 - 706.5	839.1	706.5
16 to 25	12	314 – 2862	1453.9	961.6
26 to 60	5	254.3 - 1962.5	1029.2	873.3

Pili grass (*Heteropogon contortus*) was the only native grass species found within the Property (Figure 8). *Pili* (*H. contortus*) was limited to gulches within the *kiawe*-buffelgrass grassland in the northern half of the Property (Table 3). We mapped 1,493 *pili* (*H. contortus*) plants in 66 locations within the Property. All plants were limited to gulches within the *kiawe*-buffelgrass grassland in the northern half of the Property. Most individuals occurred in the southern drainage gullies of the grassland, becoming less abundant to the north. Adult plants were flowering at the time of our surveys. We did not observe signs of superficial damage or disease.

Five endemic Hawaiian moon flower (*Ipomoea tuboides*) vines were observed within the Property; all of which are limited to the southern 'a'ā portion of the Property (Table 3, Figure 8). At the time of the survey all plants were flowering.

One hundred and one *nehe* (*Lipochaeta rockii*) were found distributed in 24 clusters across the Property (Figure 8). All were within the southern 'a'ā portion of the Property. Two large clusters

contained 22 and 23 individuals respectively and were located in the center of the mixed *kiawe-wiliwili* shrubland. Smaller clusters (< 10 individuals) were found from central to southwestern portion of the shrubland. Clusters ranged from < 1 m^2 to 78.5 m^2 in area.

Twenty-one *naio* (*Myoporum sandwicense*) shrubs/trees were observed in 17 locations distributed throughout the *kiawe-wiliwili* shrubland (Table 3, Figure 8). No *naio* (*M. sandwicense*) seedlings were found. Fifteen of the 17 locations were occupied by a single shrub/tree. Aerial cover ranged from < 1 m^2 to 78.5 m^2, the largest of which consisted of three shrubs/trees.

Forty-three *kolomona* (*Senna gaudichaudii*) trees were mapped at 32 locations within the Property (Figure 8). The majority (37 individuals) of the plants occurred in the southern portion of the mixed *kiawe-wiliwili* shrubland. The cluster size ranged from one to five individuals, and 24 of 29 mapped locations consisted of solitary plants. The areal extent ranged from < 1 m^2 to 19.6 m^2. Evidence of herbivory was observed at four of 29 locations. Many of the plants found were flowering and/ or fruiting at the time of our surveys.

We mapped 113 *'ānunu* (*Sicyos hispidus*) vines at 49 locations within the Property (Table 3, Figure 8). These vines occurred primarily in the central and northern edge of the 'a'ā lava flow. Larger clusters (> 5 individuals) tended to be located in the central portion of the *kiawe-wiliwili* shrubland. Seedlings were observed at only one location and no signs of damage or herbivory were detected.

A second species of *'ānunu* (*Sicyos pachycarpus*) was found within the Property (Figure 8). Six hundred and three *S. pachycarpus* were mapped in 102 locations. The size of clusters varied greatly and ranged from one to 110 plants per location. The majority of the larger clusters (> 15 individuals) were concentrated in the center of the *kiawe-wiliwili* shrubland. Approximately 52% of mapped plants were seedlings. Many adults were observed flowering and/ or fruiting. Most of the vines appeared to be healthy; only one plant showed signs of herbivory.

3.4 GIS Density Analysis

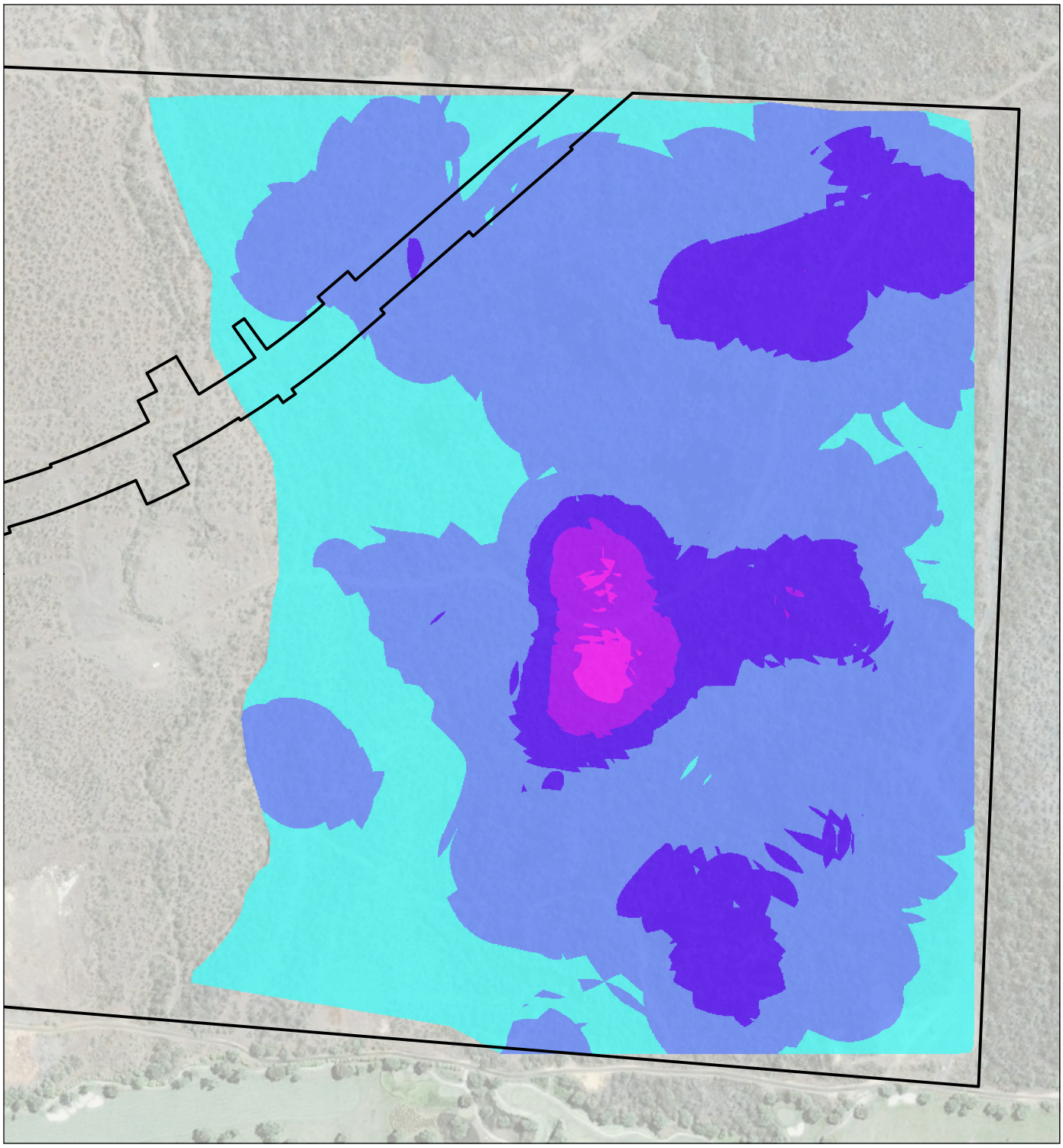
Table 2 illustrates how SWCA botanists weighted each species in Group 1 (from Table 1) for density analysis. The resulting density analysis, conducted at a resolution of 100 m (328 ft) illustrated the core areas occupied by the highest densities of the most significant plant species. Figure 9 illustrates the results of the weighted density analysis for the eight most important native plant species. The colors represent the weighted average of the densities of the eight species.

3.5 Aerial Reconnaissance Survey

Wiliwili (*E. sandwicensis*) and *kiawe* (*P. pallida*) trees were the most distinctive tree species observed from aerial surveys. In contrast, understory was difficult if not impossible to identify from the air. Dense stands of *wiliwili* trees (*E. sandwicensis*) were found in several areas adjacent to, and well outside of, the Property (Figure 10). This includes a large geographical area of approximately 400 ha (1,000 ac) east of Pu'u Olai (Figure 11), stretching from the southern boundary of the Property into the Makena property and Ahihi-Kinau Natural Area Reserve in the south, and from the Makena Resorts southeast of Honua'ula toward the 'Ulupalakua Ranch. Our aerial reconnaissance confirmed input from others (A.C. Medeiros, USGS, pers. comm.; Altenberg 2007) suggesting that several additional high density *wiliwili* (*E. sandwicensis*) groves may be found near Pu'u Olai, Kanaio, Pu'u O Kali, Makena (Figure 12), La Perouse, Kaupo, and Lualailua.

4.0 DISCUSSION

The Property was viewed by Char and Linney (1988) and Char (1993, 2004) as having unremarkable vegetation. Until SWCA (2006) and Altenberg (2007), there had been no recognition of the remnant mixed *kiawe-wiliwili* shrubland as an area worthy of special recognition. Similarly, there have been no previous efforts by any Federal, State, local government agency, or conservation Non-governmental organizations (NGOs) to acquire and protect any portion of the Property.



Weighted Average

- 5 - Highest Weighted Average
- 4
- 3
- 2
- 1 - Lowest Weighted Average

Figure 9
Visual Representation of Weighted Density Analysis of the Eight Most Important Plant Species within the Project Area

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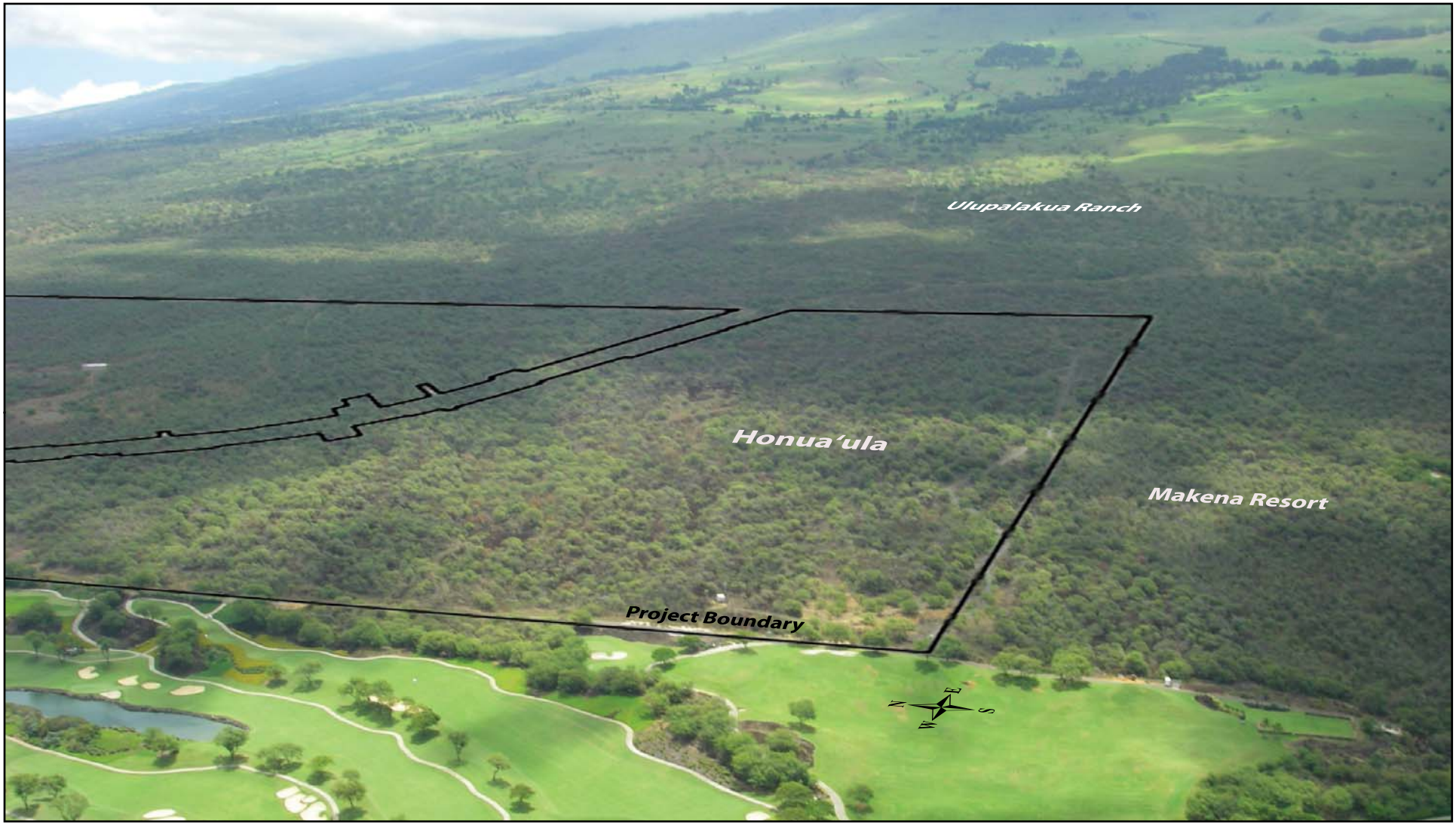


Figure 10 - An east-northeasterly aerial view of the remnant mixed kiawe-wiliwili shrubland within and adjacent to the southern and southeastern boundaries of Honua'ula, on Makena Resort and Ulupalakua Ranch lands, respectively.

Figure 11 - A westerly aerial view of the dense remnant mixed kiawe-wiliwili shrublands adjacent to Pu‘u Olai.

Figure 12. An easterly aerial view of dense remnant mixed kiawe-wiliwili shrublands surrounding the Makena Sewage Treatment Facility.

The remnant native vegetation in the remnant mixed *kiawe-wiliwili* shrubland represents a highly degraded lowland dry shrubland in which *wiliwili* trees (*E. sandwicensis*) are a natural component. High density *wiliwili* (*E. sandwicensis*) stands occur in other locations throughout the region. Altenberg (2007) identified eight areas in southeast Maui, including the Property, where *wiliwili* (*E. sandwicensis*) groves are found. In this study, we also found dense *wiliwili* (*E. sandwicensis*) groves east of Pu'u Olai.

Far from being pristine, this dry shrubland has been degraded by human activities including unrestricted grazing by ungulates, cattle grazing, invasive plant species, road works, *kiawe* (*P. pallida*) logging, and military activities. Only 26 of the 146 species reported from the parcel are native, 14 of these are endemic, and 120 are introduced non-native species (Figure 6).

Canavalia pubescens Hook. & Arnott is "…uncommon in open dry sites such as lava fields, kiawe thickets, and dry forest, 15-540m, on Ni'ihau, Kaua'i (Nāpali Coast), Lāna'i, and leeward East Maui" (Wagner et al. 1999). In 1997, the species was added as a candidate species by the U.S. Fish and Wildlife Service (USFWS). The most recent USFWS (2009) information on the species includes the following:

> *"Canavalia pubescens is found on dry, open lava fields and in dryland forest. On Kauai, C. pubescens was found in open, moist forest and in dry scrub forest at elevations between 180 to 2,900 feet (ft) (55 to 884 meters (m)). On Niihau, this species was last seen growing on an exposed basalt ledge at 300 ft (91 m) in elevation. On Lanai, C. pubescens was observed growing among sun-scorched lava rocks along a coastal trail at 50 ft (15 m) elevation with Cordia subcordata (kou) (H. Oppenheimer, PEP Program, pers. comm. 2007). On Maui, C. pubescens is found on recent lava flows in Erythrina (wiliwili) lowland dryland forest and shrubland with the following native species: Capparis sandwichiana (maiapilo), Chamaesyce celastroides var. lorifolia (akoko), Dodonaea viscosa (aalii), Ipomoea spp. (no common name), Morinda spp. (noni), Sida fallax (ilima), Rauvolfia sandwicensis (hao), and Waltheria indica (uhaloa); at elevations between 80 to 400 ft (24 to 122 m) (Wagner and Herbst 1999, p. 654; Hawaii Biodiversity and Mapping Program (HBMP) 2008)."*
>
> *"Currently, Canavalia pubescens is found on the island of Maui (HBMP 2008; H. Oppenheimer, Plant Extinction Prevention Program, pers. comm. 2006; F. Starr, U.S. Geological Survey, Biological Resources Discipline (USGS-BRD), pers. comm. 2006). No plants were observed at the last known location of this species on Lanai in 2007; however, it could possibly be found there again (H. Oppenheimer, pers. comm. 2007). There were a few individuals at Palauea-Keahou, but this area is currently undergoing development (Altenburg 2007, pp. 12-13; H. Oppenheimer, pers. comm. 2007)."*
>
> *"Five populations are known on Maui: Keokea and Puu o Kali with "hundreds" observed; southwest Kalua o Lapa with two individuals; Papaka Kai with six individuals; Ahihi-Kinau with a few individuals; and southeast Pohakea, with at least one individual (HBMP 2008; F. Starr, pers. comm. 2006; H. Oppenheimer, pers. comms. 2006, 2007). These populations total a little over 200 individuals, with the majority ("hundreds") in one population (Puu o Kali)."*

Altenberg (2007), F. Starr (pers. comm.), and H. Oppenheimer (pers. comm.) apparently presumed that the remaining *'āwikiwiki* (*C. pubescens*) at Palauea-Keahou [Honua'ula] have "… likely been destroyed by development" (as cited in USFWS 2008a and 2009). Contrary to this pessimistic outlook, all five individual on the Honua'ula Property continue to thrive. No construction or other development related activity other than recent fence building to keep cattle from the *kiawe-wiliwili* shrubland has been conducted in that area. Honua'ula Partners, LLC is committed to the Maui County Council as early as March 2006 to insure that all five *'āwikiwiki* (*C. pubescens*) plants within the Property are protected and managed to help ensure their conservation.

The Species Assessment and Listing Priority Assignment Form (USFWS 2009) notes that the USFWS has "promptly reviewed all of the information received regarding the species for the purpose of determining whether emergency listing is needed" and determined that the species "does not appear to be appropriate for emergency listing at this time because the immediacy of

the threats is not so great as to imperil a significant proportion of the taxon within the time frame of the routine listing process."

Nehe (*Lipochaeta rockii* Sherff) occurs in scattered locations on Maui, but is primarily known from Moloka'i and Kaho'olawe where it is scattered to common in coastal sites to dry forests, and along the margins of lava flows (Wagner et al. 1999). As noted above, *nehe* (*L. rockii*) within the Property have a distinct leaf shape; the leaves are less dissected compared to specimens at other Maui locations. However, it is not recognized as a separate subspecies or variety by botanical authorities (Wagner et al. 1999) and is suggested to easily hybridize with other plants of the same species (Herbst, Bishop Museum, pers. comm.). It is also not given statutory protection by State or Federal laws.

4.1 Comparison to Adjacent Hawaiian Dry Forests and Conservation Efforts

As stated above, there have been no previous efforts to acquire and protect any portion of the Property. Instead, government conservation efforts for native dry forest ecosystems have been focused on better examples of relatively intact ecosystems such as Pu'u o Kali, 'Auwahi, and similar areas. Figure 13 illustrates existing areas on southeastern Maui where remnant dry forest and shrubland communities are being protected by various entities.

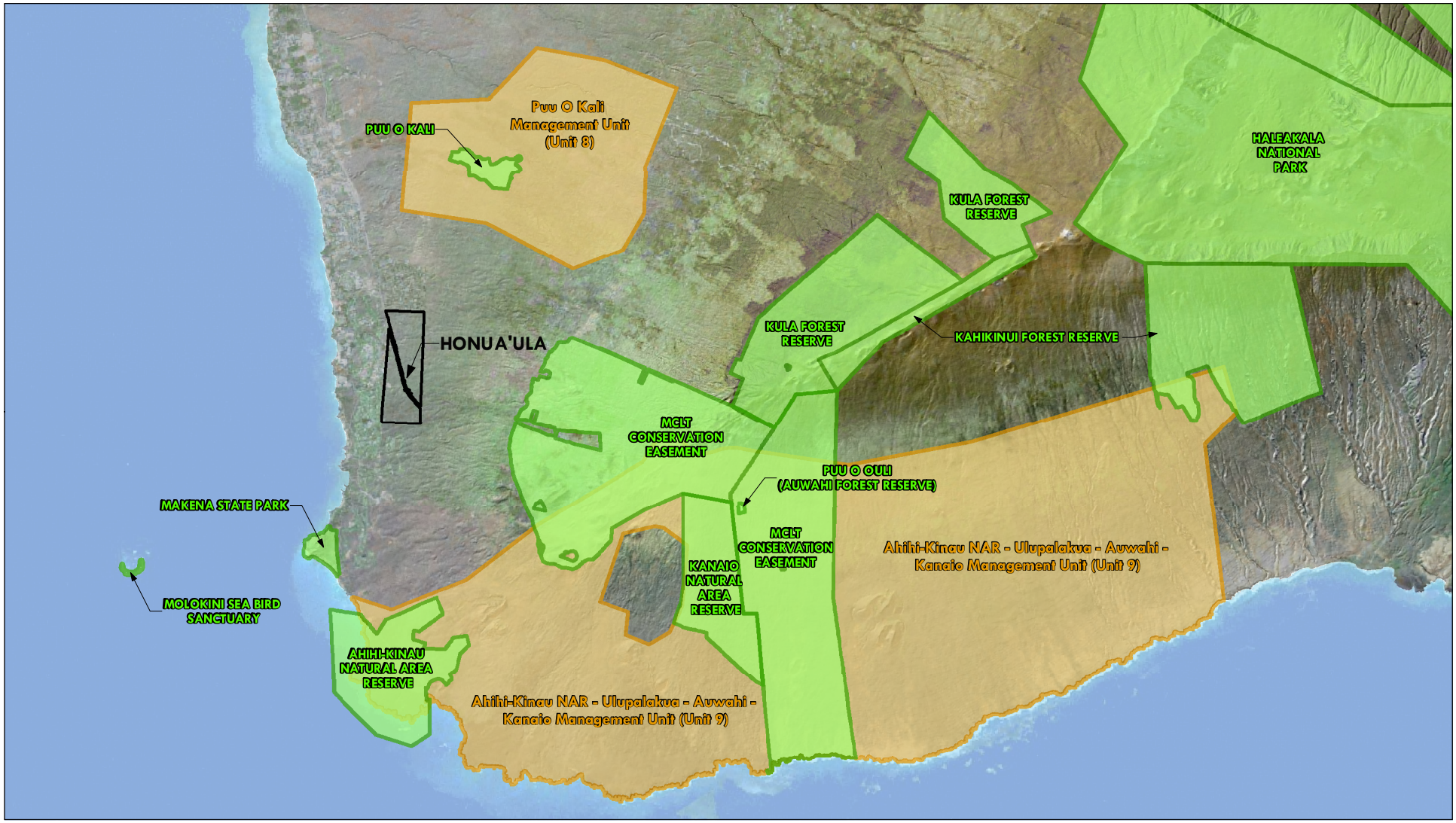
'Auwahi Forest Reserve (Medeiros 2006) is a four hectare (10 ac) remnant native dry forest on the south slope of East Maui at 1,200 m (3,937 ft) elevation (Figure 13). This site has been undergoing restoration since 1997 under a partnership between landowners, government agencies and scientists. 'Auwahi has a rich plant diversity including 50 native tree species, at least five of which are endangered (Medeiros 2006).

Pu'u O Kali Forest Reserve is a remnant *wiliwili* (*E. sandwicensis*) forest on the slopes of east Maui above Kīhei. It is among the most diverse and intact lowland dry forests on Maui which also supports endangered flora. As Monson (2005) quoted A.C. Medeiros, "*Pu'u-O-Kali* is the only place on this whole side that looks like it did in ancient times… It's the only place where a Hawaiian from long ago would look around and say, 'Oh, I know where I am.' They wouldn't recognize the rest of South Maui."

Kanaio Natural Area Reserve located to the south of the Property encompasses 354 ha (876 ac), portions of which include *wiliwili* (*E. sandwicensis*). Nearly 38% of the vegetation in Kanaio is native with about 14% indigenous and 24% endemic. Twenty-two species of Hawaiian dry land forest trees are found in Kanaio, over 35% of the total number of native species in the area (Medeiros et al. 1993).

A relatively pristine remnant native dry forest occurs at Palamanui, a 293 ha (725 ac) mixed use residential and commercial development in Kona, Hawai'i. Sixty two plant species have been described from the native forest there, of which 27 are native and 35 are introduced (Hart 2003). Roughly seven percent of the total Palamanui development parcel consists of a *lama-alahe'e-'iliahi* (*Diospyros-Psydrax-Santalum*) dry forest that has "apparently never received any major disturbance" (Hart 2003, Group 70 International 2004). Three federally listed endangered plant species are found at Palamanui: *uhi-uhi* (*Caesalpinia kavaiensis*), *aiea* (*Nothocestrum breviflorum*) and *halapepe* (*Pleomele hawaiiensis*). Several large 'akoko (*Chamaesyce multiformis*), many of which are larger than have ever been seen before, have been described from Palamanui (Group 70 International 2004).

Another plant mitigation and preserve restoration plan has been developed for construction of The Villages at La'iōpua in Kealakehe, North Kona on the Island of Hawai'i for the Department of Hawaiian Home Lands (Leonard Bisell Associates LLC and Geometrician Associates, 2008). Originally conceived in 1999, the plan addresses the protection of two listed endangered plants: *aupaka* (*Isodendrion pyrifolium*) and *uhiuhi* (*Caesalpinia kavaiensis*) and 19 associated endemic and indigenous plants. Fifty-five species of introduced plant species have been recorded within or near the proposed preserves at La'iōpua. The several small preserves are planned for La'iōpua, the largest of which is 26.6 acres in area. The other preserves are 11 and 4 acres in size, with additional 'mini-preserves' proposed to protect individual trees. As with the proposed Native Plant Preservation Area at Honua'ula, the La'iōpua preserves also incorporate archaeological features, and include specific conservation principals, management objectives, and physical plans.



Legend

- Project Boundary
- Reserves
- Proposed Management Units for the Blackburn's Shpinx Moth

Appendix 1

Figure 13
Vicinity Conservation Efforts

N

0 0.5 1 2 Miles

0 1 2 4 Km

Image Source: State of Hawaii (LANDSAT)
Reserves and Management Units Source: State of Hawaii
Boundary Source: PBR Hawaii

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Protection of at least 22 ha (55 ac) of the dry forest remnant at Palamanui is an integral part of the overall development proposal. Significant elements of the proposed preserve management plan for Palamanui (Hart 2003; J. Price, UH Hilo, pers. comm.) are directly relevant to management of the proposed native plant preserve at Honua'ula and have been incorporated into our recommendations.

4.2 Relevant Dry Forest Research in Hawai'i

In their research studies conducted at Ka'upulehu dry forest on Hawai'i Island, Cabin et al. (2000a) found that excluding ungulates with fencing is effective in helping the recruitment of some native tree species. However, fencing alone was insufficient to restore native dry forests. In another study at Ka'upulehu, Cabin et al. (2002a) experimentally manipulated micro-site conditions (canopy vs. no canopy), water (ambient vs. supplemental), and weeding (removal vs. non-removal). They also added seeds of six native species in 64 1m² plots to investigate the regeneration of native dry forest species. The authors suggest that it is possible to restore degraded dry forests in Hawai'i by manipulating the ecological conditions particularly for the fast growing understory species which then create micro-sites more favorable for the establishment of native trees. Cabin et al. (2002b) investigated how light availability (full vs. 50% shade), alien grass control (bulldoze, herbicide, plastic mulch and trim treatments), and out-planting vs. direct seeding affected the establishment of native plants and suppression of invasive grasses. Their results highlight the fact that restoration can be site specific and hence it is important to examine species and treatment specific responses to these species before attempting large scale conservation efforts. They also suggest that relatively simple techniques can be used to simultaneously suppress invasive grasses and establish populations of vigorous native understory species even at larger scales.

These and other related studies (Allen 2000, Blackmore and Vitousek 2000, Cabin et al. 2000a, 2000b, 2001; Chang 2000, Chimera 2004, Cordell et al. 2001, 2002; D'Antonio et al. 1998, Henderson et al. 2001, Litton et al. 2004, Merlin and Juvik 1992, Sandquist et al. 2004, Stratton 1998, and Tunison 1992) give hope that even small restoration efforts consisting of a few hectares can help provide habitat for rare native dry forest species and can subsequently serve as urgently-needed sources of propagules. This hope is reinforced by the numerous sources on information on successful propagation of rare native Hawaiian plants specifically for landscaping (e.g., Tamimi 1999, Friday 2000, Wong 2003, Bornhorst and Rauch 2003, CTAHR 2006).

5.0 PROPOSED MITIGATION MEASURES

The Maui County Council promulgated 28 specific conditions in granting a Phase I project district zoning approval. Specific conditions related to vegetation within the Property appear in the following paragraphs.

> *"7. That Honua'ula Partners, LLC, its successors and permitted assigns, shall prepare an animal management plan that shall be submitted during Project District Phase II processing and approved by the Department of Land and Natural Resources prior to submittal of Project District Phase III processing. Said plan shall include procedures for the management of animal intrusions including, but not limited to, construction of boundary or perimeter fencing, wildlife control permits, and rodent and feral cat control. Honua'ula Partners, LLC, its successors and permitted assigns, shall implement the approved animal management plan. The Department of Land and Natural Resources may require periodic updates of the plan.*
>
> *27. That Honua'ula Partners, LLC, its successors and permitted assigns, shall provide the report "Remnant Wiliwili Forest Habitat at Wailea 670, Maui, Hawaii by Lee Altenberg, Ph.D.", along with a preservation/mitigation plan, to the State Department of Land and Natural Resources, the United States Fish and Wildlife Service, and the United States Corps of Engineers for review and recommendations prior to Project District Phase 11 approval. The Maui Planning Commission shall consider adoption of the plan prior to Project District Phase II approval.*
>
> *Such plan shall include a minimum preservation standard as follows: That Honua'ula Partners, LLC, its successors and permitted assigns, shall establish in perpetuity a*

Conservation Easement (the "Easement"), entitled "Native Plant Preservation Area", for the conservation of native Hawaiian plants and significant cultural sites in Kīhei-Makena Project District 9 as shown on the attached map. The Easement shall comprise the portion of the property south of latitude 20°40'l 5.00"N, excluding any portions that the State Department of Land and Natural Resources, the United States Fish and Wildlife Service, and the United States Corps of Engineers find do not merit preservation, but shall not be less than 18 acres and shall not exceed 130 acres.

The scope of the Easement shall be set forth in an agreement between Honua'ula Partners, LLC and the County that shall include:

a. A commitment from Honua'ula Partners, LLC, its successors and permitted assigns, to protect and preserve the Easement for the protection of native Hawaiian plants and significant cultural sites worthy of preservation, restoration, and interpretation for public education and enrichment consistent with a Conservation Plan for the Easement developed by Honua'ula Partners, LLC and approved by the State Department of Land and Natural Resources, the United States Geological Survey, and the United States Fish and Wildlife Service; and with a Cultural Resource Preservation Plan, which includes the management and maintenance of the Easement, developed by Honua'ula Partners, LLC and approved by the State Department of Land and Natural Resources (collectively, the "Conservation/Preservation Plans").

b. That Honua'ula Partners, LLC, its successors and permitted assigns, shall agree to confine use of the Easement to activities consistent with the purpose and intent of the Easement.

c. That Honua'ula Partners, LLC, its successors and permitted assigns, shall be prohibited from development in the Easement other than erecting fences, enhancing trails, and constructing structures for the maintenance needed for the area, in accordance with the Conservation/Preservation Plans.

d. That title to the Easement shall be held by Honua'ula Partners, LLC, its successors and permitted assigns, or conveyed to a land trust that holds other conservation easements. Access to the Easement shall be permitted pursuant to an established schedule specified in the Conservation/Preservation Plans to organizations on Maui dedicated to the preservation of native plants, to help restore and perpetuate native species and to engage in needed research activities. These organizations may enter the Easement at reasonable times for cultural and educational purposes only.
e. Honua'ula Partners, LLC, its successors and permitted assigns, shall be allowed to receive all tax benefits allowable under tax laws applicable to the Easement at the time that said Easement is established in Kīhei Makena Project District 9, which will be evidenced by the recordation of the Easement in the Bureau of Conveyances, State of Hawaii."

Active conservation management of any area to be conserved is integral to the long term success of a mitigation effort. Whether the protected area is 80 ha (200 ac) or 5.3 ha (13 ac), there is no guarantee that the best possible conservation efforts and best management practices will perpetually protect all plant species in the same numbers currently found within the Property. However, the immediate concerns for the preserve on the site should be: 1) elimination of browsing, grazing, and trampling pressure on native plants by feral ungulates, 2) removal of noxious invasive plant and animal species, 3) protection against wildland fires. Honua'ula Partners, LLC is proposing to implement the following measures to conserve elements of the remnant *kiawe-wiliwili* shrubland and protect native plants and animals on the Property.

- A conservation easement, hereinafter referred to as "Native Plant Preservation Area", encompassing a contiguous area within the remnant mixed *kiawe-wiliwili* shrubland will be dedicated in perpetuity to protect as much of the remnant native lowland dry shrubland plant community as possible. The protected area will meet the 7.3-52.6 ha (18-130 ac) directive imposed by the Maui County Council, and will ultimately be subject to approval by the Council. The Native Plant Preservation Area will encompass the highest densities of the rarest elements of the native vegetation within the project parcel.

- The development will conserve as many of the *wiliwili* trees (*Erythrina sandwicensis*) as possible outside the Native Plant Preservation Area and elsewhere within the remnant mixed *kiawe-wiliwili* shrubland as possible.

- The entire perimeter of the Property has already been fenced to discourage feral ungulates from entering the *kiawe-wiliwili* shrubland; however, the fence is porous. Fencing requirements will be reviewed and updated as establishment of the Native Plant Preservation Area and site construction begin. An animal management plan will be implemented as soon as possible to ensure that goats, deer, pigs, and stray cattle are removed i*n a humane man*ner from the Property.

- A Natural Resource Manager will be employed by Honua'ula Partners, LLC to help develop and implement specific conservation programs to help ensure the protection of native plants and animals within the Native Plant Preservation Area and other areas designated for native plant protection throughout the Property.

- Honua'ula Partners, LLC will implement a program to control and eradicate invasive grasses, weeds, and other non-native plants from Native Plant Preservation Area ***with the exception of*** the non-native tree tobacco (*Nicotiana glauca*), which is a recognized host plant for the endangered Blackburn's sphinx moth (*Manduca blackburni*).

- Honua'ula Partners, LLC will implement a native plant propagation program for landscaping with plants and seed naturally occurring on the Property. All plants native to the geographic area will be considered as potential species for use in landscaping.

- Honua'ula Partners, LLC will implement a seed predator control program to control rats, mice, and other seed predators within the Native Plant Preservation Area.

- Honua'ula Partners, LLC will implement a fire control program to help protect the Native Plant Preservation Area to help insure the success of plant propagation and conservation efforts.

- Honua'ula Partners, LLC will implement an education and outreach program open to the public at large, and sponsor service groups to assist with implementation of the management programs in the Native Plant Preservation Area and other areas designated for native plant protection.

- Honua'ula Partners, LLC will apply for additional program support offered by the State of Hawai'i (Natural Area Partnership Program and Hawaii Forest Stewardship Program) and U.S. Fish and Wildlife Service to promote sound management of the natural resources on the Property.

- All copies of all SWCA reports prepared for this project, including the Conservation and Stewardship Plan, along with Altenberg (2007) will be submitted to the Department of Land and Natural Resources (DLNR), USFWS, U.S. Geological Survey, and U.S. Army Corps of Engineers for review and comment.

- Long-term vegetation monitoring during wet and dry seasons will be continued to evaluate the health of native plants, and to support the development of the conservation and stewardship plan for the Native Plant Preservation Area and other areas designated for native plant protection.

- Finally, a multi-species Habitat Conservation Plan (HCP), to include the candidate endangered *'āwikiwiki* (*Canavalia pubescens*) is being prepared under Section 10(a)(1)(B) of the Endangered Species Act and in collaboration with DLNR and USFWS.

Taken together with the mitigation measures identified for wildlife (SWCA 2009), these actions fully satisfy the objectives and the intent of the special Project District Phase I conditions promulgated by the Maui County Council and recommendations of State and Federal resources agencies.

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APPENDIX A

CHECKLIST OF PLANTS REPORTED FROM HONUA'ULA

Checklist includes plants reported from Honua'ula by Char and Linney (1988), Char (1993, 2004), Altenberg (2007), and SWCA (this study). Plant names appear alphabetically by family and then by species into each of three groups: Ferns and Fern Allies (Pteridophytes), Monocots, and Dicots. The taxonomy and nomenclature of the flowering plants are based on Wagner et al. (1999), Wagner and Herbst (1999), and Staples and Herbst (2005). Recent name changes are those recorded in the Hawaii Biological Survey series (Evenhuis and Eldredge, eds, 1999-2002). The list includes scientific name with author citation, common English and/or Hawaiian name(s), biogeographic status, and location within the three dominant vegetation types at Honua'ula.

KEY to biographic status:

E = endemic (occurring only in the Hawaiian Islands);
I = indigenous (native to the Hawaiian Islands and elsewhere);
X = introduced or alien (all those plants brought to the Hawaiian Islands after 1778).

KEY to vegetation types:

KB = *kiawe*-buffelgrass grassland;
MG = mixed gulch-vegetation;
KW = mixed *kiawe-wiliwili* shrubland.

KEY to surveys:

C = Char and Linney (1988), Char (1993), Char (2004);
A = Altenberg (2007);
S = SWCA (2008 - this study).

Scientific Name	Common Name	Status	Source Survey	Vegetation Type		
				KB	MG	KW
PTERIDOPHYTES						
Adiantaceae						
Adiantum capillus-veneris L.	maiden-hair fern	I	C		*	
Doryopteris decipiens (Hook.) J. Sm.	*'iwa'iwa*	E	C, A, S	*	*	*
Pellaea ternifolia (Cav.) Link	*pellaea*	I	C		*	*

Scientific Name	Common Name	Status	Source Survey	Vegetation Type		
				KB	MG	KW
Aspleniaceae						
Nephrolepis multiflora (Roxb.) F.M. Jarrett ex. C.V. Morton	sword fern	X	C	*		*
MONOCOTS						
Agavaceae						
Furcraea foetida (L.) Haw.	*malina*	X	S			*
Cannaceae						
Canna indica L.	indian shot	X	C	*		
Commelineaceae						
Commelina benghalensis L.	hairy *honohono*	X	C, S	*	*	*
Commelina diffusa N.L. Burm.	blue day flower	X	C	*	*	
Liliaceae						
Crinum sp.	crinum	X	C	*		
Yucca sp.	yucca	X	C	*		
Poaceae						
Bothriochloa pertusa (L.) A. Camus	hurricane grass	X	C	*	*	
Brachiara subqudripa (Trin.) A.S. Hitchc	brachiara	X	C	*		
Cenchrus ciliaris L.	buffelgrass	X	C, S			*
Cenchrus echinatus L.	sandbur	X	C	*		

Appendix 1

Scientific Name	Common Name	Status	Source Survey	Vegetation Type		
				KB	MG	KW
Chloris barbata (L.) Sw.	swollen finger grass	X	C, S	*	*	*
Chloris radiata (L.) Sw.	plush finger grass	X	C	*	*	*
Cynodon dactylon (L.) Pers	*manienie*	X	C, S	*		*
Digitaria ciliaris (Retz.) Koeler	Henry's crab grass	X	C	*		
Digitaria insularis (L.) Mez ex Ekman	sour grass	X	C, S	*	*	*
Digitaria radicosa (Presl.) Miq.	digitaria	X	C	*		
Digitaria sp.	crab grass	X	C	*		
Eleusine indica (L.) Gaertn.	goose grass	X	C	*	*	*
Eragrostis cilianensis (All.) Vign. ex Janchen	stink grass	X	C	*	*	
Eragrostis tenella (L.) Beauv. ex R. & S.	love grass	X	C	*		
Eragrostis sp.	eragrostis	X	C	*		
Heteropogon contortus (L.) P. Beauv. ex Roem. & Schult.	*pili* grass	E	C, A, S	*	*	*
Panicum maximum L.	guinea grass	X	C, S	*	*	*
Panicum torridum Gaud.	*kakonakona*	E	C			*
Rhynchelytrum repens (Willd.) Hubb.	natal red top	X	C, S			*
Setaria verticillata (L.) P. Beauv.	*mau'u pilipili*	X	C	*	*	*
Tragus berteronianus J.A. Schultes	goat grass	X	C	*	*	*
Urochloa subquadripara (Trin.) R. Webster	signal grass	X	C	*		

Appendix 1

Scientific Name	Common Name	Status	Source Survey	Vegetation Type		
				KB	MG	KW
Zoysia sp.	zoysia	X	C	*		
DICOTS						
Amaranthaceae						
Amaranthus spinosus L.	spiny amaranth	X	C, S	*	*	*
Asclepiadaceae						
Asclepias physocarpa (E.Mey.) Schltr.	balloon plant	X	C, S	*		*
Stapelia gigantea (N.E. Brown)	zulu giant	X	S			*
Asteraceae						
Ageratum conyzoides L.	*maile hohono*	X	C, S	*	*	*
Bidens cynapiifolia Kunth	beggar tick	X	C, S	*	*	*
Bidens pilosa L.	Spanish needle	X	C, S	*	*	*
Calyptocarpus vialis Less.	straggler daisy	X	C, S			*
Centaura melitensis L.	star thistle	X	S			*
Cirsium vulgare (Savi) Ten.	bull thistle	X	S			*
Conyza bonariensis (L.) Cronq.	hairy horseweed	X	C	*		
Conyza canadensis (L.) Cronq.	horseweed	X	C, S	*		*
Crassocephalum crepidioides (Benth.) S.Moore		X	C, S	*	*	*
Emilia fosbergii Nicolson	red *pualele*	X	C	*		*

Appendix 1

Scientific Name	Common Name	Status	Source Survey	Vegetation Type		
				KB	MG	KW
Galinsoga parviflora Cav.		X	C	*	*	
Gnaphalium cf. *japonicum* Thunb.	cudweed	X	C	*	*	
Hypochoeris sp. L.	cat's ear	X	C	*	*	*
Lactuca serriola L.	prickly lettuce	X	C, S			*
Lipochaeta rockii Sherff	*nehe*	E	C, A, S			*
Parthenium hysterophorus L.	false ragweed	X	S			*
Sigesbeckia orientalis L.		X	C	*	*	
Sonchus asper (L.) J. Hill	spiny snowthistle	X	C	*	*	*
Sonchus oleraceus L.	*pualele*	X	C, S	*	*	*
Sphagneticola trilobata (L.) Pruski	wedelia	X	S			*
Synedrella nodiflora (L.) Gaertn.	node weed	X	C	*	*	*
Tridax procumbens L.	coat buttons	X	C, S	*	*	*
Verbesina encelioides (Cav.) Benth. & Hook	golden crown beard	X	C, S	*	*	*
Xanthium strumarium L. var. *canadense* (Miller)	cocklebur	X	C	*	*	*
Zinnia peruviana (L.) L.	wild zinnia	X	C, S	*	*	*
Brassicaceae						
Cornopus didymus (L.) Sm.	wart cress	X	C	*		

Appendix 1

Scientific Name	Common Name	Status	Source Survey	Vegetation Type		
				KB	MG	KW
Cactaceae						
Opuntia ficus-indica (L.) Mill.	*panini*	X	C, S	*	*	*
Pilocereus royenii (L.) Byles & Rowley	Royen's tree cactus	X	S			*
Capparaceae						
Capparis sandwichiana DC.	*maiapilo*	E	C, A, S			*
Cleome gynandra L.	spider flower	X	C	*		*
Caryophyllaceae						
Polycarpon tetraphyllum (L.) L.		X	C	*	*	
Chenopodiaceae						
Chenopodium carinatum R.Br.		X	C, S	*	*	*
Chenopodium murale L.	*aheahea*	X	C, S	*	*	*
Convolvulaceae						
Dichondria repens J. R. & G. Forst.		X	C	*		
Ipomoea indica (J. Burm.) Merr.	*koali awahia*	I	C, A, S	*	*	*
Ipomoea obscura (L.) Ker Gawl.	yellow bindweed	X	C, S	*		
Ipomoea tuboides (Degener & Ooststr.)	Hawaiian moon flower	E	C, A, S			*
Merremia aegyptia (L.) Urb.		X	C, S	*	*	*

Appendix 1

Scientific Name	Common Name	Status	Source Survey	Vegetation Type		
				KB	MG	KW
Cucurbitaceae						
Cucumis dipsaceus (Ehrenb. ex Spach	wild cucumber	X	C, S	*		*
Momordica charantia L.	bitter melon	X	C, S	*	*	*
Sicyos hispidus Hillebr.	*ʻanunu*	E	C, A, S			*
Sicyos pachycarpus Hook. & Arnott	*ʻanunu*	E	A, S			*
Euphorbiaceae						
Chamaesyce celastroides var. lorifolia (A. Gray) Degener & I. Degener	*ʻakoko*	E	A			*
Chamaesyce hirta (L.) Millsp.	hairy spurge	X	C, S	*	*	*
Chamaesyce hypercifolia (L.) Millsp.	graceful spurge	X	C	*		
Euphorbia heterophylla L.	*kaliko*	X	C, S	*	*	*
Phyllanthus tenellus Roxb.		X	C, S	*		
Ricinus communis L.	castor bean	X	C, S	*	*	*
Fabaceae						
Acacia farnesiana (L.) Willd.	klu	X	C, S		*	*
Bauhinia blakeana Dunn	orchid tree	X	C	*		
Calopogonium mucunoides Desv.		X	C			*
Canavalia pubescens Hook. & Arnott	*ʻāwikiwiki*	E	C, A, S			*
Cassia fistula L.	golden shower	X	C	*		

Appendix 1

Scientific Name	Common Name	Status	Source Survey	Vegetation Type		
				KB	MG	KW
Chamaecrista nictitans (L.) Moench	partridge pea	X	C, S	*		*
Crotalaria incana L.	fuzzy rattlepod	X	C	*		
Crotalaria pallida Aiton	smooth rattlepod	X	C	*		
Desmanthus virgatus (L.) Willd.	virgate mimosa	X	C, S	*		*
Desmodium tortuosum (Sw.) DC.	beggar weed	X	C			*
Erythrina sandwicensis O.Deg.	*wiliwili*	E	C, A, S	*	*	*
Indigofera suffritocosa Mill.	*iniko*	X	C, S	*		*
Leucaena leucocephala (Lam.) de Wit	*koa haole*	X	C, S	*	*	*
Macroptilium lathyroides (L.) Urb.	wild bean	X	C, S	*		*
Prosopis pallida (Humb. & Bonpl. Ex Willd.) Kunth	*kiawe*	X	C, S	*	*	*
Samanea saman (Jacq.) Merr	monkey pod	X	C	*		
Senna alata (L.) Roxb	candle bush	X	C	*		
Senna gaudichaudii (Hook. & Arn.) H.S.Irwin & Barneby	*kolomona*	I	C, A, S		*	*
Senna occidentalis (L.) Link	coffee senna	X	C			*
Lamiaceae						
Ocimum basilicum L.	sweet basil	X	C, S	*		*
Ocimum gratissimum L.	basil	X	C, S	*	*	*
Leonotis nepetifolia (L.) R. Br.	lion's ear	X	S			*

Appendix 1

Scientific Name	Common Name	Status	Source Survey	Vegetation Type		
				KB	MG	KW
Stachys arvensis L.	stagger weed	X	C	*	*	*
Malvaceae						
Abutilon grandifolium (Willd.) Sweet	*ma'o*	X	C, S	*	*	*
Abutilon incanum (Link.) Sweet	hoary abutilon	I	C, A, S	*	*	*
Malva parviflora L.	cheese weed	X	C, S	*	*	*
Malvastrum coromandelianum (L.) Garcke	false mallow	X	C	*	*	*
Sida fallax Walp.	*'ilima*	I	C, A, S	*	*	*
Sida rhombifolia L.		X	C	*		
Meliaceae						
Melia azedarach L.	Chinaberry	X	S			*
Moraceae						
Ficus elastica Roxb.ex Hornem	rubber tree	X	C	*		
Ficus microcarpa L. f.	Chinese banyan	X	C, S	*	*	
Myoporaceae						
Myoporum sandwicensis A. Gray	*naio*	E	C, A, S			*
Myrtaceae						
Psidium guajava L.	guava	X	C	*		

Appendix 1

Scientific Name	Common Name	Status	Source Survey	Vegetation Type		
				KB	MG	KW
Nyctaginaceae						
Boerhavia coccinea Mill.		X	C	*		
Boerhavia acutifolia (Choisy) J.W.Moore	*alena*	I	S			*
Boerhavia herbstii Fosb.	*alena*	E	A			*
Boerhavia repens L.	*alena*	I	C, S			*
Mirabilis jalapa L.	four-o' clock	X	C			*
Oxalidaceae						
Oxalis corniculata L.	wood sorrel	X	C, S	*	*	
Papavaraceae						
Argemone glauca (Nutt. Ex Prain (Pope)	*pua kala*	E	A, S			*
Argemone mexicana L.	prickly poppy	X	C, S			*
Bocconia frutescens L.		X	S			*
Eschscholzia californica Cham.	California poppy	X	S			*
Passifloraceae						
Passiflora foetida L.	love-in-a-mist	X	C	*		*
Passiflora subpeltata Ort.	passion flower	X	C, S			*
Plumbaginaceae						
Plumbago zeylanica L.	*'ilie'e*	I	C, A, S	*	*	*

Appendix 1

Scientific Name	Common Name	Status	Source Survey	Vegetation Type		
				KB	MG	KW
Polygonaceae						
Antigonon leptopus H. & A.	coral vine	X	C	*		
Portulacaceae						
Portulaca oleracea L.	pigweed	X	C, S	*	*	*
Portulaca pilosa L.	*ʻakulikuli*	X	C, S	*	*	*
Primulaceae						
Anagallis viscosa L.	scarlet pimpernel	X	C	*	*	*
Sapindaceae						
Dodonaea viscosa Jacq.	*ʻaʻaliʻi*	I	C, A, S			*
Solanaceae						
Capsicum annum L.	chili pepper	X	C, S	*		
Datura stramonium L.	jimson weed	X	C	*	*	*
Lycopersicon pimpinellifolium (Jusl.)	currant tomato	X	C, S	*	*	*
Nicandra physalodes (L.) Gaertn.	apple of Peru	X	C	*	*	*
Nicotiana glauca R.C. Graham	tree tobacco	X	C, S	*	*	*
Solanum americanum Mill.	*popolo*	I	C, S	*	*	*
Solanum seaforthianum Andrews		X	S			*

Appendix 1

Scientific Name	Common Name	Status	Source Survey	Vegetation Type		
				KB	MG	KW
Sterculiaceae						
Waltheria indica L.	*'uhaloa*	I	C, A, S	*	*	*
Tiliaceae						
Triumfetta semitriloba Jacq.	Sacramento bur	X	C, S			*
Verbenaceae						
Lantana camara L.	Sacramento bur	X	C, A, S	*	*	*

Appendix 1

Appendix B

Native Plant Information Sheets

Argemone glauca (Nutt. ex Prain) Pope (Papaveraceae)

Hawaiian Name: *Pua kala*
Status: Endemic

Ecological and Cultural Significance: "Scattered to locally common in coastal dry forest and subalpine forest, 0-1,900 m, on the leeward sides of all of the main islands" (Wagner et al 1999). "Early Hawaiians used the seeds and sap of the stalk as a narcotic and analgesic for toothaches, neuralgia, and ulcers; the sap was used to treat warts" (Wagner et al 1999).

Honua'ula Photos: The majority of *pua kala* clusters occurred in the southwestern portion of the *kiawe-wiliwili* shrubland, usually in relatively open sunny locations of the lava flow. All plants we observed were flowering at the time of the surveys.

Distribution and Density at Honua'ula: We found 412 *pua kala* (*Argemone glauca*) in 26 locations within the Property. Most clusters averaged 16 individuals, most of which were seedlings (60%). Canopy cover of *pua kala* clusters ranged from one to 39 m^2 with the average being 4 m^2 (n= 26 clusters).

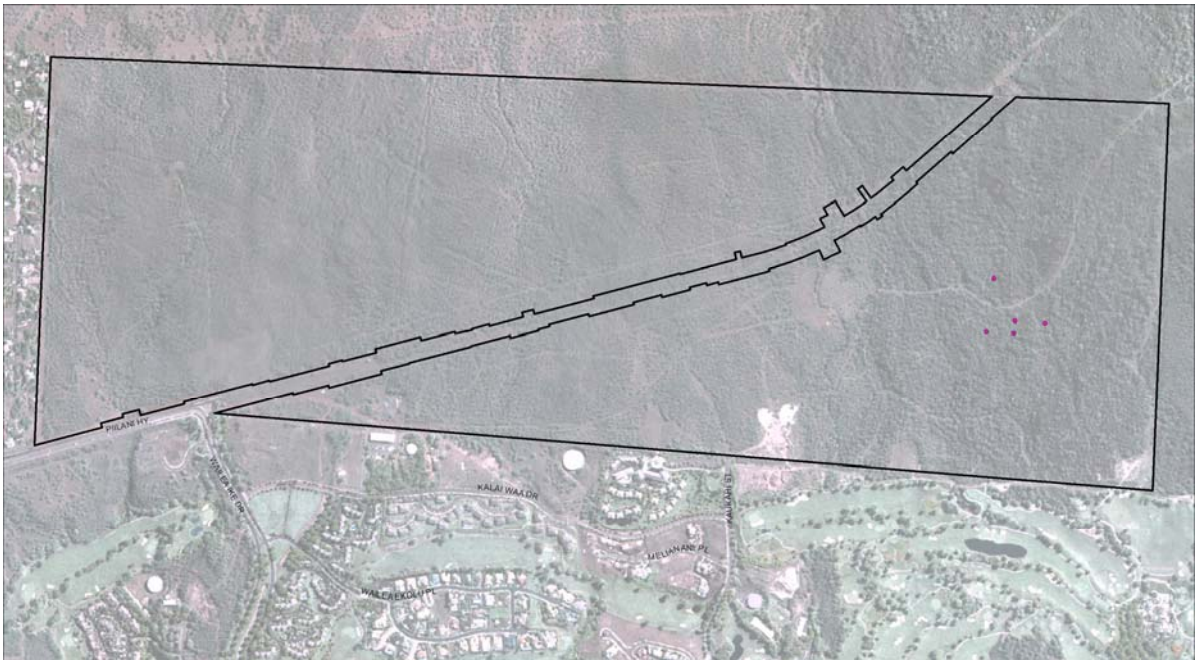
Canavalia pubescens Hook. & Arnott (Fabaceae)

Hawaiian Name: *'Āwikiwiki*
Status: Endemic (Candidate Endangered Species)

Ecological and Cultural Significance: "Presently uncommon in open dry sites such as lava fields, kiawe thickets, and dry forest, 15-540m, on Ni'ihau, Kaua'i (Nāpali Coast), Lāna'i, and leeward East Maui" (Wagner et al 1999). "Five populations are known on Maui: Keokea and Puu o Kali with "hundreds" observed, southwest Kalua o Lapa with two individuals, Papaka Kai with six individuals, Ahihi-Kinau with a few individuals, and southeast Pohakea, with at least one individual (HBMP 2008; F. Starr, pers. comm. 2006; H. Oppenheimer, pers. comm. 2006, 2008). These populations total a little over 200 individuals, with the majority ("hundreds") in one population (Puu o Kali)" (USFWS 2009).

Honua'ula Photos: All five *'āwikiwiki* were flowering and fruiting at the time of the survey; however, no seedlings were detected. The plants appeared to be healthy with no signs of damage or disease.

Distribution and Density at Honua'ula: Altenberg (2007) illustrated GPS points for some 15 plants within the development. During this intensive field survey, however, SWCA's project botanists found only five *'āwikiwiki* plants.



Capparis sandwichiana DC (Capparaceae)

Hawaiian Name: *Maiapilo*
Status: Endemic

Ecological and Cultural Significance: "Scattered on coral, basaltic rocks, or in soil along the coast or somewhat inland, 0-100 (-575) m, on Midway Atoll, Pearl and Hermes Atoll, Laysan, and all of the main islands" (Wagner et al 1999).

Honua'ula Photos: Several *maiapilo* clusters were flowering and fruiting but the frequency of seedlings was low (2.5%). About 20% of the plants showed mild to heavy signs of insect herbivory where the epidermis (upper layer of the leaves) appeared to be scrapped away.

Distribution and Density at Honua'ula: *Maiapilo* (*Capparis sandwichiana*) is a common shrub throughout the understory of mixed *kiawe-wiliwili* shrubland. We found 563 *maiapilo* during the survey and all but one individual was limited to the southern 'a'ā lava flow. Most clusters ranged from one to five individuals; 11 were larger, consisting of six to 10 individuals. The aerial cover of the largest cluster was 531 m^2, others ranged from one to 314 m^2 (average cover of 17 m^2).

Dodonaea viscosa Jacq. (Sapindaceae)

Hawaiian Name: *'A'ali'i*
Status: Indigenous

Ecological and Cultural Significance: "Pantropical; in Hawaii scattered to dominant, often in open sites such as ridges and lava fields, sometimes successional on lava or in pastures, ranging from coastal dunes, low elevation shrubland communities to dry, mesic, and wet forest, also subalpine shrubland, 3-2,350 m, on all of the main islands except Kaho'olawe" (Wagner et al 1999). "An extremely polymorphic species…Both the breeding system and morphological features of the *Dodonaea viscosa* complex are polymorphic" (Wagner et al 1999). "The fruit and leaves of *Dodonaea* are popular in lei making" (Wagner at al 1999).

Photos: One *'a'ali'i* plant was observed fruiting, and no seedlings were observed in the vicinity of the adult shrubs. All plants were healthy with no detectable signs of damage, disease or herbivory.

Both photos by Forest & Kim Starr (www.hear.org)

Left: *'a'ali'i flowers from Kanaio, Maui*

Right: 'a'ali'i near Auwahi, Maui

Distribution and Density at Honua'ula: We observed 16 *'a'ali'i* in seven locations, all limited to the south western corner of the *kiawe-wiliwili* shrubland. Six of the seven locations had one to four individuals while the largest cluster comprised of six individuals. Average cover of *'a'ali'i* is about 26 m^2 where the aerial cover of two clusters were 79 m^2 each and the remaining five ranged from one to 20 m^2.

Doryopteris decipiens (Hook.) J. Sm. (Pteridaceae)

Hawaiian Name: *Iwaiwa*
Status: Endemic

Ecological and Cultural Significance: Reported from all major Hawaiian Islands and Ni'ihau, Lehua, and Kaho'olawe" (Palmer 2003). "Common in dry shrublands, grasslands and forests, often growing on exposed basalt, 30-915 m" (Palmer 2003).

Honua'ula Photos: Some iwaiwa plants within the development area showed signs of dehydration; most plants in the largest cluster (16 individuals) were very dry.

Distribution and Density at Honua'ula: Fifty-four *Iwaiwa* (*Doryopteris decipiens*) ferns were distributed at about 14 locations within the Property. Of these seven ferns were found within the *kiawe-wiliwili* shrubland, the others in the drainage gulches within in the northern portion of the site. The number of individuals within a cluster ranged from one to 16, the majority of which were adults (96%). Aerial cover of the largest cluster was approximately 7 m^2 while the others ranged from one to 3 m^2.

Erythrina sandwicensis Degener (Fabaceae)

Hawaiian Name: *Wiliwili*
Status: Endemic

Ecological and Cultural Significance: "Locally common in dry forest, up to 600m, on leeward slopes of all the main islands". "The soft, light wood was and still is used for the outriggers of traditional Hawaiian canoes. It also was formerly used for fishnet floats and surfboards. The seeds are strung into lei." Wagner et al (1999)

Honua'ula Photos: Most wiliwili trees showed some form of damage, primarily from the Erythrina gall wasp (*Quadristichus erythrinae* Kim) and the seed eating bruchid beetle (*Specularius impressithorax* Pic). Many trees were flush with new leaves following heavy rains in the spring of 2008, suggesting recovery from gall wasp damage.

Distribution and Density at Honua'ula: Wiliwili (*Erythrina sandwicensis*) is the most common native tree species in the *kiawe-wiliwili* shrubland. We mapped a total of 2478 individuals of which 2439 occurred in the southern 'a'ā portion of the Property in groves of various sizes. The largest groves (>15 individuals) tended to be located in the eastern portion of the kiawe-wiliwili shrubland. The frequency of adult wiliwili trees was greater (86%) than seedlings and juveniles.

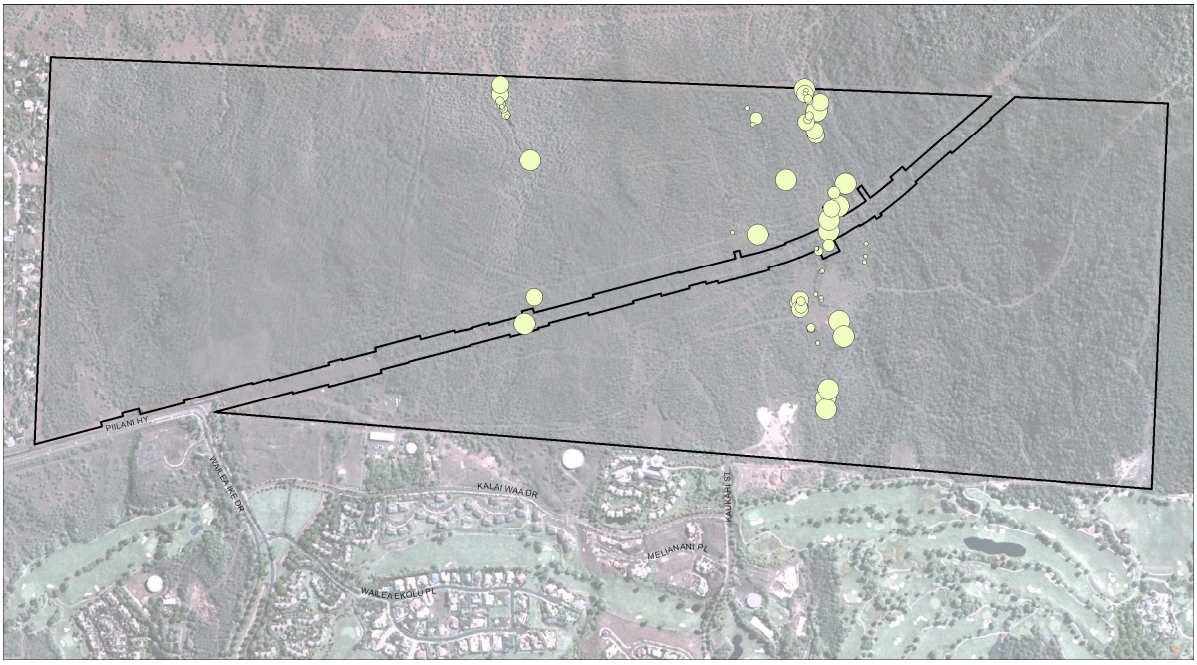
Heteropogon contortus (L.) P. Beauv. ex Roem. & Schult. (Poaceae)

Hawaiian Name: *Pili* grass
Status: Indigenous

Ecological and Cultural Significance: "Widely distributed throughout the tropics; in Hawai'i indigenous or possibly a Polynesian introduction, occurring on dry rocky cliffs, ledges, or slopes close to ocean exposure, 0-700 m, on all the main islands" (Wagner et al 1999). In dryer places, *pili* was favored for thatching material because of its pleasant odor, and was often used under a finishing thatch of *tī*, *hala*, or *kō* (Abbott 1992).

Honua'ula Photos: *Pili* grass (*Heteropogon contortus*) was the only native grass species found within the project area. Adult plants were flowering at the time of our surveys. We did not observe signs of superficial damage or disease.

Distribution and Density at Honua'ula: *Pili* grass was limited to gulches within the kiawe-buffel grass grassland in the northern half of the Project site. Most of *pili* grass occurred in the southern drainage gullies of the grassland, becoming less abundant to the north. We mapped 1493 *pili* grass plants in 66 locations within the Property.



Ipomoea tuboides Degener & Ooststr. (Convolvulaceae)

Hawaiian Name: Hawaiian Moon Flower
Status: Endemic

Ecological and Cultural Significance: "Occurring on arid rocky talus slopes or aa lava, 0-610 m, on all of the main islands" (Wagner et al 1999).

Honua'ula Photos: At the time of the SWCA 2008 surveys, all the Hawaiian moon flower plants within the development were flowering.

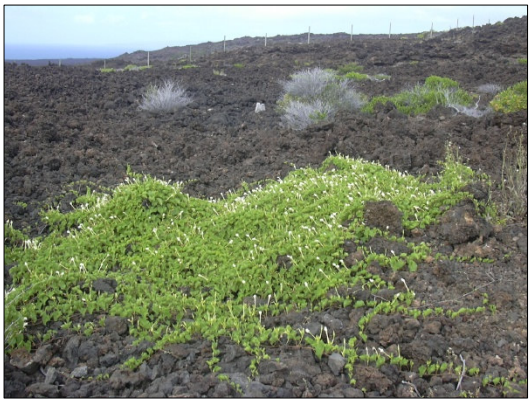


Photo above by Forest & Kim Starr of *Ipomoea tuboides* at Kanaio, Maui. (www.hear.org).

Distribution and Density at Honua'ula: Five Hawaiian moon flower (*Ipomoea tuboides*) vines were observed within the southern 'a'ā portion of the Property .

Lipochaeta rockii Sherff (Asteraceae)

Hawaiian Name: *Nehe*
Status: Endemic

Ecological and Cultural Significance: "Scattered to common in coastal sites to dry forest, often in disturbed areas and margins of lava flows, 15-550m, on Moloka'i, from scattered localities on Maui, common the coast on Kaho'olawe, also a single collection presumably from Hawai'i" (Wagner et al 1999). Synonymous with *L. lobata* (Gaud.) DC var. *makenensis* Degener & Sherff, *L. rockii* today is not recognized as a separate variety or subspecies (Herbst, Bishop Museum, pers. comm.)

Honua'ula Photos: The population of nehe within the Honua'ula project area has a unique leaf shape.

Distribution and Density at Honua'ula: One hundred and one *nehe* (*Lipochaeta rockii*) were found distributed in 24 locations. Two large clusters contained 22 and 23 individuals respectively and were located in the center of the mixed *kiawe-wiliwili* shrubland. Smaller clusters (< 10 individuals) were found from central to southwestern portion of the shrubland. The aerial cover of clusters ranged from < 1 m^2 to 78.5 m^2.

Myoporum sandwicense A. Gray (Myoporaceae)

Hawaiian Name: *Naio*
Status: Indigenous

Ecological and Cultural Significance: "Occurring on Mangaia in the Cook Islands and Hawai'i; in Hawai'i, occasional to common in strand vegetation, dry forest, 'a'ā lava, mesic to wet forest, and a dominant element of subalpine forest, 0-2,380 m, probably on all of the main islands but not documented from Kaho'olawe" (Wagner et al 1999). "The wood, while drying or burning, has an odor similar to that of sandalwood. It was once shipped to China as a substitute after the local sandalwood supply was exhausted, but it was not accepted. Also,it formerly was a preferred wood for house frames" (Wagner et al 1999).

Honua'ula Photos:

Distribution and Density at Honua'ula: Twenty one *naio* (*Myoporum sandwicense*) trees were observed in 17 locations distributed throughout the southern portion of the *kiawe-wiliwili* shrubland. No *naio* seedlings were found. Fifteen of the 17 locations were occupied by a single tree. Aerial cover ranged from < 1 m^2 to 78.5 m^2, the largest of which consisted of three trees.

Senna gaudichaudii (Hook. & Arnott) H. Irwin & Barneby (Fabaceae)

Hawaiian Name: *Kolomona, uhiuhi*
Status: Indigenous

Ecological and Cultural Significance: "Occurring in the Pacific Basin, including the New Hebrides, Austral Islands, Rapa, Henderson Island, Fiji, Hawai'i, and perhaps New Caledonia and Tahiti; in Hawai'i primarily occurring in leeward sites usually on talus slopes, lava flows, or rocky sites in coastal *Leucaena-Prosopis* shrubland, disturbed hala forest, dry forest, and occasionally lower portions of mesic forest, 5-920 m, documented from all of the main islands except Ni'ihau and Kaho'olawe" (Wagner et al 1999).

Honua'ula Photos: Evidence of herbivory was observed at four of 32 locations. Many of the plants found were flowering and / or fruiting at the time of our surveys.

Distribution and Density at Honua'ula: Thirty-nine *kolomona* (*Senna gaudichaudii*) trees were mapped at 32 locations within the Property. Most were distributed in the southern portion of the mixed *kiawe-wiliwili* shrubland. The cluster size ranged from one to five individuals, and 24 of 32 mapped locations consisted of solitary plants. The aerial cover ranged from < 1 m^2 to 19.6 m^2.

Sicyos hispidus Hillebr. (Cucurbitaceae)

Hawaiian Name: *ʻĀnunu*
Status: Endemic

Ecological and Cultural Significance: "Occurring in dry forest or alien vegetation, from near sea level up to 800 m, on Molokaʻi, Lānaʻi, Maui in the valley area from Kahului and Kīhei, and Hawaiʻi in the North Kona area" (Wagner et al 1999).

Honuaʻula Photos: *ʻĀnunu* vines within the Property did not show any signs of damage or herbivory.

Distribution and Density at Honuaʻula: We mapped 113 *ʻānunu* (*Sicyos hispidus*) vines at 49 locations within the Property. *ʻĀnunu* occurred primarily in the central and northern edge of the *kiawe-wiliwili* shrubland. Larger clusters (> 5 individuals) tended to be located in the central portion of the *kiawe-wiliwili* shrubland.

Sicyos pachycarpus Hook. & Arnott (Cucurbitaceae)

Hawaiian Name: *'ānunu*
Status: Endemic

Ecological and Cultural Significance: "Widespread in herb or shrubland coastal communities, dry forest, and alien vegetation such as *Leucaena* or *Prosopis* shrubland, on coral sand and clay loam, 0-900 m, primarily on the lower leeward slops of all the main islands; also on the Northwestern Hawaiian Islands where collected from Laysan and Nihoa" (Wagner et al 1999).

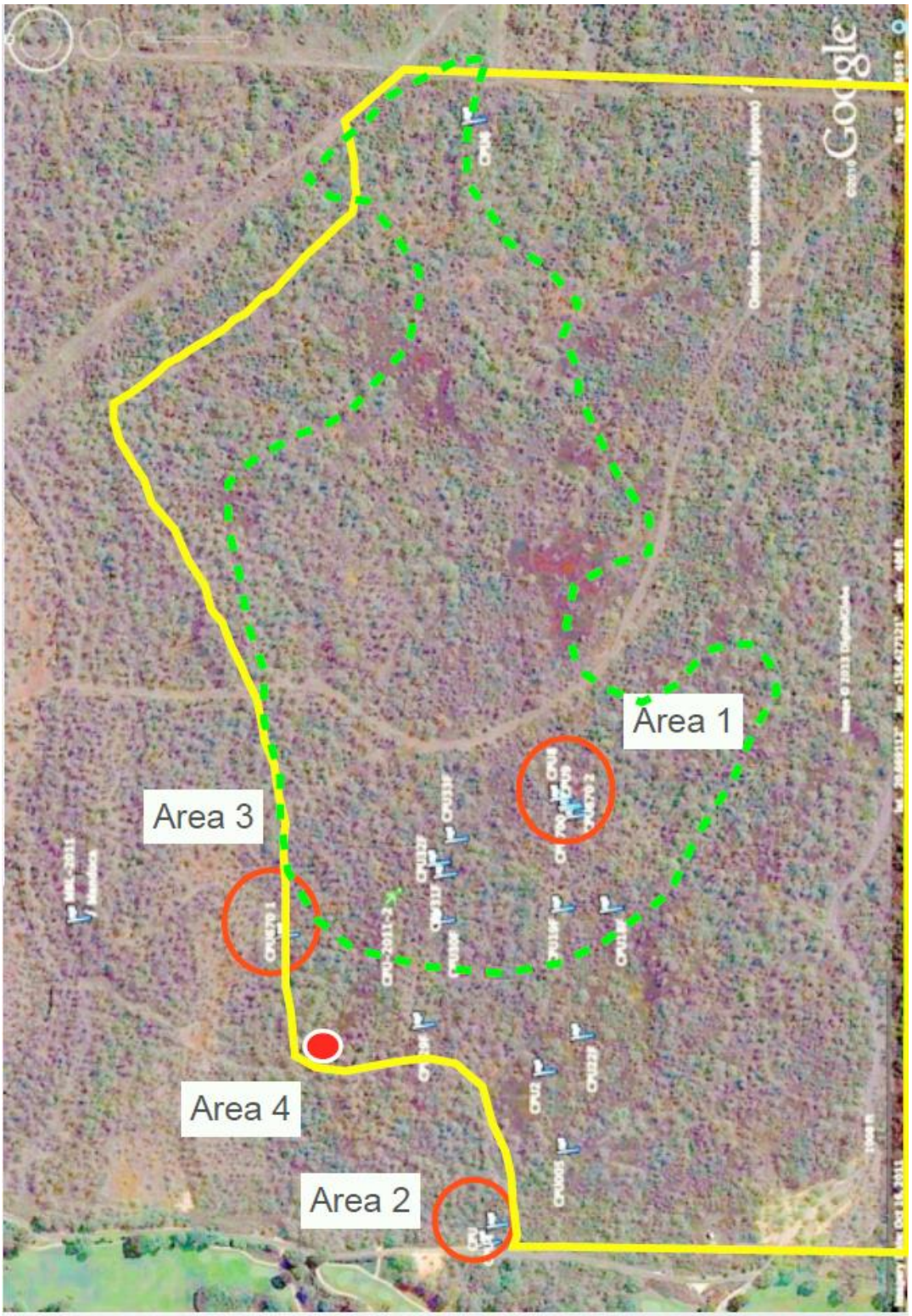
Honua'ula Photos: Approximately 52% of mapped plants were seedlings. Many adults were observed flowering and/ or fruiting. Most of the *'ānunu* vines appeared to be healthy with only one plant showing some signs of herbivory.

Distribution and Density at Honua'ula: Six hundred and three *S. pachycarpus* were mapped in 102 locations. The size of clusters varied greatly and ranged from one to 110 plants per location. The majority of the larger clusters (> 15 individuals) were concentrated in the south and central portions of the *kiawe-wiliwili* shrubland.

Appendix 2

Appendix 2

‘Āwikiwiki locations recorded by Maui Cultural Lands volunteers 2003-2014. Flags indicate location of plants recorded between 2003-2014. Circled areas are plant clusters recorded in 2014.



Appendix 3

Appendix 3

2016 USFWS Guidance

Potential Project Impacts to the Blackburn's Sphinx Moth

Vegetation disturbance can dislodge Blackburn's sphinx moth eggs and soil disturbance can result in crushing of pupae. The death of individual Blackburn's sphinx moths would impact the moth population in the short term, but the insect's vulnerability is even more closely tied to to the availability of host plants within suitable habitat. Therefore, disturbance of a site containing Blackburn's sphinx moth larval host plants may result in a decline in successful Blackburn's sphinx moth breeding.

Recommended Measures to Minimize and Offset Project Impacts to the Blackburn's Sphinx Moth

Disturbance of occupied (or assumed to be occupied) Blackburn's sphinx moth habitat should be avoided where possible. In particular, areas containing native dry or mesic forest, even if the native habitat is degraded by invasive plants, should not be disturbed. Unavoidable permanent impacts to native forest should be offset with the restoration and conservation, in perpetuity, of native forest. A minimum of two acres of native forest should be restored and protected for each acre of habitat that is removed as a result of the project. The removal of occupied (or assumed to be used/occupied) non-native breeding habitat should be offset. We recommend loss of non-native breeding habitat be offset with a combination of conducting research to benefit the future conservation of the Blackburn's sphinx moth population and restoration and conservation of native Blackburn's sphinx moth breeding habitat.

To minimize the potential for Blackburn's sphinx moth pupae to be crushed as a result of soil disturbance within the project area, we recommend the following measures be taken one year prior to groundbreaking to remove larval host plants from the site and thereby stop attracting moths to a site where they may be injured or killed. The following procedures entail habitat removal and translocation of eggs and larvae and therefore should not be conducted until take resulting from such actions is addressed pursuant to the Endangered Species Act (via section 7 consultation or an HCP) and Hawaii Revised Statute 195D.

1. Host plants without eggs or larvae should be cut to minimize the likelihood that a moth may use the plant and pupate in the soil near the plant. Maintain cut stems free of growth by painting them with herbicide to prevent use by the Blackburn's sphinx moth. Root disturbance could dislodge pupae; therefore, the unoccupied plant should be cut and treated, but soil and plant roots should be left undisturbed for a period of one year. A 10-meter (33-foot) disturbance-free buffer must be established around the host plant to prevent disturbance of any pupating larvae in the ground around the plant. After one year, roots may be removed and soil compaction and disturbance related to the project may take place within the buffer area.

2. If Blackburn's sphinx moth eggs or larvae are present on the plant, either wait until plant is free of Blackburn's sphinx moth eggs and larvae and then follow the steps outlined above to remove the plant or follow the protocols specified in your Permit to remove them to a new location. Repeat surveys and removal of Blackburn's sphinx moth-free plants until all plants are removed.

3. Once tree tobacco is removed from project sites, these areas should be kept free of tree tobacco to minimize the likelihood that moths will be attracted to the project site to breed in an area where they may not survive. If soil is disturbed and left fallow during project build-out, there is the potential for tree tobacco plants to become established within the project site after groundbreaking. Therefore, after groundbreaking, disturbed areas should be monitored closely and maintained to ensure no Solanaceous plant regrowth or kept covered by barrier material to prevent tree tobacco from becoming established within active construction zones. If tree tobacco becomes established the steps above would need to be repeated to ensure Blackburn's sphinx moths are not injured or killed as a result of the project.

Appendix 4

DRAFT Honua`ula Emergency Response Protocol for Threatened and Endangered Species at the Property.

As part of the HCP process, Honua`ula will implement the following protocol for any injured or deceased threatened or endangered bird species on the property, including but not limited to Nēnē (Hawaiian goose), ae'o (Hawaiian stilt), 'alae ke'oke'o (Hawaiian coot)'alae 'ula (Hawaiian moorhen), or koloa (Hawaiian duck).

1. Emergency Contacts

Upon discovery of an injured bird, or a bird, egg, or nest in imminent danger, or carcass of a threatened or endangered species, all work in the area should be stopped immediately. Honua`ula staff should immediately contact the Natural Resources Manager, *and* the Maui Division of Forestry & Wildlife (DOFAW) Wildlife Management Staff, as listed below. If the first contact on the priority list is not available, leave a voicemail message, but then call the next person on the contact list. It is essential that person-to-person contact be made with Maui DOFAW staff.

1. John Medeiros
2. Fern Duvall

If unable to reach the Maui DOFAW contacts identified above, call Maui Police Dispatch and request that they contact "Wildlife". If the Maui DOFAW staff cannot be reached in an emergency, the closest State- permitted wildlife rehabilitator should be contacted:

The Maui DOFAW Wildlife Management staff, or if they cannot be reached, the closest State-permitted wildlife rehabilitator, have authority to make decisions concerning the disposition and care of injured birds. DOFAW has the authority to make decisions concerning the disposition and care of birds, eggs, or nests in imminent danger. In case of emergency, their direction should be followed immediately, without further consultation. (See Item III below for details).

After contacting the Natural Resources Manager, and the Maui DOFAW staff, or in the case that Maui DOFAW staff cannot be reached, the closest State-permitted wildlife rehabilitator, Honua`ula staff or their designated representative should notify the DOFAW HCP Coordinator (808-347-6740) or Wildlife Manager (808-227-3403), and the USFWS HCP Coordinator (Jeff Newman, office: 808-792-9442, cell: 808-551-5122) or USFWS Office of Law Enforcement (Keith Swindle, 808-791-0853) to inform them of the situation, and what action has been taken. Such notification to the USFWS is required by federal regulation. Emergency response should proceed as directed by the Maui DOFAW Wildlife Management staff, and should not wait for notification of these additional contacts.

2. Procedures for Handling Injured Birds and Bird Carcasses

Federal and State permits, or other appropriate Federal and State authorization, are required for any person handling live or dead specimens. Injured or ill protected species may only be captured and handled by personnel who have been trained in the capture and collection and after approval is received from USFWS and DOFAW personnel.

A. Equipment

The following equipment will be needed for use in responding to injured or dead birds:

- Pet carriers – 1 large
- Pieces of artificial turf/outdoor carpeting to place on floors of pet carriers
- Gloves
- Digital camera
- Large plastic bags (4+)

B. Procedures for Injured or Ill Birds
If an injured or ill bird cannot fly, do not immediately remove it from the field. Notify Maui DOFAW Wildlife Management staff or the nearest State-permitted wildlife rehabilitator as soon as possible, as described in Section I. Mark the area and monitor the bird if possible until DOFAW staff arrive. Record the following information, and photograph the bird (if possible):

1. Date
2. Location
3. Band numbers (if banded)
4. Condition of bird (e.g., type of injury). Be specific in describing injury type, and location on bird. Also indicate if a predator is evident in the vicinity. All reasonable measures to eliminate the predator should be taken.
5. Additional comments
6. Name, address, and telephone number of observer

Injured birds may be captured only by personnel trained and authorized for the capture and collection of live birds. The following procedures must be employed:

1. Gently pick up and place bird into carrier equipped with turf/carpet. Place only one bird in a carrier.
2. Mark exact spot of find(s) with tent stake(s)
3. Transport the bird pursuant to instructions received from DOFAW or USFWS, as described above.

The DOFAW HCP Coordinator (or Wildlife Manager), and the USFWS HCP Coordinator should be contacted , to inform them of the situation, and what action has been taken. Emergency response should proceed as directed by the Maui DOFAW Wildlife Management staff, and should not wait for notification of these additional contacts.

C. Procedures for Dead Birds and Disturbed Nests
Dead birds and disturbed nests must be left in place. Notify Maui DOFAW Wildlife Management staff and USFWS Law Enforcement (cell: 808-221-3558 or office: 808-791-0853), as soon as possible. Mark the area and monitor the bird or nest until DOFAW personnel arrive. If DOFAW is unable to respond, The natural Resources Manager of designated staff may receive verbal permission from DOFAW or USFWS to place the specimen in a sealed plastic bag, transport the carcass to a refrigerator for later retrieval, after they record the following information:

1. Date
2. Location (collection site)
3. Band numbers (if banded)
4. Condition of bird (e.g., type of injury)
5. Whether the bird was found dead, or died subsequent to discovery
6. Additional comments
7. Name, address and telephone number of observer
8. Photograph showing, at a minimum, the condition and location of the bird, nest, or eggs

Honua`ula will cooperate with Maui DOFAW and USFWS staff in their investigations of any dead birds or disturbed nests, and follow their direction.
The DOFAW HCP Coordinator (or Wildlife Manager), and the USFWS HCP Coordinator should be contacted, to inform them of the situation, and what action has been taken. Emergency and/or law enforcement response should proceed as directed by DOFAW and/or USFWS Law Enforcement staff, and should not wait for notification of these additional contacts.

3. Procedures for Birds, Nests, or Eggs in Imminent Danger

If Honua`ula staff observe or are informed of any birds, nests, or eggs of threatened or endangered species in imminent danger unrelated to construction-related activities, they will immediately contact Maui DOFAW Wildlife Management staff. DOFAW has the authority to make decisions concerning the disposition and care of birds, eggs, or nests in imminent danger. In case of emergency, their direction should be followed immediately, without need for additional consultation.
In these situations if eggs or nests are to be manipulated: (1) prior to cross-fostering attempts, confirm synchrony between foster female and egg(s) to be moved, and (2) all attempts will be made to avoid splitting eggs of a single clutch among multiple foster parents.
Details of the incident, including documentation and description of the subsequent management action, will be reported by Honua`ula to the DOFAW and USFWS HCP Coordinators.

IV. Modifications

This protocol may be modified if new biological information becomes available or by agreement among the DOFAW and USFWS.

Appendix 4

Appendix 5

Enclosure

U.S. Fish and Wildlife Service
Recommended Standard Best Management Practices

The U.S. Fish and Wildlife Service recommends that the following measures be incorporated into projects to minimize the degradation of water quality and impacts to aquatic fish and wildlife resources:

a. Turbidity and siltation from project-related work will be minimized and contained to within the vicinity of the site through the appropriate use of effective silt containment devices and the curtailment of work during adverse weather conditions;

b. Dredging and filling in the aquatic environment will be designed to avoid or minimize the loss special aquatic site habitat (pool/riffle areas, wetlands, etc.) and the unavoidable loss of such habitat will be compensated for;

c. All project-related materials and equipment (dredges, barges, backhoes, etc.) to be placed in the water will be cleaned of pollutants prior to use;

d. No project-related materials (fill, revetment rock, pipe, etc.) will be stockpiled in the water (stream channels, wetlands, etc.);

e. All debris removed from the aquatic environment will be disposed of at an approved upland or ocean dumping site;

f. No contamination (trash or debris disposal, alien species introductions, etc.) of adjacent aquatic environments (stream channels, wetlands, etc.) will result from project-related activities;

g. Fueling of project-related vehicles and equipment should take place away from the water and a contingency plan to control petroleum products accidentally spilled during the project will be developed. Absorbent pads and containment booms will be stored on-site, if appropriate, to facilitate the clean-up of accidental petroleum releases;

h. Any under-layer fills used in the project will be protected from erosion with (rock, core-loc units, etc.) as soon after placement as practicable; and

i. Any soil exposed near water as part of the project will be protected from erosion (with plastic sheeting, filter fabric, etc.) after exposure and stabilized as soon as practicable (with vegetation matting, hydroseeding, etc.).

Appendix 6

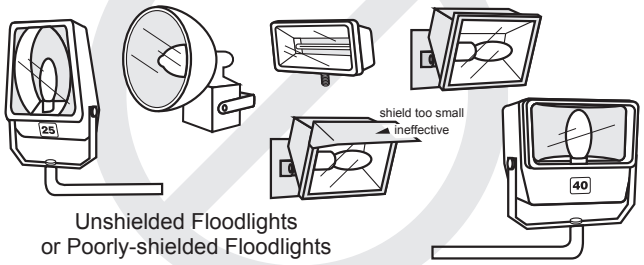
Appendix 6

SEABIRD FRIENDLY LIGHTING SOLUTIONS

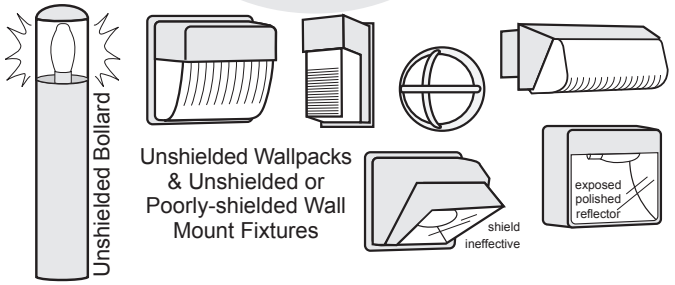
Help eliminate seabird light attraction. Select the best fixture for your application using this guide. Avoid uplighting, always shield floodlights, and aim downlights carefully to avoid light trespass. For more information go to www.kauai-seabirdhcp.info.

Unacceptable / Discouraged

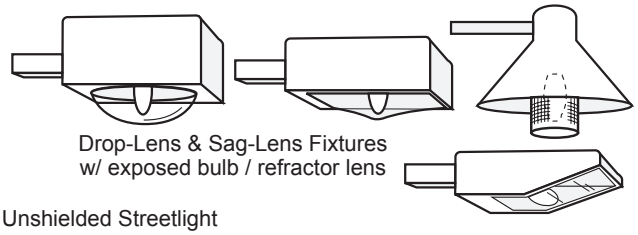
Fixtures that produce glare and light trespass



Unshielded Floodlights
or Poorly-shielded Floodlights

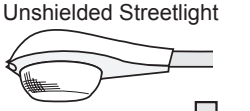


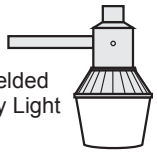
Unshielded Wallpacks
& Unshielded or
Poorly-shielded Wall
Mount Fixtures



Drop-Lens & Sag-Lens Fixtures
w/ exposed bulb / refractor lens

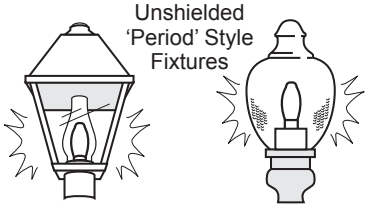
Unshielded Streetlight



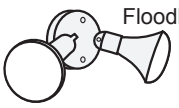


Unshielded
Security Light

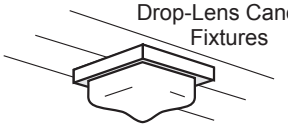
Unshielded
'Period' Style
Fixtures



Unshielded PAR
Floodlights

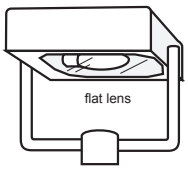


Drop-Lens Canopy
Fixtures

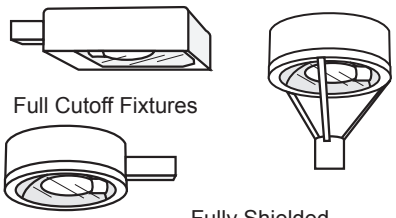


Acceptable

Fixtures that shield the light source to minimize glare and light trespass and to facilitate better vision at night

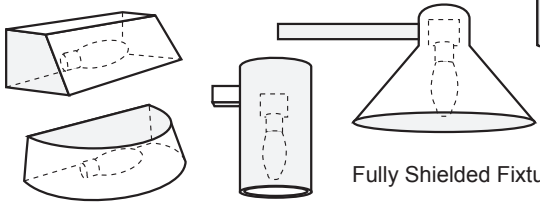


Full Cutoff Fixtures



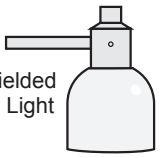
Fully Shielded
Wallpack & Wall
Mount Fixtures

Fully Shielded
Walkway
Bollards



Fully Shielded Fixtures

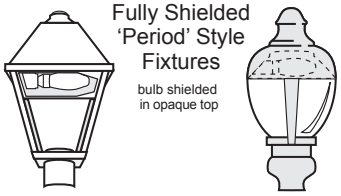
Full Cutoff Streetlight

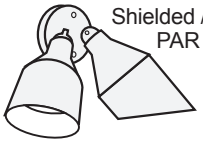


Fully Shielded
Security Light

Fully Shielded
'Period' Style
Fixtures

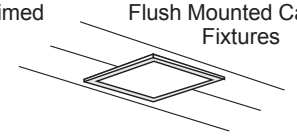
bulb shielded
in opaque top



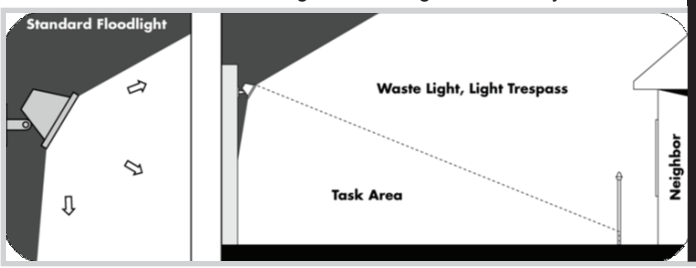


Shielded / Properly-aimed
PAR Floodlights

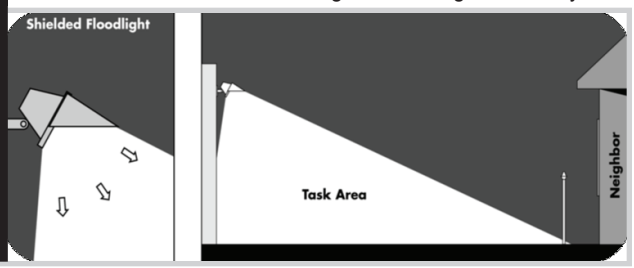
Flush Mounted Canopy
Fixtures



Unshielded floodlight that is angled incorrectly



Shielded floodlight that is angled correctly



Illustrations from
www.darksky.org and
www.darkskysociety.org

Appendix 6

Appendix 7

Appendix 7

Illuminating
ENGINEERING SOCIETY

JOINT IDA - IES

MODEL LIGHTING ORDINANCE (MLO)

with USER'S GUIDE

June 15, 2011

The User Notes

The User Notes are intended to clarify the sections of the MLO for the various audiences who will use it: lighting designers, city officials, engineers, citizen groups, and others. Every effort has been made to keep the language technically accurate and clear, but since different disciplines may use the same term in different ways, or have different interpretations, some guidance may be helpful. While these Notes can not be a full tutorial on modern lighting design, it is hoped that the Notes will help facilitate the dialogue necessary to adopt the MLO.

Background

The problems of light pollution first became an issue in the 1970s when astronomers identified the degradation of the night sky due to the increase in lighting associated with development and growth. As more impacts to the environment by lighting have been identified, an international "dark sky" movement is advocating for the precautionary approach to outdoor lighting design.

Many communities have passed anti-light-pollution laws and ordinances. However, there is little or no agreement among these laws, and they vary considerably in language, technical quality, and stringency. This is confusing for designers, engineers, and code officials. The lack of a common basis prevents the development of standards, educational programs, and other means of achieving the goal of effective lighting control.

This MLO will allow communities to drastically reduce light pollution and glare and lower excessive light levels. The recommended practices of the IES can be met using readily available, reasonably priced lighting equipment. However, many conventional lighting practices will no longer be permitted, or will require special permits.

This Model Lighting Ordinance (MLO) is the result of extensive efforts by the International Dark Sky Association (IDA) and the Illuminating

Engineering Society of North America (IES). Among its features is the use of lighting zones (LZ0-4) which allow each governing body to vary the stringency of lighting restrictions according to the sensitivity of the area as well as accommodating community intent. In this way, communities can fine-tune the impact of the MLO without having to customize the MLO. The MLO also incorporates the Backlight-Uplight-Glare (BUG) rating system for luminaires, which provides more effective control of unwanted light.

Joint IDA-IESNA Model Outdoor Lighting Ordinance (MLO)

June 15, 2011

CONTENTS

General Notes in Adopting this Model Ordinance

Adoption of this ordinance should follow the established development, review, and approval processes of the adopting authority. If no such processes are in place, this ordinance may be adopted as a new independent section of the Municipal Code.

The MLO is probably best adopted as an "overlay zoning" ordinance. This means that it overlays, but is different from, land-use zoning. It can be added to or integrated into existing ordinances or codes and cross-referenced to other applicable codes and ordinances such as the electrical code, the sign code, planning ordinances, etc.

The MLO may best be managed by assigning it to planning officials and using existing administrative structures.

Because of the diverse community and lighting needs across large areas, this MLO is not intended for adoption as a state, provincial or national ordinance. Regional coordination is encouraged. Light pollution knows no boundaries, and the effects of polluting light persist as far as 200 kilometers (about 120 miles) from the source. One large city could adopt the MLO and dramatically affect a region, but adoption in suburbs and small towns must be part of a regional effort to achieve significant improvements in the overall quality of the night sky.

Adopting agencies should also consider that the MLO, like all other modern codes, is designed to evolve over time. Lighting technology will change, and MLO changes will be needed every few years. On-going renewal cycles are strongly recommended as any part of an adopting ordinance.

MLO Development and Task Force Members

This Model Lighting Ordinance has been developed as a joint undertaking by the Illuminating Engineering Society and the International Dark-Sky Association.

The Joint Task Force responsible for developing the MLO include

IDA	IES
Co-Chair: Jim Benya	Naomi Miller
Co-Chair: Nancy Clanton	Cheryl English
Leslie Lipstein	Denis Lavoie
Leo Smith	Eric Gibson
Michael Mutmansky	

John Walter representing the electric utility industry also contributed as a member of the Joint Task Force.

I. PREAMBLE - User's Guide

In general, the preamble is part of the ordinance but is typically not part of the code. It establishes the reasons why the municipality is undertaking these regulations.

Local governments may add other purposes to the Preamble including established local government environmental or energy goals that support the model lighting ordinance. The environmental impacts of outdoor lighting fall into two categories: carbon footprint (energy used in the life of a lighting product) and obtrusive light.

CARBON FOOTPRINT	OBTRUSIVE LIGHT
Cost & Impact of Mining the Materials Used	Impact on Humans
Energy Used in Production	Impact on the Environment
Energy Used during Product Life	
Disposal/Recylcing Costs	

II. LIGHTING ZONES - User's Guide

Lighting zones reflect the base (or ambient) light levels desired by a community. The use of lighting zones (LZ) was originally developed by the International Commission on Illumination (CIE) and appeared first in the US in IES Recommended Practice for Exterior Environmental Lighting, RP-33-99.

It is recommended that lower lighting zone(s) be given preference when establishing zoning criteria. Selection of lighting zone or zones should be based not on existing conditions but rather on the type of lighting environments the jurisdiction seeks to achieve. For instance, new development on previously rural or undeveloped land may be zoned as LZ-1.Using lighting zones allows a great deal of flexibility and customization without the burden of excessive regulation. For example, a jurisdiction may choose to establish vertical lighting zones with the lighting zone at street level at a higher zone than the residential housing on upper levels.

I. PREAMBLE - Ordinance Text

The purpose of this Ordinance is to provide regulations for outdoor lighting that will:

a. Permit the use of outdoor lighting that does not exceed the minimum levels specified in IES recommended practices for night-time safety, utility, security, productivity, enjoyment, and commerce.

b. Minimize adverse offsite impacts of lighting such as light trespass, and obtrusive light.

c. Curtail light pollution, reduce skyglow and improve the nighttime environment for astronomy.

d. Help protect the natural environment from the adverse effects of night lighting from gas or electric sources.

e. Conserve energy and resources to the greatest extent possible.

II. LIGHTING ZONES - Ordinance Text

The Lighting Zone shall determine the limitations for lighting as specified in this ordinance. The Lighting Zones shall be as follows:

LZ0: No ambient lighting

Areas where the natural environment will be seriously and adversely affected by lighting. Impacts include disturbing the biological cycles of flora and fauna and/or detracting from human enjoyment and appreciation of the natural environment. Human activity is subordinate in importance to nature. The vision of human residents and users is adapted to the darkness, and they expect to see little or no lighting. When not needed, lighting should be extinguished.

II. LIGHTING ZONES (cont.) - User's Guide

However, if an adjacent use could be adversely impacted by allowable lighting, the adopting authority may require that a particular site meet the requirements for a lower lighting zone. For example, the authority could specify Lighting Zone 1 or 2 requirements if a commercial development were adjacent to a residence, hospital or open space, or to any land assigned to a lower zone.

Lighting zones are best implemented as an overlay to the established zoning especially in communities where a variety of zone districts exists within a defined area or along an arterial street. Where zone districts are cohesive, it may be possible to assign lighting zones to established land use zoning. It is recommended that the lighting zone includes churches, schools, parks, and other uses embedded within residential communities.

Zone	Recommended Uses or Areas	Zoning Considerations
LZ-0	Lighting Zone 0 should be applied to areas in which permanent lighting is not expected and when used, is limited in the amount of lighting and the period of operation. LZ-0 typically includes undeveloped areas of open space, wilderness parks and preserves, areas near astronomical observatories, or any other area where the protection of a dark environment is critical. Special review should be required for any permanent lighting in this zone. Some rural communities may choose to adopt LZ-0 for residential areas.	Recommended default zone for wilderness areas, parks and preserves, and undeveloped rural areas. Includes protected wildlife areas and corridors.
LZ-1	Lighting Zone 1 pertains to areas that desire low ambient lighting levels. These typically include single and two family residential communities, rural town centers, business parks, and other commercial or industrial/ storage areas typically with limited nighttime activity. May also include the developed areas in parks and other natural settings.	Recommended default zone for rural and low density residential areas. Includes residential single or two family; agricultural zone districts; rural residential zone districts; business parks; open space include preserves in developed areas.

II. LIGHTING ZONES (cont.) - Ordinance Text

LZ1: Low ambient lighting

Areas where lighting might adversely affect flora and fauna or disturb the character of the area. The vision of human residents and users is adapted to low light levels. Lighting may be used for safety and convenience but it is not necessarily uniform or continuous. After curfew, most lighting should be extinguished or reduced as activity levels decline.

LZ2: Moderate ambient lighting

Areas of human activity where the vision of human residents and users is adapted to moderate light levels. Lighting may typically be used for safety and convenience but it is not necessarily uniform or continuous. After curfew, lighting may be extinguished or reduced as activity levels decline.

LZ3: Moderately high ambient lighting

Areas of human activity where the vision of human residents and users is adapted to moderately high light levels. Lighting is generally desired for safety, security and/or convenience and it is often uniform and/or continuous. After curfew, lighting may be extinguished or reduced in most areas as activity levels decline.

LZ4: High ambient lighting

Areas of human activity where the vision of human residents and users is adapted to high light levels. Lighting is generally considered necessary for safety, security and/or convenience and it is mostly uniform and/or continuous. After curfew, lighting may be extinguished or reduced in some areas as activity levels decline.

II. LIGHTING ZONES (cont.) - User's Guide

Zone	Recommended Uses or Areas	Zoning Considerations
LZ-2	**Lighting Zone 2 pertains to areas with moderate ambient lighting levels. These typically include multifamily residential uses, institutional residential uses, schools, churches, hospitals, hotels/motels, commercial and/or businesses areas with evening activities embedded in predominately residential areas, neighborhood serving recreational and playing fields and/or mixed use development with a predominance of residential uses. Can be used to accommodate a district of outdoor sales or industry in an area otherwise zoned LZ-1.**	**Recommended default zone for light commercial business districts and high density or mixed use residentialdistricts.** Includes neighborhood business districts; churches, schools and neighborhood recreation facilities; and light industrial zoning with modest nighttime uses or lighting requirements.
LZ-3	**Lighting Zone 3 pertains to areas with moderately high lighting levels. These typically include commercial corridors, high intensity suburban commercial areas, town centers, mixed use areas, industrial uses and shipping and rail yards with high night time activity, high use recreational and playing fields, regional shopping malls, car dealerships, gas stations, and other nighttime active exterior retail areas.**	**Recommended default zone for large cities' business district.** Includes business zone districts; commercial mixed use; and heavy industrial and/or manufacturing zone districts.
LZ-4	**Lighting zone 4 pertains to areas of very high ambient lighting levels. LZ-4 should only be used for special cases and is not appropriate for most cities. LZ-4 may be used for extremely unusual installations such as high density entertainment districts, and heavy industrial uses.**	**Not a default zone**. Includes high intensity business or industrial zone districts.

III. GENERAL REQUIREMENTS - User's Guide

This Section sets out the requirements that apply to all lighting, both residential and non-residential.

Each adopting jurisdiction should incorporate their existing standards as to when compliance with new regulations is required, when repair or remodeling triggers compliance and if the new ordinance will be retroactive to existing development. The Applicability section of this model ordinance should serve as a guide if the adopting jurisdiction does not have standards or policies in place. Likewise, the adopting jurisdiction should use their existing policies and definitions of what constitutes public monuments, and temporary and/or emergency lighting. Community attitudes and precedents should be taken into account in deciding to regulate seasonal holiday lighting.

EXEMPTIONS - User's Guide

This is standard language intended to prevent conflict of laws and to give the community the ability to set specific lighting requirements in special plans and under use permits. It can be amended to conform to similar language in other ordinances. For example, while public monuments, statuary, and flags should be lighted, the lighting also should be limited to avoid excess.

Lighting for streets, roads, and highways is usually regulated by a street lighting ordinance, and is not covered by this model ordinance. However, since street lighting can affect nearby areas, some recognition of its effect is appropriate. (See Section XI)

SIGN LIGHTING - User's Guide

A sign lighting ordinance is strongly recommended if not already in place. It should carefully limit lighting to prevent over-lighted signs from being used to circumvent lighting ordinances.

III. GENERAL REQUIREMENTS - Ordinance Text

A. Conformance with All Applicable Codes

All outdoor lighting shall be installed in conformance with the provisions of this Ordinance, applicable Electrical and Energy Codes, and applicable sections of the Building Code.

B. Applicability

Except as described below, all outdoor lighting installed after the date of effect of this Ordinance shall comply with these requirements. This includes, but is not limited to, new lighting, replacement lighting, or any other lighting whether attached to structures, poles, the earth, or any other location, including lighting installed by any third party.

Exemptions from III.(B.) The following are not regulated by this Ordinance

a. Lighting within public right-of-way or easement for the principal purpose of illuminating streets or roads. No exemption shall apply to any lighting within the public right of way or easement when the purpose of the luminaire is to illuminate areas outside the public right of way or easement, unless regulated with a streetlighting ordinance.

Note to adopting agency: if using the street lighting ordinance (Section XI), this exemption should read as follows:

Lighting within the public right-of-way or easement for the principal purpose of illuminating roads and highways. No exemption shall apply to any street lighting and to any lighting within the public right of way or easement when the purpose of the luminaire is to illuminate areas outside of the public right of way or easement.

b. Lighting for public monuments and statuary.

c. Lighting solely for signs (lighting for signs is regulated by the Sign Ordinance).

d. Repairs to existing luminaires not exceeding 25% of total installed luminaires.

LIGHTING CONTROLS - User's Guide

This section requires all outdoor lighting to have lighting controls that prohibit operation when sufficient daylight is available, and to include the capability, either through circuiting, dimming or alternating sources, to be able to reduce lighting without necessarily turning all lighting off.

III. GENERAL REQUIREMENTS (cont.) - Ordinance Text

e. Temporary lighting for theatrical, television, performance areas and construction sites;

f. Underwater lighting in swimming pools and other water features

g. Temporary lighting and seasonal lighting provided that individual lamps are less than 10 watts and 70 lumens.

h. Lighting that is only used under emergency conditions.

i. In lighting zones 2, 3 and 4, low voltage landscape lighting controlled by an automatic device that is set to turn the lights off at one hour after the site is closed to the public or at a time established by the authority.

Exceptions to III. (B.) All lighting shall follow provisions in this ordinance; however, any special requirements for lighting listed in a) and b) below shall take precedence.

a. Lighting specified or identified in a specific use permit**.**

b. Lighting required by federal, state, territorial, commonwealth or provincial laws or regulations.

C. Lighting Control Requirements

1. Automatic Switching Requirements
   Controls shall be provided that automatically extinguish all outdoor lighting when sufficient daylight is available using a control device or system such as a photoelectric switch, astronomic time switch or equivalent functions from a programmable lighting controller, building automation system or lighting energy management system, all with battery or similar backup power or device.

CURFEW REQUIREMENTS - User's Guide

The intent is to reduce or eliminate lighting after a given time. Benefits include reduced environmental impact, longer hours of improved astronomy, energy savings, and improved sleeping conditions for residents. Additionally, some police departments have indicated that post-curfew light reductions make drive-by patrolling easier because it allows them to see further into and through a site.

The authority should determine the time of curfew and the amount of lighting reduction based on the character, norms and values of the community.

Typically, curfews go into effect one hour after the close of business. Restaurants, bars and major entertainment facilities such as sports stadiums, may require the curfew go into effect two hours after the close of business. The authority may elect to have no curfew for facilities with shift workers and 24 hour operations, or to extend the curfew time to meet specific needs. The MLO can be modified to address those concerns.

Areas without street lights or with very low ambient light levels should consider turning off all non-emergency lighting at curfew while commercial areas or urban areas may prefer a reduction in lighting levels. A reduction of at least 30% is recommended for most uses.

III. GENERAL REQUIREMENTS (cont.) - Ordinance Text

Exceptions to III.(C.) 1. Automatic lighting controls are not required for the following:

a. Lighting under canopies.

b. Lighting for tunnels, parking garages, garage entrances, and similar conditions.

2. Automatic Lighting Reduction Requirements
The Authority shall establish curfew time(s) after which total outdoor lighting lumens shall be reduced by at least 30% or extinguished.

Exceptions to III.(C.) 2. Lighting reductions are not required for any of the following:

a. With the exception of landscape lighting, lighting for residential properties including multiple residential properties not having common areas.

b. When the outdoor lighting consists of only one luminaire.

c. Code required lighting for steps, stairs, walkways, and building entrances.

d. When in the opinion of the Authority, lighting levels must be maintained.

e. Motion activated lighting.

f. Lighting governed by special use permit in which times of operation are specifically identified.

g. Businesses that operate on a 24 hour basis.

IV. NON-RESIDENTIAL LIGHTING - User's Guide

This section addresses non-residential lighting and multiple-family residences having common spaces, such as lobbies, interior corridors or parking. Its intent is to:

- **Limit the amount of light that can be used**
- **Minimize glare by controlling the amount of light that tends to create glare**
- **Minimize sky glow by controlling the amount of uplight**
- **Minimize the amount of off-site impacts or light trespass**

This MLO provides two methods for determining compliance. The *prescriptive method* contains precise and easily verifiable requirements for luminaire light output and fixture design that limit glare, uplight, light trespass and the amount of light that can be used. The *performance method* allows greater flexibility and creativity in meeting the intent of the ordinance. Note that both the prescriptive and the performance method limit the *amount* of light that can be used, but do not control *how* the lighting is to be used.

Most outdoor lighting projects that do not involve a lighting professional will use the prescriptive method, because it is simple and does not require engineering expertise.

For the prescriptive method, the initial luminaire lumen allowances defined in Table A (Parking Space Method) or B (Hardscape Area Method) will provide basic lighting (parking lot and lighting at doors and/or sensitive security areas) that is consistent with the selected lighting zone. The prescriptive method is intended to provide a safe lighting environment while reducing sky glow and other adverse offsite impacts. The Per Parking Space Method is applicable in small rural towns and is a simple method for small retail "mom and pop" operations without drive lane access and where the parking lot is immediately adjacent to the road. A jurisdiction may

IV. NON-RESIDENTIAL LIGHTING - Ordinance Text

For all non-residential properties, and for multiple residential properties of seven domiciles or more and having common outdoor areas, all outdoor lighting shall comply either with Part A or Part B of this section.

PRESCRIPTIVE METHOD - User's Guide

also allow a prescriptive method for classes of sites, such as car dealerships, gas stations, or other common use areas.

Note that the values are for initial luminaire lumens, not footcandles on the target (parking lot, sidewalk, etc). Variables such as the efficiency of the luminaire, dispersion, and lamp wear can affect the actual amount of light so the lumens per square foot allowance is not equal to footcandles on the site. By specifying initial luminaire lumen values, it is easier for officials to verify that the requirement is being met. Initial luminaire lumens are available from photometric data. Each initial luminaire lumens calculation should be supplied on the submittal form.

Solid state luminaires, such as LEDs, do not have initial lamp lumens, only initial luminaire lumens (absolute photometry). Other luminaires tested with relative photometry will have initial luminaire lumens which can be calculated by multiplying initial lamp lumens by the luminaire efficiency. In this example, three types of luminaires are used to light a parking area and building entry in a light commercial area. Two of these three luminaires use metal halide lamps: 70 watt wall mounted area lights and 150 watt pole mounted area lights. For these, the Initial Luminaire Lumens is equal to the initial lamp lumens multiplied by the luminaire efficiency. These values are entered into the compliance chart. The lumen value for the building mounted LED luminaires is equal to the lumens exiting the luminaire. Therefore, the value already represents the Initial Luminaire Lumens and no luminaire efficiency is needed. The total Luminaire Lumens for the site is equal to 247,840.

The allowable lumens are based on the lighting zone and the total hard-scape area. Referencing Table B, the allowed lumens are 2.5/SF for LZ2. Multiplying this by the total hardscape square footage gives a value of 250,000 lumens allowed. Because this value is greater than the value calculated for the site, the project complies. Listed below is an example on a typical compliance worksheet for the Prescriptive Method.

IV. NON-RESIDENTIAL LIGHTING (cont.) - Ordinance Text

A. Prescriptive Method

An outdoor lighting installation complies with this section if it meets the requirements of subsections 1 and 2, below.

1. Total Site Lumen Limit

   The total installed initial luminaire lumens of all outdoor lighting shall not exceed the total site lumen limit. The total site lumen limit shall be determined using either the Parking Space Method (Table A) or the Hardscape Area Method (Table B). Only one method shall be used per permit application, and for sites with existing lighting, existing lighting shall be included in the calculation of total installed lumens.

   The total installed initial luminaire lumens is calculated as the sum of the initial luminaire lumens for all luminaires.

IV. NON-RESIDENTIAL LIGHTING (cont.) - User's Guide

In this example, three types of luminaires are used to light a parking area and building entry in a light commercial area. Two of these three luminaires use metal halide lamps: 70 watt wall mounted area lights and 150 watt pole mounted area lights. For these, the Initial Luminaire Lumens is equal to the initial lamp lumens multiplied by the luminaire efficiency. These values are entered into the compliance chart. The lumen value for the building mounted LED luminaires is equal to the lumens exiting the luminaire. Therefore, the value already represents the Initial Luminaire Lumens and no luminaire efficiency is needed. The total Luminaire Lumens for the site is equal to 247,840. The allowable lumens are based on the lighting zone and the total hardscape area. Referencing Table B, the allowed lumens are 2.5/SF for LZ2. Multiplying this by the total hardscape square footage gives a value of 250,000 lumens allowed. Because this value is greater than the value calculated for the site, the project complies.

PRESCRIPTIVE METHOD EXAMPLE - COMPLIANCE CHART			
Lamp Descriptions	*QTY*	*Initial Luminaire Lumens*	*Total*
70 W Metal Halide	8	3,920	31,360
150 W Metal Halide	20	9,600	192,000
18 W LED	24	1,020	24,480
TOTAL INITIAL LUMINAIRE LUMENS			247,840
SITE ALLOWED TOTAL INITIAL LUMENS*			250,000
PROJECT IS COMPLIANT?			YES

* Listed below is the method of determining the allowed total initial lumen for non-residential outdoor lighting using the hardscape areamethod. (Table B).

SITE ALLOWED TOTAL INITIAL LUMENS	
Site Description	Light Commercial
Lighting Zone	LZ-2
Hardscape Area (SF)	100,000
Allowed Lumens per SF of Hardscape (Table B)	2.5
Site Allowed Total Initial Lumens (lumens per SF X hardscape area)	250,000

IV. NON-RESIDENTIAL LIGHTING (cont.) - Ordinance Text

PRESCRIPTIVE METHOD (cont.) - User's Guide

LIMITS TO OFFSITE IMPACTS

The prescriptive method of the MLO restricts uplighting, including upward light emitted by decorative luminaires. A jurisdiction may choose to preserve some types of lighting, including lighting of monuments or historic structures. In this case, the adopting jurisdiction should exempt or otherwise regulate these types of lighting carefully so that it does not inadvertently allow glaring or offensive lighting systems.

Offsite effects of light pollution include glare, light trespass, sky glow, and impacts on the nocturnal environment . All of these are functions of the fixture or luminaire design and installation. This document replaces the previous luminaire classification terminology of full cut-off, semi cut-off, and cut-off because those classifications were not as effective in controlling offsite impacts as with the new IESNA luminaire classification system as described in TM-15-07.

A traditional method of defining light trespass is to identify a maximum light level at or near the property line. However, this method does not address offensive light that is not directed toward the ground, or the intensity of glaring light shining into adjacent windows. The requirements defined in Table C limit the amount of light in all quadrants that is directed toward or above the property line. The Backlight/Uplight/Glare (BUG) rating will help limit both light trespass and glare. (A detailed explanation of the BUG system is provided in the section on Table C.)

The limits for light distribution established in Table C (for the BUG rating system) prevent or severely limit all direct upward light. A small amount of uplight reflected by snow, light-colored pavement or a luminaire's supporting arms is inevitable and is not limited by the prescriptive method of this ordinance.

IV. NON-RESIDENTIAL LIGHTING (cont.) - Ordinance Text

PRESCRIPTIVE METHOD

2. Limits to Off Site Impacts

All luminaires shall be rated and installed according to Table C.

3. Light Shielding for Parking Lot Illumination

All parking lot lighting shall have no light emitted above 90 degrees.

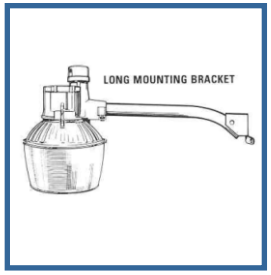
Exception:

a) Ornamental parking lighting shall be permitted by special permit only, and shall meet the requirements of Table C-1 for Backlight, Table C-2 for Uplight, and Table C-3 for Glare, without the need for external field-added modifications.

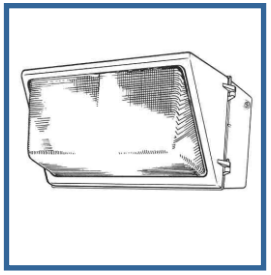
PRESCRIPTIVE METHOD (cont.) - User's Guide

LIMITS TO OFFSITE IMPACTS

A seemingly non-compliant fixture, such as a post-top translucent acorn luminaire, may in certain cases meet the BUG ratings, as long as it has proper interior baffling within the acorn globe. However, the BUG ratings in Table C will limit the use of the following types of luminaires in all lighting zones:



Barn Lights



Non-Shielded Wall Packs

Floodlights or lights not aimed downward

IV. NON-RESIDENTIAL LIGHTING (cont.) - Ordinance Text

PERFORMANCE METHOD - User's Guide

The performance method is best for projects with complex lighting requirements or when the applicant wants or needs more flexibility in lighting design. The performance method is also used when any lighting designer plans to aim or direct any light fixture upward (above 90 degrees). An engineer or lighting professional generally will be required to design within the performance method. An adopting jurisdiction may also wish to hire an engineer or lighting professional to review and approve projects using this method and/or incorporate review of the performance method into special review procedures.

The Performance Method is also best for projects where higher lighting levels are required compared to typical area lighting. An example might be a car sales lot where more light might be required on the new cars than would be needed for a standard parking lot. Another example is a gas station canopy requiring more light than a building entrance canopy.

The first step in the Performance Method regulates overlighting by establishing the Total Initial Site Lumens (Table D) that are allowed.

Allowances include the summation of the following (Table D):

1) Initial lumen allowance per site
2)Per area (SF) of hardscape

Table E allows additional lumens for unique site conditions.
Examples of allowances include:

1)Per building entrance/exit
2)Per length (linear feet) of Outdoor Sales Frontage Perimeter
3)Per area (SF) of Vehicle Service Station Canopy
4)Plus more …

The Site Total Initial Site Lumens allowed are a combination of allowances from Table D and Table E.

IV. NON-RESIDENTIAL LIGHTING (cont.) - Ordinance Text

B. Performance Method

1. Total Site Lumen Limit

The total installed initial luminaire lumens of all lighting systems on the site shall not exceed the allowed total initial site lumens. The allowed total initial site lumens shall be determined using Tables D and E. For sites with existing lighting, existing lighting shall be included in the calculation of total installed lumens.

The total installed initial luminaire lumens of all is calculated as the sum of the initial luminaire lumens for all luminaires.

IV. NON-RESIDENTIAL LIGHTING (cont.) - User's Guide

LIMITS TO OFFSITE IMPACTS (cont.)

The second step in the Performance Method is to determine if the proposed luminaires are producing off site impacts such as glare, sky glow and light trespass. One may either use Option A which are the Maximum Allowable BUG Ratings in Table C, or Option B through computer lighting calculations show compliance with Maximum Vertical Illuminance at any point in the plane of the property line in Table F. Option B will be required for all non-residential luminaires that
A) do not have BUG ratings, or
B) exceed the BUG ratings,
C) are not fully shielded, or
D) have adjustable mountings.

For the performance method, Option B (2) requires photometric calculations for the site perimeter, to a height of no less than 33 feet (10 meters) above the tallest luminaire. Vertical illuminances at eye height (5 feet above grade) will give values that can be used to verify compliance by comparing actual site conditions to the photometric plan submitted during review.
Note that the MLO specifies 'total initial luminaire lumens' as a measurement in addition to footcandles/lux. The footcandle (lux) is equal to one lumen per square meter. Lux is the metric unit and is equal to one lumen per square meter.

IV. NON-RESIDENTIAL LIGHTING (cont.) - Ordinance Text

PERFORMANCE METHOD

2. Limits to Off Site Impacts
All luminaires shall be rated and installed using either Option A or Option B. Only one option may be used per permit application.

Option A: All luminaires shall be rated and installed according to Table C.
Option B: The entire outdoor lighting design shall be analyzed using industry standard lighting software including inter-reflections in the following manner:

1) Input data shall describe the lighting system including luminaire locations, mounting heights, aiming directions, and employing photometric data tested in accordance with IES guidelines. Buildings or other physical objects on the site within three object heights of the property line must be included in the calculations.

2) Analysis shall utilize an enclosure comprised of calculation planes with zero reflectance values around the perimeter of the site. The top of the enclosure shall be no less than 33 feet (10 meters) above the tallest luminaire. Calculations shall include total lumens upon the inside surfaces of the box top and vertical sides and maximum vertical illuminance (footcandles and/or lux) on the sides of the enclosure.

The design complies if:

a) The total lumens on the inside surfaces of the virtual enclosure are less than 15% of the total site lumen limit; and

b) The maximum vertical illuminance on any vertical surface is less than the allowed maximum illuminance per Table F.

DESIGN COMPLIANCE - User's Guide

The application form will require information about the number of luminaires, the number of lamps in each luminaire, the initial luminaire lumens for each luminaire and the initial lumen output for each lamp (based on the wattage and type of lamp selected) as well as plans showing the site area measurements. This will allow the reviewer to verify that the lumen output of all the luminaires does not exceed the allowance.

Field verification can be achieved by asking the applicant and/or owner to verify that the luminaire type, lamp type and wattages specified have been used. Also ask the applicant for photometric data for each luminaire, since the initial luminaire lumens and B-U-G ratings are stated on the photometric report.

However, if a jurisdiction requires additional on-site verification, it may also request a point-by-point photometric plan. While this will not be a true measure of compliance with the criteria of this Ordinance, comparing the actual measured levels on site to the photometric plan can be an indication whether or not the installed lighting varies from the approved design.

V. RESIDENTIAL LIGHTING - User's Guide

This section applies to single family home, duplexes, row houses, and low rise multi-family buildings of 6 dwelling units or less.

RESIDENTIAL LIGHTING EXCEPTIONS

The exceptions allow for typical lighting that might exceed the specified limits.

Landscape Lighting - While not common in residential areas, it can cause light pollution and light trespass if it is not controlled.

Lighting controlled by Vacancy (Motion) Sensor - Reduces light pollution and light trespass and should be encouraged.

RESIDENTIAL LIGHTING EXAMPLE

In this example on the following page, five different luminaires are used on a residential property. Each luminaire must comply to meet the requirements. The site plan following shows luminaire types followed by a tabulation of each uminaire, whether or not it is fully shielded, lamp type, and initial luminaire lumens. If the luminaire lumens are not known, multiply the initial lamp lumens by the luminaire efficiency. If the efficiency is not known, multiply the initial lamp lumens by 0.7 as a reasonable assumption. The maximum allowable lumen values come from Table G, based on the shielding classification and location on the site. In this case, each luminaire complies with the requirements of Table G.

Comparison of efficacy by power
(120 Volt Incandescent lamps)

Output (Lumens)	Power (Watt)		
	Incan	CFL	LED
500	40	8 - 10	9
850	60	13 - 18	12 - 15
1,200	75	18 - 22	15
1,700	100	23 - 28	18

V. RESIDENTIAL LIGHTING - Ordinance Text

A. General Requirements

For residential properties including multiple residential properties not having common areas, all outdoor luminaires shall be fully shielded and shall not exceed the allowed lumen output in Table G, row 2.

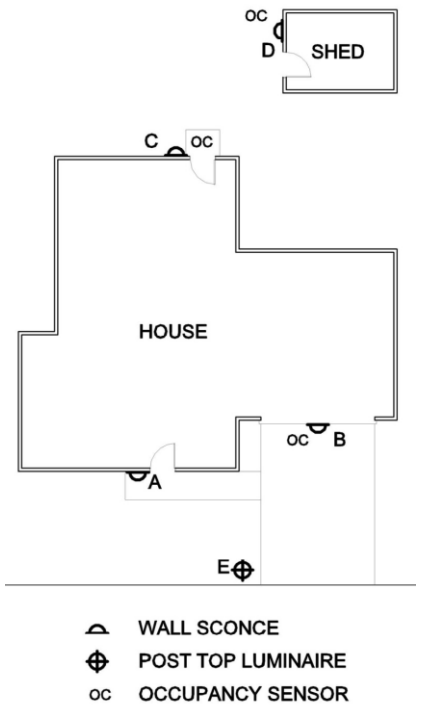
Exceptions

1. **One partly shielded or unshielded luminaire at the main entry, not exceeding the allowed lumen output in Table G row 1.**
2. **Any other partly shielded or unshielded luminaires not exceeding the allowed lumen output in Table G row 3.**
3. **Low voltage landscape lighting aimed away from adjacent properties and not exceeding the allowed lumen output in Table G row 4.**
4. **Shielded directional flood lighting aimed so that direct glare is not visible from adjacent properties and not exceeding the allowed lumen output in Table G row 5.**
5. **Open flame gas lamps.**
6. **Lighting installed with a vacancy sensor, where the sensor extinguishes the lights no more than 15 minutes after the area is vacated.**
7. **Lighting exempt per Section III (B.).**

B. Requirements for Residential Landscape Lighting

1. **Shall comply with Table G.**
2. **Shall not be aimed onto adjacent properties.**

V. RESIDENTIAL LIGHTING - User's Guide



Property Type: Residential
Lighting Zone 1

Luminaire Type	Location	Luminaire Description	Fully Shielded	Lamp Type	Initial Luminiare Lumens*	Maximum Allowed Initial Luminaire Lumens (Table G)	Controls	Compliant
A	Front Entry	Decorative wall sconce	No	9W CFL	420	420	None	Yes
B	Garage Door	Fully shielded wall pack	Yes	23W CFL	1050	1260	Occupancy Sensor	Yes
C	Back Entry	Decorative wall sconce	No	7W CFL	280	315	Occupancy Sensor	Yes
D	Shed Entry	Fully shielded wall pack	Yes	40W INC	343	1260	Occupancy Sensor	Yes
E	Driveway	Fully shielded post top	Yes	13W CFL	1260	1260	None	Yes

*Initial Luminaire Lumens are calculated by multiplying the total initial lamp lumens by the luminaire efficiency.
If the luminaire efficiency is not known, assume an efficiency of 70% and multiply the lamp lumen value by 0.7.

VI. LIGHTING BY SPECIAL PERMIT ONLY - User's Guide

This section addresses types of lighting that are intrusive or complex in their impacts and need a higher level of scrutiny and/or site sensitivity.

It should be noted that safety could be compromised if lighting conforming to this ordinance is located adjacent to excessively bright and/or glaring lighting.

It is important that the authority set clear and reasonable guidelines for applying for a special lighting use permit, and establish rules and procedures for granting or refusing them. They may differ from existing special use policies, in which case one or the other may be changed to achieve the overall goal of effective lighting without glare, sky glow, or light trespass.

SPORTS FIELD LIGHTING

For athletic and sports fields, the appropriate level of lighting will depend on the Class of Play and Facilities. Class of Play is divided into 4 categories, depending on the number of fixed spectator seats. (Competition play intended for nighttime TV broadcast may require higher lighting levels).

CLASS I: Competition play at facilities with 5,000 or more fixed spectator seats. (Professional, Colleges & Universities, some Semi-Professional & Large Sports Cubs)

CLASS II: Games at facilities with over 1,500 fixed spectator seats. (Smaller Universities and Colleges, some Semi-pro, large amateur leagues and high schools with large spectator facilities)

CLASS III: Games at facilities with over 500 fixed spectator seats. (Sports Clubs and amateur leagues, some high schools and large training professional training facilities with spectator sections)

CLASS IV: Competition or recreational play at facilities with 500 fixed spectator seats or less. Class IV Class of Play applies to games at which family and close friends of the players and staff are usually the majority of spectators. (Smaller amateur leagues, park and recreation department facilities, most Little Leagues smaller high schools, elementary and middle schools, and social events)

VI. LIGHTING BY SPECIAL PERMIT ONLY - Ordinance Text

A. High Intensity and Special Purpose Lighting

The following lighting systems are prohibited from being installed or used except by special use permit:

1. Temporary lighting in which any single luminaire exceeds 20,000 initial luminaire lumens or the total lighting load exceeds 160,000 lumens.
2. Aerial Lasers.
3. Searchlights.
4. Other very intense lighting defined as having a light source exceeding 200,000 initial luminaire lumens or an intensity in any direction of more than 2,000,000 candelas.

B. *Complex and Non-Conforming Uses*

Upon special permit issued by the Authority, lighting not complying with the technical requirements of this ordinance but consistent with its intent may be installed for complex sites or uses or special uses including, but not limited to, the following applications:

1. Sports facilities, including but not limited to unconditioned rinks, open courts, fields, and stadiums.
2. Construction lighting.
3. Lighting for industrial sites having special requirements, such as petrochemical manufacturing or storage, shipping piers, etc.
4. Parking structures.
5. Urban parks
6. Ornamental and architectural lighting of bridges, public monuments, statuary and public buildings.
7. Theme and amusement parks.
8. Correctional facilities.

To obtain such a permit, applicants shall demonstrate that the proposed lighting installation:

a. Has sustained every reasonable effort to mitigate the effects of light on the environment and surrounding properties, supported by a signed statement describing the mitigation measures. Such statement shall be accompanied by the calculations required for the Performance Method.

SPORTS FIELD LIGHTING

When Class of Play is above Class IV, a dual control should be installed to limit illumination to Class IV levels during practices where spectators are fewer than 500.

(See IES Recommended Practice for Sports and Recreational Area Lighting RP-6)

VII. EXISTING LIGHTING - User's Guide

Adoption of this section on existing lighting is strongly encouraged.

If the adopting jurisdiction has criteria in place that require a property to come into compliance with the current zoning ordinance, it is recommended that the criteria also be applied to bringing existing lighting into compliance. If there are no established criteria, this section of the MLO is recommended.

Amortization allows existing lighting to gradually and gracefully come into compliance. Substantial changes or additions to existing properties are considered the same as new construction, and must comply.

Most outdoor lighting can be fully depreciated once it is fully amortized, usually no longer than 10 years, if not sooner, from the date of initial installation. Some jurisdictions may prefer to require phase-out in a substantially shorter period. The Authority may also wish to require compliance much sooner for "easy fixes" such as re-aiming or lowering lumen output of lamps. Where lighting is judged to be a safety hazard, immediate compliance can be required.

VI. LIGHTING BY SPECIAL PERMIT ONLY (cont.) - Ordinance Text

b. Employs lighting controls to reduce lighting at a Project Specific Curfew ("Curfew") time to be established in the Permit.
c. Complies with the Performance Method after Curfew.

The Authority shall review each such application. A permit may be granted if, upon review, the Authority believes that the proposed lighting will not create unwarranted glare, sky glow, or light trespass.

VII. EXISTING LIGHTING - Ordinance Text

Lighting installed prior to the effective date of this ordinance shall comply with the following.

A. Amortization

On or before [amortization date], all outdoor lighting shall comply with this Code.

B. New Uses or Structures, or Change of Use

Whenever there is a new use of a property (zoning or variance change) or the use on the property is changed, all outdoor lighting on the property shall be brought into compliance with this Ordinance before the new or changed use commences.

C. Additions or Alterations

1. Major Additions.
   If a major addition occurs on a property, lighting for the entire property shall comply with the requirements of this Code. For purposes of this section, the following are considered to be major additions:

VIII. ENFORCEMENT AND PENALTIES - User's Guide

Enforcement and penalties will vary by jurisdiction. There are, however, certain practices that will promote compliance with lighting regulations. Education is a key tool in promoting compliance. Proactive enforcement procedures can include providing a copy of the lighting regulations to every contractor at the time they visit to obtain a building permit. Another effective tool is a requirement that the builder or developer acknowledge in writing that the he or she is familiar with the lighting requirements and will submit a lighting plan for approval.

VII. EXISTING LIGHTING (cont.) - Ordinance Text

Additions of 25 percent or more in terms of additional dwelling units, gross floor area, seating capacity, or parking spaces, either with a single addition or with cumulative additions after the effective date of this Ordinance.

Single or cumulative additions, modification or replacement of 25 percent or more of installed outdoor lighting luminaires existing as of the effective date of this Ordinance.

2. Minor Modifications, Additions, or New Lighting Fixtures for Non-residential and Multiple Dwellings

For non-residential and multiple dwellings, all additions, modifications, or replacement of more than 25 percent of outdoor lighting fixtures existing as of the effective date of this Ordinance shall require the submission of a complete inventory and site plan detailing all existing and any proposed new outdoor lighting.

Any new lighting shall meet the requirements of this Ordinance.

3. Resumption of Use after Abandonment

If a property with non-conforming lighting is abandoned for a period of six months or more, then all outdoor lighting shall be brought into compliance with this Ordinance before any further use of the property occurs.

VIII. ENFORCEMENT & PENALTIES - Ordinance Text

(Reserved)

VIII. ENFORCEMENT AND PENALTIES (cont.) - User's Guide

Submission of the Lighting Plan should be required as a precondition to any approvals. The Lighting Plan should include the location and BUG rating for each luminaire, specify whether compliance is by the performance or prescriptive method, and a worksheet to show that the luminaires and their BUG ratings are compliant.

IX. TABLES - User's Guide

The tables are to be reviewed periodically by a joint committee of the IES and IDA, and adjusted as standards and technology permit. If more research on the impacts of outdoor lighting shows the effects of light pollution to be a significant concern, then the values in the tables may be modified. Such changes will have no significant impact to the balance of the language of the Ordinance or Code.

VIII. ENFORCEMENT & PENALTIES - Ordinance Text

IX. TABLES - Ordinance Text

Table A - Allowed Total Initial Luminaire Lumens per Site for Non-residential Outdoor Lighting, Per Parking Space Method
May only be applied to properties up to 10 parking spaces (including handicapped accessible spaces).

LZ-0	LZ-1	LZ-2	LZ-3	LZ-4
350 lms/space	490 lms/space	630 lms/space	840 lms/space	1,050 lms/space

Table B - Allowed Total Initial Lumens per Site for Non-residential Outdoor Lighting, Hardscape Area Method
May be used for any project. When lighting intersections of site drives and public streets or road, a total of 600 square feet for each intersection may be added to the actual site hardscape area to provide for intersection lighting.

LZ-0	LZ-1	LZ-2	LZ-3	LZ-4
Base Allowance				
0.5 lumens per SF of Hardscape	1.25 lumens per SF of Hardscape	2.5 lumens per SF of Hardscape	5.0 lumens per SF of Hardscape	7.5 lumens per SF of Hardscape

IX. TABLES - Ordinance Text

Table B - *Lumen Allowances, in Addition to Base Allowance*

	LZ 0	LZ 1	LZ 2	LZ 3	LZ 4
Additional allowances for sales and service facilities. No more than two additional allowances per site, Use it or Lose it.					
Outdoor Sales Lots. This allowance is lumens per square foot of uncovered sales lots used exclusively for the display of vehicles or other merchandise for sale, and may not include driveways, parking or other non sales areas. To use this allowance, luminaires must be within 2 mounting heights of sales lot area.	**0**	**4 lumens per square foot**	**8 lumens per square foot**	**16 lumens per square foot**	**16 lumens per square foot**
Outdoor Sales Frontage. This allowance is for lineal feet of sales frontage immediately adjacent to the principal viewing location(s) and unobstructed for its viewing length. A corner sales lot may include two adjacent sides provided that a different principal viewing location exists for each side. In order to use this allowance, luminaires must be located between the principal viewing location and the frontage outdoor sales area	**0**	**0**	**1,000 per LF**	**1,500 per LF**	**2,000 per LF**
Drive Up Windows. In order to use this allowance, luminaires must be within 20 feet horizontal distance of the center of the window.	**0**	**2,000 lumens per drive-up window**	**4,000 lumens per drive-up window**	**8,000 lumens per drive-up window**	**8,000 lumens per drive-up window**
Vehicle Service Station. This allowance is lumens per installed fuel pump.	**0**	**4,000 lumens per pump (based on 5 fc horiz)**	**8,000 lumens per pump (based on 10 fc horiz)**	**16,000 lumens per pump (based on 20 fc horiz)**	**24,000 lumens per pump (based on 20 fc horiz)**

IX. TABLES - TABLE C BUG RATING - User's Guide

Work on the BUG system started in 2005 when the IES upgraded the roadway cutoff classification system. The original system, which included the ratings full cutoff, cutoff, semi-cutoff and non cutoff, had been designed as a rating system focused on brightness and glare control. However, with increasing demand for control of uplight and light trespass in addition to glare, IES realized that a more comprehensive system was needed. IES developed TM-15 *Luminaire Classification System for Outdoor Luminaires*.

As this is a relatively new rating system, and many people may not be familiar with it, more explanation of how the rating system works is provided here. For example, some people are familiar with terms such as "full cutoff" and they may expect the MLO to include those terms. It will be very important that all groups recognize that older terms and concepts are inadequate for the complex tasks of controlling light pollution. It is recommended that the new rating system adopted in TM-15, as followed herein by the MLO, be used intact and exclusively.

BUG requires downlight only with low glare (better than full cut off) in lighting zones 0, 1 and 2, but allows a minor amount of uplight in lighting zones 3 and 4. In lighting zones 3 and 4, the amount of allowed uplight is enough to permit the use of very well shielded luminaires that have a decorative drop lens or chimney so that dark sky friendly lighting can be installed in places that traditional-appearing luminaires are required. BUG typically cannot be used for residential luminaires unless they have been photometrically tested. For non-photometrically tested residential luminaires, shielding description is used instead.

The lumen limits established for each lighting zone apply to all types of lighting within that zone. This includes, but is not limited to, specialty lighting, façade lighting, security lighting and the front row lighting for auto dealerships. BUG rating limits are defined for each luminaire and

IX. TABLES (cont.) - Ordinance Text

Table C - Maximum Allowable Backlight, Uplight and Glare (BUG) Ratings

May be used for any project. A luminaire may be used if it is rated for the lighting zone of the site or lower in number for all ratings B, U and G. Luminaires equipped with adjustable mounting devices permitting alteration of luminaire aiming in the field shall not be permitted.

TABLE C-1	Lighting Zone 0	Lighting Zone 1	Lighting Zone 2	Lighting Zone 3	Lighting Zone 4
Allowed Backlight Rating*					
Greater than 2 mounting heights from property line	B1	B3	B4	B5	B5
1 to less than 2 mounting heights from property line and ideally oriented**	B1	B2	B3	B4	B4
0.5 to 1 mounting heights from property line and ideally oriented**	B0	B1	B2	B3	B3
Less than 0.5 mounting height to property line and properly oriented**	B0	B0	B0	B1	B2

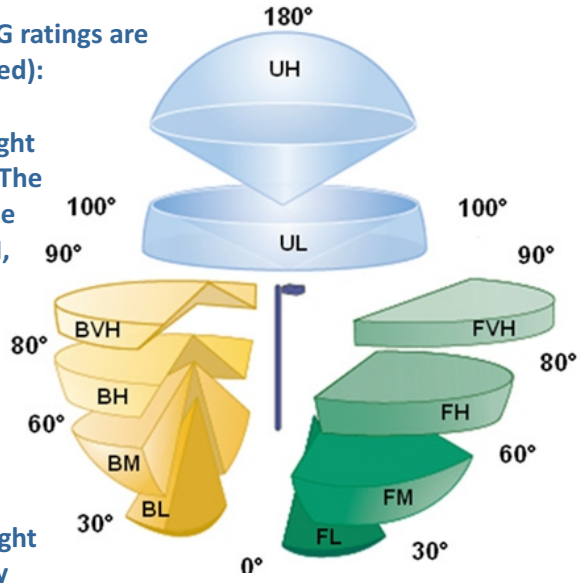
*For property lines that abut public walkways, bikeways, plazas, and parking lots, the property line may be considered to be 5 feet beyond the actual property line for purpose of determining compliance with this section. For property lines that abut public roadways and public transit corridors, the property line may be considered to be the center-line of the public roadway or public transit corridor for the purpose of determining compliance with this section. NOTE: This adjustment is relative to Table C-1 and C-3 only and shall not be used to increase the lighting area of the site.

** To be considered 'ideally oriented', the luminaire must be mounted with the backlight portion of the light output oriented perpendicular and towards the property line of concern.

IX. TABLES - TABLE C BUG RATING (cont.) - User's Guide

are based on the internal and external design of the luminaire, its aiming, and the initial luminaire lumens of the specified luminaires. The BUG rating limits also take into consideration the distance the luminaire is installed from the property line in multiples of the mounting height (See Table C).

The three components of BUG ratings are based on IES TM-15-07 (revised):



Backlight, which creates light trespass onto adjacent sites. The B rating takes into account the amount of light in the BL, BM, BH and BVH zones, which are in the direction of the luminaire OPPOSITE from the area intended to be lighted.

Uplight, which causes artificial sky glow. Lower uplight (zone UL) causes the most sky glow and negatively affects professional and academic astronomy. Upper uplight (UH) not reflected off a surface is mostly energy waste. The U rating defines the amount of light into the upper hemisphere with greater concern for the light at or near the horizontal angles (UL).

Glare, which can be annoying or visually disabling. The G rating takes into account the amount of frontlight in the FH and FVH zones as well as BH and BVH zones.

BUG ratings apply to the Lighting Zone of the property under consideration.

IX. TABLES (cont.) - Ordinance Text

IX. TABLES - TABLE C BUG RATING (cont.) - User's Guide

(Key: UH=Uplight High, UL=Uplight Low, BVH=Backlight Very High, BH=Backlight High, BM=Backlight Medium, BL=Backlight Low, FVH=Forward Light Very High, FH=Forward Light High, FM=Forward Light Medium, FL=Forward Light Low.)

In general, a higher BUG rating means more light is allowed in solid angles, and the rating increases with the lighting zone. However, a higher B (backlight) rating simply indicates that the luminaire directs a significant portion of light behind the pole, so B ratings are designated based on the location of the luminaire with respect to the property line. A high B rating luminaire maximizes the spread of light, and is effective and efficient when used far from the property line. When luminaires are located near the property line, a lower B rating will prevent unwanted light from interfering with neighboring properties.

At the 90-180 degree ranges:

- Zone 0 allows no light above 90 degrees.
- Zone 1 allows only 10 lumens in the UH and UL zones, 20 lumens total in the complete upper hemisphere. (This is roughly equivalent to a 5 W incandescent lamp).
- Zone 2 allows only 50 lumens in the UH and UL zones, 100 lumens total (less than a 25W incandescent lamp).
- Zone 3 allows only 500 lumens in the UH and UL zones, 1000 lumens total (about the output of a 75W incandescent bulb).
- Zone 4 allows only 1,000 lumens in the UH and UL zones, 2000 lumens total (about the output of a 100W incandescent bulb).

IX. TABLES (cont.) - Ordinance Text

Table C - 2 Maximum Allowable Uplight (BUG) Ratings - Continued

TABLE C-2	Lighting Zone 0	Lighting Zone 1	Lighting Zone 2	Lighting Zone 3	Lighting Zone 4
Allowed Uplight Rating	U0	U1	U2	U3	U4
Allowed % light emission above 90° for street or Area lighting	0%	0%	0%	0%	0%

Table C - 3 Maximum Allowable Glare (BUG) Ratings - Continued

TABLE C-3	Lighting Zone 0	Lighting Zone 1	Lighting Zone 2	Lighting Zone 3	Lighting Zone 4
Allowed Glare Rating	G0	G1	G2	G3	G4
Any luminaire not ideally oriented*** with 1 to less than 2 mounting heights to any property line of concern	G0	G0	G1	G1	G2
Any luminaire not ideally oriented*** with 0.5 to 1 mounting heights to any property line of concern	G0	G0	G0	G1	G1
Any luminaire not ideally oriented*** with less than 0.5 mounting heights to any property line of concern	G0	G0	G0	G0	G1

*** Any luminaire that cannot be mounted with its backlight perpendicular to any property line within 2X the mounting heights of the luminaire location shall meet the reduced Allowed Glare Rating in Table C-3.

TABLE D EXAMPLE - PERFORMANCE METHOD - User's Guide

The first step in the Performance Method is to establish the Site Total Initial Site Lumens which regulates overlighting. The performance method allows layers of light depending on the complexity of the site.

Table D establishes the basic total initial site lumens allowed. These lumen allowances are added together for a total initial site lumen allowance. Allowances include:

1) Initial lumen allowance per site

2) Per area (SF) of hardscape

IX. TABLES (cont.) - Ordinance Text

Table D Performance Method Allowed Total Initial Site Lumens

May be used on any project.

Lighting Zone	LZ 0	LZ 1	LZ 2	LZ 3	LZ 4
Allowed Lumens Per SF	0.5	1.25	2.5	5.0	7.5
Allowed Base Lumens Per Site	0	3,500	7,000	14,000	21,000

Table E Performance Method Additional Initial Luminaire Lumen Allowances. All of the following are "use it or lose it" allowances.

All area and distance measurements in plan view unless otherwise noted.

Lighting Application	LZ 0	LZ 1	LZ 2	LZ 3	LZ 4
Additional Lumens Allowances for All Buildings except service stations and outdoor sales facilities. A MAXIMUM OF THREE (3) ALLOWANCES ARE PERMITTED. THESE ALLOWANCES ARE "USE IT OR LOSE IT".					
Building Entrances or Exits. This allowance is per door. In order to use this allowance, luminaires must be within 20 feet of the door.	400	1,000	2,000	4,000	6,000
Building Facades. This allowance is lumens per unit area of building façade that are illuminated. To use this allowance, luminaires must be aimed at the façade and capable of illuminating it without obstruction.	0	0	8/SF	16/SF	24/SF

TABLE E PERFORMANCE METHOD - User's Guide

The allowable light levels for these uses defined in Table E may be used to set a prescriptive lighting allowance for these uses in each lighting zone. It should be noted that the lighting allowance defined in Table E is only applicable for the area defined for that use and cannot be transferred to another area of the site. For some uses, such as outdoor sales, the jurisdiction is encourages to define a percentage of the total hardscape area that is eligible for the additional lighting allowance. For example, a set percentage of a car dealership's lot may be considered a display area and receive the additional lighting allowance where the remainder of the lot would be considered storage, visitor parking, etc. and cannot exceed the base light levels defined in Table A.

TABLE E EXAMPLE - PERFORMANCE METHOD - User's Guide

IX. TABLES (cont.) - Ordinance Text

Table E - Performance Method Additional Initial Lumen Allowances (cont.)

Lighting Application	LZ 0	LZ 1	LZ 2	LZ 3	LZ 4
Sales or Non-sales Canopies. This allowance is lumens per unit area for the total area within the drip line of the canopy. In order to qualify for this allowance, luminaires must be located under the canopy.	0	3/SF	6/SF	12/SF	18/SF
Guard Stations. This allowance is lumens per unit area of guardhouse plus 2000 sf per vehicle lane. In order to use this allowance, luminaires must be within 2 mounting heights of a vehicle lane or the guardhouse.	0	6/SF	12/SF	24/SF	36/SF
Outdoor Dining. This allowance is lumens per unit area for the total il-luminated hardscape of outdoor dining. In order to use this allowance, luminaires must be within 2 mounting heights of the hardscape area of outdoor dining	0	1/SF	5/SF	10/SF	15/SF
Drive Up Windows. This allowance is lumens per window. In order to use this allowance, luminaires must be within 20 feet of the center of the window.	0	2,000 lumens per drive-up window	4,000 lumens per drive-up window	8,000 lumens per drive-up window	8,000 lumens per drive-up window
Additional Lumens Allowances for Service Stations only. Service stations may not use any other additional allowances.					
Vehicle Service Station Hardscape. This allowance is lumens per unit area for the total illuminated hardscape area less area of buildings, area under canopies, area off property, or areas obstructed by signs or structures. In order to use this allowance, luminaires must be illuminating the hardscape area and must not be within a building, below a canopy, beyond property lines, or obstructed by a sign or other structure.	0	4/SF	8/SF	16/SF	24/SF

Table E - Performance Method Additional Initial Lumen Allowances (cont.)

Lighting Application	LZ 0	LZ 1	LZ 2	LZ 3	LZ 4
Vehicle Service Station Canopies. This allowance is lumens per unit area for the total area within the drip line of the canopy. In order to use this allowance, luminaires must be located under the canopy.	**0**	**8/SF**	**16/SF**	**32/SF**	**32/SF**
Additional Lumens Allowances for Outdoor Sales facilities only. Outdoor Sales facilities may not use any other additional allowances. **NOTICE:** lighting permitted by these allowances shall employ controls extinguishing this lighting after a curfew time to be determined by the Authority.					
Outdoor Sales Lots. This allowance is lumens per square foot of uncovered sales lots used exclusively for the display of vehicles or other merchandise for sale, and may not include driveways, parking or other non sales areas and shall not exceed 25% of the total hardscape area. To use this allowance, Luminaires must be within 2 mounting heights of the sales lot area.	**0**	**4/SF**	**8/SF**	**12/SF**	**18/SF**
Outdoor Sales Frontage. This allowance is for lineal feet of sales frontage immediately adjacent to the principal viewing location(s) and unobstructed for its viewing length. A corner sales lot may include two adjacent sides provided that a different principal viewing location exists for each side. In order to use this allowance, luminaires must be located between the principal viewing location and the frontage outdoor sales area.	**0**	**0**	**1,000/ LF**	**1,500/ LF**	**2,000/ LF**

IX. TABLES (cont.) - Ordinance Text

Table F Maximum Vertical Illuminance at any point in the plane of the property line

Lighting Zone 0	Lighting Zone 1	Lighting Zone 2	Lighting Zone 3	Lighting Zone 4
0.05 FC or 0.5 LUX	0.1 FC or 1.0 LUX	0.3 FC or 3.0 LUX	0.8 FC or 8.0 LUX	1.5 FC or 15.0 LUX

TABLE G RESIDENTIAL LIGHTING - User's Guide

Residential Light Levels

Most residential lighting has traditionally used incandescent lamps which are identified by their wattage. However, since new technologies provide more light for fewer watts, it is no longer possible to regulate residential lighting solely by providing a maximum wattage. Table G, therefore, lists maximum initial luminaire lumens only.

IX. TABLES (cont.) - Ordinance Text

Table G - Residential Lighting Limits

Lighting Application	LZ 0	LZ 1	LZ 2	LZ 3	LZ 4
Row 1 Maximum Allowed Luminaire Lumens* for Unshielded Luminaires at one entry only	Not allowed	420 lumens	630 lumens	630 lumens	630 lumens
Row 2 Maximum Allowed Luminaire Lumens* for each Fully Shielded Luminaire	630 lumens	1,260 lumens	1,260 lumens	1,260 lumens	1,260 lumens
Row 3 Maximum Allowed Luminaire Lumens* for each Unshielded Luminaire excluding main entry	Not allowed	315 lumens	315 lumens	315 lumens	315 lumens
Row 4 Maximum Allowed Luminaire Lumens* for each Landscape Lighting	Not allowed	Not allowed	1,050 lumens	2,100 lumens	2,100 lumens
Row 5 Maximum Allowed Luminaire Lumens* for each Shielded Directional Flood Lighting	Not allowed	Not allowed	1,260 lumens	2,100 lumens	2,100 lumens
Row 6 Maximum Allowed Luminaire Lumens* for each Low Voltage Landscape Lighting	Not allowed	Not allowed	525 lumens	525 lumens	525 lumens

*** Luminaire lumens equals Initial Lamp Lumens for a lamp, multiplied by the number of lamps in the luminaire**

X. DEFINITIONS - User's Guide

Definitions are typically generally added to any code when new code sections are added. The definitions are legally required and play a significant role in the interpretation of the ordinance and code.

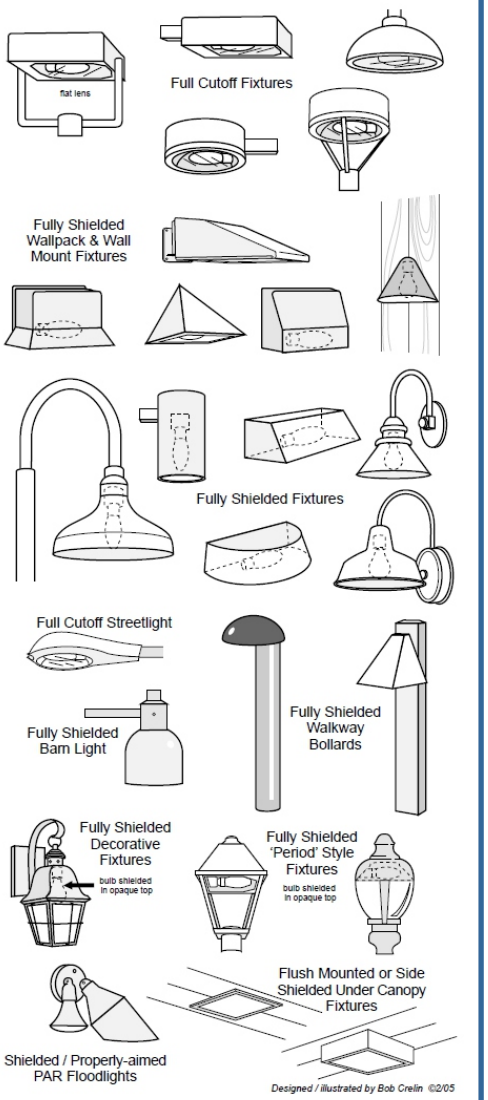
Most city attorneys will not accept references to outside sources regardless of credibility, such as the IES Handbook. Thus as a general rule, a definition for an unfamiliar term (e.g. lumens) must be added by the adopting ordinance.

When adopting or integrating the MLO definitions, be sure to retire conflicting technical terminology. In particular, the latest IES Luminaire Classification System as defined in IES TM-15-07 is likely to need attention.

X. DEFINITIONS - Ordinance Text

Absolute Photometry	Photometric measurements (usually of a solid-state luminaire) that directly measures the footprint of the luminaire. Reference Standard IES LM-79
Architectural Lighting	Lighting designed to reveal architectural beauty, shape and/or form and for which lighting for any other purpose is incidental.
Authority	The adopting municipality, agency or other governing body.
Astronomic Time Switch	An automatic lighting control device that switches outdoor lighting relative to time of solar day with time of year correction.
Backlight	For an exterior luminaire, lumens emitted in the quarter sphere below horizontal and in the opposite direction of the intended orientation of the luminaire. For luminaires with symmetric distribution, backlight will be the same as front light.
BUG	A luminaire classification system that classifies backlight (B), uplight (U) and glare (G).
Canopy	A covered, unconditioned structure with at least one side open for pedestrian and/or vehicular access. (An unconditioned structure is one that may be open to the elements and has no heat or air conditioning.)
Common Outdoor Areas	One or more of the following: a parking lot; a parking structure or covered vehicular entrance; a common entrance or public space shared by all occupants of the domiciles.
Curfew	A time defined by the authority when outdoor lighting is reduced or extinguished.

Examples of Fully Shielded Luminaires



X. DEFINITIONS - Ordinance Text

Emergency conditions	Generally, lighting that is only energized during an emergency; lighting fed from a backup power source; or lighting for illuminating the path of egress solely during a fire or other emergency situation; or, lighting for security purposes used solely during an alarm.
Footcandle	The unit of measure expressing the quantity oflight received on a surface. One footcandle is the illuminance produced by a candle on a surface one foot square from a distance of one foot.
Forward Light	For an exterior luminaire, lumens emitted in the quarter sphere below horizontal and in the direction of the intended orientation of the luminaire.
Fully Shielded Luminaire	A luminaire constructed and installed in such a manner that all light emitted by the luminaire, either directly from the lamp or a diffusing element, or indirectly by reflection or refraction from any part of the luminaire, is projected below the horizontal plane through the luminaire's lowest light-emitting part.
Glare	Lighting entering the eye directly from luminaires or indirectly from reflective surfaces that causes visual discomfort or reduced visibility.
Hardscape	Permanent hardscape improvements to the site including parking lots, drives, entrances, curbs, ramps, stairs, steps, medians, walkways and non-vegetated landscaping that is 10 feet or less in width. Materials may include concrete, asphalt, stone, gravel, etc.
Hardscape Area	The area measured in square feet of all hardscape. It is used to calculate the Total Site Lumen Limit in both the Prescriptive Method and Performance Methods. Refer to Hardscape definition.

X. DEFINITIONS - Ordinance Text

Hardscape Perimeter	The perimeter measured in linear feet is used to calculate the Total Site Lumen Limit in the Performance Method. Refer to Hardscape definition.
IDA	International Dark-Sky Association.
IESNA	Illuminating Engineering Society of North America.
Impervious Material	Sealed to severely restrict water entry and movement
Industry Standard Lighting Software	Lighting software that calculates point-by-point illuminance that includes reflected light using either ray-tracing or radiosity methods.
Lamp	A generic term for a source of optical radiation (i.e. "light"), often called a "bulb" or "tube". Examples include incandescent, fluorescent, high-intensity discharge (HID) lamps, and low pressure sodium (LPS) lamps, as well as light-emitting diode (LED) modules and arrays.
Landscape Lighting	Lighting of trees, shrubs, or other plant material as well as ponds and other landscape features.
LED	Light Emitting Diode.
Light Pollution	Any adverse effect of artificial light including, but not limited to, glare, light trespass, sky-glow, energy waste, compromised safety and security, and impacts on the nocturnal environment.

X. DEFINITIONS - Ordinance Text

Light Trespass	Light that falls beyond the property it is intended to illuminate.
Lighting	"Electric" or "man-made" or "artificial" lighting. See "lighting equipment".
Lighting Equipment	Equipment specifically intended to provide gas or electric illumination, including but not limited to, lamp(s), luminaire(s), ballast(s), poles, posts, lens(s), and related structures, electrical wiring, and other necessary or auxiliary components.
Lighting Zone	An overlay zoning system establishing legal limits for lighting for particular parcels, areas, or districts in a community.
Lighting Equipment	Equipment specifically intended to provide gas or electric illumination, including but not limited to, lamp(s), luminaire(s), ballast(s), poles, posts, lens(s), and related structures, electrical wiring, and other necessary or auxiliary components.
Low Voltage Landscape Lighting	Landscape lighting powered at less than 15 volts and limited to luminaires having a rated initial luminaire lumen output of 525 lumens or less.
Lumen	The unit of measure used to quantify the amount of light produced by a lamp or emitted from a luminaire (as distinct from "watt," a measure of power consumption).
Luminaire	The complete lighting unit (fixture), consisting of a lamp, or lamps and ballast(s) (when applicable), together with the parts designed to distribute the light (reflector, lens, diffuser), to position and protect the lamps, and to connect the lamps to the power supply.

***Mounting Height*: The horizontal spacing of poles is often measured in units of "mounting height". Example: "The luminaires can be spaced up to 4 mounting heights apart."**

X. DEFINITIONS - Ordinance Text

Luminaire Lumens	For luminaires with relative photometry per IES, it is calculated as the sum of the initial lamp lumens for all lamps within an individual luminaire, multiplied by the luminaire efficiency. If the efficiency is not known for a residential luminaire, assume 70%. For luminaires with absolute photometry per IES LM-79, it is the total luminaire lumens. The lumen rating of a luminaire assumes the lamp or luminaire is new and has not depreciated in light output.
Lux	The SI unit of illuminance. One lux is one lumen per square meter. 1 Lux is a unit of incident illuminance approximately equal to 1/10 footcandle.
Mounting height	The height of the photometric center of a luminaire above grade level.
New lighting	Lighting for areas not previously illuminated; newly installed lighting of any type except for replacement lighting or lighting repairs.
Object	A permanent structure located on a site. Objects may include statues or artwork, garages or canopies, outbuildings, etc.
Object Height	The highest point of an entity, but shall not include antennas or similar structures.
Ornamental lighting	Lighting that does not impact the function and safety of an area but is purely decorative, or used to illuminate architecture and/or land-scaping, and installed for aesthetic effect.

X. DEFINITIONS - Ordinance Text

Ornamental Street Lighting	A luminaire intended for illuminating streets that serves a decorative function in addition to providing optics that effectively deliver street lighting. It has a historical period appearance or decorative appearance, and has the following design characteristics: · designed to mount on a pole using an arm, pendant, or vertical tenon; · opaque or translucent top and/or sides; · an optical aperture that is either open or enclosed with a flat, sag or drop lens; · mounted in a fixed position; and · with its photometric output measured using Type C photometry per IESNA LM-75-01.
Outdoor Lighting	Lighting equipment installed within the property line and outside the building envelopes, whether attached to poles, building structures, the earth, or any other location; and any associated lighting control equipment.
Partly shielded luminaire	A luminaire with opaque top and translucent or perforated sides, designed to emit most light downward.
Pedestrian Hardscape	Stone, brick, concrete, asphalt or other similar finished surfaces intended primarily for walking, such as sidewalks and pathways.
Photoelectric Switch	A control device employing a photocell or photodiode to detect daylight and automatically switch lights off when sufficient daylight is available.
Property line	The edges of the legally-defined extent of privately owned property.

X. DEFINITIONS - Ordinance Text

Relative photometry	Photometric measurements made of the lamp plus luminaire, and adjusted to allow for light loss due to reflection or absorption within the luminaire. Reference standard: IES LM-63.
Repair(s)	The reconstruction or renewal of any part of an existing luminaire for the purpose of its on-going operation, other than relamping or replacement of components including capacitor, ballast or photocell. Note that retrofitting a luminaire with new lamp and/or ballast technology is not considered a repair and for the purposes of this ordinance the luminaire shall be treated as if new. "Repair" does **not** include normal relamping or replacement of components including capacitor, ballast or photocell.
Replacement Lighting	Lighting installed specifically to replace existing lighting that is sufficiently broken to be beyond repair.
Sales area	Uncovered area used for sales of retail goods and materials, including but not limited to automobiles, boats, tractors and other farm equipment, building supplies, and gardening and nursery products.
Seasonal lighting	Temporary lighting installed and operated in connection with holidays or traditions.
Shielded Directional Luminaire	A luminaire that includes an adjustable mounting device allowing aiming in any direction and contains a shield, louver, or baffle to reduce direct view of the lamp.
Sign	Advertising, directional or other outdoor promotional display of art, words and/or pictures.

X. DEFINITIONS - Ordinance Text

Sky Glow	The brightening of the nighttime sky that results from scattering and reflection of artificial light by moisture and dust particles in the atmosphere. Skyglow is caused by light directed or reflected upwards or sideways and reduces one's ability to view the night sky.
Temporary lighting	Lighting installed and operated for periods not to exceed 60 days, completely removed and not operated again for at least 30 days.
Third Party	A party contracted to provide lighting, such as a utility company.
Time Switch	An automatic lighting control device that switches lights according to time of day.
Translucent	Allowing light to pass through, diffusing it so that objects beyond cannot be seen clearly (not transparent or clear).
Unshielded Luminaire	A luminaire capable of emitting light in any direction including downwards.
Uplight	For an exterior luminaire, flux radiated in the hemisphere at or above the horizontal plane.
Vertical Illuminance	Illuminance measured or calculated in a plane perpendicular to the site boundary or property line.

XI. OPTIONAL STREETLIGHT ORDINANCE - User's Guide

This section was added since the first public review. It is designed to work closely with the proposed revision to ANSI/IES RP-8 Standard Practice for Roadway and Street Lighting.

Street and roadway lighting is one of the world's largest causes of artificial skyglow. Many adopting agencies will recognize that the MLO will make privately owned lighting more efficient and environmentally responsible than their street lighting systems. But because the process of designing street lighting often requires more precise lighting calculations, applying the MLO directly to street lighting is not advised. Using existing standards of street lighting is recommended, particularly IES RP-8 and AASHTO standards.

Until a new recommended practice for street lighting can be developed, this section can serve to prevent most of the uplight of street lighting systems without setting specific requirements for the amount of light, uniformity of light, or other performance factors. Adopting agencies should include these basic improvements to street lighting along with regulations to private lighting.

Lighting streets with "period" ornamental luminaires that evoke the look of a time when the light source was a gas flame can cause glare if high-lumen lamps are used. Such ornamental street lights should not exceed a BUG rating of G1. If additional illuminance and/or uniformity is desired, the ornamental fixtures should be supplemented by higher mounted fully shielded luminaires, as illustrated in RP-33-99.

Few street lighting warranting processes exist. The adopting agency needs to gauge whether a complex warranting systems is required, or if a simple one using posted speeds, presence of pedestrians, or other practical considerations is sufficient.

Examples of a current street lighting warranting system are included in the Transportation Association of Canada's Guide for the Design of Roadway Lighting 2006.

XI. OPTIONAL STREETLIGHT ORDINANCE - Ordinance Text

Note to the adopting authority: the intent of this section is that it only applies to streets and not to roadways or highways.

A. Preamble

The purpose of this Ordinance is to control the light pollution of street lighting, including all collectors, local streets, alleys, sidewalks and bikeways, as defined by ANSI/IES RP-8 Standard Practice for Roadway and Street Lighting and in a manner consistent with the Model Lighting Ordinance.

B. Definitions

Roadway or Highway lighting is defined as lighting provided for freeways, expressways, limited access roadways, and roads on which pedestrians, cyclists, and parked vehicles are generally not present. The primary purpose of roadway or highway lighting is to help the motorist remain on the roadway and help with the detection of obstacles within and beyond the range of the vehicle's headlights.

Street lighting is defined as lighting provided for major, collector, and local roads where pedestrians and cyclists are generally present. The primary purpose of street lighting is to help the motorist identify obstacles, provide adequate visibility of pedestrians and cyclists, and assist in visual search tasks, both on and adjacent to the roadway.

Ornamental Street Lighting is defined as a luminaire intended for illuminating streets that serves a decorative function in addition to providing optics that effectively deliver street lighting. It has a historical period appearance or decorative appearance, and has the following design characteristics:

- designed to mount on a pole using an arm, pendant, or vertical tenon;
- opaque or translucent top and/or sides;
- an optical aperture that is either open or enclosed with a flat, sag or drop lens;
- mounted in a fixed position; and
- with its photometric output measured using Type C photometry per IESNA LM-75-01.

XI. OPTIONAL STREETLIGHT ORDINANCE - Ordinance Text

C. Scope

All street lighting not governed by regulations of federal, state or other superceding jurisdiction.

EXCEPTION: lighting systems mounted less than 10.5 feet above street level and having less than 1000 initial lumens each.

D. Master Lighting Plan

The Authority shall develop a Master Lighting Plan based on the American Association of State Highway and Transportation Officials (AASHTO) Roadway Lighting Design Guide GL-6, October 2005, Chapter 2. Such plan shall include, but not be limited to, the Adoption of Lighting Zones and:

1. Goals of street lighting in the jurisdiction by Lighting Zone
2. Assessment of the safety and security issues in the jurisdiction by Lighting Zone
3. Environmentally judicious use of resources by Lighting Zone
4. Energy use and efficiency by Lighting Zone
5. Curfews to reduce or extinguish lighting when no longer needed by Lighting Zone

E. Warranting

The Authority shall establish a warranting process to determine whether lighting is required. Such warranting process shall not assume the need for any lighting nor for continuous lighting unless conditions warrant the need. Lighting shall only be installed where warranted.

XI. OPTIONAL STREETLIGHT ORDINANCE - Ordinance Text

F. Light Shielding and Distribution

All street lighting shall have no light emitted above 90 degrees.

Exception: Ornamental street lighting for specific districts or projects shall be permitted by special permit only, and shall meet the requirements of Table H below without the need for external field-added modifications.

Table H - Uplight Control Requirements for Ornamental Street Lights - by Special Permit Only

Lighting Zone	Maximum Uplight Rating
LZ-0	U-0
LZ-1	U-1
LZ-2	U-2
LZ-3	U-3
LZ-4	U-4

Appendix 8

CHEKCLIST OF PLANTS REPORTED FROM HONUA'ULA AND ULUPALAKUA-KANAIO PARCELS

Checklist includes plants reported from Honua'ula by Char and Linney (1988), Char (1993, 2004), Altenberg (2007), and SWCA (2010); and for Ulupalakua by Medeiros et al. (2003) plant inventory of Kanaio NAR. Plant names appear alphabetically by family and then by species into each of three groups: Ferns and Fern Allies (Pteridophytes), Monocots, and Dicots. The taxonomy and nomenclature of the flowering plants are based on Wagner et al. (1999), Wagner and Herbst (1999), and Staples and Herbst (2005). Recent name changes are those recorded in the Hawaii Biological Survey series (Evenhuis and Eldredge, eds, 1999-2002). The list includes scientific name with author citation, common English and/or Hawaiian name(s), and biogeographic status.

KEY to biographic status: E = endemic (occurring only in the Hawaiian Islands); I = indigenous (native to the Hawaiian Islands and elsewhere); X = introduced or alien (all those plants brought to the Hawaiian Islands after 1778). O indicates that the species was observed by SWCA; R indicates species was reported by others.

KEY to site occurrence: O = observed during recent SWCA surveys, R = recorded during previous non-SWCA surveys.

Scientific Name	Common Name	Status	Site	
			Honua'ula	Ulupalakua
PTERIDOPHYTES				
Adiantaceae				
Adiantum capillus-veneris L.	maiden-hair fern	I	R	
Doryopteris decipiens (Hook.) J. Sm.	*iwaiwa*	E	O	O
Pellaea ternifolia (Cav.) Link	pellaea	I	R	O
Aspleniaceae				
Asplenium adiantum-nigrum		I		R
Asplenium praemorsum		I		R
Nephrolepis multiflora (Roxb.) F.M. Jarrett ex. C.V. Morton	sword fern	X	R	O
Dennstaediaceae				

Scientific Name	Common Name	Status	Site	
			Honuaʻula	Ulupalakua
Pteridium aquilinum var. decompositum		E		R
Dryopteridaceae				
Dryopteris unidentata		E		R
Polypodiaceae				
Pleopeltis thunbergiana		I		R
Polhypodium pellucidum		E		R
Psilotaceae				
Psilotum nudum	*moa*	I		O
Pteridaceae				
Pityrogramma austroamericana		X		R
MONOCOTS				
Agavaceae				
Furcraea foetida (L.) Haw.	*malina*	X	O	
Pleomele auwahiensis	*hala pepe*	E		O
Cannaceae				
Canna indica L.	indian shot	X	R	
Commelineaceae				
Commelina benghalensis L.	hairy *honohono*	X	O	

Scientific Name	Common Name	Status	Site	
			Honuaʻula	Ulupalakua
Commelina diffusa N.L. Burm.	blue day flower	X	R	
Cyperaceae				
Carex wahuensis		E		O
Cyperus gracilis		X		R
Cyperus hillebrandii		E		R
Liliaceae				
Crinum sp.	crinum	X	R	
Yucca sp.	yucca	X	R	
Poaceae				
Bothriochloa pertusa (L.) A. Camus	hurricane grass	X	R	R
Brachiara subqudripa (Trin.) A.S. Hitchc	brachiara	X	R	
Cenchrus agrimoniodes var. agrimoniodes		E		R
Cenchrus ciliaris L.	buffelgrass	X	O	O
Cenchrus echinatus L.	sandbur	X	R	O
Chloris barbata (L.) Sw.	swollen finger grass	X	O	
Chloris radiata (L.) Sw.	plush finger grass	X	R	
Cynodon dactylon (L.) Pers	*manienie*	X	O	
Digitaria ciliaris (Retz.) Koeler	Henry's crab grass	X	R	R

Scientific Name	Common Name	Status	Site	
			Honuaʻula	Ulupalakua
Digitaria insularis (L.) Mez ex Ekman	sour grass	X	O	
Digitaria radicosa (Presl.) Miq.	digitaria	X	R	
Digitaria sp.	crab grass	X	R	
Eleusine indica (L.) Gaertn.	goose grass	X	R	
Eragrostis cilianensis (All.) Vign. ex Janchen	stink grass	X	R	
Eragrostis tenella (L.) Beauv. ex R. & S.	love grass	X	R	
Eragrostis variabilis		E		R
Eragrostis sp.	eragrostis	X	R	
Heteropogon contortus (L.) P. Beauv. ex Roem. & Schult.	*pili* grass	E	O	
Melinis minutiflora	molasses grass	X		O
Panicum maximum L.	guinea grass	X	O	R
Panicum pellitum	*kai`oi`o*	E		O
Panicum torridum Gaud.	*kakonakona*	E	R	
Pennisetum clandestinum	kikuyu grass	X		O
Pennisetum purpureum	elephant grass	X		O
Rhynchelytrum repens (Willd.) Hubb.	natal red top	X	O	O
Setaria verticillata (L.) P. Beauv.	*mauʻu pilipili*	X	R	
Sporobolus africanus	african dropseed	X		O

Scientific Name	Common Name	Status	Site	
			Honuaʻula	Ulupalakua
Tragus berteronianus J.A. Schultes	goat grass	X	R	
Urochloa subquadripara (Trin.) R. Webster	signal grass	X	R	
Zoysia sp.	zoysia	X	R	

Scientific Name	Common Name	Status	Site	
			Honuaʻula	Ulupalakua
DICOTS				
Amaranthaceae				
Amaranthus spinosus L.	spiny amaranth	X	O	O
Nototrichium sandwicense		E		R
Anacardiaceae				
Schinus terebinthifolius		X		R
Apiaceae				
Foeniculum vulgare		X		R
Petroselinum crispum	parsley	X		O
Apocynaceae				
Alyxia oliviformis		E		R
Rauvolfia sandwicensis	*hao*	E		O
Araliaceae				
Reynoldsia sandwicensis		E		O
Asclepiadaceae				
Asclepias curassavica		X		R
Asclepias physocarpa (E.Mey.) Schltr.	balloon plant	X	O	O
Stapelia gigantea (N.E. Brown)	zulu giant	X	O	

Scientific Name	Common Name	Status	Site	
			Honuaʻula	Ulupalakua
Asteraceae				
Ageratina adenophora		X		R
Ageratina riparia		X		R
Ageratum conyzoides L.	*maile hohono*	X	O	R
Bidens cynapiifolia Kunth	beggar tick	X	O	
Bidens pilosa L.	spanish needle	X	O	O
Calyptocarpus vialis Less.	straggler daisy	X	O	
Centaura melitensis L.	star thistle	X	O	
Cirsium vulgare (Savi) Ten.	bull thistle	X	O	R
Conyza bonariensis (L.) Cronq.	hairy horseweed	X	R	O
Conyza canadensis (L.) Cronq.	horseweed	X	O	
Crassocephalum crepidioides (Benth.) S.Moore		X	O	
Dubautia linearis subsp. linearis		E		R
Emilia fosbergii Nicolson	red *pualele*	X	R	O
Galinsoga parviflora Cav.		X	R	O
Gamochaeta purpurea	purple cudweed	X		O
Gnaphalium cf*. japonicum* Thunb.	cudweed	X	R	R
Heterotheca grandiflora		X		R

Scientific Name	Common Name	Status	Site	
			Honuaʻula	Ulupalakua
Hypochoeris glabra		X		O
Hypochoeris radicata		X		R
Hypochoeris sp. L.	cat's ear	X	R	O
Lactuca serriola L.	prickly lettuce	X	O	R
Lipochaeta rockii Sherff	*nehe*	E	O	
Parthenium hysterophorus L.	false ragweed	X	O	
Pluchea symphytifolia		X		R
Pseudognaphalium sandwicensium var. sandwicensium		E		R
Sigesbeckia orientalis L.		X	R	R
Sonchus asper (L.) J. Hill	spiny snowthistle	X	R	R
Sonchus oleraceus L.	*pualele*	X	O	
Sphagneticola trilobata (L.) Pruski	wedelia	X	O	
Synedrella nodiflora (L.) Gaertn.	node weed	X	R	O
Tridax procumbens L.	coat buttons	X	O	O
Verbesina encelioides (Cav.) Benth. & Hook	golden crown beard	X	O	O
Vernonia cinerea		X		R
Wollastonia lavarum		E		R
Xanthium strumarium L. var. *canadense* (Miller)	cocklebur	X	R	R

Scientific Name	Common Name	Status	Site	
			Honuaʻula	Ulupalakua
Zinnia peruviana (L.) L.	wild zinnia	X	O	R
Brassicaceae				
Capsella bursa-pastoris	shepherd's purse	X		O
Cornopus didymus (L.) Sm.	wart cress	X	R	
Lepidium virginicum	pepperwort	X		O
Sisymbrium officinale	hedge mustard	X		O
Cactaceae				
Opuntia ficus-indica (L.) Mill.	*panini*	X	O	O
Pilocereus royenii (L.) Byles & Rowley	Royen's tree cactus	X	O	
Capparaceae				
Capparis sandwichiana DC.	maiapilo	E	O	R
Cleome gynandra L.	spider flower	X	R	
Caryophyllaceae				
Arenaria serpyllifolia		X		R
Polycarpon tetraphyllum (L.) L.		X	R	R
Silene gallica		X		O
Chenopodiaceae				
Chenopodium ambrosioides		X		R

Scientific Name	Common Name	Status	Site	
			Honuaʻula	Ulupalakua
Chenopodium carinatum R.Br.		X	O	
Chenopodium murale L.	*aheahea*	X	O	
Chenopodium oahuense		E		O
Convolvulaceae				
Bonamia menziesii		E		R
Dichondria repens J. R. & G. Forst.		X	R	
Ipomoea indica (J. Burm.) Merr.	*koali awahia*	I	O	O
Ipomoea obscura (L.) Ker Gawl.	yellow bindweed	X	O	
Ipomoea tuboides (Degener & Ooststr.)	Hawaiian moon flower	E	O	O
Jacquemontia ovalifolia		E		R
Merremia aegyptia (L.) Urb.		X	O	
Crassulaceae				
Kalanchoe pinnata		X		O
Cucurbitaceae				
Cucumis dipsaceus (Ehrenb. ex Spach	wild cucumber	X	O	O
Momordica charantia L.	bitter melon	X	O	O
Sicyos hispidus Hillebr.	*ʻanunu*	E	O	
Sicyos pachycarpus Hook. & Arnott	*ʻanunu*	E	O	O

Scientific Name	Common Name	Status	Site	
			Honuaʻula	Ulupalakua
Ebenaceae				
Diospyros sandwicensis		E		O
Epacridaceae				
Styphelia tamciameiae		I		O
Euphorbiaceae				
Aleurites moluccana		X		R
Antidesma pulvinatum		E		R
Chamaesyce celastroides var. lorifolia (A. Gray) Degener & I. Degener	*ʻakoko*	E	R	R
Chamaesyce hirta (L.) Millsp.	hairy spurge	X	O	O
Chamaesyce hypercifolia (L.) Millsp.	graceful spurge	X	R	
Euphorbia heterophylla L.	*kaliko*	X	O	
Euphorbia peplus		X		R
Phyllanthus tenellus Roxb.		X	O	
Ricinus communis L.	castor bean	X	O	O
Fabaceae				
Acacia farnesiana (L.) Willd.	klu	X	O	O
Acacia koaia		E		R
Bauhinia blakeana Dunn	orchid tree	X	R	

Scientific Name	Common Name	Status	Site	
			Honuaʻula	Ulupalakua
Calopogonium mucunoides Desv.		X	R	
Cannavalia pubescens Hook. & Arnott	*ʻawikiwiki*	E	O	
Cassia fistula L.	golden shower	X	R	
Chamaecrista nictitans (L.) Moench	partridge pea	X	O	R
Crotalaria incana L.	fuzzy rattlepod	X	R	R
Crotalaria pallida Aiton	smooth rattlepod	X	R	
Desmanthus virgatus (L.) Willd.	virgate mimosa	X	O	
Desmodium incanum		X		R
Desmodium sandwicense		X		R
Desmodium tortuosum (Sw.) DC.	beggar weed	X	R	
Desmodium triflorum		X		R
Erythrina sandwicensis O.Deg.	*wiliwili*	E	O	O
Indigofera suffritocosa Mill.	*iniko*	X	O	O
Leucaena leucocephala (Lam.) de Wit	*koa haole*	X	O	R
Macroptilium lathyroides (L.) Urb.	wild bean	X	O	O
Mimosa pudica		X		O
Neonotonia wightii		X		O
Prosopis pallida (Humb. & Bonpl. Ex Willd.) Kunth	*kiawe*	X	O	

Scientific Name	Common Name	Status	Site	
			Honuaʻula	Ulupalakua
Samanea saman (Jacq.) Merr	monkey pod	X	R	
Senna alata (L.) Roxb	candle bush	X	R	
Senna gaudichaudii (Hook. & Arn.) H.S.Irwin & Barneby	*kolomona*	I	O	
Senna occidentalis (L.) Link	coffee senna	X	R	
Sophora chrysophylla		E		R
Tephrosia purpurea		X		R
Triflorum repens		X		R
Vigna o-wahuensis		E		R
Flacourtiaceae				
Xylosma hawaiiense		E		R
Gentianaceae				
Centaurium erythraea		X		R
Lamiaceae				
Leonotis nepetifolia (L.) R. Br.	lion’s ear	X	O	
Ocimum basilicum L.	sweet basil	X	O	
Ocimum gratissimum L.	basil	X	O	
Plectranthus parviflorus		I		O
Salvia coccinea		X		O

Scientific Name	Common Name	Status	Site	
			Honuaʻula	Ulupalakua
Salvia occidentalis		X		R
Stachys arvensis L.	stagger weed	X	R	
Lauraceae				
Cinnamomum camphora		X		R
Malvaceae				
Abutilon grandifolium (Willd.) Sweet	*maʻo*	X	O	O
Abutilon incanum (Link.) Sweet	hoary abutilon	I	O	
Malva parviflora L.	cheese weed	X	O	O
Malvastrum coromandelianum (L.) Garcke	false mallow	X	R	O
Sida fallax Walp.	*ʻilima*	I	O	O
Sida rhombifolia L.		X	R	O
Meliaceae				
Melia azedarach L.	Chinaberry	X	O	
Menispermaceae				
Cocculus orbiculatus		I		O
Moraceae				
Ficus elastica Roxb.ex Hornem	rubber tree	X	R	
Ficus microcarpa L. f.	Chinese banyan	X	O	

Scientific Name	Common Name	Status	Site	
			Honuaʻula	Ulupalakua
Myoporaceae				
Myoporum sandwicensis A. Gray	*naio*	E	O	O
Myrsinaceae				
Myrsine lanaiensis		E		O
Myrtaceae				
Metrosideros polymorpha		E		R
Psidium guajava L.	guava	X	R	R
Nyctaginaceae				
Boerhavia acutifolia (Choisy) J.W. Moore	*alena*	I	O	
Boerhavia coccinea Mill.		X	R	O
Boerhavia herbstii Fosb.	*alena*	E	R	O
Boerhavia repens L.	*alena*		O	
Boerhavia sp.		I?		O
Mirabilis jalapa L.	four-o' clock	X	R	R
Oleaceae				
Nestegis sandwicensis		E		O
Oxalidaceae				
Oxalis corniculata L.	wood sorrel	X	O	O

Scientific Name	Common Name	Status	Site	
			Honuaʻula	Ulupalakua
Papavaraceae				
Argemone glauca (Nutt. Ex Prain (Pope)	*pua kala*	E	O	O
Argemone mexicana L.	prickly poppy	X	O	
Bocconia frutescens L.		X	O	O
Eschscholzia californica Cham.	California poppy	X	O	
Hunnemannia fumarifolia		X		R
Passifloraceae				
Passiflora foetida L.	love-in-a-mist	X	R	
Passiflora subpeltata Ort.	passion flower	X	O	R
Piperaceae				
Peperomia leptostachya		I		R
Peperomia tetraphylla		I		R
Plantaginaceae				
Plantago lanccolata		X		O
Plantago major		X		O
Plumbaginaceae				
Plumbago zeylanica L.	*ʻilieʻe*	I	O	R
Polygonaceae				

Scientific Name	Common Name	Status	Site	
			Honuaʻula	Ulupalakua
Antigonon leptopus H. & A.	coral vine	X	R	
Rumex acetosella		X		R
Portulacaceae				
Portulaca oleracea L.	pigweed	X	O	R
Portulaca pilosa L.	*ʻakulikuli*	X	O	O
Primulaceae				
Anagallis arvensis		X		O
Anagallis viscosa L.	scarlet pimpernel	X	R	
Proteaceae				
Grevillea robusta		X		R
Rhamnaceae				
Alphitonia ponderosa		E		R
Rosaceae				
Osteomeles anthyllidifolia		I		O
Rubiaceae				
Psychotria mauiensis		E		R
Psydrax odoratum		I		O
Rutaceae				

Scientific Name	Common Name	Status	Site	
			Honuaʻula	Ulupalakua
Melicope adscendens		E		R
Melicope hawaiensis		E		R
Melicope knudsenii		E		R
Melicope mucronulata		E		R
Santalaceae				
Santalum ellipticum		E		O
Santalum freycinetianum var. lanaiense		E		R
Sapindaceae				
Dodonaea viscosa Jacq.	*ʻaʻaliʻi*	I	O	O
Sapotaceae				
Nesoluma polynesicum		E		R
Pouteria sandwicensis		E		O
Scrophulariaceae				
Veronica arvensis		X		R
Solanaceae				
Capsicum annum L.	chili pepper	X	O	
Datura stramonium L.	jimson weed	X	R	R
Lycopersicon pimpinellifolium (Jusl.)	currant tomato	X	O	

Scientific Name	Common Name	Status	Site	
			Honuaʻula	Ulupalakua
Nicandra physalodes (L.) Gaertn.	apple of Peru	X	R	
Nicotiana glauca R.C. Graham	tree tobacco	X	O	O
Nothocestrum latifolium		E		O
Physalis peruviana		X		O
Solanum americanum Mill.	*popolo*	I	O	O
Solanum linnaeanum		X		O
Solanum seaforthianum Andrews		X	O	
Sterculiaceae				
Waltheria indica L.	*ʻuhaloa*	I	O	O
Thymelaeaceae				
Wikstroemia monticola		E		O
Tiliaceae				
Triumfetta semitriloba Jacq.	Sacramento bur	X	O	O
Verbenaceae				
Lantana camara		X	O	O
Stachytarphela cayennensis		X		O
Verbena littoralis		X		O
Viscaceae				

Scientific Name	Common Name	Status	Site	
			Honuaʻula	Ulupalakua
Korthalsella cylindrica		E		R

Appendix 9

Appendix 9

DRAFT
Honua'ula Mitigation Budget ITL/ITP

On-Site Mitigation Associated With the 134 acre Native Plant Preservation Area (Conservation Easement),	[1] Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Years 7-15	Permit Total	Annual Cost Year 16 Forward
Easement for 134 acre Plant Preservation Area	[2] Provided								
Fence for NPPA Boundary	3 Provided								
Remove deer, goats, cattle, and pigs from 130 acre NPPA area ($500/acre)	$ -	$ 47,100.00	$ 11,100.00	$ 11,377.00	$ 11,662.00	$ -	$ -	$ 81,239.00	$ -
On-site outplanting and weed control	$ -	$ 44,100.00	$ 184,400.00	$ 189,010.00	$ 193,735.00	$ 50,000.00	$ 180,000.00	$ 841,245.00	
Hire a full-time Natural Resources Manager	$ 70,000.00	$ 71,750.00	$ 71,750.00	$ 71,750.00	$ 71,750.00	$ 71,750.00	$ 645,750.00	$ 1,074,500.00	$ 71,750.00
-- Develop and implement a fire control plan for the project area	Assigned tasks of full-time Natural Resources Manager							$ -	
-- Develop and implement a long-term monitoring plan								$ -	
Supplemental budget for Conservation Stewardship Program implementation	$ 140,000.00	$ 45,000.00	$ 45,000.00	$ 45,000.00	$ 45,000.00	$ 30,000.00	$ 270,000.00	$ 620,000.00	$ 30,000.00
Wildlife Education and Observation Program (WEOP)	$ 2,500.00	$ 2,500.00	$ 2,500.00	$ 2,500.00	$ 2,500.00	$ 2,500.00	$ 22,500.00	$ 37,500.00	$ 2,500.00
On-Site Native Plant Preservation Area Subtotal	$ 212,500.00	$ 210,450.00	$ 314,750.00	$ 319,637.00	$ 324,647.00	$ 154,250.00	$ 1,118,250.00	$ 2,654,484.00	$ 104,250.00

KANAIO/AUWAHI Off-Site Mitigation for Blackburn's Sphinx Moth	1 Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Subsequent Years (9)	Permit Total	Annual Cost Year 16 Forward
Supplemental Aiea Outplanting by Pono Pacific/Lump sum for material and services	$ 50,000.00				$ -	$ -	$ -	$ 50,000.00	$ -
Off-Site Blackburn's sphinx moth at Kanaio Subtotal	$ 50,000.00	$ -	$ -	$ -	$ -	$ -	$ -	$ 50,000.00	$ -

On-site Monitoring	1 Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Subsequent Years (9)	Permit Total	Annual Cost Year 16 Forward
Funding for monitoring, including independent verification (DOFAW)	$ 5,000.00	$ 5,000.00	$ 5,000.00	$ 5,000.00	$ 5,000.00	$ 5,000.00	$ 45,000.00	$ 75,000.00	$ -
Off-site Monitoring	**1 Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Subsequent Years (9)**	**Permit Total**	**Annual Cost Year 16 Forward**
Funding for monitoring, including independent verification (DOFAW)	$ 5,000.00	$ 5,000.00	$ 5,000.00	$ 5,000.00	$ 5,000.00	$ 5,000.00	$ 45,000.00	$ 75,000.00	$ -
Off-Site Mitigation for Hawaiian Goose	**[1] Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Subsequent Years (9)**	**Permit Total**	**Annual Cost Year 16 Forward**
One time contribution to DOFAW nene conservation program	$ 30,000.00	$ -	$ -	$ -	$ -	$ -	$ -	$30,000	$0
Off-site Hawaiian Goose Subtotal	$ 30,000.00	$ -	$ -	$ -	$ -	$ -	$ -	$ 30,000	$ -

ANNUAL TOTALS	$ 302,500.00	$ 220,450.00	$ 324,750.00	$ 329,637.00	$ 334,647.00	$ 164,250.00	$ 1,208,250.00	$ 2,854,484.00	$ 104,250.00

[1] Timeline starts at the initiation of Project's Phase I construction.

[2] Easements will be established upon HCP approval. Funding assurances will be provided for Off-Site Mitigation Costs at start of Project's Phase I construction.

[3] Provided, included in project plan.

Appendix 10

Wildlife Survey of Honua'ula (Wailea 670) Kīhei, Maui

Prepared for

Honua'ula Partners, LLC
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1.0 BACKGROUND AND PURPOSE OF THE STUDY

SWCA Environmental Consultants (SWCA) was tasked to conduct botanical and wildlife surveys within the 271 hectare (ha) or 670 acre (ac) Honua'ula (Wailea 670) Property (hereinafter referred to as the 'Property') in Kīhei, Maui. This report documents the results of the wildlife surveys conducted by SWCA within the Property. Specific objectives include documenting the presence and relative abundance of birds, mammals, amphibians, and reptiles at the Property; and, determining the presence and abundance of any protected species including migratory shorebirds, waterbirds, federally and state listed endangered or threatened species, and 'species of concern'.

The study supplements prior surveys of the same parcel by Bruner (1988, 1993, and 2004), and satisfies Condition 9 of the Maui County Council for Project District II Zoning approval. This report also satisfies the requirements of Hawai'i Revised Statutes Chapter 343 for description of natural resources, and will be cited in the Environmental Impact Statement (EIS) being prepared for Honua'ula. A companion document addressing vegetation issues was prepared by SWCA and is being submitted under separate cover (SWCA 2009).

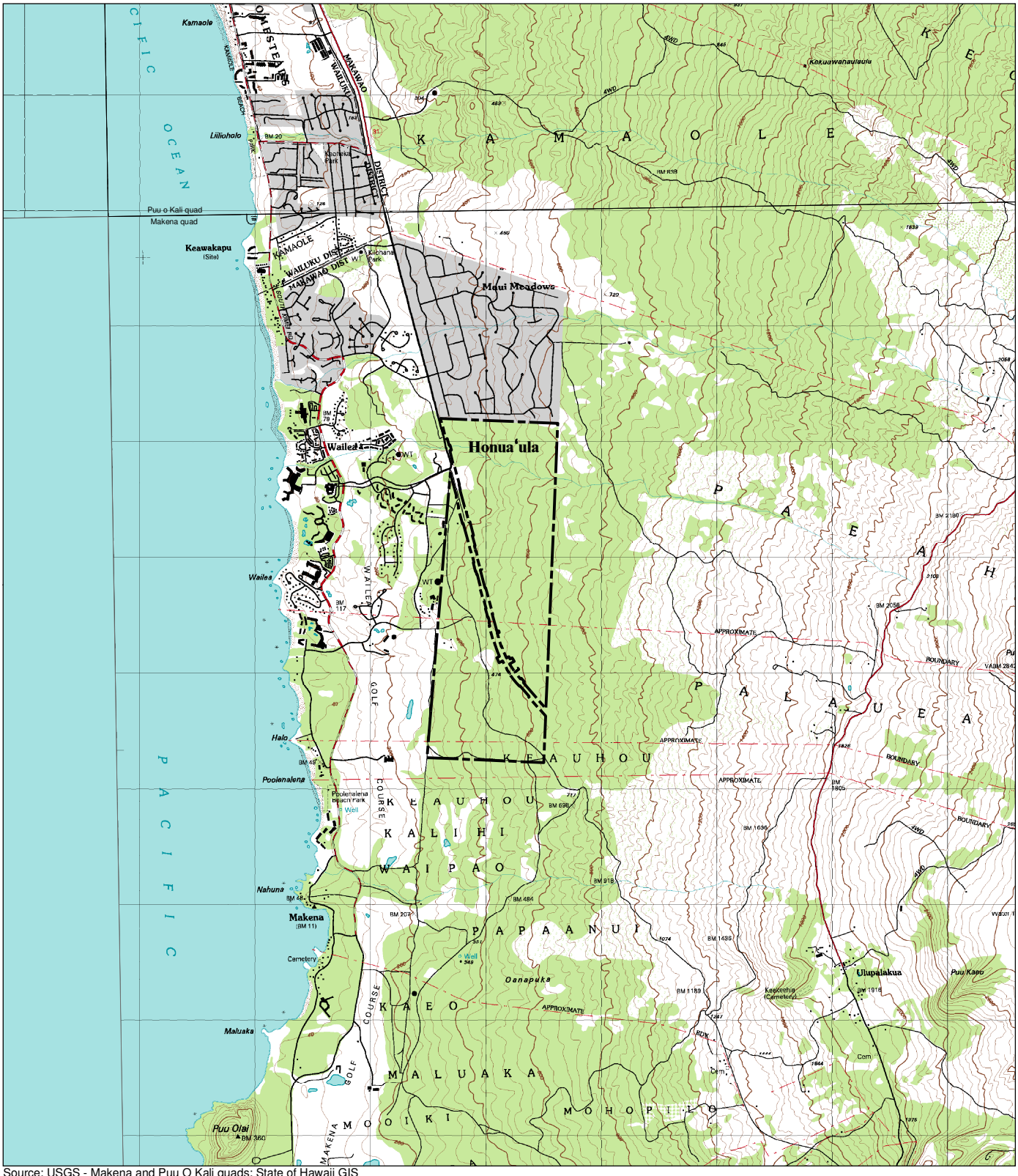
This report was authored by Ling Ong, Ph.D., Stephen M. Mosher, M.S., Tiffany Thair, (M.S. candidate), and Ryan Taira, B.A. of SWCA. Peer review was provided by Michelle Christy, Ph.D. and John Ford, M.S. of SWCA. Field work was conducted by Dr. Ong and Mr. Mosher with assistance from Dr. David Preston of the Bishop Museum Department of Entomology, Betsy Gagne of the Natural Area Reserve System, Hawai'i Department of Land and Natural Resources-Division of Forestry and Wildlife (DLNR-DOFAW), and biologist James Kwon of the U.S. Fish and Wildlife Service (USFWS) Division of Ecological Services, Honolulu.

2.0 DESCRIPTION OF THE PROPERTY

Honua'ula (Wailea 670) encompasses 270 ha (670 ac) on the southeastern slope of Mt. Haleakalā, Maui, between approximately 89 m (290 ft) and 220 m (720 ft) elevation (Figure 1). Approximately 200 ha (500 ac) in the northern portion of the parcel is underlain by older lavas of the Kula Volcanic Series. The remaining 70 ha (170 ac) on the south side of the Property is underlain by relatively younger Hana Volcanic Series lavas. This area is characterized by an extremely rough surface composed of broken 'a'ā lava. Weathering led to the formation of a thin layer of soil over the northern 200 ha, but since the southern portion is derived from younger volcanic eruptions, less weathering of the 'a'ā in this region has led to presence of little or no soil (PBR Hawaii 1988).

Twenty-six (26) native plant species and 120 non-native plant species were described by SWCA (2009) and other investigators in three distinct vegetation types that provide habitat for wildlife within the Property (Figure 2). The three vegetation types within the Property are the *kiawe*-buffelgrass (*Prosopis pallida-Cenchrus ciliaris*) grassland, mixed gulch vegetation, and remnant mixed *kiawe-wiliwili* (*Prosopis pallida-Erythrina sandwicensis*) shrubland. About 75% of the northern portion of the Property is characterized by an extensive grassland comprised primarily of *kiawe* (*Prosopis pallida*) *and* buffelgrass (*Cenchrus ciliaris*).. The *kiawe*-buffelgrass grassland is bisected from east to west by several gulches that carry flood waters to the sea. The gulch vegetation is comprised of various species of ferns, native *Pili* grass (*Heteropogon contortus*), and other species. The third vegetation type is limited to the 'a'ā lava flow in the southern quarter of Property and consists of scattered groves of large-stature *wiliwili* (*Erythrina sandwicensis*) and co-dominant *kiawe* trees (*P. pallida*) (SWCA 2009).

Axis deer (Axis axis) and feral goats (Capra hircus hircus) have had unrestricted access throughout the Property and pose a serious threat to native plant species and to the integrity of the remnant mixed kiawe-wiliwili shrubland. Many of the wiliwili trees on the Property have been recently infested by the invasive gall wasp (Quadratichus erythrinae) which also threatens the entire ecosystem. Historically, the Property has been exposed to cattle grazing.



Source: USGS - Makena and Puu O Kali quads; State of Hawaii GIS

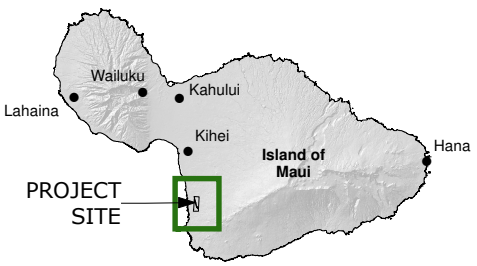


Figure 1
Location Map

N

0 1,000 2,000 4,000 ft

0 250 500 1,000 M

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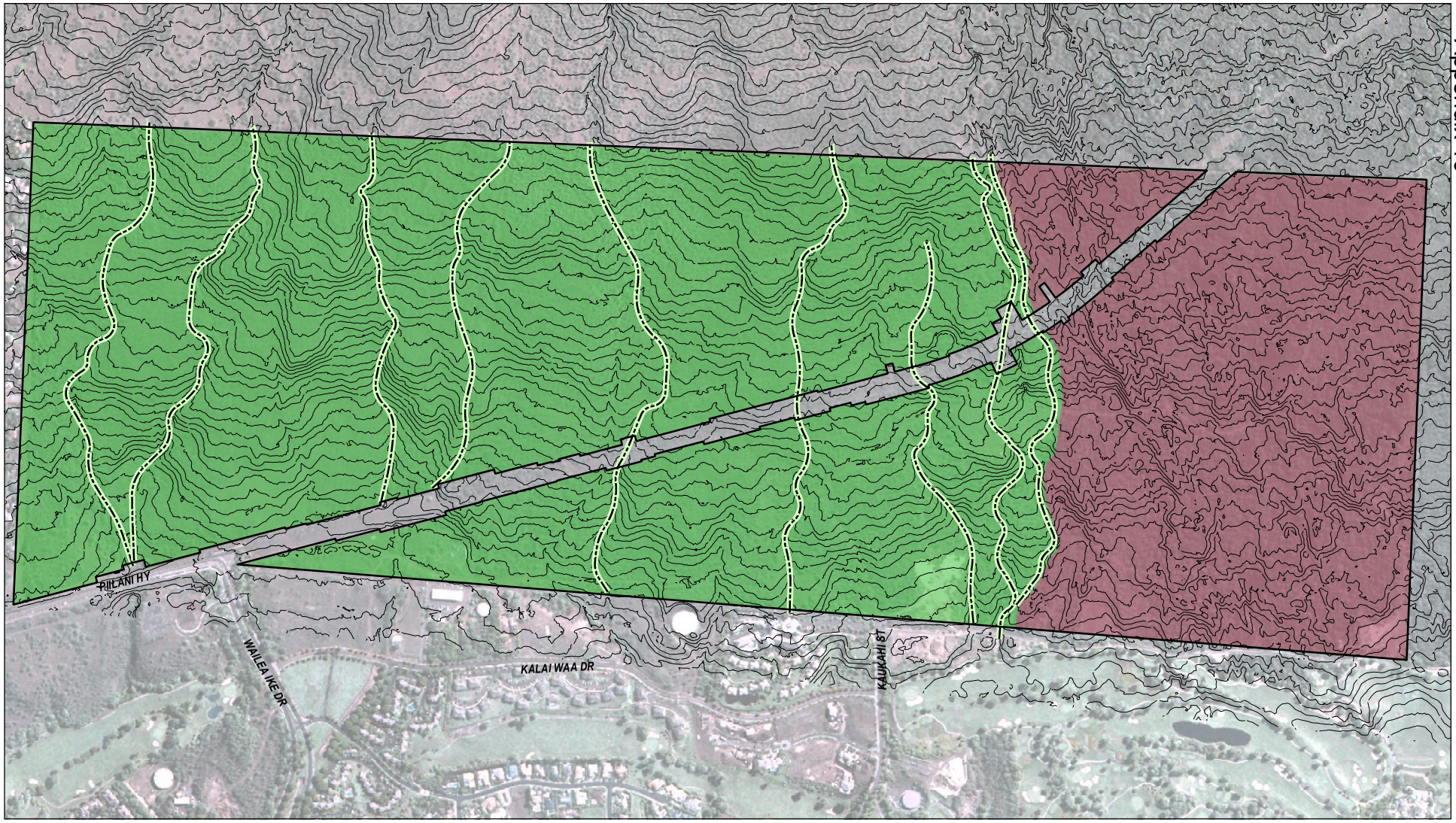

Legend

Project Boundary

Vegetation Types

Kiawe-buffel Grass Grassland

Kiawe-wiliwili Shrubland

Mixed Gully, Kiawe-Guinea Grass Vegetation

Figure 2
Vegetation Types

0 250 500 1,000 ft

0 50 100 200 M

N

Boundary Source: PBR Hawaii
Aerial Source: PDC (Pacific Disaster Center)

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Small portions of the northern *kiawe*-buffelgrass grassland are infrequently grazed by cattle belonging to 'Ulupalakua Ranch under agreement with Honua'ula Partners, LLC. Honua'ula Partners, LLC constructed a cattle fence bisecting the parcel to prevent cattle from entering the remnant *kiawe-wiliwili* shrubland in the southern portion of the Property. There is no evidence of other agricultural activity having occurred previously (PBR Hawaii 1988); however, the area was used during the Second World War as a training and maneuver area for armored vehicles (Erdman, Ulupalakua Ranch, pers. comm.).

3.0 METHODS OF STUDY

SWCA initially conducted a literature review of natural resources within the region that encompasses the Property, and considered the comments and concerns expressed by resource agencies and the Maui County Council in prior correspondence.

3.1 Avian Survey Methods

Point count surveys were conducted by SWCA biologists Ling Ong, Ph.D. and Stephen Mosher, M.S. on May 27-29 and September 19-21, 2008. Twenty-eight (28) point count stations were established throughout the Property in all habitat types (Figure 3). The location of each point count site was confirmed with a GPS receiver and two observers were present at each point count. Visual observations of birds were conducted with 10 x 50 binoculars with a 6.5 degree field of vision; and aural observations were also conducted by listening for vocalizations.

The relative densities of species were estimated using five-minute 200 m (656 ft) radius point counts conducted during peak bird activity periods (0600 - 1100 and 1600 - 1900). Five minute point counts maximized the likelihood of detecting new species during the survey (Lynch 1995). Bird density data and species composition from the study were compared with the findings of Bruner (1988, 1993, and 2004). Mammals and reptiles seen or heard during the point count surveys were also recorded as incidental sightings. Rare or previously unrecorded bird, mammal, reptile, or amphibian species seen between count stations were also noted.

Line transect surveys were conducted by SWCA biologists Ling Ong, Ph.D. and Stephen Mosher, M.S. from September 19-21, 2008 to determine the presence and density of the two owl species known to inhabit the Property: the barn owl (*Tyto alba*) and the Hawaiian short-eared owl or pueo (*Asio flammeus sandwichensis*) (Figure 4). Twelve transects between 900-1000 m (2,952-3,280 ft) long were oriented east-west across the entire length of the parcel. These transects were at least 250 m (820 ft) apart. An additional eight transects of 250 m (820 ft) were oriented north-south at the eastern and western boundaries of the property. Total transect length in *kiawe*-buffelgrass grassland habitat was 8.6 kilometers (5.4 miles), and 5.0 kilometers (3.1 miles) in the remnant *kiawe-wiliwili* shrubland portion of the Property.

Two observers were present on each transect survey. Owls observed along transects were identified to species and recorded, along with perpendicular distance between transect and owl. The density of owls present on site was calculated using the DISTANCE 5.0 program. As the resulting sample size was small, data from both species were pooled to obtain a combined owl density. Pueo densities were calculated by determining the ratio of pueo to barn owl sightings and adjusting the calculated owl density from the DISTANCE 5.0 program proportionately. Due to habitat differences, owl densities within the *kiawe*-buffelgrass area were analyzed separately from the remnant *kiawe-wiliwili* shrubland habitat.

3.2 Nocturnal Surveys for Hawaiian Hoary Bats

Surveys for endangered Hawaiian hoary bats (*Lasiurus cinereus semotus*) were conducted at the Property between 1830 and 0000 from September 19-21, 2008 by SWCA biologists Dr. Ling Ong and Stephen Mosher. These surveys were conducted under ideal weather conditions using night vision goggles (Morovison PVS-7 Ultra) and an Anabat detector (Titley Electronics, NSW Australia).

Anabat detectors assist in the identification of bats by recording their echolocation calls. The device also produces real-time audible output for humans to hear of the ultrasonic sounds the bat generates. Bat point count stations were established at 14 locations at least 400 m (1,312 ft) apart on jeep roads within the Property, and surveyed for five minutes each (Figure 3). The detection distance for bats using night vision goggles was estimated to be 30 m (98 ft) radius at each point count station.

3.3 Surveys for the Blackburn's Sphinx Moth

Surveys for endangered Blackburn's sphinx moths (*Manduca blackburni*) were conducted within the Property on March 13, 2008, May 27-29, 2008, and November 11, 2008. The March and May surveys were conducted by Bishop Museum entomologist David Preston, Ph.D. and Betsy Gagné, M.S. of the Hawai'i Division of Forestry and Wildlife, accompanied by SWCA biologist John Ford, M.S. Dr. Preston and Ms. Gagné were accompanied by biologist James Kwon of the USFWS. These surveys focused on host plants used by the various life stages of Blackburn's sphinx moth (*Manduca blackburni*) that are known to occur within the Property. Leaves and stems were examined carefully for the presence or sign of moths, including frass (fecal matter), cut stems and leaves, and eggs.

4.0 RESULTS

4.1 Endangered Species

Although not detected during pervious wildlife surveys by Bruner (1988, 1993 and 2004), endangered Blackburn's sphinx moth (*Manduca blackburni*) caterpillars and sign, as well as a single endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*), were found within the Property during this study. Details of the sightings are presented in the following sections.

4.1.1 Blackburn's Sphinx Moth (*Manduca blackburni*)

The Blackburn's sphinx moth (Family: Sphingidae) was listed as federally endangered in February 2000 and was the first Hawaiian insect to be listed as an endangered species. It is the largest native insect in Hawai'i, with a wing span of up to 120 millimeters (5 inches) and long, narrow forewings (Figure 5). It is primarily grayish brown, with black bands across the top margins of the hind wings and five orange spots along each side of the abdomen. The body is thick and spindle shaped, tapering at both ends (USFWS 2003, Black 2005, and USFWS 2005). The caterpillar has two color morphs: bright green (Figures 6) or gray. White speckles are scattered throughout the caterpillar's back and a horizontal white stripe is present on the side of each segment (Black 2005). Characteristic of other hornworms, the caterpillar has a horn-like protrusion on the last abdominal segment (USFWS 2005). The species is often confused with the non-native potato hornworm (*Agrius cingulata*) which has also been recorded in the Hawaiian Islands.

The Maui Nui Recovery Unit for the Blackburn's sphinx moth consists of seven management units comprising approximately 22,788 ha (56,305 ac; USFWS 2002, 2003, 2005). Of these, approximately 45,867 ha (18,564 ac) located in four units are on Maui. The closest management units to the Property are Pu'u O Kali (Unit 8) and the Ahihi-Kinau NAR – Ulupalakua – Auwahi – Kanaio Management Unit (Unit 9), located roughly 2.5 and 4 km (1.6 and 2.5 miles) from the Property, respectively (Figure 7).

On March 13, 2008 in the early afternoon, Dr. Preston found a small Blackburn's sphinx moth caterpillar feeding on leaves of a non-native tree tobacco (*Nicotiana glauca*) in the southeastern corner of the Property (Figure 8). On that same day, he found evidence of feeding (cut stems and leaves, and the presence of frass) by Blackburn's sphinx moth caterpillars on tree tobacco plants at numerous other locations within the Property (Figure 10), and recorded the location of each with a GPS receiver. No Blackburn's sphinx moth caterpillars were recorded during the May survey, however, grazing damage was evident and recorded (Figure 10).

Legend

- Project Boundary
- Bird Count Points May 29, 2008
- Bird Count Points Sept 19-21, 2008
- Bat Point Counts Sept 19-20, 2008

Vegetation Types

- Kiawe-buffel Grass Grassland
- Kiawe-wiliwili Shrubland
- Mixed Gully, Kiawe-Guinea Grass Vegetation

Figure 3
Bird and Bat Point Count Stations

0 250 500 1,000 ft

N

0 50 100 200 M

Boundary Source: PBR Hawaii
Aerial Source: PDC (Pacific Disaster Center)

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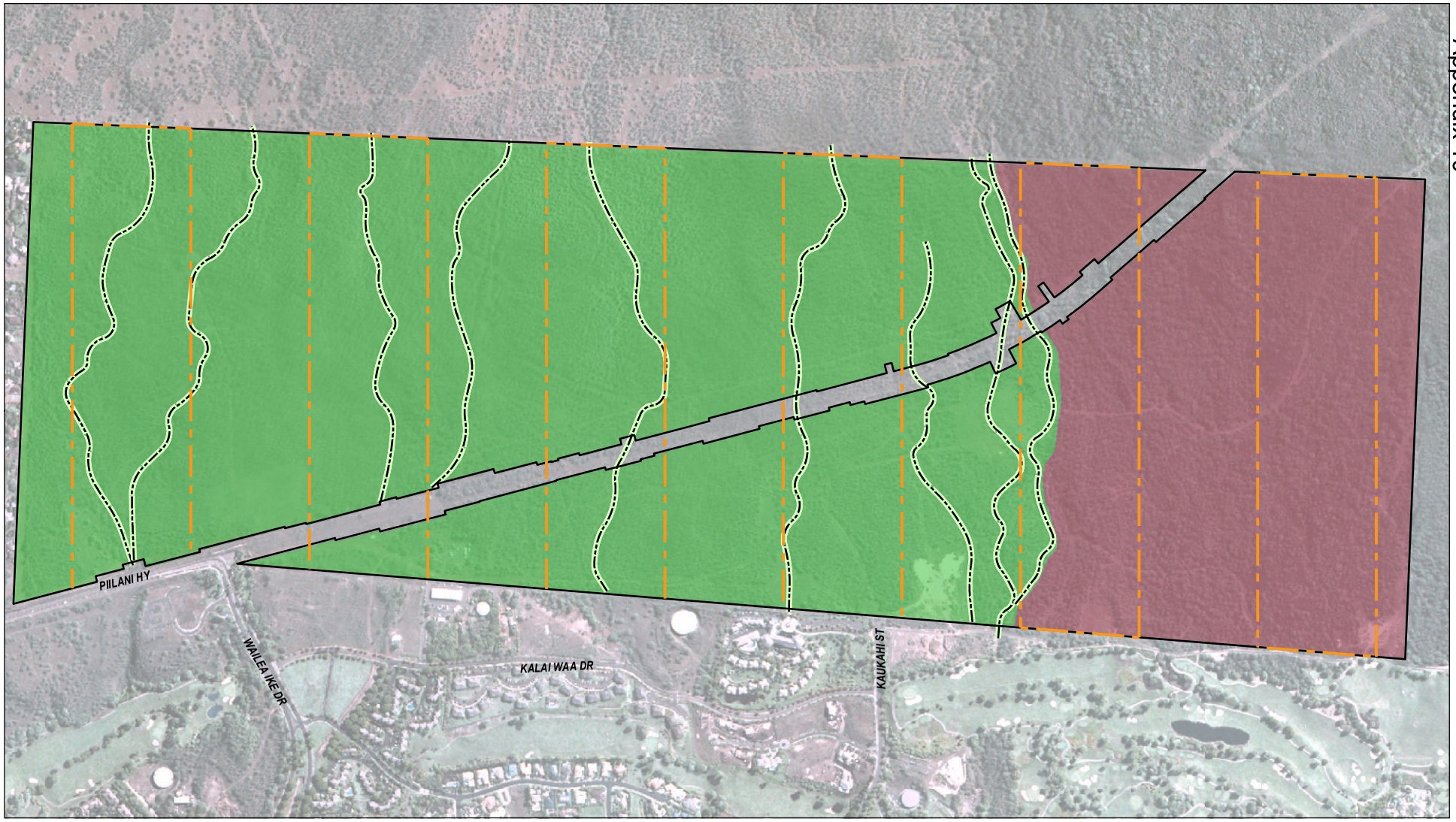

Legend

Project Boundary

Transect

Vegetation Types

Kiawe-buffel Grass Grassland

Kiawe-wiliwili Shrubland

Mixed Gully, Kiawe-Guinea Grass Vegetation

Figure 4
Pueo Transects

0 250 500 1,000 ft

0 50 100 200 M

N

Boundary Source: PBR Hawaii
Aerial Source: Pacific Disaster Center (PDC)

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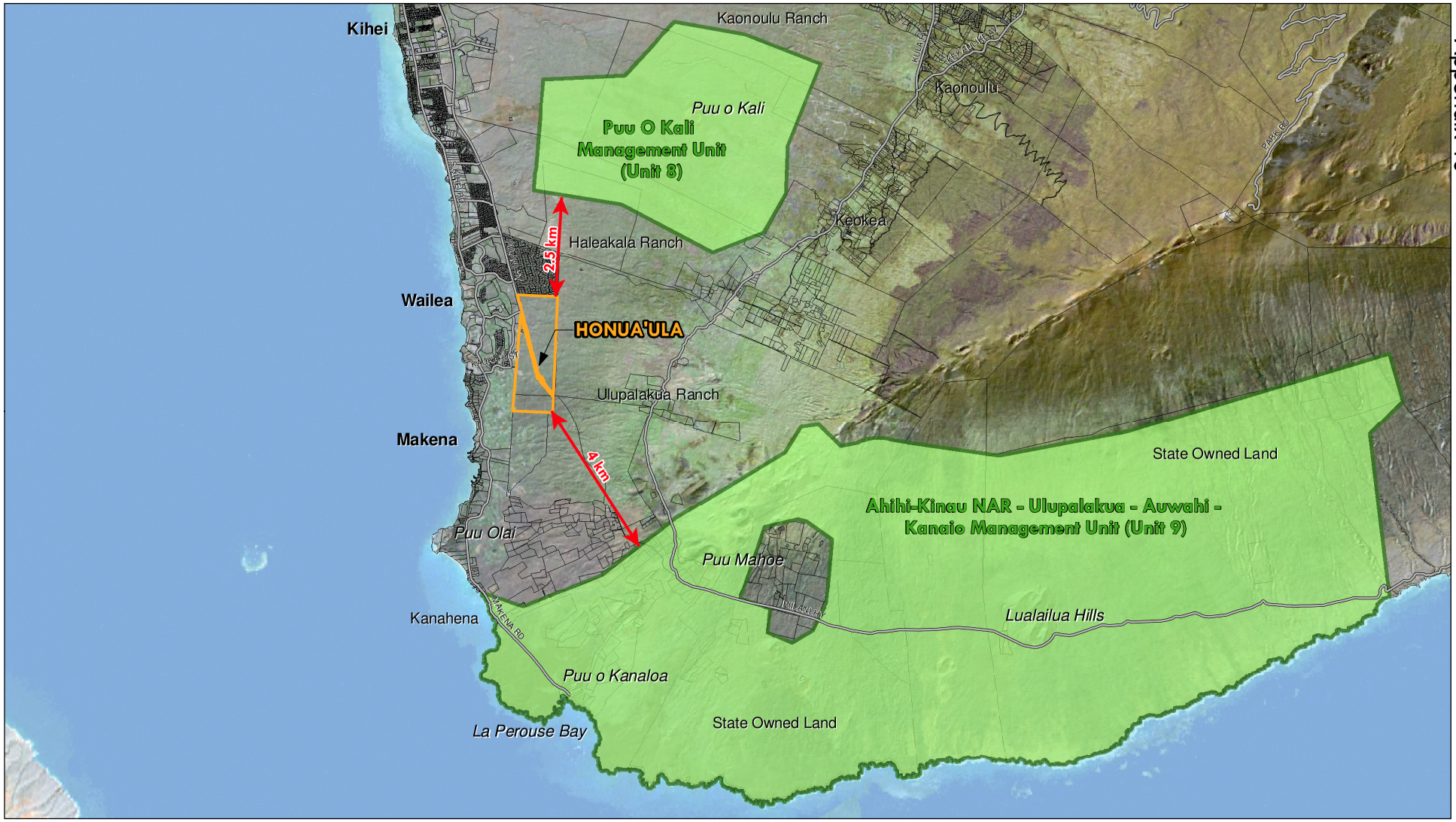
Figure 5. An adult endangered Blackburn's sphinx moth. Photo by W.P. Mull.

Figure 6. This large green morph caterpillar of *M. blackburni* was photographed at Honua'ula on November 11, 2008 by SWCA staff.



Appendix 10

Legend

- Project Boundary
- Management Units

Figure 7
Management Units for Blackburn's Sphinx Moth in South Maui

N

0 0.5 1 2 Mi

0 1 2 4 Km

Boundary Source: PBR Hawaii
Base Data Source: State of Hawaii GIS

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Figure 8. This young M. blackburni caterpillar was photographed by Dr. David Preston (Bishop Museum) feeding on a non-native tree tobacco leaf (Nicotiana glauca) on March 13, 2008 in the southeastern portion of the Property.

On November 11, 2008, two large Blackburn's sphinx moth caterpillars were observed on the stems of tree tobacco plants within the Property by Dr. Preston and Ms. Gagne. The larger of the two caterpillars, approximately 100 mm (4 in) in length, was found about 30 m (100 ft) inside the Property from the Diamond Resort gate. The smaller caterpillar, approximately 50 mm (2 in) in length, was seen near the southern boundary of the Property (Figure 11).

Other non-native host plants of the Blackburn's sphinx moth caterpillars include *Solanum melongena* (eggplant), *Lycopersicon esculentum* (tomato), and possibly *Datura stramonium* (Jimson weed). These species have not been found within the Honua'ula Property in any previous study (Char 1988, 1993, 2004; SWCA 2009). However, adult moths are known to feed on nectar of the native *koali awahia* (*Ipomea indica*), and *halapepe* (*Pleomele auwahiensis*) plants, and possibly upon the native *maiapilo* (*Capparis sandwichiana*) and *'ilie'e* (*Plumbago zeylanica*) (USFWS 2005). The native *koali awahia*, *maiapilo*, and *'ilie'e* are widespread throughout the Honua'ula Property (SWCA 2009).

4.1.2 Hawaiian Hoary Bat (*Lasiurus cinereus semotus*)

SWCA biologists Ong and Mosher sighted a single endangered Hawaiian hoary bat at the southern boundary of the Property flying seaward at 18:44 hours on September 19, 2008. A single call from this individual was simultaneously recorded on the Anabat detector. No other sightings of bats were made during the period of study. The location of the bat sighting is illustrated on Figure 10. *Kiawe* which is abundant on the Property has been documented as roost trees for the Hawaiian hoary bat, thus, while it was not observed, it is possible that Hawaiian hoary bats roost within the Property.

4.2 Endemic Birds

No Hawaiian short-eared owls or *pueo* (*Asio flammeus sandwichensis*) were recorded during the wildlife surveys by Bruner (1988, 1993, and 2004). However, pueo were observed within the Property during the line transect surveys (Figure 4 and Figure 10). Neither the *pueo* nor barn

owls were observed during the bird point counts. Twelve (12) barn owls, six *pueo*, and six other unidentified owls were sighted in grassland habitat. The ratio of barn owl sightings to *pueo* sightings in grassland was estimated at 2:1. No pueo or barn owls were sighted in the southern remnant *kiawe-wiliwili* shrubland portion of the Property. No owl nests were found. Based on these surveys, the estimated density of owls in the grassland was 13.3 ± 3.7 SE individuals per km^2 (or 34.5 ± 9.1 individuals/$mile^2$). The estimated number of owls property-wide was 26.0 ± 0.3 SE (95% confidence interval: 14 - 46 owls). This results in an estimate of eight individual pueo (95% confidence interval: 5 – 15 individuals) present on the Property. These individuals are likely to occur within the *kiawe*-buffelgrass grassland habitat. The grasslands present at the Honua'ula Property are likely to provide good foraging, and nesting habitat for *pueo*. However, these nesting habits increase the species vulnerability to predation by rats (*Rattus* spp.), cats (*Felis catus*), and the small Indian mongoose (*Herpestes auropunctatus*), all of which are present in the area.

4.3 Indigenous Birds

No confirmed sighting of native birds occurred within the Property during the point count or transects surveys. No native birds had been recorded in or flying over the Property during the wildlife surveys by Bruner (1988, 1993, and 2004). Hawai'i DLNR-DOFAW biologist Betsy Gagné and SWCA biologist John Ford sighted a native black-crowned night heron (*Nycticorax nycticorax hoactli*) roosting in and flying among *kiawe* trees adjacent to a jeep road near an elevation of 150 m (500 ft) on the southern border of the Property. On the same day, the biologists also observed a flock of perhaps five to seven great frigatebirds or 'iwa (*Fregata minor palmerstoni*) hovering above and swooping down to feed or drink in one of the golf course ponds at the Wailea Resort, immediately west of the Honua'ula Property boundary. This suggestive that the Honua'ula golf course, once completed, will also serve to attract additional bird species.

Seabirds forage over the ocean, but many species return to nest inland. Seabirds that may be seen over the Property during the day include the great frigatebird or 'iwa (*Fregata minor palmerstoni*) and tropic birds (*Phaethon* spp.). The USFWS suggested that seabirds may fly over the Property at night to and from nesting sites at higher elevations on the slopes of Haleakalā. These seabirds include the endangered Hawaiian petrel (*Pterodroma sandwichensis*) and threatened Newell's shearwater (*Puffinus auricularis newelli*). While seabirds may traverse the area at night, they do not nest on the Property. Neither of the latter two species was observed during any of the wildlife surveys cited herein.

4.4 Migratory Birds

SWCA biologists have seen Pacific golden plovers (*Pluvialis dominica*) on golf cart roads and greens on adjacent golf courses on several occasions during winter months in past years. Dr. Phil Bruner also recorded one Pacific golden plover within the Property during his February 1988 survey. Some migratory birds overwinter in Hawai'i, most appearing in late August or September and leaving in May (Hawaiian Audubon Society 2005).

In a chance sighting in March 2006, SWCA biologist John Ford, M.S. observed a Northern harrier (*Circus cyaneus*) flying east to west, then back again and low over *wiliwili* trees in the southern portion of the Honua'ula Property near an elevation of 150 m (500 ft). Sightings of this relatively recent arrival to the islands have also been reported by others near Hosmer's Grove and over the Paliku end of the Haleakalā Crater floor and the surrounding hills, on the Island of Hawai'i over the Saddle Road, and on Kawailoa Ridge above Hale'iwa, O'ahu. That no other migratory birds were observed during this study could be a result of surveying at the start of the migration season.

4.5 Alien or Introduced Birds

In his most recent survey of the Property, Bruner (2004) found Japanese white-eye (*Zosterops japonicus*), house finch (*Carpodacus mexicanus*), black francolin (*Francolinus francolinus*), and zebra dove (*Geopelia striata*) to be the most abundant non-native birds at Honua'ula, followed by the nutmeg manikin (*Lonchura punctulata*), northern cardinal (*Cardinalis cardinalis*). He reported

no substantive change in the composition or abundance of alien bird species he described from the Property over a span of 16 years (Bruner 1988, 1993, and 2004).

SWCA biologists observed 16 species of introduced birds within the Property during this study. Japanese white-eye (*Zosterops japonicus*), nutmeg manikin (*Lonchura punctulata*), zebra dove (*Geopelia striata*), and northern cardinal (*Cardinalis cardinalis*) were found to be the most abundant (Table 1). African silverbills (*Lonchura cantans*) and red-crested cardinals (*Paroaria coronata*) were common along the southern border of the Property. Four additional introduced birds not reported by Bruner (1988, 1993, and 2004) were recorded during this study. Cattle egrets (*Bubulcus ibis*) were seen flying overhead on several occasions. Mourning doves (*Zenaida macroura*) were only heard in the 'a'ā section of the Property. Chestnut munias (*Lonchura atricapilla*) were seen on one occasion and Erckel's francolin (*Francolinus erckelli*) were heard once.

Table 1. Bird species and relative abundance observed on the Honua'ula Property during bird surveys in May and September 2008.

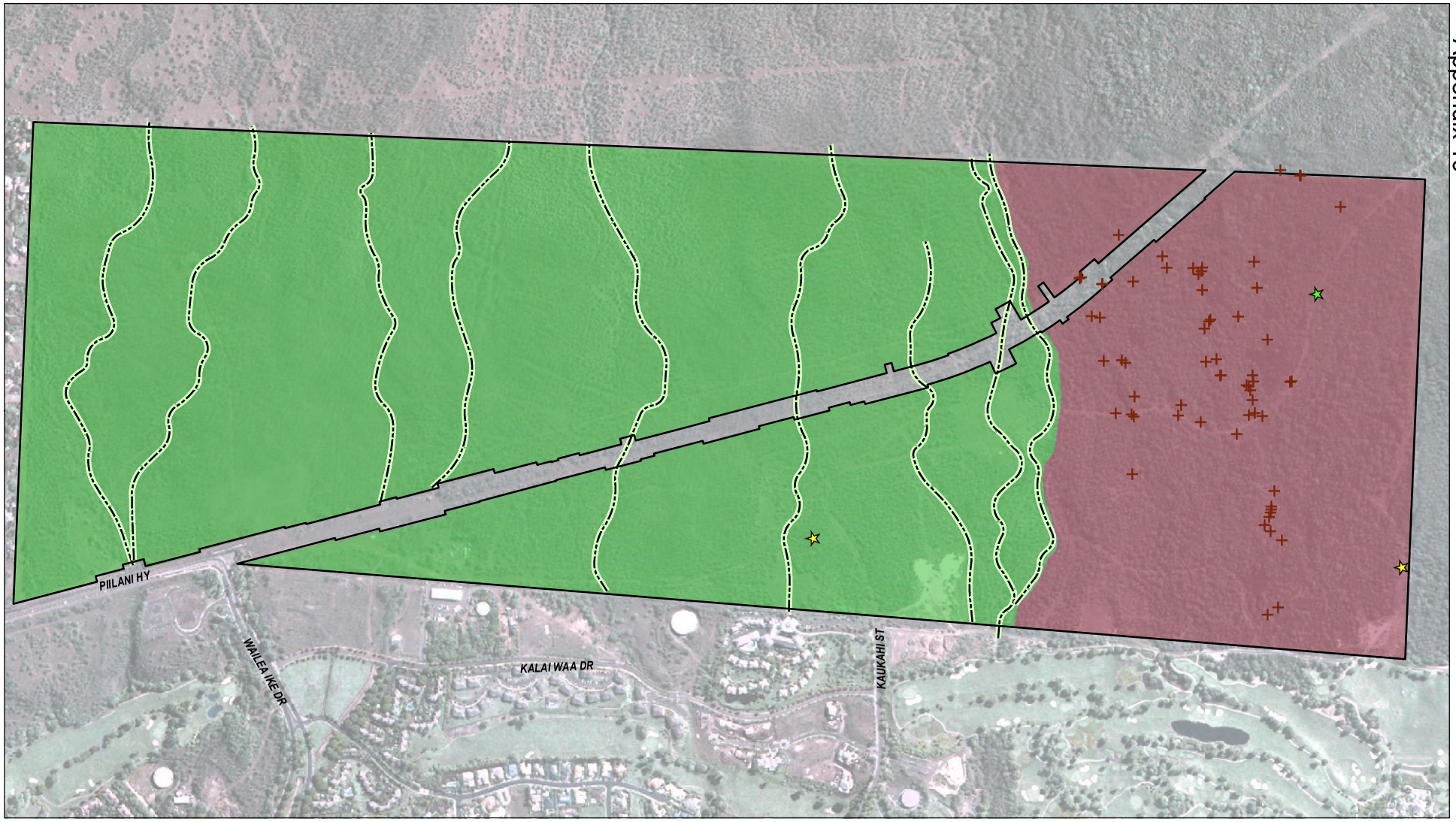
Species	Common Name	Status	Birds per point count (n=30)	Abundance Rank
Asio flammeus sandwichensis	Pueo	N (NR)	x	-
Bubulcus ibis	Cattle Egret	I (NR)	x	-
Zenaida macroura	Mourning Dove	I (NR)	0.03	12
Francolinus erckelli	Erckel's Francolin	I (NR)	0.03	12
Francolinus pondicerianus	Gray Francolin	I	0.23	9
Francolinus francolinus	Black Francolin	I	0.73	5
Streptopelia chinensis	Spotted Dove	I	0.30	7
Geopelia striata	Zebra Dove	I	1.70	3
Tyto alba	Barn owl	I	x	-
Zosterops japonicus	Japanese White eye	I	3.50	1
Mimus polyglottos	Common Mockingbird	I	0.03	12
Acridotheres tristis	Common Myna	I	0.07	11
Cardinalis cardinalis	Northern Cardinal	I	1.3	4
Carpodacus mexicanus	House Finch	I	0.23	9
Lonchura punctulata	Nutmeg Mannikin	I	3.03	2
Lonchura atricapilla	Chestnut Munia	I (NR)	x	-
Lonchura cantans	African Silverbill	I	0.67	6

I = introduced, N = native NR = new record since 2004
X= observed outside point counts

4.6 Mammals

The Hawaiian hoary bat (see 5.1.2) was the only native mammal observed on the Property. The small Indian mongoose (*Herpestes javanicus*) was observed within the Property, but was uncommon. Small herds of four to 12 axis deer (*Axis axis*) were commonly seen. Deer scat, tracks, and evidence of buck rubs (rubbing of antlers on trees) were evident throughout the entire parcel. Mongoose and deer were previously reported by Bruner (1988, 1993 and 2004). Goats (*Capra hircus*) have also been seen by others in the Property; however, none were observed during this study.

Domestic cattle (*Bos taurus*) are grazed infrequently within the northern portion of the Property and regularly to the east on lands owned by 'Ulupalakua Ranch; however, no cattle or evidence of cattle were observed within the boundaries of the Property during this study.



Legend

- Project Boundary
- *Manduca blackburni* (Blackburn's Sphinx Moth) Caterpillar Sighting March 13, 2008
- *Manduca blackburni* (Blackburn's Sphinx Moth) Caterpillar Sighting Nov 11, 2008
- *Manduca blackburni* (Blackburn's Sphinx Moth) Sign Observed May 27-28, 2008

Vegetation Types

- Kiawe-buffel Grass Grassland
- Kiawe-wiliwili Shrubland
- Mixed Gully, Kiawe-Guinea Grass Vegetation

Figure 9
Locations of Blackburn Sphinx Moth Caterpillars and Sign Locations

0 250 500 1,000 ft

0 50 100 200 M

N

Boundary Source: PBR Hawaii
Aerial Source: Pacific Disaster Center (PDC)

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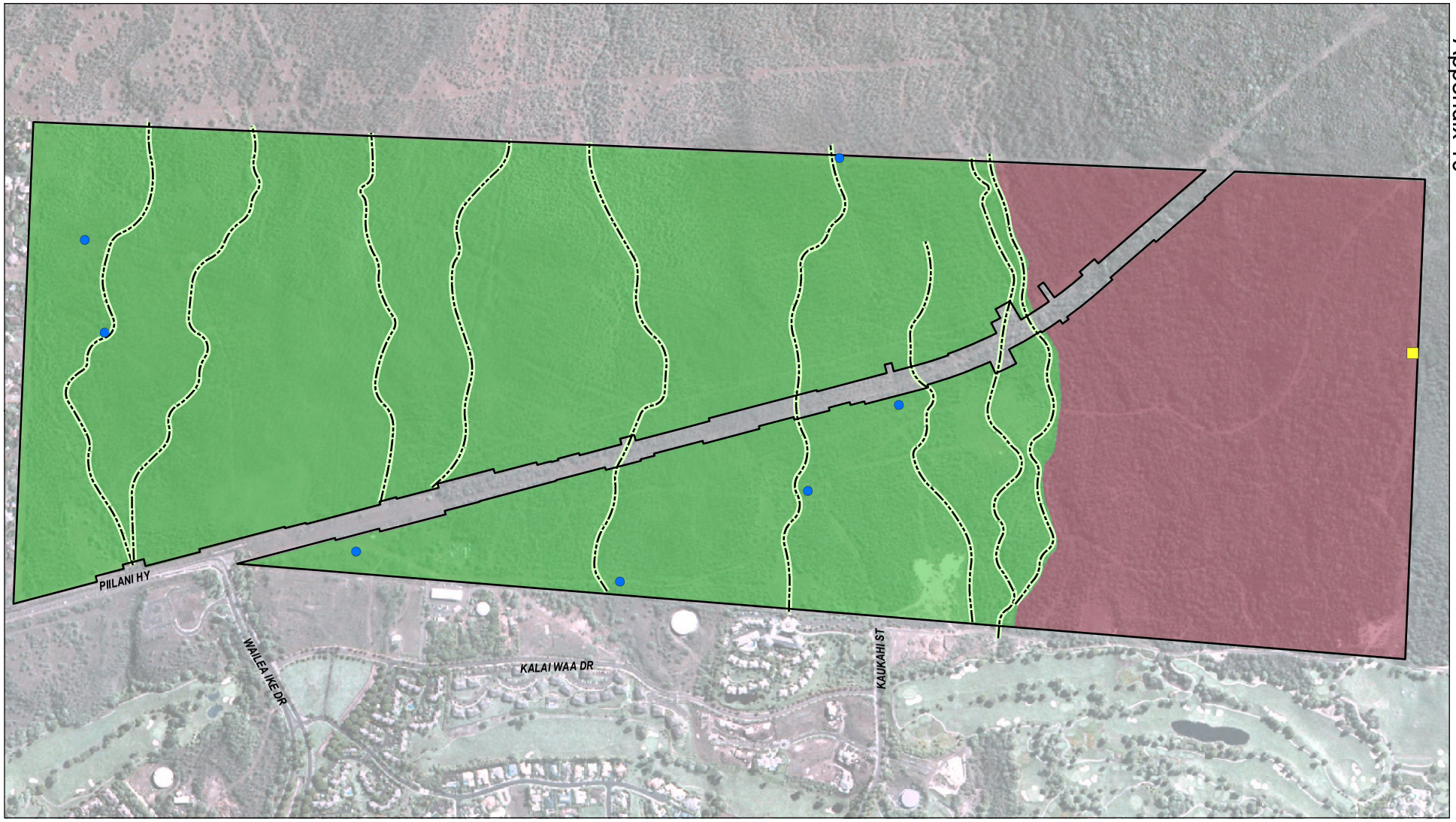

Legend

- Project Boundary
- *Asio flammeus sandwichensis* (Pueo) Sighting
- *Lasiurus cinereus semotus* (Hoary Bat) Sighting

Vegetation Types

- Kiawe-buffel Grass Grassland
- Kiawe-wiliwili Shrubland
- Mixed Gully, Kiawe-Guinea Grass Vegetation

Figure 10
Pueo and Bat Sightings

N

0 250 500 1,000 ft

0 50 100 200 M

Boundary Source: PBR Hawaii
Aerial Source: Pacific Disaster Center (PDC)

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Following this study; however, cattle were allowed to graze within the northern *kiawe*-buffelgrass lands within the Property. Cats (*Felis catus*), rats (*Rattus* spp.) and mice (*Mus*), while not observed, are expected to be present within the Property due to its proximity to the Maui Meadows subdivision and the Wailea Resort. Rat and mouse remains were detected in owl pellets found on the Property.

4.7 Reptiles and Amphibians

There are no native reptiles or amphibians in Hawai'i (McKeown 1996). Geckos (Gekkonidae) were heard calling, but not seen during avian point counts. Geckos were also heard but not seen along jeep roads on the southern border of the Property. No skinks (Scincidae) were observed during avian point counts. No amphibians were seen within the Property.

5.0 DISCUSSION

Two endangered animal species and one species of concern have been documented by SWCA biologists on the Property: the endangered Blackburn's sphinx moth (*Manduca blackburni*), the endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*), and the pueo (*Asio flammeus sandwichensis*), respectively.

Of particular interest is the surprising number of endangered Blackburn sphinx moth (*Manduca blackburni)* sightings (caterpillars and sign) within the Property. All sightings were associated with non-native tree tobacco plants (*Nicotiana glauca*). These are aggressive weedy plants that grow opportunistically in open, arid, disturbed locations (Wagner et al 1999) and are commonly found along road grades in the northern portion of the Property and throughout the *kiawe-wiliwili* shrubland. The USFWS's Recovery Plan for this species (USFWS 2005) identified conservation and recovery activities, including protection, management, and restoration of habitat and the species' host plants, specifically the native *'aiea* (*Nothocestrum* spp.), and a captive breeding and translocation program. While *'aiea* is not found within the Property and is not known to thrive at low elevations in areas like Honua'ula, the non-native tree tobacco is common here and is apparently frequented by the moths. The removal of non-native tobacco plants during construction will likely result in the loss of non-native feeding habitat for the caterpillar. The potential loss of food plants for the adult moths also exists as some other native plants are removed in portions of the Property.

Three recovery units encompassing 13 management units were identified in the Blackburn Sphinx Moth Recovery Plan (USFWS 2005) as necessary for the long-term survival and recovery of the species. The Pu'u O Kali Management Unit (Unit 8) and the Ahihi-Kinau NAR – Ulupalakua – Auwahi – Kanaio Management Unit (Unit 9) in South Central Maui are closest to Honua'ula (Figure 8). Designated critical habitat is found within Units 8 and 9, and within Kanaha Pond – Spreckelsville Management Unit (Unit 7) located near the Kahului Airport on Maui's north central coastline.

The pueo is most likely to be affected during the construction phase of the project on the site. Construction through grassland habitat will potentially disturb roosting and nesting pueo and is likely to permanently displace pueo from the Property due to the loss of grassland habitat.

No evidence of roosting or foraging by endangered Hawaiian hoary bats was observed by Bruner (1988, 1993, 2004) or SWCA (2009). Definitive conclusions about habitat use cannot be made on existing evidence. The removal of *kiawe* trees during construction may result in the loss of roosting habitat; however, many large stature trees suitable for roosting will be preserved and others propagated for landscaping as the site is developed.

Upon construction of the residential community and golf course at Honua'ula, water features and open fairways associated with the golf course will attract a number of endangered species to the Property. These include the *koloa* (*Anas wyvilliana*), *ae'o* (*Himantopus mexicanus knudseni*), 'alae ke'oke'o (*Fulica alai*), *'alae 'ula* (*Gallinula chloropus sandvicensis*), and *nēnē* (*Branta sandvicensis*).

In addition, there is the potential for lighting present on the Property to present an attraction hazard to juveniles of the threatened Newell's shearwater (*Puffinus auricularis newelli*) and endangered Hawaiian petrel (*Pterodroma sandwichensis*).

The native migratory *kolea* (*Pluvialis fulva*) which are protected under the Migratory Bird Species Act, frequently uses roads and open spaces when over-wintering in Hawai'i and may be displaced if construction occurs during the migratory season. However, it is anticipated that the construction of open spaces, gardens and lawns on the Property will provide additional habitat that kolea can utilize.

6.0 PROPOSED MITIGATION MEASURES

The Maui County Council promulgated 28 specific conditions in granting a Phase I project district zoning approval. Their specific conditions related to wildlife within the Property include:

> *7. That Honua'ula Partners, LLC, its successors and permitted assigns, shall prepare an animal management plan that shall be submitted during Project District Phase II processing and approved by the Department of Land and Natural Resources prior to submittal of Project District Phase III processing. Said plan shall include procedures for the management of animal intrusions including, but not limited to, construction of boundary or perimeter fencing, wildlife control permits, and rodent and feral cat control.*
>
> *Honua'ula Partners, LLC, its successors and permitted assigns, shall implement the approved animal management plan. The Department of Land and Natural Resources may require periodic updates of the plan.*
>
> *9. That Honua'ula Partners, LLC, its successors and permitted assigns, shall prepare an assessment of the owl (Pueo or Hawaiian Short-eared Owl) and the Hawaiian Hoary Bat in coordination with the Department of Land and Natural Resources, and, if appropriate, mitigative measures shall be incorporated into Kīhei-Makena Project District 9. Said assessment shall be prepared prior to submittal of Project District Phase II processing.*

Honua'ula Partners, LLC is proposing to implement the following measures to conserve elements of the remnant *kiawe-wiliwili* shrubland and to protect the native plants and animals within the Property.

- To help provide habitat for Blackburn sphinx moths (*Manduca blackburni*), a Native Plant Preservation Area encompassing a contiguous area within the remnant *kiawe-wiliwili* shrubland will be dedicated in perpetuity to protect as much of the remnant *kiawe-wiliwili* shrubland plant community as possible. The protected area will meet the 7.3-52.6 ha (18-130 ac) directive imposed by the Maui County Council, and will ultimately be subject to approval by the Council. The Native Plant Preservation Area will encompass the highest densities of the rarest elements of the native vegetation within the project parcel. The only non-native species that will be allowed to remain in this area will be the tree tobacco (*Nicotiana glauca*) so as to provide food and habitat for endangered Blackburn's sphinx moths (*Manduca blackburni*). This may enhance the geographic connectivity between the two recovery units; and may also provide a source of sphinx moth caterpillars for the translocation program which has been identified as a desirable recovery activity (USFWS 2005).

- Conversely, non-native tree tobacco (*Nicotiana glauca*) plants will be removed from the property outside the Native Plant Preservation Area prior to construction. This will be done in consultation with biologists from DLNR-DOFAW and the USFWS to prevent accidental take of the Blackburn's sphinx moth (*Manduca blackburni*) caterpillar.

- Construction operations will be closely monitored to prevent accidental take of the various Blackburn's sphinx moth (*Manduca blackburni*) life stages. Should sphinx moths be found,

host plants will be marked for protection and not removed until deemed appropriate by DLNR-DOFAW and USFWS biologists.

- Upon completion of the proposed project, restrictions on landscaping and gardening will be enacted to prevent propagation of any plant in the Solanaceae (Nightshade) family that may attract Blackburn's sphinx moths (*Manduca blackburni*).

- A translocation program for Blackburn's sphinx moth (*Manduca blackburni*) caterpillars will be developed and implemented through preparation of a Habitat Conservation Plan (HCP), particularly for caterpillars found in landscaped areas of the Property, in consultation with DLNR-DOFAW and the USFWS.

- Intensive wildlife surveys will be continued from November – May through construction of the proposed project to look for signs of endangered Blackburn sphinx moths (*Manduca blackburni*) within the Property, to distinguish any signs found as the Blackburn sphinx moth (*Manduca blackburni*) and not other more common horn worm species, and to protect individual moths from destruction.

- Additional Hawaiian hoary bat (*Lasiurus cinereus semotus*) point count surveys will be conducted prior to construction to document the changes in abundance and determine habitat utilization of these species during the wet and dry seasons.

- A qualified wildlife biologist will monitor the Property for bats (*Lasiurus cinereus semotus*) during construction. Should bats (*Lasiurus cinereus semotus*) be found at the site during construction, assistance will be requested from the USFWS office in Honolulu.

- Clearing of habitat during construction will be monitored to reduce the potential take of non-volent juvenile bats (*Lasiurus cinereus semotus*) (Hart 2003).

- Propagation of native tree species will be conducted during landscaping to provide suitable bat (*Lasiurus cinereus semotus*) roosting habitat to mitigate for the loss of possible roosting trees during construction.

- Potential impacts to seabirds will be minimized by shielding outdoor lights in compliance with Chapter 20.35 (Outdoor Lighting) of the Maui County Code, avoiding night-time construction, and providing all project staff with information regarding seabird fallout. All project lights will be shielded so the bulb can only be seen from below. This is a common and successful mitigation measure employed throughout the Hawaiian Islands.

- Construction around areas found with pueo (*Asio flammeus sandwichensis*) nests will be delayed until the chicks have fledged.

- The entire perimeter of the Property has already been fenced to discourage feral ungulates and grazing cattle from entering the remnant *kiawe-wiliwili* shrubland; however, the fence is porous. Fencing requirements will be reviewed and updated as establishment of the Native Plant Preservation Area construction begins. An animal management plan will be implemented by the Natural Resource Manager to insure that goats, deer, pigs, and stray cattle are removed in a human manner from the proposed for native plant protection on the Property

- A Natural Resource Manager will be employed by Honua'ula Partners, LLC to develop and implement specific conservation programs to help insure the protection of native plants and animals within the Native Plant Preservation Area and other areas designated for native plant protection on the Property.

- An Animal Management Plan is being prepared under separate cover in cooperation with DLNR-DOFAW and USFWS during Project District Phase II processing.

- A Conservation and Stewardship Plan is also being prepared under separate cover to implement a natural resource management plan for the Native Plant Preservation Area and other areas designated for native plant protection on the Property.

- Finally, a multi-species Habitat Conservation Plan (HCP), to include the candidate endangered *'āwikiwiki* (*Canavalia pubescens*) is being prepared under Section 10(a)(1)(B) of the Endangered Species Act and in collaboration with DLNR and USFWS.

Taken together with the mitigation measures identified in the Botanical Survey of Honua'ula (Wailea 670) (SWCA 2009), these actions fully satisfy the objectives and the intent of the special Project District Phase II conditions promulgated by the Maui County Council.

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