PAUL T. MATSUDA

P.E., LEED AP
Principal
Director of Civil Engineering

Paul Matsuda, P.E., LEED AP is a principal and the Director of Civil Engineering of G70. Paul has more than 20 years of civil engineering experience in a wide variety of site development, transportation and utility infrastructure projects throughout Hawai'i and the Pacific Northwest. He is responsible for management and delivery of the firm's engineering projects and is actively involved in design and project management for many of them. Paul received a Bachelor of Science degree in civil engineering from the University of Washington and is a licensed professional in Hawai'i, Oregon, and Washington.

SELECTED PROJECTS:

Innergex Paeahu 15MW Solar Farm
Ulupalakua Ranch, Maui

Innergex Hale Kuawhi 30MW Solar Farm
Parker Ranch, Hawai'i Island

Longroad Mahi 120MW Solar Farm
Kunia, O'ahu

Longroad Pulehu 40MW Solar Farm
Pulehu, Maui

Clearway Mililani 12.1MW Solar Farm Phase 1
Mililani, O'ahu

Clearway Mililani 12.1MW Solar Farm Phase 2
Mililani, O'ahu

Clearway Waipio 47.6MW Solar Farm
Waipio, O'ahu

Clearway Kawailoa 47.6MW Solar Farm
Kawailoa, O'ahu

Clearway Waiawa I 36MW Solar Farm
Waiawa, O'ahu

Ho'ohana 52MW Solar Farm
Kunia, O'ahu

Waipio 11MW Solar Farm
Waipio, O'ahu

ASEF Kalaeloa Solar Farm
Kalaeloa, O'ahu

East Kapolei Solar Farm
Kapolei, O'ahu

Sunetric Wai'anae Two 5MW Solar Farms Phases I & II (FIT & PPA)
Wai'anae, O'ahu

Sunetric Residential Solar, Farrington - Permitting
Wai'anae, O'ahu

Sunetric Residential Solar, Mahinaau - Permitting
Wai'anae, O'ahu

Hawai'i BioEnergy - HECO Biofuels Program Development
Kaua'i and Hawai'i

University of Hawai'i at Mānoa - Photovoltaic Power Plant Master Plan
Honolulu, O'ahu

University of Hawai'i at Mānoa - Metcalf Water System Improvements
Honolulu, O'ahu

University of Hawai'i at Mānoa - Student Housing Study
Honolulu, O'ahu

University of Hawai'i at Mānoa - College of Education Master Plan
Honolulu, O'ahu

University of Hawai'i at Mānoa - Richardson School of Law Outreach Center
Honolulu, O'ahu

University of Hawai'i at Mānoa - Webster Hall
Honolulu, O'ahu

Office of Hawaiian Affairs - 4531 Kuamo'o Road Civil Infrastructure Assessment
Kapa'a, O'ahu

Office of Hawaiian Affairs - Kaka'ako Makai Master Plan
Honolulu, O'ahu

PROFESSIONAL REGISTRATIONS & ASSOCIATIONS:

State of Hawai'i – Professional Engineer (P.E.) Civil #10901

State of Oregon – Professional Engineer (P.E.) Civil #19,250

State of Washington – Professional Engineer (P.E.) Civil #35,943

U.S. Green Building Council (USGBC) - Leadership in Energy and Environmental Design Accredited Professional (LEED AP)

U.S. Green Building Council, Hawai'i Chapter

American Society of Civil Engineers (ASCEH), Member

American Council of Engineering Companies Hawai'i (ACECH), Member

American Water Works Association (AWWA), Member

EDUCATION:

B.S. Civil Engineering
University of Washington, WA

TETRA TECH

TRANSMITTAL

To: Gloria Takara, City & County of Honolulu Department of Planning and Permitting

From: Lisa Kettley, Tetra Tech, Inc.

Date: Monday, December 07, 2020

Subject: AES West Oahu Solar Plus Storage Project – Copies of State Special Use Permit Application

Hi Gloria,

Enclosed are the following documents related to the State Special Use Permit (SUP) application for the AES West Oahu Solar Plus Storage Project:

1. 12 hard copies of application submittal documents
2. 1 CD with electronic copy of application submittal documents

Please let me know if you have any questions or require further information.

Thank you,
Lisa

cc: Nick Molinari, AES Distributed Energy

Tetra Tech, Inc.
737 Bishop St., Suite 2340, Mauka Tower, Honolulu, HI 96813
Tel 808.441.6655 Fax 808.836.1689 www.tetratech.com

STATE SPECIAL USE PERMIT APPLICATION

West O‘ahu Solar Plus Storage Project

University of Hawai‘i West O‘ahu Mauka Lands Property

‘Ewa District, O‘ahu, Hawai‘i

Tax Map Key 9-2-002:007 (por.)

AES West O‘ahu Solar, LLC

AES
we are the energy

AUGUST 2020

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Abbreviations and Acronyms

AES	AES Distributed Energy, Inc.
AC	alternating current
AIS	Archaeological Inventory Survey
ALISH	Agricultural Lands of Importance to the State of Hawaii
ATCT	Air traffic control tower
amsl	above mean sea level
BMP	Best Management Practice
CIA	Cultural Impact Assessment
CUP	Conditional Use Permit
CZM	Coastal Zone Management
DBEDT	Hawai‘i Department of Business, Economic Development and Tourism
DC	direct current
DOFAW	State of Hawai‘i Department of Land and Natural Resources, Division of Forestry and Wildlife
DOT	State of Hawai‘i Department of Transportation
DPP	City and County of Honolulu Department of Planning and Permitting
EA	Environmental Assessment
EIS	Environmental Impact Statement
ESCP	Erosion and Sediment Control Plan
FAA	Federal Aviation Administration
FCC	Federal Communications Commission
HAR	Hawai‘i Administrative Rules
Hawaiian Electric	Hawaiian Electric Company
HCEI	Hawai‘i Clean Energy Initiative
HRS	Hawai‘i Revised Statutes
IAL	Important Agricultural Land
IRS	Interconnection Requirement Study
kV	kilovolt
LID	Low impact development
LSB	Land Study Bureau

LUO	Land Use Ordinance
MW	megawatt
MWh	megawatt-hour
NCT	Notice Criteria Tool
NEC	National Electric Code
NFPA	National Fire Protection Association
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
OEG	Obstruction Evaluation Group
PPA	Power Purchase Agreement
Project	West Oʻahu Solar Plus Storage Project
PSIP	Power Supply Improvement Plan
PUC	Public Utilities Commission
RF	radio frequency
RFP	Request for Proposal
RPS	renewable portfolio standard
SCADA	supervisory control and data acquisition
SHPD	State Historic Preservation Division
SMA	Special Management Area
SPCC	Spill Prevention Control and Countermeasure
SWPPP	Stormwater Pollution Prevention Plan
TIAR	Traffic Impact Analysis Report
TMK	tax map key
TMP	Traffic Management Plan
UH	University of Hawaiʻi
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
WEOP	wildlife education and observation program

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Master Application Form

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City and County of Honolulu
DEPARTMENT OF PLANNING AND PERMITTING
650 South King Street, 7th Floor
Honolulu, Hawaii 96813

PLANNING DIVISION MASTER APPLICATION FORM

Additional data, drawings/plans, and fee requirements are listed on a separate sheet title "Instructions for Filing". *PLEASE ASK FOR THESE INSTRUCTIONS.*

All specified materials described in the "Instructions for Filing" and required fees must accompany this form; incomplete applications will delay processing. You are encouraged to consult with Planning Division staff in completing the application. Please call appropriate phone number given in the "Instructions for Filing".

Please print legibly or type the required information.

SUBMITTED FEE: $ $15,000

PERMIT/APPROVAL REQUESTED (Check one or more as appropriate):

☐ GENERAL PLAN AMENDMENT	☒ SPECIAL USE PERMIT _X_ New ____ Modify Existing
☐ STATE LAND USE BOUNDARY AMENDMENT (<15 acres) From _____ (District) To _____ (District)	☐ ZONING DISTRICT BOUNDARY ADJUSTMENT, ADMINISTRATIVE
☐ DEVELOPMENT PLAN (DP)/SUSTAINABLE COMMUNITIES PLAN (SCP) AMENDMENT Indicate DP/SCP area _____	☐ ZONE CHANGE From _____ (District) To _____ (District) ☐ AMEND UNILATERAL AGREEMENT TO ORDINANCE NO._____

☐ PUBLIC INFRASTRUCTURE MAP REVISION (Indicate Map Symbol Request): ☐CY (Corporation Yard) ☐DSP (Desalination Plant) ☐D (Drainage Way (Open Channel) ☐TS (Transit Station) ☐FS (Fire Station) ☐GB (Government Building) ☐GC (Golf Course) ☐P (Parks) ☐PS (Police Station) ☐PKG (Parking Facility/Transit Center) ☐RES (Water Reservoir) ☐SPS (Sewage Pump Station) ☐STP (Sewage Treatment Plant) ☐SW (Solid Waste Facility) ☐RTC (Rapid Transit Corridor) ☐R (Arterial & Collector Roadway) ☐W (Potable Well)

(Project/Parcel specific information should be provided for General Plan and Development Plan amendments only if appropriate.)

TAX MAP KEY(S): 9-2-002:007
STREET ADDRESS/LOCATION OF PROPERTY: Palehua Road (near intersection of Kualakai Parkway and H-1 Freeway); Kapolei, Oahu
APPLICATION/SUBJECT AREA *(Acres/sq.ft.)*: 97 acres (see footnote in Section 2 of the Written Statement)
THE PROPOSED PROJECT IS LOCATED ☐ INSIDE ☒ OUTSIDE THE:

☐Urban Growth Boundary ☒Community Growth Boundary
☐Urban Community Boundary ☐Rural Community Boundary

OF THE Ewa Development Plan
ZONING DISTRICT(S): AG-1

DEVELOPMENT PLAN/SUSTAINABLE COMMUNITY PLAN
STATE LAND USE DISTRICT: Agriculture

RECORDED FEE OWNER:
Name (& title, if any) Jan Gouveia, VP for Administration
Organization University of Hawaii (UH)
Mailing Address 2444 Dole Street, Bachman 109H
Honolulu, Hawaii 96822
Phone Number (808) 956-6405
Signature _____

APPLICANT:
Name Rob Cooper, VP Development
Organization AES West Oahu Solar, LLC
Mailing Address 282 Century Place, Suite 2000
Louisville, CO 80027
Phone Number (720) 496-5068
Signature _____

PRESENT USE(S) OF PROPERTY/BUILDING:
Fallow agricultural land with intermittent grazing

AUTHORIZED AGENT/CONTACT PERSON:
Name Lisa Kettley, Tetra Tech
Mailing Address 737 Bishop Street, Suite 2340
Honolulu, Hawaii 96813
Phone Number (808) [illegible]-6651
Signature _____

PROJECT NAME (If any): West Oahu Solar Plus Storage Project

REQUEST/PROPOSAL (Briefly describe the nature of the request, proposed activity or project):
The Project involves construction and operation of a 12.5-MW solar photovoltaic and 50-MWh battery energy storage system on land owned by UH. The Project area would also be made available for compatible agricultural activities. The Project would be decommissioned at the end of its 25-year lifespan.

DPP/ELOG NO._____ DPP/POSSE NO._____

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Written Statement

This document has been prepared in support of the application for a State Special Use Permit for the proposed West Oʻahu Solar Plus Storage Project (Project). Pursuant to Hawaiʻi Revised Statutes (HRS) § 205, a Special Use Permit may be sought for uses within the State agricultural or rural districts that are "certain unusual and reasonable uses….other than those for which the district is classified."

The Project would involve construction and operation of a solar photovoltaic and battery energy storage system within an area designated by the State of Hawaiʻi Land Use Commission as agricultural district. Based on the Land Study Bureau (LSB) soil classification system, the Project area includes approximately 48 acres of Class B soils, 36 acres of Class D soils, and 13 acres of Class E soils. The Project would not involve construction of any facilities on LSB Class A soils. Pursuant to HRS § 205-2(d)(6), solar energy facilities that occupy more than ten percent of a parcel or 20 acres of land in an area with LSB Class B or C soils are an allowed use within the State agricultural district with a Special Use Permit issued by the County planning commission. Because the land area in question is greater than fifteen acres, the permit is also subject to approval by the State Land Use Commission under HRS § 205-6(d).

This document and associated attachments contain all of the content requirements identified by the City & County of Honolulu Department of Planning and Permitting (DPP) for a Special Use Permit, as listed in Table 1. As detailed herein, the Project would comply with all requirements for solar energy facilities in the State agricultural district as specified in HRS § 205-4.5(a)(21), including provisions for compatible agricultural activities and future decommissioning of the Project.

Table 1. Checklist of Special Use Permit Application Requirements

Requirements	Section of Application
Pre-Application Procedures	
A. Pre-Application Meeting	Initial meeting held with DPP on April 2, 2019
B. Presentation to Neighborhood Board	Presentation provide on August 26, 2020; see Section 5.3
C. Environmental Assessment (EA)/Environmental Impact Statement (EIS) (Special Use Permit application cannot be accepted for processing until requirements of HRS § 343 are met.)	Final EA and FONSI published by OEQC on July 8, 2020
Application Requirements	
A. DPP Master Application Form	Front matter
B. Filing Fee	Attached to application package
C. Written Statement	
C1. Land Use Commission Guidelines	Section 7
C2. Consistency with State and County Plans and Programs	Section 8
a. Coastal Zone Management (HRS § 205A)	Section 8.1
b. Hawai'i State Plan (HRS § 226)	Section 8.2
c. General Plan	Section 8.3
d. Sustainable Communities Plan	Section 8.4
C3. Compliance with LUO	Section 9
C4. Compliance with HRS § 205, Part III (Important Agricultural Lands [IAL])	Section 10
C5. Site Description	Section 2
a. Soil Types and Classifications	Section 2.4
b. Topography, abutting uses and chronological history of the use of the land including the present use of the property	Sections 2, 2.1 and 2.3
C6. Project Description	Section 3
a. Details on existing and proposed uses and activities, such as hours of operation, number of persons (clients and staff) on the site, and use and number of structures.	Sections 3.1., 3.2, 3.3 and 3.4
b. Site plan showing all structures (proposed and existing), easements and driveways, uses (proposed and existing), and setbacks.	Attachment H
c. Landscape plan showing disposition of existing landscaping and proposed landscaping.	Section 3.3.4, Attachments H and K
d. Details on existing and proposed structures, building heights, building and site alterations, including parking areas, grading, setbacks, and buffering from adjoining parcels.	Section 3.1 and Attachment H
C7. Infrastructure Requirements	Section 4
a. Wastewater System	Section 4.1
b. Water	Section 4.2
c. Drainage and Flooding	Section 4.3
d. Streets and Transportation	Section 4.4
C8. Mitigative Measures	Sections 5 and 6
C9. Photos	Attachment D
If the Special Use Permit involves a portion of a lot, a metes and bounds map and description of the Special Use Permit area should be provided.	Attachment H

1 Introduction

AES Distributed Energy, Inc. is proposing the West O'ahu Solar Plus Storage Project on the island of O'ahu, Hawai'i. The Project involves construction and operation of a solar photovoltaic and battery energy storage system on land owned by University of Hawai'i ("UH" and "university" are used interchangeably throughout this document), approximately 3 miles northeast of Kapolei on the southwest side of O'ahu. The Project area encompasses approximately 97 acres[1] within an approximately 861-acre parcel (identified as tax map key [TMK] 9-2-002:007), which is part of a larger area commonly referred to as the UH West O'ahu Mauka Lands property.[2] The Project location and general setting, TMK boundaries, and land ownership are shown in Figures 1 through 4 (contained in Attachment A), respectively.

The Project is envisioned to help the State of Hawai'i achieve its Renewable Portfolio Standard (RPS) energy goals of generating 100 percent of the state's energy from renewable sources. It would include an approximately 12.5-megawatt (MW) ground-mounted solar photovoltaic system plus 50 MW-hour (MWh) battery energy storage system, as well as ancillary support facilities. It would interconnect with the Hawaiian Electric Company (Hawaiian Electric) island-wide grid via an existing 46-kilovolt (kV) sub-transmission line that traverses the Project area. The Project area would be secured for use through an agreement with UH (see Attachment B).[3] The power generated by the Project would be sold to Hawaiian Electric under a new 25-year power purchase agreement (PPA). In addition to generating and storing solar energy, the Project area would also be made available for compatible agricultural activities.

The Project would be owned and operated by AES West O'ahu Solar, LLC (AES), a Delaware limited liability company and affiliate of AES Distributed Energy, Inc., which is a subsidiary of the AES Corporation. AES Distributed Energy, Inc. has a long history in the development and operation of solar energy facilities throughout the United States, including several solar energy facilities in Hawai'i.

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[1] Based on the preliminary design, the Project is not expected to occupy the entire 97 acres within the Project area (refer to the site plan, contained in Attachment H). As further discussed in Section 2, it is anticipated that the area to be secured for the Project through an agreement with UH will be a subset of the 97-acre Project area. Any such reduction in the area secured for Project use from UH would not substantively change the size, scope, intensity, use, location or timing of the Project itself, as described in either the Final Environmental Assessment (EA) or this application.

[2] In total, the UH West O'ahu Mauka Lands property encompasses approximately 991 acres. In addition to the parcel in which the Project would be located, it also includes the following parcels: 9-2-002:001 (80 acres), 9-2-002:005 (12 acres), and 9-2-002:003 (38 acres).

[3] Under an August 2019 option agreement with UH (as amended in May 2020), AES will enter into a Grant of System Easement under which AES will have the right to develop, construct, install, operate, maintain, repair, and replace the Project upon and/or remove the Project on a portion of the UH West O'ahu Mauka Lands property. The easement area will include an exclusive area for the Project facilities, a non-exclusive access easement along existing shared-use access roads, and a non-exclusive utility easement for Hawaiian Electric. As detailed in Attachment B, AES is required to take actions as necessary to designate the area as an easement; AES expects to seek approval from the City and County of Honolulu for the easement designation in late 2020 followed by approval from Land Court in early 2021.

1.1 Background Information

Hawai‘i is widely recognized as the most fossil fuel dependent state in the nation and is exceedingly vulnerable to fluctuations in resource availability. In an effort to reduce Hawai‘i’s dependence on imported fossil fuels and increase the amount of locally produced renewable energy, the Hawai‘i Clean Energy Initiative (HCEI) was launched in 2008 through an agreement between the State of Hawai‘i and the Department of Energy. The HCEI provides a regulatory framework to address the various systems that govern energy planning and delivery within the state (DBEDT, 2019a). As part of the HCEI, the State established an RPS, as codified in Hawai‘i Revised Statutes (HRS) § 269-92. The RPS specifies that the electric utility companies that sell electricity for consumption in Hawai‘i are required to use renewable energy for the equivalent of 30 percent of net electricity sales by 2020, 40 percent by 2030, seventy percent by 2040, and 100 percent by 2045.

In 2016, Hawaiian Electric issued an update to their Power Supply Improvement Plan (PSIP) presenting specific actions that would be implemented over a five-year planning period to accelerate achievement of Hawai‘i’s renewable energy goals. In particular, the PSIP commits Hawaiian Electric to aggressively seek grid-scale renewable resources and to achieve a consolidated RPS of 52 percent by 2021. The resource needs identified for the island of O‘ahu include approximately 352 MW of grid-scale solar energy and 64 MW of grid-scale wind energy (Hawaiian Electric, 2016). To meet these resource requirements, Hawaiian Electric established a process for solicitation and procurement of qualified renewable dispatchable generation.

Through this process, Hawaiian Electric issued its *Request for Proposals for Variable Renewable Dispatchable Generation for the Island of O‘ahu* (RFP; Docket No. 2017-0352) in February 2018.[4] The RFP established a competitive bidding process for projects to provide grid-scale renewable generation to the Hawaiian Electric system, thus contributing to the State’s RPS. Based on responses to the RFP, Hawaiian Electric selected a total of eight solar plus storage projects, each of which required subsequent approval of a PPA by the Public Utilities Commission (PUC).[5] The West O‘ahu Solar Plus Storage Project was one of the projects selected by Hawaiian Electric; the PPA for the Project was approved by the PUC in August 2019 (PUC, 2019).

The area proposed for the West O‘ahu Solar Plus Storage Project is part of the overall 991-acre UH West O‘ahu Mauka Lands property. In September 2014, the UH Board of Regents approved the UH – West O‘ahu Land Use Plan, in which approximately 273 acres of the Mauka Lands property was identified for

[4] As detailed in the RFP, Hawaiian Electric indicated that renewable dispatchable generation would be sought in stages, such that a second phase of the RFP may be issued if the generation needed to meet the PSIP requirements was not fully met in the first phase of the procurement process. Phase 2 of the Hawaiian Electric RFP was issued on August 22, 2019, with projects selected in May 2020.

[5] A total of six projects (with a total capacity of approximately 247 MW and one gigawatt hour of storage) were initially approved by the PUC, including three projects on O‘ahu, one on Maui and two on Hawai‘i Island. Two additional projects, including the West O‘ahu Solar Project and a 15 MW project on Maui were also selected by Hawaiian Electric and were subsequently added to this portfolio.

an energy farm (UH, 2015). Based on the opportunity presented by the Hawaiian Electric RFP process, UH sought potential developers for a renewable energy facility in this location and ultimately awarded AES site control with development rights for the Project area. Consistent with UH's land development strategy, the Project would be enabled through an agreement in which the university would retain ownership of the land while securing a revenue stream.

1.2 Purpose and Need

Collectively, the HCEI and the State of Hawai'i's RPS establish the need to reduce Hawai'i's dependence on imported fossil fuels and increase the amount of locally produced renewable energy. The need for development and implementation of renewable energy projects is further demonstrated by the commitments detailed in Hawaiian Electric's PSIP and the associated RFP process (Hawaiian Electric, 2016; Hawaiian Electric, 2018).

The purpose of the Project is to construct and operate facilities on the UH West O'ahu Mauka Lands property that would generate and store electricity derived from solar resources, thereby providing clean, renewable energy for the island of O'ahu. The Project would help to meet the state's need for renewable energy by providing up to 12.5 MW of solar energy and 50 MWh of battery storage, which is enough to provide electricity for approximately 4,600 homes (based on average energy use). In doing so, it would directly contribute to the state's renewable energy goals, fulfilling approximately 0.5 percent of Hawaiian Electric's RPS on average over the contract term (Hawaiian Electric, 2019a). The solar energy from the Project would replace a portion of electricity that is currently generated by burning fossil fuels, thus reducing greenhouse gas emissions and other forms of pollution that are detrimental to the environment and human health. In total, the Project is expected to offset the use of approximately 545,794 barrels of fuel and 64 tons of coal, and would decrease greenhouse gas emissions by approximately 244,394 tons over its lifetime (Hawaiian Electric, 2019a). Furthermore, based on the 25-year fixed-price PPA, the energy produced by the Project would be sold at a price that is less than the current cost of fossil fuel power and would help to hedge against long-term price volatility. Hawaiian Electric estimates the ratepayer savings (assuming a typical residential bill for 500 kilowatt-hours) would be approximately $0.22 per month in 2022 and range up to $0.91 per month over the 25-year term of the Project (Hawaiian Electric, 2019a).[6,7] The Project would also help to improve electric grid stability by enabling Hawaiian Electric to utilize stored solar energy to meet peak demand. As an additional benefit, the Project's agreement with UH would provide a valuable revenue stream for the university over the next 25 years or more.

[6] Project-related cost and ratepayer savings information is based on analyses conducted by Hawaiian Electric at the time the Project was approved (Hawaiian Electric, 2019b).

[7] As part of the estimation of impacts to customer bills, as presented in their application to the PUC, Hawaiian Electric specifically notes: "Bill impacts are highly dependent on the particular production simulation modeling assumptions used for each particular year analyzed, and will be different than estimated herein over the project term as actual conditions deviate from the assumed conditions."

1.3 HRS § 343 Environmental Review

Among other things, HRS § 343-5(a) requires an environmental assessment (EA) for an action that proposes the use of state lands. Hawai'i Administrative Rules (HAR) § 11-200.1-9(a)(2)(A) further provides that "[u]nder section 343-5(a), HRS, . . . use of state or county lands includes any use (title, lease, permit, easement, license, etc.) or entitlement to those lands." The Project will entail execution of an agreement with UH for the use of state land. As described above, based on an option agreement with UH, AES will enter into a Grant of System Easement (including an exclusive area for the Project facilities, a non-exclusive access easement along existing shared-use access roads, and a non-exclusive utility easement).

Pursuant to HAR § 11-200.1-7, DPP was determined to be the approving agency for the purposes of HRS § 343 compliance because they are the agency initially responsible for receiving and processing the request for a Special Use Permit. An EA was prepared in compliance with HRS § 343 and HAR § 11-200.1. Based on the findings of the EA and application of the significance criteria in HAR § 11-200.1-13, DPP issued a "Finding of No Significant Impact" (FONSI). The Final EA and FONSI (Attachment C) supports this application and is hereby incorporated by reference.

2 Site Description

The Project area is located within the ahupua‘a of Honouliuli in the ‘Ewa District on the island of O‘ahu. It is approximately 97 acres[8] in size and sits within the southwestern portion of the 991-acre UH West O‘ahu Mauka Lands property. The UH West O‘ahu Mauka Lands property is bordered on its southeastern edge by the H-1 Freeway, beyond which is the UH West O‘ahu campus and the communities of East Kapolei. The southern and western portions of the property are bordered by vacant land, with Makakilo Quarry and the residential community of Makakilo located just beyond. The area to the north generally comprises open space associated with the Wai‘anae Mountains. To the northeast is the former Honouliuli Internment Camp site, which the National Park Service is currently working to incorporate as a National Monument. The eastern portion of the property is bordered by Honouliuli Gulch and a variety of agricultural operations; further east is Kunia Road and the Village Park community (see Figure 1; Attachment A).

The UH West O‘ahu Mauka Lands property is accessed via Pālehua Road, which extends north then west from the intersection of Kualaka‘i Parkway and H-1 Freeway; Pālehua Road is also used for access to the Makakilo Quarry, which is owned and operated by Grace Pacific. An existing gate and 24-hour security controls entry to both the UH West O‘ahu Mauka Lands property and Makakilo Quarry. From the gated entry and security guard station, located adjacent to Pālehua Road, access to the Project area would be via a network of former plantation roads which were originally constructed and used for sugar cane haul trucks; these roads have been maintained and provide continued access for various uses throughout the UH West O‘ahu Mauka Lands property. The portion of Pālehua Road and the existing access roads that would be used to access the Project area are located entirely on land owned by UH; the agreement with UH will include a non-exclusive access easement along these roadways.

Photographs of the Project area (including street access, uses on adjoining properties, and existing structures) along with a key map are provided in Attachment D.

2.1 Historic and Current Uses

Historically, the area within and surrounding the Project area was put into cultivation in the 1920s as part of an extensive sugar cane and pineapple plantation that extended across O‘ahu’s ‘Ewa Plain. The plantation included agricultural fields, irrigation and other associated infrastructure, as well as

[8] The Project area is based upon a 97-acre area defined in the option agreement with UH (see Attachment B). Given the current preliminary design, the Project is not expected to occupy the entire 97-acre Project area (refer to the site plan, contained in Attachment H). It is anticipated that the area to be secured for the Project through the easement(s) required under the option agreement with UH will be a subset of the 97-acre Project area, subject to a possible reduction of approximately 25-35 acres; the final area secured for Project use from UH will be based on the final design and engineering plans, subject to review and input by Hawaiian Electric. This area will be defined through the easement designation process, and submitted to the City and County of Honolulu and Land Court for approval. Any such reduction in the area secured for Project use from UH would not substantively change the size, scope, intensity, use, location or timing of the Project itself, as described in either the Final EA or this application.

plantation camps and housing. Since closure of the plantation in the 1990s, the land has been fallow and is intermittently used for cattle grazing. Remnants of infrastructure associated with the former plantation remains onsite, including an abandoned mill building, pump station and components of the irrigation system, as well as a portion of the Waiahole Ditch; none of this infrastructure is currently functional. The only other structure within the property is a Board of Water Supply water tank (East Kapolei 440' Reservoir), which supplies water for the UH West O'ahu campus.

2.2 Land Use Designations

Based on the land use district boundaries established by the State Land Use Commission, the Project area is entirely within the State agricultural district (see Figure 5; Attachment A). No portion of the Project area is designated or identified as Important Agricultural Land (IAL) under HRS §§ 205-47 or 205-49. According to the zoning district boundaries established by the City and County of Honolulu, the Project area is entirely within the Restricted Agriculture (AG-1) zoning district (see Figure 6; Attachment A). It is identified as agricultural and preservation area according to the Urban Land Use Map in the 'Ewa Development Plan (DPP, 2013). The Project area is not located within the Special Management Area (SMA) or any special zoning districts regulated by the City and County of Honolulu.

2.3 Topography and Elevation

The Project area is located on the lower slopes of the southern Wai'anae Mountains. The topography ranges from relatively flat to moderately sloping (see Figure 7; Attachment A). The elevation along the southeastern boundary of the Project area is approximately 280 feet above mean sea level (amsl) and rises to approximately 675 feet amsl in the northwestern portion. Pu'u Kapuai, which rises to approximately 1,050 feet amsl, is located approximately 0.5 mile northwest of the Project area.

2.4 Soil Types and Classification

2.4.1 Soil Survey, U.S. Soil Conservation Service

According to data published by U.S. Soil Conservation Service (subsequently renamed the Natural Resources Conservation Service [NRCS]), the majority of the soils within the Project area are identified as Mahana silty clay loam (McC2, McD2, and McE2), as shown on Figure 8 (Attachment A). The land capability classification for McC2 is 3e if irrigated and 4e if non-irrigated (severe to very severe limitations on cultivated use due to erosion). For types McD2 and McE2, the land capability classification is 4e if irrigated and 6e if non-irrigated (very severe limitations on cultivated use to unsuitable for cultivation due to erosion) (NRCS, 2019; NRCS, 2020).

In addition to the Mahana series, small areas of Molokai silty clay loam (MuC, MuD) and Kawaihapai clay loam (KIB) are also present. The land capability classification for MuC is 3e if irrigated and 4e if non-irrigated (severe to very severe limitations on cultivated use due to erosion); MuD has a classification of 4e for both irrigated and non-irrigated conditions (very severe limitations on cultivated use due to

erosion). Soil type KIB has a land capability classification of 2e for both irrigated and non-irrigated conditions (moderate limitations on cultivated use due to erosion) (NRCS, 2019; NRCS, 2020).

All of the NRCS soil types mapped within the Project area are generally described as well-drained, with a medium to high potential for runoff (NRCS, 2019). Overall, the soils within the Project area have been highly modified over time as a result of extensive cultivation for the previous sugarcane plantation. Evidence of soil erosion, such as rills and small gullies, are present within portions of the Project area.

2.4.2 Agricultural Lands of Importance in the State of Hawai‘i (ALISH)

The State Department of Agriculture developed and compiled the Agricultural Lands of Importance to the State of Hawai‘i (ALISH) Classification System in 1977 in cooperation with the NRCS. The ALISH system identifies and classifies agriculturally suitable land based on a wide range of factors including soil characteristics, climate, moisture supply, and other general production-related factors. The three classification ratings are: (1) prime agricultural lands, (2) unique agricultural lands, and (3) other important lands. Unclassified lands are not considered important for agriculture. As shown in Figure 9 (Attachment A), most of the Project area is classified as other important lands, which is land other than prime or unique agricultural land that is also considered to be of statewide or local importance to agricultural use. A portion of the Project area is classified as prime agricultural land, which is considered to have the soil quality, growing season, and moisture supply needed to produce sustained high yields of crops when properly managed (NRCS, 2008).

2.4.3 Land Study Bureau

This statewide inventory was developed by the LSB of the University of Hawai‘i in the 1970s, and provides an agricultural productivity rating based on characteristics including texture, slope, salinity, erodibility, and rainfall. It classifies land into categories ranging from Class A to Class E (with Class A representing the most productive soils and Class E representing the least productive soils). As previously noted, the Project area is designated as having LSB Class B, D, and E soils (see Figure 10; Attachment A). In total, the Project area includes approximately 48 acres of Class B soils, approximately 36 acres of Class D soils, and approximately 13 acres of Class E soils. The Project would not involve construction of any facilities on LSB Class A soils.

2.5 Water Resources

The Project area is within the upper portion of the Kalo‘i Gulch watershed. Surface water features within the Project area include tributaries to Kalo‘i Gulch and a portion of the Waiahole Ditch. No perennial streams or wetlands occur within the Project area.

The Kalo‘i Gulch system consists of numerous tributaries that originate in the Wai‘anae Mountain Range and enjoin to form one channel just mauka of the H-1 Freeway (Parham et al., 2008). Tributaries to Kalo‘i Gulch run along the southern boundary and through the central portion of the Project area (Figure 11; Attachment A). Within and immediately adjacent to the Project area, these tributaries have physical

indicators of occasional surface water flow (e.g., defined bed and bank, ordinary high water mark), but the features are typically dry and only carry water during and immediately following rain events.

The portion of the Waiahole Ditch within the Project area consists of a concrete ditch, with a metal pipe (roughly 4.5 inches in diameter) immediately adjacent to the ditch. The Waiahole Ditch and associated pipeline feature are part of the Waiahole Ditch System, which was constructed in the early 1900s to transport water from the windward side of the Koʻolau Mountains to leeward Oʻahu to irrigate dry agricultural lands. Within the Project area, the ditch and pipeline no longer function to carry water.

To confirm whether the features within the Project area are subject to regulation by the U.S. Army Corps of Engineers (USACE) under Section 404 of the Clean Water Act, a jurisdictional delineation was conducted in May 2019 in accordance with the 2015 Clean Water Rule (USACE and EPA, 2015). The delineation report was submitted to the USACE for review and verification in July 2019. On September 4, 2019, the USACE provided written confirmation that the features within the Project area are not jurisdictional Waters of the U.S., and therefore are not subject to regulation under the Clean Water Act.

2.6 Biological Resources

A biological resources survey was conducted within the Project area on January 31, 2019 and February 5, 2019, with a follow-up survey on November 14, 2019 to confirm the findings relative to an adjustment in the Project area boundary. The purpose of the survey was to characterize the existing habitat and assess the potential for state or federally listed threatened, endangered, or otherwise rare plants or animals to occur within the Project area. As part of this effort, a survey specifically intended to detect pueo or Hawaiian short-eared owl (*Asio flammeus sandwichensis*) was conducted within the Project area. To increase detectability, three additional pueo surveys were conducted in September, November, and December 2019. These surveys followed the Pueo Project survey protocol (Price and Cotín, 2018) and were conducted during twilight hours when pueo are more likely to be detected (M. Price/ UH Mānoa, pers. comm., September 2019; Cotín et al., 2018). The survey results are summarized below, with additional detail provided in the attached survey reports (Attachment E).

2.6.1 Vegetation

In general, the survey indicates that the Project area has been extensively modified by previous agricultural use and the introduction of invasive species, which has resulted in a reduction of the number and abundance of native species and habitats suitable for native species. Vegetation within the Project area is dominated by Koa Haole Scrub. This vegetation type is characterized by open to dense stands of non-native koa haole trees (*Leucaena leucocephala*), ranging from 4 to 8 feet in height. Guinea grass (*Urochloa maxima*) is the most abundant plant in the understory, although buffelgrass (*Cenchrus ciliaris*) is also occasionally present. Kiawe trees (*Prosopis pallida*) are sparsely scattered throughout the Project area. Other common species widely occurring in the Project area include klu (*Acacia farnesiana*), ʻilima (*Sida fallax*), ʻuhaloa (*Waltheria indica*), and *Sida ciliaris*.

A total of 29 plant species were observed during the biological survey; a complete list is provided in the Biological Resources Survey Report (Attachment E). Of the species observed, only four are native to the Hawaiian Islands, including hoary abutilon (*Abutilon incanum*), ʻilima, ʻuhaloa, and wiliwili (*Erythrina sandwicensis*). In the Project area, wiliwili are limited to several trees scattered in the gulch along the southern boundary. This endemic tree is relatively rare on Oʻahu primarily due to coastal development and insect pests, but is more abundant on Maui and Hawaiʻi Island. The remaining three native plant species occur throughout the Project area; all three species are indigenous (i.e., found in the Hawaiian Islands and elsewhere) and are common across the Hawaiian Islands (Wagner et al. 1999). The native ʻaʻaliʻi (*Dodonaea viscosa*) was also observed immediately outside the Project area. No federal or state-listed threatened, endangered, proposed listed, or candidate plant species were observed in the Project area during the biological survey.

2.6.2 Wildlife

A total of 21 bird species were observed during the biological survey. All of the observed avian species are non-native to the Hawaiian Islands and are commonly found in rural or agricultural areas. Zebra dove (*Geopelia striata*) and common myna (*Acridotheres tristis*) were the most commonly observed avian species during the survey within the Project area. A complete list of the bird species observed is provided in the Biological Resources Survey Report (Attachment E).

Two non-native terrestrial mammal species were observed in the Project area – cattle (*Bos taurus*) and small Indian mongoose (*Herpestes auropunctatus*). Although not observed, other introduced mammals, such as dogs (*Canis familiaris*), cats (*Felis catus*), house mice (*Mus musculus*), and rats (*Rattus* spp.) are likely to occur in the Project area.

Large insects observed during the biological survey include yellow garden spider (*Argiope aurantia*), globe skimmer (*Pantala flavescens*), fork-tailed bush katydid (*Scudderia furcata*), praying mantis (*Mantis religiosa*), large orange sulfur (*Phoebis agarithe*), gulf fritillary (*Agraulis vanillae*), and Carolina locust (*Dissosteira carolina*). Of these species, only the globe skimmer is native to the Hawaiian Islands.

2.6.2.1 Federally and State Listed Species

No federally or state listed species were observed during the biological surveys, nor has any portion of the Project area been designated as critical habitat. Although not observed during the surveys, several federally or state listed species have the potential to occur within or traverse over the Project area, as listed below. Additional details regarding the life history and habitat requirements for these species is provided in Section 3.4 of the EA.

Hawaiian Hoary Bat (ʻŌpeʻapeʻa; *Lasiurus cinereus semotus*)

The biological survey for the Project did not include focused surveys for the Hawaiian hoary bat (e.g., acoustic bat detectors or night vision goggles). As the U.S. Fish and Wildlife Service (USFWS) and State of Hawaiʻi Department of Land and Natural Resources Division of Forestry and Wildlife (DOFAW) recognize all woody vegetation greater than 15 feet tall as potential bat roosting habitat (DOFAW, 2015; USFWS, 2019), Tetra Tech noted the presence of any such trees or shrubs within the Project area which could be

used for roosting. Although the majority of the woody vegetation within the Project Area is relatively short and scrubby (e.g., koa haole), the scattered kiawe trees throughout the Project Area and the wiliwili trees within the southern tributary to Kaloʻi Gulch may provide potentially suitable roosting habitat. Given the species' wide range of foraging habitat, it is also likely that bats forage in or near the Project Area. The nearest known detection of a Hawaiian hoary bat is from a detector deployed near the West Loch Golf Course (approximately 2.2 miles from the Project area) for a systematic survey being conducted across Oʻahu as part of an island-wide occupancy and distribution study (Starcevich et al. 2019).

Hawaiian Short-eared Owl (Pueo; *Asio flammeus sandwichensis*)

As previously noted, a survey specifically intended to detect pueo was conducted on the morning of February 5, 2019 (from civil twilight to 60 minutes after sunrise) as part of the biological survey. Pueo were not seen or heard within the Project area during this initial survey. To increase detectability, three additional pueo surveys were conducted on September 26, November 14, and December 19, 2019; these surveys followed the Pueo Project survey protocol (Price and Cotín, 2018) and were conducted during twilight hours when pueo are more likely to be detected (M. Price/ UH Mānoa, pers. comm., September 2019; Cotín et al., 2018). Pueo were not seen or heard within the Project area during these surveys. Although not detected within the Project area, this species has been reported to use the surrounding areas; the nearest known observation to the Project area is near the southern edge of the UH West Oʻahu campus (Price and Cotín, 2018; Pueo Project, 2019b). Given the habitat present, pueo could potentially forage or nest in and around the Project area. However, based on consultation with DOFAW biologists and Pueo Project researchers regarding the survey results and previous pueo detections in the vicinity, it is understood that pueo are not likely to use the Project area on a regular basis given the lack of detection during the surveys (A. Siddiqui/ DOFAW, pers. comm., October 2019).

Hawaiian Seabirds

Federally and state listed seabird species that occur in Hawaiʻi include the Hawaiian petrel (ʻua'u; *Pterodroma sandwichensis*), band-rumped storm petrel (ʻake'ake; *Oceanodroma castro*) and Newell's shearwater (ʻa'o; *Puffinis auricularis newelli*). These species spend most of their time at sea, returning to land only during the breeding season. Seabirds have not been documented in the Project area and suitable nesting habitat does not exist in or near the Project area. However, suitable nesting habitat may exist in upper elevations of the Waiʻanae Mountains, suggesting the potential for these birds to fly over the Project area at night while transiting between nest sites and the ocean.

Hawaiian Waterbirds

Listed waterbird species that occur in Hawaiʻi include Hawaiian stilt (aeʻo; *Himantopus mexicanus knudseni*), Hawaiian coot (ʻalea kea; *Fulica alai*), Hawaiian common gallinule (ʻalea ʻula; *Gallinula galeata sandvicensis*), and Hawaiian duck (koloa maoli; *Anas wyvilliana*).[9] Listed Hawaiian waterbirds are found in fresh and brackish-water marshes and natural or man-made ponds. Hawaiian stilts may also be found

[9] Although the Hawaiian duck is included in this discussion, genetic studies indicate that the Oʻahu population is heavily compromised by hybridization with feral mallards (*Anas platyrhynchos*) and few ducks with predominantly Hawaiian duck characteristics remain (Browne et al., 1993; Fowler et al., 2009; USFWS, 2011).

wherever ephemeral or persistent standing water may occur. No suitable habitat for listed waterbirds occurs in the Project area, and none of these species were observed during the biological survey.

2.7 Historic Properties

To identify, document and assess the significance of historic properties within the Project area, an archaeological inventory survey (AIS) was conducted by Cultural Surveys Hawai‘i. The AIS included background research (with sources including archival documents, historic maps, Land Commission Awards [LCAs], and previous archaeological reports) to construct a history of land use and to determine if historic properties have been previously recorded in or near the Project area, as well as to formulate a predictive model of the types and locations of historic properties that would be expected to occur. The field component included a 100 percent pedestrian inspection of the Project area to identify any potential historic properties within the Project area. The results of the background research and field investigation were documented in an AIS Report, which was submitted to the State of Hawai‘i Historic Preservation Division (SHPD) in compliance with HRS § 6E and HAR § 13-284 on February 5, 2020; SHPD’s review and acceptance of the AIS Report is pending. The findings of the AIS are summarized below; a copy of the AIS Report is provided in Attachment F.

The Project area is located within the ahupua‘a of Honouliuli, which stretches from the summit of the Wai‘anae Mountains to the west shore of Pearl Harbor in the east, and is separated from the Pearl Harbor entrance channel and the ocean by Pu‘uloa Ahupua‘a on its southeast side. Background research indicates little traditional land use occurred in the portion of Honouliuli Ahupua‘a in which the Project area is situated. Large settlements were primarily concentrated near the coast, near marine and estuarine resources, or in the irrigated lowlands suitable for wetland cultivation. Indigenous activities that might have occurred in the vicinity of the Project area, which is situated between the limestone plain and upland forest resources, are believed to have been limited to dryland agriculture within gulches or near springs, and mauka to makai trails and associated temporary shelters. However, any evidence of traditional land use that might have occurred in the area is likely to have been eliminated by historic agricultural and ranching activities that spanned this region through most of the mid-twentieth century. From 1913 to 1916, the Waiahole Ditch was constructed to transport water from the windward side of O‘ahu, through tunnels in the Ko‘olau Mountains, to irrigate agricultural fields for the Oahu Sugar Company in ‘Ewa. Most of the Project area and the surrounding lands were being cultivated by Oahu Sugar Company by 1925. Small residential camps associated with the plantation were the only settlements found in the upper slopes in the early twentieth century; historic maps show “Pump Camp 5” located within the Project area. Various roads and fence lines related to agricultural and/or ranching activities in the region are known to have existed in the Project area at one time. Previous archaeological studies have documented various plantation-era historic properties in the vicinity of the Project area; these include walls, alignments, mounds, ditches and other irrigation features, as well as the Waiahole Ditch (Dega et al., 1998). As part of the current AIS fieldwork, two historic properties were documented within the Project area, as follows:

- **Historic irrigation and plantation infrastructure (State Inventory of Historic Places [SIHP] # 50-80-08-5593):** This historic property was originally identified by Dega et al. (1998) as part of a 1998 AIS conducted for the UH West Oʻahu campus. SIHP # 50-80-08-5593 consists of an historic irrigation system and plantation infrastructure, including a mill building and pump station, bridges, troughs, transport ditches, pipes, culvert, sluice gate and various other features related to water retention and movement. Based on the previous documentation, the boundaries of this site extend well beyond the current Project area. As part of the current AIS, components of SIHP # 50-80-08-5593 were documented extending from outside the northwestern boundary and through the central portion of the Project area toward the southeast. Two new features of SIHP # 50-80-08-5593 were documented within the Project area: drain pipes (Feature 1) and a complex of water control features related to the pump house and mill building located just southeast of the project area (Feature 2A through 2E).[10]
- **Waiahole Ditch System (SIHP # 50-80-09-2268):** The Waiahole Ditch System was also identified as a historic property by Dega et al. (1998). SIHP # 50-80-09-2268 consists of the entire ditch system, which spans approximately 22 miles to transport water from the windward side of the Koʻolau Mountains across central Oʻahu to the ʻEwa Plain. The portion of the ditch in the vicinity of the Project area is not part of the main Waiahole Ditch that carries water from windward Oʻahu (most of which is still in use); rather it is one of several ditches that extends from a reservoir fed by the main Waiahole Ditch. While the remnant of the ditch within the Project area is undoubtably part of the Waiahole Ditch System as a whole, the portion within the Project area and its components are in remnant condition. Within the Project area, the ditch extends along the northwestern border, then crosses through the central portion and exits across the southern boundary, beyond which it continues in a southwesterly direction. Seven new features were documented within the Project area: a culvert and bridge (Feature E), two ditch portions with metal pipes and sluice gate components (Features F and G), a metal drainage flume (Feature H), a bridge components of the ditch (Features I and J), and culvert and tunnel feature with metal sluice gate (Feature K).

No indications of traditional land use were observed, nor were remnants of Pump Camp 5 identified within the Project area.

2.8 Cultural Resources

To evaluate the potential effect of the Project on cultural beliefs, practices, and resources, including traditional cultural properties, Cultural Surveys Hawaiʻi conducted a cultural impact assessment (CIA). The assessment included archival research regarding Hawaiian activities including kaʻao (legends), wahi pana (storied places),ʻōlelo noʻeau (proverbs), oli (chants), mele (songs), traditional moʻolelo (stories),

[10] Schematic drawings from previous studies (based on Dega et al. 1998, as shown in Figures 26 and 43 in the AIS Report) suggest the pump house and mill building are within Project area; however, these drawings are sketches based on approximate locations. The pump station and mill building are accurately shown in the Project figures as being located just beyond the southeastern boundary of the Project area.

traditional subsistence and gathering methods, ritual and ceremonial practices; background research focused on land transformation, development, and population changes beginning with the early post-Contact era to the present day. Cultural documents, primary and secondary cultural and historical sources, historic maps, and photographs were reviewed for information pertaining to the Project area. Community consultation was also conducted to obtain input from knowledgeable individuals regarding present and past uses, cultural sites, traditional gathering practices, cultural association and any associated cultural concerns. This effort included outreach to approximately 70 Hawaiian organizations, agencies and community members. A total of 12 people responded, with one providing written testimony and three kamaʻāina (Native-born) and/or kūpuna (elders) participating in formal interviews, as follows:

- Christian Kaimanu Yee - kamaʻāina and knowledgeable of moʻolelo and wahi pana
- Shad Kāne - member of Kapolei Hawaiian Civic Club, Chair of the Oʻahu Council of Hawaiian Civic Clubs Committee on the Preservation of Historic Sites and Cultural Properties, Aliʻi Ai Moku of the Kapuāiwa Chapter of the Royal Order of Kamehameha Ekahi, and ʻEwa Moku Representative on the State Aha Moku Advisory Committee
- Lynette Paglinawan - cultural practitioner and educator; teaches a course on Native Hawaiian Healing at UH West Oʻahu
- Tom Berg - former Councilman, District 1

Based on information gathered from the archival research and community consultation, no culturally significant resources were identified within the Project area. At present, there is no documentation or community input indicating traditional or customary Native Hawaiian rights are currently being exercised within the Project area. While no cultural resources, practices, or beliefs were identified as currently existing within the Project area, there is a rich cultural history of traditional or customary Native Hawaiian rights exercised within the Honouliuli Ahupuaʻa. A summary of the discussion contained in the CIA Report is provided below; a copy of the CIA Report is contained in Attachment G.

Honouliuli Ahupuaʻa is the largest ahupuaʻa in the moku of ʻEwa. Early historical accounts indicate that pre-Contact settlement in this ahupuaʻa was centered around the rich cultivated lands of Honouliuli ʻIli (where Honouliuli Stream empties into the ocean) which provided for extensive wetland taro cultivation and abundant coastal resources. An extensive coastal plain consisting of an exposed limestone platform also included recurrent use habitations for fishermen and gatherers, and sometimes gardeners. Dissolution pits and caves that formed in exposed limestone outcroppings were accessed for water that accumulated via a subterranean or karst system; this water also contained nutrient-rich sediment that allowed for cultivation of plants such as taro or kalo (*Calocasia esculenta*), ti or kī (*Cordyline fruticosa*), and Indian mulberry or noni (*Morinda citrifolia*) within the pits (McAllister, 1933). The upland dry forest areas were used for hunting and gathering of forest resources, but likely not for widespread permanent settlement. In the intermediate area between the limestone plain and the upland forests, in the vicinity of the Project area, indigenous Hawaiian activities would have been limited to dryland agriculture within

gulches or near springs, and mauka to makai trails and associated temporary shelters. No evidence of traditional gathering practices in the vicinity of the Project area was encountered.

In traditional times, trails were well used for travel within the ahupuaʻa between mauka and makai areas and laterally between ahupuaʻa. A historical trail system existed on Oʻahu extending from Honolulu to Waiʻanae. A cross-ahupuaʻa (east-west) trail passed through Honouliuli inland of Puʻu o Kapolei, and continued along the coast to Waiʻanae following the route of the modern Farrington Highway; this trail was approximately 0.9 mile (1.5 kilometers) southeast of the Project area. Another main trail extending up the central plain of Oʻahu was approximately 1.8 miles (3 kilometers) to the east (see Figure 6 in the CIA; Attachment G). Early historic maps also depict a trail branching off the cross-ahupuaʻa trail into the uplands in the Pālehua area. An 1825 map shows this trail passing a couple hundred meters southwest of the Project area (see Figure 7 in the CIA; Attachment G). A 1919 map shows an unimproved road alignment (labeled as Pālehua Road) south of the Project area, approximating the traditional Hawaiian footpath into the uplands on the north slope of Puʻu Makakilo, as well as a less formal trail into the uplands skirting the west side of Puʻu Kapuaʻi to the west of the Project area (see Figure 16 in the CIA; Attachment G). A subsequent map (1922) shows the road to Pālehua as arcing through the southwest portion of the Project area before traversing the north side of Puʻu Makakilo. However, the alignment indicated on the 1922 map is believed to be an approximation, as all other maps show the location further to the southwest toward Puʻu Makakilo; furthermore, no trail was identified on the ground along the alignment indicated on the 1922 map during either of the AIS studies conducted in this area (Dega et al., 1998; Welser et al., 2020). The Pālehua trail may always have been somewhat braided, but is not believed to have extended into the Project area. Access into the southeastern Waiʻanae Mountains today is facilitated by Makakilo Drive. Based on the available information, no historic trails are known to be extant within the Project area.

As previously described in Section 2.6.2, faunal resources that occur in Honouliuli Ahupuaʻa include the pueo or Hawaiian short-eared owl and the ōpeʻapeʻa or Hawaiian hoary bat; these are both endemic species and are federally and/or state listed as endangered. Culturally, the pueo is one of the most important ʻaumākua gods and ancestral deities of the family (Valeri, 1985). As part of the CIA, Mr. Tom Berg provided input that the pueo has "a direct connection to Native Hawaiian family lineage in ʻEwa Beach," noting that the pueo is the ʻaumakua for the Michael Lee family. He described the Project area as being within a "pueo (owl) foraging and breeding ecosystem," and stated that historic records indicate the pueo is most abundant on the slopes from Puʻu Kapuaʻi to West Loch. He added that "Hunehune Gulch, Kaloʻi Gulch, and Honouliuli Gulch are migratory routes used by the pueo to go from mountain to sea to court, mate, forage, and raise their brood." Mr. Berg also provided input that the Project area is inhabited by the ōpeʻapeʻa, noting that in 1910, the species was documented by the State of Hawaiʻi within a half-mile of the Project area. While ʻōpeʻapeʻa are rarely documented as ʻaumakua, they fit the intersection of classes of animals (mammal and bird) and intersection of two domains (air and land) that would make them an appropriate manifestation of the ʻaumakua (Valeri, 1985). Both pueo and ʻōpeʻapeʻa are greatly celebrated in the moʻolelo of Hawaiʻi's past.

3 Project Description

The proposed Project consists of construction and operation of an approximately 12.5 MW ground-mounted solar photovoltaic system, coupled with a 50 MWh battery energy storage system and related interconnection and ancillary facilities. Specifically, it includes the following major components: (1) solar photovoltaic system, (2) battery energy storage system, (3) a network of electrical collector lines, (4) Project substation and Hawaiian Electric interconnection equipment, (5) communication equipment, and (6) service roads and fencing. Each of these components is described in Section 3.1. In addition to these facilities, the Project area would be made available for compatible agricultural activities, as described in Section 3.2. A discussion of the proposed construction, operations and maintenance, and decommissioning activities is provided in Section 3.3.

The site layout and details of the Project components are provided in Attachment H.[11] As indicated in the site layout, all of the Project components as well as Project-related construction activities would occur within the limits of the 97-acre Project area. Representative photographs that show examples of the components at similar projects are provided in Attachment I.

3.1 Project Components

3.1.1 Solar Photovoltaic System

The solar photovoltaic system would consist of a series of 405-watt (minimum) modules mounted on a fixed-tilt racking system and related electrical equipment. The Project would include four solar array areas, within which the modules would be organized in rows (or "strings"); the row-to-row spacing would be approximately 22 feet (with approximately 8 feet of open space between adjacent rows). The racking system would hold the modules at a fixed angle of 15 degrees facing toward the south. The racking system would include steel posts installed to a depth of approximately 6 feet (depending on soil conditions). Once on the racking system, the highest point of the modules is expected to extend approximately 8.5 feet above the ground, with an average of 3 feet of clearance below the modules.

The modules would produce direct current (DC) electricity at a maximum voltage of 1500 volts. Within each solar array area, the DC electricity from the modules would be transmitted via DC electrical wiring to a 2.8 MW central inverter, where it would be converted to alternating current (AC) electricity. The inverter would connect to a step-up transformer, which would increase the electrical voltage to 12.5 kV.

[11] The site layout and details shown in Attachment H are based on an approximately 60 percent design milestone. The exact layout and configuration of these components will be refined through the final design process; in particular, refinements are anticipated based on Hawaiian Electric's technical review and the equipment procurement process. Any such refinements would be expected to be relatively minor such that they would not substantively change the size, scope, intensity, use, location or timing of the Project, and the resulting footprint and dimensions would not exceed those shown in the site layout and details contained in Attachment G. The final site layout and design details will be submitted to DPP for review and approval as part of the application for grading, grubbing and stockpiling and building permits.

Safety features incorporated into the solar photovoltaic system include mechanisms to allow for disconnection and rapid shutdown of the system, if needed; these would be installed throughout the solar arrays, and would include DC disconnects (which would allow the DC current between the modules to be interrupted before reaching the inverters) and AC disconnects (which would separate the inverters from the electrical grid).

The DC electrical wiring extending from the modules would be integrated into the above-ground portion of the racking system. At the terminus of each array disconnect, the wiring would connect to the inverter and transformer via underground trenching. The trenches would be up to approximately 10 feet wide and 4 feet deep to accommodate multiple circuits of DC electrical wiring, low-voltage AC electrical wiring and communications wiring. The inverter and transformer for each of the solar array areas would be installed on a concrete equipment pad (also referred to as a power conversion station). A total of five equipment pads would be installed within the Project area; each would be up to approximately 3,480 square feet and would also support the battery units and communication equipment (see below).

3.1.2 Battery Energy Storage System

The battery energy storage system would include a total of ten 1,300-kilowatt (approximate) lithium-ion battery units, collectively providing approximately 50 MWh of total storage. The batteries would be charged with energy generated by the solar photovoltaic system and would allow the energy to be dispatched to offset night-time customer demand and assist in grid stabilization. Each battery unit would be housed in a container up to approximately 10 feet (height) by 8 feet (width) by 53 feet (length); a total of 2 battery units would be installed at each of the five power conversion stations. Based on the preliminary battery configuration, each battery unit would include up to 44 racks of batteries (approximate) and would incorporate multiple layers of protection to avoid failures and to contain potential hazardous substances. Specific features would include integrated monitoring and circuit protection, a self-contained heating ventilation air cooling system, and a fire detection and suppression system specifically designed for lithium-ion battery energy storage systems. The fire detection and suppression system would incorporate specific controls with automatic safety responses in response to conditions including high battery temperature, high air temperature and the presence of smoke. The system would also have emergency stop buttons, which would isolate the battery units from the solar arrays and electrical grid.

3.1.3 Electrical Collector Lines

The electricity generated and stored within each of the solar array areas would be transmitted from the power conversion stations to the Project substation and interconnection equipment via a network of medium-voltage electrical collector lines. Similar to the DC electrical wiring from the solar modules, the medium-voltage electrical collector lines would be installed in underground trenching. Trenches for the electrical collector lines would be approximately 5 feet wide and 4 feet deep. In total, it is anticipated that the Project would include approximately 3,000 linear feet of trenching for the medium-voltage electrical collector lines.

3.1.4 Substation and Interconnection Equipment

The Project would include a substation, which would further increase the voltage of electricity to allow for integration into the Hawaiian Electric electrical grid. The Project substation and associated interconnection facilities would include equipment such as free-standing steel switch structures, a transformer, breakers, utility poles, associated electrical lines, and centralized controls structure(s) for communication equipment (see below). These facilities would be constructed immediately adjacent to the existing Hawaiian Electric ʻEwa Nui #42 46-kV sub-transmission line which traverses the Project area; they would occupy up to approximately 9,464 square feet and would include concrete foundations, pole structures, containerized structure(s) and security fencing. A short overhead electrical line, which is expected to be approximately 300 feet in length and include approximately three 60-foot-tall wood poles, would also be required for interconnection with the ʻEwa Nui #42 46-kV sub-transmission line.[12]

3.1.5 Communication Equipment

Communication equipment would be installed to interface with Hawaiian Electric's supervisory control and data acquisition (SCADA) system so that the electricity generated and stored by the Project can be remotely controlled and dispatched.[13] The Project would also include an emergency management system that would allow all operations to be supervised and all system functions to be protected in response to real-time dispatch signals from Hawaiian Electric, as well as report production data, energy forecasts, and other system health data. This equipment would be housed within the various inverters located in each solar array area and in the Project substation, as well as within centralized control structure(s) also within the substation footprint. Most of the communications equipment would be connected via cabling, although some wireless features for inter-Project communications are being evaluated.

3.1.6 Service Roads and Fencing

As described in Section 2, the Project area would be accessed via the existing gated entry on Pālehua Road and the network of former plantation roads within the UH West Oʻahu Mauka Lands property. Within the Project area, a series of new service roads would be installed to accommodate construction vehicles and to allow ongoing access for operations and maintenance. These roads would have a compacted gravel bed with a width of approximately 10 feet (plus compacted 5-foot shoulders), as well as the required clearance and turning radius needed for emergency response vehicles in accordance

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[12] The interconnection facilities would be owned and operated by Hawaiian Electric, and as such, are subject to Hawaiian Electric's design and engineering specifications. The design and engineering process, which will include technical review and input by Hawaiian Electric commenced in August 2020, following completion of an Interconnection Requirement Study (IRS). As such, the design details for the interconnection facilities are not yet fully known but are expected to be commensurate with the description provided herein. The final design details will be included in the final design package to be submitted to DPP for review and approval as part of the application for grading, grubbing and stockpiling and building permits.

[13] The specific telecommunications requirements to facilitate interaction between the Project and Hawaiian Electric are currently being reviewed by Hawaiian Telecom and Hawaiian Electric.

with fire code. The service roads would provide primary access to each of the solar array areas, including the power conversion stations, as well as the Project substation and interconnection equipment. The ample spacing between the rows of modules would allow for localized access within each of the solar array areas.

Fencing would be installed around the perimeter of the Project for general security purposes. The fence is expected to be approximately 7-foot-tall chain link (or similar); no barbed wire would be installed. Gates would be installed for pedestrian and vehicular access. The total fenced portion of the Project area is expected to be approximately 52 acres.

3.2 Compatible Agricultural Activities

HRS § 205-4.5(a)(21)(A) requires that for solar energy facilities on LSB Class B or C land in the agricultural district, "the area occupied by the solar energy facilities is also made available for compatible agricultural activities[14] at a lease rate that is at least fifty percent below the fair market rent for comparable properties." Following is an evaluation of potential agricultural activities and a discussion of the proposed approach for compatible agriculture within the Project area. This approach has been developed to meet and exceed the requirements of HRS § 205-4.5(a)(21)(A); further discussion of compliance with HRS § 205 is provided in Section 7.

3.2.1 Evaluation of Potential Agricultural Activities

Solar facilities provide a unique opportunity for co-location with agricultural activities, given that they typically have a minimal footprint with tracts of open space interspersed between the equipment, and involve relatively passive operation and maintenance activities. However, there are various factors that must be considered when seeking agricultural activities to be co-located with solar facilities. Specific factors that were considered for this Project include: (1) historic and current agricultural use, (2) water availability, and (3) suitable agricultural activities. A brief discussion of each of these considerations is provided below.

3.2.1.1 Historic and Current Agricultural Use

As previously described, the Project area was part of an extensive sugar cane and pineapple plantation that extended across O'ahu's 'Ewa Plain. Cultivation occurred on a nearly continual basis from the 1920s until the plantation was closed in the 1990s. Since that time, the land within the Project area has been fallow and used intermittently for cattle grazing. Although remnant agricultural infrastructure is present onsite, none of it is believed to still be operable.

Most of the other nearly 900 acres of the UH West O'ahu Mauka Lands property also comprise fallow, vacant land with some livestock pasturage, and remain available for agricultural activities. Scattered

[14] Within the context of HRS § 205-4.5, agricultural activities are understood to include: (1) cultivation of crops, including crops for bioenergy, flowers, vegetables, foliage, fruits, forage, and timber; (2) game and fish propagation; and (3) raising of livestock, including poultry, bees, fish, or other animal or aquatic life that are propagated for economic or personal use.

agricultural operations occur in the broader vicinity of the Project area; however, there are relatively extensive amounts of vacant agricultural lands throughout the region.

3.2.1.2 Water Availability

Given the highly arid conditions in the ʻEwa District, past agricultural activities within this region relied on imported water for irrigation. In particular, this area was served by the Waiahole Ditch, an approximately 26-mile-long tunnel and ditch system built in the early 1900s to deliver water from the windward side to the leeward side of Oʻahu. On average, the ditch delivered approximately 27 million gallons of water per day (Environment Hawaiʻi, 2000). In the 1990s, a legal challenge resulted in restoration of water flows to the streams in windward Oʻahu and a significant decrease in the amount of water delivered via the Waiahole Ditch.

Although remnant portions of the Waiahole Ditch remain within the Project area, this infrastructure no longer functions to deliver water; no functional irrigation infrastructure or water delivery system currently exists within the Project area. As part of the planning process for the Project, a request for guidance and input regarding potential water sources was submitted to the Board of Water Supply. Their response included a request for more information regarding the anticipated demands and indicated the need to first investigate the use of non-potable water for irrigation purposes. Installation of a private water source such as a groundwater well or reservoir was determined to be prohibitive given the Project schedule mandated by the PUC, the temporary nature of the Project (per the 25-year PPA) and that compatible agricultural activities such as grazing and honey could be accommodated within the Project area without such source. While trucking and storing non-potable water on site could be possible for modest water demands (such as for establishment of landscaping), it would not be feasible to meet the significant demand of crop cultivation. Subsequent communication with the Board of Water Supply confirmed that water service for irrigation purposes could not be provided by the Board of Water Supply as their water system has limited capacity and cannot accommodate the proposed agricultural demands. However, they indicated that it may be possible to use the existing water tank (East Kapolei 440' Reservoir) as a source of irrigation water, but that this would need to be coordinated through UH. Based on coordination with UH about the availability of this water, it was determined that a modest amount of water could be made available to support compatible agricultural uses, but that there is not sufficient availability to support uses with significant water needs (e.g., crop cultivation). AES is continuing to coordinate with the Board of Water Supply and UH to confirm the use of water from the existing East Kapolei 440' Reservoir for compatible agricultural uses within the Project area. Relevant correspondence with the Board of Water Supply and UH regarding water availability is contained in Attachment J.

3.2.1.3 Suitable Agricultural Activities

Solar facilities are considered to be highly compatible with agricultural activities, and there are a growing number of examples of successful dual use and the associated benefits to both solar and agricultural production (PRI, 2018; Scientific American, 2018). However, there are factors that contribute to certain types of agricultural activities being more or less suitable for co-location with solar

facilities. When considering crop production, low-growing species are preferred as they can be located within the same space as the solar photovoltaic modules with little to no risk of reducing solar exposure, as compared to taller stature plants which can cast shadows across the modules as they grow in height. Given the proximity to the solar photovoltaic modules, it is also important that selected species are semi shade-tolerant. Any such low-growing and shade-tolerant species must also be well-suited for the site-specific conditions, which in this case includes relatively arid conditions and disturbed soils with a medium to high runoff potential.

Other agriculture activities, such as raising livestock, are also highly viable and provide dual use benefits. For example, use of the solar array areas for grazing animals not only provides affordable pasturage for grazing, but also provides a form of natural vegetation management around the solar equipment. However, the size and characteristics of the livestock must be carefully considered. Grazing is typically limited to smaller animals (such as sheep and calves) as they easily fit between and beneath the solar photovoltaic modules and present little risk of damage to the equipment; goats are typically avoided as they tend to climb on the equipment. Beekeeping is also highly compatible with solar equipment and is successfully being conducted as part commercial solar projects across the United States (CleanTechnica, 2019; PRI, 2018; Scientific American, 2018).

3.2.2 Proposed Agricultural Activities

As part of the Project development process, AES engaged the services of former Hawai'i Department of Agriculture Chairperson and Deputy Director Scott Enright, and has proactively sought partners to develop a compatible agricultural plan for the Project. Along with the input and counsel of Mr. Enright, AES contacted and worked with a wide range of potential partners to explore opportunities that go beyond the statutory requirements to simply provide land for complementary agricultural uses, and instead seek to provide meaningful contributions and generate agricultural products. Potential partners were identified based on knowledge of active agricultural organizations as well as input received through community outreach; these include the UHWO agricultural program, Ma'o Farms, Mālama Learning Center, Hui Kū Maoli Ola, various cattle and sheep ranchers (Rocker G Livestock and others) and beekeepers (Aloha Bee, LLC). Various options for agricultural activities that could be conducted in parallel with the solar energy facilities within the Project area were examined, based on the considerations described above. The results of this effort indicate that the most promising agricultural activities that could be implemented as part of the Project are honey production and/or cattle grazing and production. As further detailed below, these activities are both compatible with solar energy facilities, well-suited to the site-specific conditions, and require minimal water resources.

3.2.2.1 Honey Production

Honeybees are a critical component of the agricultural system as they serve to pollinate a wide variety of crops. It is estimated that honeybees pollinate about one-sixth of the world's flowering plant species and more than 400 agricultural crops (American Beekeeping Federation, 2019; New Agriculturist, 2019). Examples of bee-pollinated plants in Hawai'i include fruit trees such as lychee, avocados, oranges and macadamia nut, and vegetables such as cucumbers, squash and watermelon. Through pollination,

honeybees may significantly increase crop yields and contribute to higher quality fruit. It is estimated that honeybees contribute nearly $20 billion to the value of U.S. crop production (American Beekeeping Federation, 2019). In recent years, Hawai'i's honeybee population has been negatively affected by introduction and spread of the parasitic Varroa mite. Feral honeybee colonies have been particularly impacted, resulting in a declining number of colonies and loss of a major source of pollinators. Such impacts to feral colonies underscore the importance of managed hives for agricultural production in Hawai'i (CTAHR, 2009).

Beekeeping is considered to be highly compatible with solar facilities, as it is a relatively passive activity and requires minimal infrastructure. Furthermore, the general setting of the Project area, including the topography and surrounding vegetation make this location particularly suitable for beekeeping. Honeybees forage up to several miles in any direction; flowering plants within and surrounding the Project area, which include koa haole (*Leucaena leucocephala)*, sweet acacia (*Vachellia farnesiana*), 'ilima (*Sida fallax*) and long-thorned kiawe (*Prosopis juliflora*), offer abundant pollen and nectar for bees. Honeybees are well-adapted to the range of temperatures that occur in the vicinity of the Project area, as demonstrated by other successful hives in the 'Ewa and Nānākuli districts. To maintain temperatures with a hive, honeybees utilize both ventilation (by fanning their wings) and evaporative cooling mechanisms (with water collected and spread by worker bees) (Tautz, 2008; Winston, 1987). There is expected to be adequate access to natural sources of water for bees throughout this region, such that a dedicated water source would not be needed within the Project area. However, if needed, a 15-gallon tub of water (with floating aquatic plants, such as *Pistia* and *Lemna*, and guppies) could be provided as a safe, nearby source.

Aloha Bee LLC is an established beekeeping operation that manages more than 30 healthy honeybee colonies across O'ahu and produces a variety of bee-related products. The partners in Aloha Bee LLC include renowned entomologist Dr. Steve Montgomery and Daniel Mills, an experienced beekeeper and honey producer. They are seeking to expand their operation and need additional land that is well-suited for placement of beehives. In coordination with Aloha Bee LLC, AES has incorporated specific beekeeping requirements into the site plan for the Project.

It is anticipated that a beekeeping operation within the Project area would involve installation of approximately four beekeeping stations to support honeybee activity throughout the Project and surrounding areas. The stations would be located within the fenced perimeter of the solar array areas and would be accessible via the proposed service roads; they would also be sited at a reasonable distance from the Project facilities to minimize interference between the solar and beekeeping operations. Each station would include a packed gravel or cement pad foundation, approximately 40 square feet in area. The foundations would provide a stable surface to minimize the chances of the hives falling over, and would help to limit weeds and bugs in the vicinity of the hives. The hives would be installed on a series of cinder block stands placed directly on the foundation. In addition, the hives would be cordoned off to minimize potential damage from cattle (another proposed compatible agricultural use within the Project area, as described below). It is anticipated that the Project area could support a total of 20-60 hives. To launch the honey production operation, Aloha Bee LLC would establish

existing hives in the Project area; the partners in Aloha Bee LLC also have access to additional hives and relationships within the beekeeping community to ensure a productive operation.

Activities associated with maintenance of the beehives would be minimal, generally consisting of periodic inspections, replacement of hive equipment and/or bees, and honey harvesting. It is anticipated that beekeepers would conduct inspections on a routine basis (approximately once per month); inspections would be focused on checking the health and productivity of the individual hives and determining if any remedial actions are needed. Remedial actions could include treatment for invasive pests, replacement or care of queen bees, maintenance or expansion of hive boxes, or similar activities. In general, it is anticipated that the beekeeping stations would be accessed during daytime hours; however, some visits could occur during evening hours to accommodate transport of bees.

Through their operation within the Project area, Aloha Bee LLC expects to produce up to 500 gallons of honey annually; these products would be marketed for sale locally on O‘ahu. In addition to agricultural products, the beehives would also provide an important ecological service through pollination of commercial crops, home garden vegetables and fruits, as well as wild plants.

3.2.2.2 Cattle Production and Grazing

The UH West O‘ahu Mauka Lands property has been used for cattle ranching as part of a rotational pasture system. These activities have been managed by Henry Edward “Bud” Gibson and his firm Rocker G Livestock, a grass farming and livestock ranching operation. In total, Rocker G Livestock stewards and manages approximately 3,200 acres of pastureland across O‘ahu, including the UH West O‘ahu Mauka Lands property. They care for three herds of cattle; two of the herds are beef cows (each with an average of 325 head) and one herd includes approximately 25 registered American Bucking Bull, Inc. cows which are raised as registered bucking and breeding bulls. These herds are rotated across the pasturelands, depending on rainfall and forage volume for fire prevention and erosion control purposes.

Rocker G Livestock is seeking to maintain their current operation within the Project area.[15] Based on consultation with owner Bud Gibson, cattle grazing facilities have been incorporated into the site plan for the Project. To maximize compatibility with the solar facilities, the Project area would be used specifically to graze and wean stocker-size (smaller) steer and heifers. Limiting the cattle within the Project area to smaller and younger animals would minimize potential damage to solar modules while still benefiting the overall ranching operation. These cattle would be managed in the same manner as Rocker G Livestock’s current ranching operation. The animals would be rotated through fenced portions of the Project area with rotation management based on rainfall levels and forage growth and volume. In addition to supporting ongoing agricultural operations, grazing cattle within the Project area would also provide a sustainable form of vegetation management.

To support the proposed cattle production and grazing operation, AES would work with Rocker G Livestock to install support facilities and equipment within the Project area. One or two cattle trap

[15] Rocker G Livestock is currently in discussions with UH regarding the extent to which their cattle ranching operations would be allowed to continue within the UH West O‘ahu Mauka Lands property. Regardless of the outcome of these discussions, AES would seek to make the Project area available to Rocker G Livestock for cattle grazing, subject to approval by UH.

areas, each up to approximately 72 feet by 72 feet, would be installed. Each trap area would be equipped with a water trough set on a concrete slab, including an approximately 4-foot apron to minimize erosion caused by cattle traffic around the trough. Mineral tubs and external parasite control rubs would also be placed in the trap areas. A system for loading and unloading cattle would be constructed using a series of galvanized steel panels and gates.

Rocker G Livestock produces an average of more than 175,000 pounds of beef annually that is sold locally throughout the state. In addition to contributing an important source of local food production for Hawai‘i, their operation also provides valuable land stewardship services including increased soil carbon storage, vegetation management, and fire prevention. Use of the Project area would help to further support these efforts.

3.2.3 Other Agricultural Alternatives Considered

Other alternatives for compatible agricultural activities were also explored; however, due to a number of factors, these options were deemed to be unviable. These include the following:

- Sheep Production and Grazing: AES actively engaged a sheep farmer from Wai‘anae to explore possible sheep production and grazing within the Project area. Unfortunately, due to the limited vegetation within the Project area along with relatively low rainfall, it was determined that sheep’s aggressive feeding habits would pose a significant risk of denuding the Project area, thus resulting in possible erosion and runoff issues. Additionally, given the limited rainfall, it was determined that vegetation could not be effectively maintained to ensure a sufficient food supply for the sheep without a rotational grazing effort that would be economically prohibitive. For these reasons, this agricultural activity was not pursued further.
- Food Crop Production: AES explored options for food crop production with various O‘ahu-based organizations, including the UHWO agricultural program, Ma‘o Farms, Mālama Learning Center. Given the limited rainfall and insufficient water supply for irrigation, as well as the relatively steep and rocky terrain, this option was not pursued further.
- Landscape Plant Propagation: AES also examined the option of native plant propagation for landscaping purposes, including possible re-landscaping needs at Makakilo Quarry, adjacent to the Project area. Although Grace Pacific, owner of the Makakilo Quarry, expressed an interest in purchasing the supply of plants, this option was not further pursued due to the limited rainfall, insufficient water supply for irrigation, and relatively steep and rocky terrain.

3.2.4 Future Agricultural Activity

As detailed above, AES will comply with HRS § 205-4.5(a)(21)(A) by making the Project area available for honey production and cattle grazing, as well as providing support for the long-term success of these activities. In the event that the agricultural activities outlined above are determined to not be viable or an agriculture partner ceases operations or an interest in partnering, AES would seek other potential

partners for similar agricultural activities and would continue to make the Project area available at a lease rate that is at least fifty percent below fair market rent for comparable properties.

At the end of the Project's operational life, the Project would be decommissioned with the Project area returned to its existing condition (or comparable), as further discussed in Section 3.5. Following decommissioning and upon expiration of the agreement with AES, a full range of future agricultural activities would continue to be an option for UH as the landowner.

3.3 Construction Activities

Project-related construction activities are expected to include transport and delivery of Project equipment and materials, site preparation, equipment installation, and revegetation and landscaping. Each of these activities is generally described below.

3.3.1 Transport and Delivery

The Project equipment would be transported to one of O'ahu's commercial harbors via a freight shipping company and offloaded to standard transportation trucks. The trucks would deliver the equipment to the Project area via existing state and county roadways. No roadway improvements or other construction is expected to be required to accommodate the equipment transport.

3.3.2 Site Preparation and BMP Implementation

Initial site preparation would involve grubbing and vegetation clearing within the Project area, along with installation of best management practices (BMPs) as described below. Clearing and grubbing would be phased, and soil would be temporarily stabilized as appropriate. Service roads and staging areas would also be established; these would be located entirely within the Project area. It is anticipated that the staging areas would rotate throughout the Project area as the Project is built out, with these areas installed incrementally as needed; in total, it is anticipated that staging would require approximately 12 acres (non-contiguous). For each staging area, some grading may be needed to level the ground surface, with geotextile materials and compacted gravel installed as needed. Similarly, installation of new service roads would also involve grading, smoothing and placement of geotextile material and compacted gravel. Clearing, grubbing, and grading would be conducted using equipment such as bulldozers, excavators, compactors, graders, and front-end loaders. Water trucks would be used to provide moisture for compaction as well as dust control during construction as needed.

Project implementation would incorporate BMPs to avoid and minimize potential impacts to the surrounding environment. In particular, BMPs would include various procedures, practices, treatments, structures and/or devices designed to eliminate and minimize the potential discharge of pollutants to downstream waters. The BMPs to be implemented would be determined in accordance with applicable regulatory requirements, including those associated with the National Pollution Discharge Elimination System (NPDES) program and the City and County of Honolulu's Rules Relating to Water Quality (Administrative Rules § 20-3), which require approval of a Stormwater Pollution Prevention Plan (SWPPP) and Erosion and Sediment Control Plan (ESCP) prior to construction. As further discussed in

Section 6.1, specific BMPs would address erosion prevention, sediment control, and good housekeeping. No ground disturbing activities would occur until BMPs have been properly implemented.

In addition, the Project would also incorporate a series of infiltration trenches to capture and treat stormwater in areas with increased impervious surfaces associated with the Project facilities. Throughout the majority of the Project area, including the area beneath the solar modules, minimal grading would be required such that the existing drainage patterns would not be altered. In general, grading would be focused around the service roads, equipment pads and substation foundation. The infiltration trenches would be located within the Project area, downgradient of these facilities and would be designed to retain and allow for infiltration or evapotranspiration of stormwater, as needed to reduce peak flows to pre-development levels. The size and design of the trenches would be based on site-specific conditions as well as the requirements of the City and County of Honolulu's Rules Relating to Water Quality and Storm Drainage Standards (DPP, 2017a).

3.3.3 Equipment Installation

Following site preparation activities, the general sequence for construction would involve installation of the following: (1) racking system, (2) concrete equipment pads and substation foundation, (3) solar photovoltaic modules and associated wiring, (4) electrical collector lines, (5) electrical equipment, and (6) battery units. Overall, these facilities are being designed to specifically accommodate the existing topography of the site in order to minimize the amount of earthwork needed. As further detailed below, grading for installation of the Project equipment is expected to be limited to the areas comprising the equipment pads and substation foundation, as well as in localized areas within the solar arrays.

Overall, the extent of ground disturbance associated with the solar photovoltaic system is expected to be relatively minimal, as the racking system would be installed using structural posts and can tolerate the existing slopes within the Project area (based on the manufacturers' specifications); grading would be limited to localized areas as needed to smooth existing topography. The posts for the racking system would be installed using a hydraulic pile driver and/or augur for pre-drilling, with approximate depths of 6 feet (depending on soil conditions). In the event it is determined that the desired depth cannot be achieved, foundations would be pre-drilled and supported with concrete.[16] The frames and other components of the racking system would be bolted to the posts, with the solar photovoltaic modules affixed to the frames.

Trenches would be excavated for both the DC electrical wiring, as well as some AC low-voltage wiring and communications wiring (running from the solar photovoltaic modules to the power conversion stations) and the medium-voltage collector lines (running from the power conversion stations to the substation) using wheel- or track-mounted excavators (or similar). The trenches for the DC and low-voltage electrical wiring would be up to 10 feet wide and 4 feet deep to accommodate multiple circuits

[16] Ground screws, which are installed by auguring directly into the ground, are being considered as an alternative to the support posts for the racking system. Although a greater number of screws would be required, they would have a smaller overall footprint than the support posts.

of wiring. The trenches for the medium-voltage collector lines would be up to 5 feet wide and 4 feet deep. Following placement of the electrical lines, the excavated soil would be backfilled into the trench and tamped back to the appropriate level of compaction per the design specifications. Although not anticipated, if the desired trench depth cannot be achieved (due to basalt rock or other prohibitive subsurface conditions), the electrical wiring or collector lines would be covered with concrete slurry in accordance with the applicable electrical code requirements.

The equipment pads and substation foundation would involve excavation up to approximately 3 feet in depth and installation of concrete. Certain interconnection facilities would be supported by steel pier foundations, which would be installed to an approximate depth of 10 – 15 feet. Excavated soil would either be used elsewhere within the Project area or hauled to an approved offsite facility. Concrete for the pads and foundation would be delivered in ready-mix concrete trucks; the Project would not include a concrete batch plant. Once the equipment pads and substation foundation have been installed, the battery units and various electrical equipment would be installed. All electrical equipment and wiring would be installed and inspected in accordance with applicable code requirements and best industry practices.

Once fully installed, the Project equipment is expected to have a total areal extent of approximately 38.8 acres and a permanent footprint of approximately 2.2 acres, as summarized in Table 2. It is important to note that these dimensions are estimates based on the current level of design for the Project. The exact dimensions for these components will be refined through the final design process; in particular, refinements are anticipated based on Hawaiian Electric's technical review and the equipment procurement process. Any refinements are expected to be relatively minor, with the resulting dimensions similar to (or less than) that listed in Table 2.

Table 2. Approximate Extent of Project Components

Project Component	Quantity and Dimensions (approximate)	Total Area (approximate)	Permanent Footprint (approximate)
Solar Photovoltaic Modules[1]	43,008 modules (each approx. 22 ft^2) (2,304 posts for racking system)[2]	939,264 ft^2 (21.6 acres)	3,197 ft^2 (0.1 acres)
Power Conversion Stations (Battery Units and Electrical Equipment)	5 equipment pads (each approximately 3,480 ft^2)	17,400 ft^2 (0.4 acres)	17,400 ft^2 (0.4 acres)
Substation and Interconnection Equipment[3]	Substation foundation and interconnection equipment (9,464 ft^2)	9,464 ft^2 (0.2 acres)	9,464 ft^2 (0.2 acres)
Trenching (DC and Low-Voltage Electrical Wiring)	11,000 linear feet (10 feet wide)	110,000 ft^2 (2.5 acres)	0
Trenching (Medium-Voltage Collector Lines)	3,000 linear feet (5 feet wide)	15,000 ft^2 (0.3 acres)	0
Service Roads[4]	3,235 linear feet (20 feet wide)	64,710 ft^2 (1.5 acres)	64,710 ft^2 (1.5 acres)

Staging and Laydown Areas	To be rotated throughout Project area; up to 12 acres (non-contiguous)	522,720 ft^2 (12.0 acres)	0
Agricultural Facilities[5]	4 beekeeping stations (40 ft^2 each) 2 cattle trap areas (5,184 ft^2 each)	10,528 ft^2 (0.2 acre)	360 ft^2 (0.01 acre)
TOTAL		**38.8 acres**	**2.2 acres**

[1] The calculation of total area is based on the surface area of the modules. The calculation of permanent footprint is based on the dimensions of the post foundations; it is assumed that 60% of the posts would require a concrete pier with a diameter of approximately 20 inches.

[2] Ground screws, which are installed by auguring directly into the ground, are being considered as an alternative to the posts for the racking system. Although a greater number of screws would be required (approximately 7,100 screws), they would have a smaller diameter than the posts such that the permanent footprint of the screws would be less than that shown for the support posts.

[3] The exact requirements for the interconnection equipment are still being determined by Hawaiian Electric. It is currently assumed that an approximately 300-foot overhead electrical line with 3 supporting wooden poles would be required in addition to equipment within the footprint of the substation.

[4] The calculation of new service roads does not include existing access roads; new service roads are assumed to have a width of approximately 20 feet (i.e., 10-foot road width plus 5-foot compacted shoulders).

[5] The permanent footprint of the agricultural facilities is assumed to include four beekeeping stations and concrete pads for the water troughs (one in each cattle trap area).

3.3.4 Revegetation and Landscaping

Following construction, areas that have been temporarily disturbed would be revegetated for soil stabilization and erosion control purposes. It is anticipated that revegetation would involve application of hydroseeding, with a suitable mix of native and/or non-invasive grass species. Any species used for revegetation would also be considered in terms of compatibility with onsite agricultural activities (e.g., forage for grazing stock and/or pollinator plants for honeybees).

Landscaping would also be installed to provide visual buffering of Project equipment from surrounding areas to the extent practicable. In particular, this effort would address the requirements of the City and County of Honolulu's Land Use Ordinance (Revised Ordinances of Honolulu Section 21-5.650(a)(1)) which emphasizes visual buffering from adjacent streets and highways, as further described in Section 9.1.3. Development of the proposed landscape plan involved a comprehensive review of site-specific characteristics, such as those related to climate, geography, cultural and biological resources, to determine a landscaping approach that is sensitive and appropriate to this particular location. Within this context, the areas around the perimeter of the Project were explored to identify the most effective and practical locations for installation of landscaping. This effort considered the orientation and topography of the Project and surrounding areas, as well as plant installation and irrigation requirements, safety, cost and maintenance needs, all relative to the potential degree of visual buffering that would be provided relative to nearby public vantage points. In addition to these factors, specific constraints and limitations that were also considered include (1) a request from the landowner to not plant large trees due to long-term maintenance and liability concerns, (2) the lack of available infrastructure for irrigation purposes, (3) limited vehicular access, and (4) the need to minimize potential shading of the solar arrays. A detailed discussion of these factors and limitations is provided in the landscape plan narrative, contained in Attachment K.

Several options were evaluated as part of development of the landscape plan, particularly installation of plant material along the western-southwestern boundary of the Project area, facing the nearby Makakilo neighborhood. Given the Project's orientation and elevation relative to the Makakilo neighborhood, it was determined that landscape screening in this location would require plants with mature heights of approximately 40-50 feet. However, as stated above, UH requested that the landscaping effort avoid planting of large trees. In addition, the steep and rocky terrain in this portion of the Project area make construction of new service roads challenging and costly, such that vehicular access to the western-southwestern boundary is not feasible and landscape installation and maintenance would be unsafe and cost prohibitive. Similarly, landscape irrigation in this location would require pumping and storage of water approximately 130 feet above the nearest access road. For these reasons, installation of landscaping along the western-southwestern boundary of the Project area was determined to be infeasible. Regardless, the existing vegetation along the western-southwestern boundary beyond the Project fence would be preserved, which is expected to provide a visual buffer and soften views of the Project from various vantage points.

Based on the results of the evaluation process described above, the landscape plan includes clustering of primarily native plant material along the eastern boundary of the Project area facing the H-1 Freeway and Farrington Highway. Species to be planted would include ʻaʻaliʻi (*Dodonaea viscosa*), kuluʻi (*Nototrichium sandwicense*) and ʻilima (*Sida fallax*). This palette was selected based on feedback received during the community outreach process, and is in keeping with AES' desire to support the reintroduction of species indigenous to the region. In addition, ʻilima was specifically identified and incorporated into the plan as an important food source for honeybees and would support the compatible agricultural activities through honey production. Although the landscaping would not completely screen the Project facilities, it would yield additional environmental and agricultural benefits to further support the community's vision and statewide goals related to agriculture and energy.

Overall, the proposed landscaping species are relatively drought tolerant and are well suited for the arid conditions, but would require regular watering during the initial establishment phase. As the Project area lacks water transmission infrastructure, water would need to be transported and stored onsite for irrigation purposes. A temporary irrigation system would be installed (consisting of an approximately 1000-gallon water storage tank, mainline and lateral piping, and in-line drip tubing), with water delivered via a water truck to fill/refill the water storage tank. The anticipated water demand for the proposed landscaping is approximately 6,100 gallons/year, which would require a water truck to refill the tank approximately 6-7 times per year.

The landscape plan, which is contained in Attachment H (Drawings L1, L2 and L3), shows the location of proposed landscaping, and provides details regarding the plant types and size, spacing for installation, and irrigation system. Supporting information regarding the approach and evaluation process is provided in Attachment K. The plant materials and irrigation system would be routinely inspected for a full year following installation, with replacement of dead plants, application of fertilizer, and repair of irrigation components as needed.

3.3.5 Post-Construction Site Control

In addition to revegetation of temporarily disturbed areas, permanent BMPs would be implemented to address long-term stormwater requirements. To the extent practicable, the BMPs would incorporate low impact development (LID) design strategies and source control measures, in accordance with the requirements of the City and County of Honolulu's Rules Relating to Water Quality. The specific strategies and measures would be identified as part of a Stormwater Quality Strategic Plan, which would be submitted for approval prior to construction. As further discussed in Section 6.1, specific BMPs would address retention and biofiltration of stormwater.

3.4 Operations and Maintenance

Following construction and commissioning, the Project would generally involve passive operations for both solar power generation and agricultural activities. Normal operation of the Project would not require onsite personnel and, therefore, the facility would not be manned on a daily basis. Metering equipment would send solar photovoltaic system performance and production data to continuously-monitored servers; electronic notification would be sent to the operations and maintenance team if these data indicate the system is underperforming. If necessary, a technician would be dispatched to the Project to address any issues. AES would employ dedicated staff to remotely monitor the Project on a full-time basis.

Periodic maintenance and inspection of the facilities would occur intermittently over the course of Project operations, and would include testing and replacement of component parts on the inverters, transformers and substation equipment. Decommissioned parts would be salvaged or recycled to the extent feasible or properly disposed of in accordance with applicable regulations, consistent with the approach described in Section 3.5.

Vegetation within the Project area would be managed throughout the life of the Project. In addition to possible livestock grazing as part of the onsite agricultural activities, vegetation management could also include mowing, weed whacking, and localized application of herbicide, if needed. Vegetation would be actively monitored to ensure the cover is sufficient for erosion control as well as for agricultural purposes.

3.5 Decommissioning

Based on the approved PPA with Hawaiian Electric, the Project is expected to have an operational life of approximately 25 years. At that point in time, the facility may be re-powered under a re-negotiated PPA (with subsequent permits/approvals) or decommissioned. In accordance with the requirements of HRS § 205-4.5(a)(21) as well as the terms of the Option Agreement to Grant System Easement with UH (see Item III(2)(g) on page 12 of Attachment B), decommissioning would involve removal of all equipment associated with the Project and returning the Project area to substantially the same condition as existed prior to Project development. As further required by HRS § 205-4.5(a)(21), financial assurance for decommissioning would be provided to the City and County of Honolulu Planning Commission prior to the commencement of commercial generation. The financial security would be in the form of a parent guaranty or letter of credit, with the security to remain in place for the duration of the Project. The

activities that would be expected to occur as part of decommissioning are summarized below and described in further detail in the Decommissioning Plan (Attachment L).[17]

Decommissioning would commence once the Project has been fully de-energized and isolated from all external electrical connections, in coordination with Hawaiian Electric. Consistent with the measures described for construction and operation of the Project, BMPs would be implemented and maintained throughout the decommissioning phase as needed to avoid and minimize potential impacts to the surrounding environment, particularly those related to dust, erosion and stormwater. Once the site has been adequately prepared for decommissioning, the following equipment would be removed: (1) solar photovoltaic modules and racking system, including steel posts, (2) battery units, (3) inverters and transformers, (4) electrical wiring and connections, (5) substation components, (6) communication equipment, and (6) fencing.[18] All foundations would also be removed. The decommissioning would be conducted in accordance with industry standards, with all equipment and materials treated according to the highest and best use. Equipment and materials would be salvaged or recycled to the extent feasible and in coordination with licensed sub-contractors, local waste haulers and/or other facilities that recycle construction/demolition waste; the remaining materials would be disposed of by the contractor at authorized sites on O‘ahu, in accordance with applicable laws. All waste requiring special disposal (e.g., transformers) would be handled according to regulations that are in effect at the time of disposal. Following removal of Project equipment, site restoration would be conducted such that the physical conditions of the Project area are returned to substantially the same condition as existed prior to Project development; these activities would include (1) removal of gravel and other aggregate material, (2) localized grading and disking to match surrounding elevations and/or aerate soil, (3) replacement of topsoil, and (4) revegetation of disturbed areas with an appropriate hydroseed mix. Decommissioning would occur within 6-12 months of the conclusion of Project operation. Decommissioning plans would be communicated with the landowner, the public and the regulatory agencies, prior to and during the decommissioning phase, as appropriate.

3.6 Project Schedule

Construction of the Project is expected to require approximately 9 to 12 months, beginning once all permits and approvals have been obtained. It is currently anticipated that construction would begin in 2021, with commercial operation commencing in 2022. Once operational, the Project is expected to have an operational life of approximately 25 years. Decommissioning would occur within 6-12 months of the conclusion of Project operations.

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[17] Decommissioning activities would be conducted in accordance with all relevant ordinances and regulatory requirements that are in place at the time of decommissioning. Because decommissioning would not be expected to occur for many years, and given that regulatory requirements could change, the applicable permitting and regulatory requirements would be reviewed with the appropriate local and state agencies prior to decommissioning activities to ensure compliance.

[18] The extent to which the service roads, infiltration trenches and landscaping within the Project area would be removed would be coordinated with the landowner at the time of decommissioning.

4 Infrastructure Requirements

The Project would not require public infrastructure improvements or burden existing infrastructure. The following sections summarize the Project infrastructure requirements related to wastewater, water supply, drainage and flooding, and streets and transportation.

4.1 Wastewater System

The Project facilities would not generate any sanitary wastewater. As operation of the facilities would not require full-time, on-site staff, no sanitary wastewater system would be required. Portable sanitation units would be brought onsite during construction, as needed.

4.2 Water Supply

Water would be required during construction and operation for dust control, vehicle washdown, temporary irrigation of the landscaping, and for the proposed agricultural activities (e.g., filling of the cattle water troughs). Total water consumption for both construction and operation of the Project would be minimal, likely using temporary water tanks (filled using water trucks) or through a connection to the existing East Kapolei 440' Reservoir, subject to further coordination with the Board of Water Supply and UH. No connection to the domestic water system is expected to be required.

4.3 Drainage and Flooding

No stormwater drainage facilities are located within or surrounding the Project area. In general, stormwater flows across the site toward the natural drainage features. The Project would not significantly alter the existing drainage patterns within the Project area and would incorporate stormwater BMPs both during construction and throughout operation, as further discussed in Section 6.1. As the Project would not direct additional stormwater flows to the stormwater drainage system and would minimize the potential for increased discharge of sediment or other pollutants, significant impacts to the stormwater drainage system are not anticipated. Accordingly, it is expected that the Project would be in compliance with the City and County of Honolulu's Rules Relating to Water Quality and Storm Drain Standards.

The Project is located in an area designated as Flood Zone D, where analysis of flood hazards has not been conducted and flood hazards are undetermined (see Figure 12; Attachment A). No portion of the Project area is within a special flood hazard zone. It is also more than 4.5 miles inland from the tsunami evacuation zone, and more than 3.5 miles inland from the extreme tsunami evacuation zone (see Figure 13; Attachment A).

4.4 Streets and Transportation

As described in Section 2, the UH West Oʻahu Mauka Lands property is accessed via Pālehua Road, which extends north then west from the intersection of Kualakaʻi Parkway and H-1 Freeway, with entry controlled by an existing gate and 24-hour security. From the gated entry on Pālehua Road, access to the Project area would be via a network of former plantation roads within the UH West Oʻahu Mauka Lands property. The portion of Pālehua Road and the existing access roads that would be used to access the Project area are located entirely on land owned by UH; the agreement with UH will include a non-exclusive access easement to allow use of these roadways for the Project.

Within the Project area, a series of new service roads would be installed to accommodate construction vehicles and to allow ongoing access for operations and maintenance. These roads would have a compacted gravel bed with a width of approximately 10 feet (plus compacted 5-foot shoulders), as well as the required clearance and turning radius needed for emergency response vehicles in accordance with fire code. No centralized parking facilities are planned for the Project.

The Project is not expected to involve any construction or improvements within any state or county roadway. However, the roadway network would be used by construction workers and for equipment deliveries to the Project area. As further discussed in Section 6.10.1, a Traffic Impact Analysis Report (TIAR) was prepared for the Project and concluded that Project construction is not expected to measurably affect the overall level of service at the signalized intersections adjacent to the Project area. However, recognizing that construction could result in minor, localized impacts to traffic and the roadway network, a Traffic Management Plan (TMP) would be prepared prior to construction. The TMP would detail the measures that would be implemented to avoid, minimize and mitigate potential impacts to the surrounding roadway network based on Complete Streets principles. Further information regarding the anticipated measures is provided in Section 6.10.1.

5 Agency and Stakeholder Input

5.1 Community Outreach and Agency Coordination

Subsequent to the Project being selected for development through the Hawaiian Electric RFP process, AES initiated early consultation with key community leaders and elected officials to introduce the Project and to seek preliminary input. The initial outreach efforts also included notification regarding a community meeting; the purpose of the meeting was to provide an overview of the Project and to solicit feedback from the broader community. In addition to strategic community outreach, a community meeting notice was mailed to approximately 2,264 addresses in the adjacent Makakilo neighborhood. The community meeting was held on February 26, 2019; a total of 19 individuals attended the meeting. Additional detail regarding the community meeting is provided in the Community Meeting and Outreach Summary Report (contained in Attachment M).

AES has continued to conduct outreach and consultation through follow-up meetings and written correspondence with a range of community leaders, neighborhood associations, adjacent landowners, interested organizations and individuals, as well as regulatory and resource agencies with jurisdiction related to the Project; the list of specific parties engaged through these efforts is provided in Table 3. In addition to these efforts, a website was published for the Project (www.westoahusolar.com), with a dedicated email for receiving input regarding the Project.

Table 3. Summary of Agency Consultation and Community Outreach Conducted To Date

Name / Entity	Date	Description
City Council Member Kymberly Pine, District 1	January 29, 2019	Meeting to discuss Project and request input; Provide community meeting notice
State Senator Mike Gabbard, District 20	February 11, 2019 February 21, 2019	Meeting to discuss Project and request input; Provide community meeting notice
State Representative Ty Cullen, District 39	February 19, 2019 Oct 8, 2019	Meeting(s) to discuss Project and request input; Provide community meeting notice
State Representative Sharon Har, District 42	February 21, 2019	Meeting to discuss Project and request input; Provide community meeting notice
Neighborhood Board members	February 11, 2019 August 26, 2019	Meeting to discuss Project and request input; Provide community meeting notice
Representative community members[1]	February 22-26, 2019 May 31, 2019 July 20, 2019 August 26, 2019	Meeting to discuss Project and request input; Provide community meeting notice
Villages of Kapolei Association	February 11, 2019 July 16, 2019 August 26, 2019	Outreach to discuss Project and request input; Provide community meeting notice
Pālehua Community Association	February 11, 2019 August 26, 2019	Meeting to discuss Project and request input

Name / Entity	Date	Description
Wai Kaloʻi Community Association	August 26, 2019 September 9, 2019	Meeting to discuss Project and request input
City and County of Honolulu Department of Planning and Permitting staff	April 2, 2019	Meeting to discuss Project and request input
State of Hawaiʻi Land Use Commission staff	September 9, 2019	Meeting to discuss Project and request input
Malama Learning Center	July 11, 2019	Discuss potential for compatible agricultural activities
Sheep Rancher	July 20, 2019	Discuss potential for compatible agricultural activities
Hui Kū Maoli Ola	July – August 2019 February – March 2020	Discuss potential for compatible agricultural activities; potential educational partnerships for ʻāina-based learning
Aloha Bee, LLC	July - December 2019	Discuss and develop plans for compatible agricultural activities
Rocker G Livestock	October 24, 2019 July 11, 2019 January 16, 2020 February 11, 2020	Discuss and develop plans for compatible agricultural activities
City and County of Honolulu Fire Department	November 14, 2019	Discuss requirements with Fire Prevention Bureau
Grace Pacific	August – December 2019	Discuss traffic and access, water resources, other community and land use issues
University of Hawaiʻi Office of Sustainability Uluniu Project	February - May 2020	Discuss potential for incorporating cultural components as part of landscaping
Hawaiʻi Farm Bureau	May 21, 2020	Meeting to discuss Project and request input
[1.] A listing of specific community members that have been engaged in the public outreach effort is provided in the Community Meeting and Outreach Summary Report (contained in Attachment M).		

Key issues and concerns identified through community outreach and agency coordination for the Project to date and the efforts to address them are summarized below.

- **Agricultural Activities:** Project stakeholders have raised questions regarding the potential impacts to agriculture. As described in Section 3.2, the Project area would be made available for compatible agricultural activities at a lease rate that is at least fifty per cent below the fair market rent for comparable properties, pursuant to HRS § 205-4.5(a)(21). Furthermore, AES has evaluated the feasibility of a range of potential agricultural activities, and has proactively engaged and sought out compatible agriculture partners. As part of this effort, AES engaged the services of former Hawai'i Department of Agriculture Chairperson and Deputy Director Scott Enright to assist in developing a compatible agricultural plan for the Project. With the input and counsel of Mr. Enright, AES has worked with potential partners to develop opportunities that go beyond the statutory requirements to simply provide land for complementary agricultural uses, and instead seek to provide meaningful contributions and generate agricultural products.

- **Visual Impacts:** The potential for visual impacts to the surrounding community has been identified as an important consideration. In response to this concern, AES incorporated a sensitive siting approach into the design process, with the Project designed and laid out to reduce visual impacts from neighboring areas to the extent possible. As discussed in Section 3.3.4, landscaping would be installed to provide visual buffering of Project facilities from adjacent areas to the extent practicable. As further discussed in Section 6.6, detailed visual analyses have been conducted to characterize the potential views of the Project and to inform the Project development efforts.
- **Traffic and Access:** Community members have raised concerns about access along Makakilo Drive and the potential for Project related-traffic. As part of the Project development process, AES coordinated with both UH West O‘ahu and Grace Pacific to confirm access to the Project area from Pālehua Road, such that the Project would not involve any access via Makakilo Road. In response to concerns about traffic, a TIAR was conducted; as further discussed in Section 6.10, this analysis concluded that the Project would not measurably impact traffic during either construction or operation. To further minimize traffic-related impacts during construction, AES would also prepare and implement a TMP.
- **Vandalism and Safety:** Community members have raised concerns about safety and vandalism and requested information regarding how the Project would address these issues. As discussed in Section 2, entry to the UH West O'ahu Mauka Lands property is controlled through a 24-hour security service. In addition, AES would staff the Project area with security personnel, as needed during construction.
- **Decommissioning:** Project stakeholders have pointed to the need for proper decommissioning and a firm commitment to implement those activities. As discussed in Section 3.5, a decommissioning plan has been prepared for the Project and would include removal of all Project-related equipment, with the Project area returned to substantially the same condition as existed prior to development. In accordance with the requirements of HRS § 205-4.5(a)(21), financial assurance for decommissioning would be provided to the City and County of Honolulu Planning Commission prior to the commencement of commercial generation.
- **Opportunities for Continued Public Input:** Community leaders have emphasized community concerns related to projects that do not provide adequate opportunities for stakeholder input. As detailed above, community engagement efforts to date have included a community meeting, follow-up discussions with neighborhood associations and adjacent landowners, and a Project website. As further discussed below, input was also sought from more than 80 agencies, elected officials, organizations, interested individuals and other stakeholders through the HRS § 343 environmental review process. The Special Use Permit process also includes additional opportunities for public input, and AES will continue to proactively engage the community through the remainder of the Project development process.

5.2 HRS § 343 Scoping and Public Review

In addition to the general community outreach and agency coordination described above, additional consultation was conducted specifically for the HRS § 343 environmental review process. This effort included consultation with DPP as the approving agency for the EA, pre-assessment scoping and distribution of the Draft EA for public comment, in accordance with the requirements of HRS § 343 and HAR § 11-200.1.

During pre-assessment scoping for the Draft EA, letters inviting comments regarding issues that the EA should address were sent to federal, state and county agencies, as well as elected officials, organizations and interested individuals. Subsequently, a notice regarding availability of the Draft EA for public review and requesting comments was sent to these parties, as well as additional stakeholders identified through the Project planning process. In total, more than 80 agencies, elected officials, organizations, interested individuals and other stakeholders were engaged through the HRS § 343 environmental review process; a detailed list of these stakeholders is included in Section 7 of the EA. Table 4 summarizes the comments received during the 30-day Draft EA review period; copies of the comment letters are contained in Appendix N of the Final EA. These comments were incorporated into the Final EA, as well as this Special Use Permit application.

Table 4. Summary of Draft EA Comments

Commenting Party	Summary of Comments
Tom Berg	- States it is premature to develop solar project on the property as an extensive survey for Hawaiian hoary bat and pueo has not been conducted - Provides copy of testimony in response to Senate Bill 2755 Relating to Pueo Research - Suggests that support for House Concurrent Resolution 170, which relates to development of a map that defines the most suitable area within Honouliuli Gulch for a dedicated pueo preserve, could provide mitigation for habitat loss - States that grow lights associated with agricultural activities on adjacent properties may be reflected by solar panels and affect migratory species
State of Hawai'i Department of Accounting and General Services	No comment at this time
Honolulu Fire Department	- Summarizes requirements for fire department access roads, water supply to provide fire flow, and fire apparatus access roads; requests submittal of civil drawings to DPP for review and approval
U.S. Fish and Wildlife Service	- Provides federally listed species that may occur or transit through the vicinty of the Project area; states that there is no critical habitat within Project area - Summarizes potential impacts and impact avoidance measures for the Hawaiian hoary bat, Hawaiian waterbirds and Hawaiian seabirds - States that implementation of impact avoidance measures typically allows for determination of no adverse effects
City and County of Honolulu Police Department	- Recommends that the contractor address potential security issues with regards to construction equipment and machinery, as well as the location of the solar modules and battery storage to be kept on site during operations

Commenting Party	Summary of Comments
State of Hawai'i Office of Planning	- Summarizes the relevant land use designations and permitting requirements for the proposed Project, including those related to the 'Ewa Development Plan, City and County of Honolulu Land Use Ordinance, and State Land Use Law (HRS § 205) - Summarizes the agricultural activities that are currently planned within the Project area, including honey production and cattle grazing, and notes the compatibility of these uses with solar facilities - Reiterates the findings that no federally or state listed plant species were observed in the Project area; notes that the endemic wiliwili tree occurs within Kalo'i Gulch but would not be impacted - Notes that the EA describes proposed mitigation measures for listed wildlife species including the Hawaiian hoary bat, pueo, Hawaiian seabird and waterbird species - Summarizes the findings and recommendations of the Archaeological Inventory Survey (AIS) and acknowledges that the AIS report is pending review and concurrence by SHPD; states that letter from SHPD should be obtained prior to the Special Use Permit decision by the City - Summarizes the approach and findings of the CIA and specifically references the input provided by Ms. Lynette Paglinawan regarding ao kuewa (wandering spirits) in the vicinity of the Project area; states that EA should indicate if recommendation to plant trees will be incorporated into the Project - Summarizes the impact analysis relative to glare and radio frequency interference on airport facilities, and acknowledges the commitment to immediately mitigate any glare or radio frequency interference hazards upon notification by FAA and/or DOT Airports Division - Acknowledges that the Office of Planning's pre-assessment scoping comments and responses to those comments are included in Appendix M of the EA
University of Hawai'i, Dean of the College of Engineering	- Expresses support for the Project; references the various benefits of the Project and emphasizes the value of using state land to help meet the renewable energy goal while also generating revenue for UH
State of Hawai'i Department of Hawaiian Home Lands	- Acknowledges the discussion of job generation; recommends development of a system to target local residents for job opportunities and partnering with employment training programs like Alu Like - Encourages continued consultation with Hawaiian Homestead community associations and other (N)native Hawaiians organizations
University of Hawai'i, Office of Project Delivery	- Provides support for the Project, noting it is consistent with UH policies and objectives; emphasizes that the Project would contribute to the RPS renewable energy goal, as well as reduce greenhouse gas emissions, while preserving long-term agricultural uses; reiterates the extent to which the Project is expected to offset the use of fossil fuels and decrease greenhouse gas emissions, and notes the creation of "green jobs"
State of Hawai'i Department of Transportation, Airports Division	- Reiterates the applicability of TAM-2016-1 and notes that EA addresses concerns raised by HDOT Airports Division including parabolic troughs, heliostats, mirrors and power towers - Reiterates the need to file FAA Form 7460-1 Notice of Proposed Construction or Alteration for projects within three nautical miles of an airport or having footprints approaching one acre - Reiterates the use of the FAA Notice Criteria Tool and the Solar Glare Hazard Analysis Tool - Emphasizes the need to immediately mitigate radio frequency interference upon notification by the HDOT Airports Division and/or FAA - Notes that thick smoke plumes in the protected airspace are hazardous to aircraft operations and states that applicant should ensure that the battery storage facility has an adequate fire suppression system and unobstructed access for emergency and fire fighting vehicles
State of Hawai'i Department of Transportation, Highways Division	- Acknowledges the responses to the pre-assessment scoping comments - Reiterates that no stormwater runoff would be directed to a state highway - Notes that no construction or improvements would occur within the state ROW - Summarizes the conclusions relative to visual impacts from H-1 Freeway - Summarizes the findings of the TIAR and the conclusion that the Project would not measurably impact traffic during either construction or operations, but would still include TMP - States that an HDOT permit is required to transport oversized/overweight loads on HDOT roadways

Commenting Party	Summary of Comments
City and County of Honolulu Department of Planning and Permitting	- States that the EA should include clarification that the proposed revised General Plan was re-introduced by the City Council as Resolution No. 20-44 - Confirms that the Project is considered a "Type B Utility Installation" and is required to obtain a CUP minor, in accordance with the LUO. The comment also states that the EA and CUP minor application should discuss compliance with the applicable development standards in Article 3 of the LUO, as well as other development standards such as parking, access, fencing and landscaping - States that the Project's compliance with the Rules Relating to Water Quality and Storm Drainage Standards will be verified when the grading plans are submitted to DPP for review - Requests additional visual simulations from specified viewpoints - Recommends that the site plans and visual simulations include the battery storage structures - Requests clarification why the western portion of the site is included in the Project area and/or Special Use Permit (SUP) boundary as it does not include any proposed improvements - Requests additional information as to the feasibility of other forms of agriculture; also requests clarification regarding sources of water and pollen for bees - Notes that portions of H-1 Freeway and Kualaka'i Parkway are shown in Figure 1-4 as privately owned; requests clarification as to whether these roadway portions are still in private ownership or have been (or are being) transferred to the government - Requests clarification as to whether all construction staging, construction vehicle storage/maintenance, concrete washout, and any storm or other wastewater containment areas would be located within the Project area - Requests that EA describe the final disposition of the cultural remains in the Project area; also states that a copy of SHPD's response to the AIS must be included in the SUP application.
Hawai'i State Energy Office	- Recommends that AES continue its efforts to (1) seek and incorporate community input throughout Project permitting and development and (2) work with local agricultural interests to ensure the Project's compatibility with Hawaii's agriculture industry - Recommends the EA summarize the primary concerns voiced during community outreach and how AES is addressing them - Recommends the EA provide the most currently available data on the amount of electricity (percentage-wise) the Project would contribute to the state's overall renewable energy portfolio - Recommends the EA provide information on the expected savings to Oahu ratepayers - Recommends the EA explain if/how the Project would contribute to retirement of AES's coal plant and the potential impact relative to the coal plant retirement should the proposed action not occur - Encourages AES to use local workforce and support local workforce development programs - Suggests the EA quantify the economic benefits such as income to the landowner and those related to compatible agricultural activities to summarize the total economic benefits of the Project - Recommends the Hawai'i Farm Bureau be added to the list of stakeholders to be consulted during Project scoping and development
State of Hawai'i Department of Health	- Provides the Clean Air Branch's standard comments (https://health.hawaii.gov/cab/files/2019/04/Standard-Comments-Clean-Air-Branch-2019.pdf)
City and County of Honolulu, Department of Transportation Services	- Reiterates that any existing pedestrian, bicycle and vehicle access/crossing shall be maintained with the highest safety measures during construction - States that a street usage permit should be obtained for any construction-related work requiring temporary closure of any traffic lane on a City street - States that Project plans should be reviewed and approved by DCAB to ensure full compliance with American with Disabilities Act requirements - States that construction materials and equipment should be transported to and from the Project site during off-peak traffic hours (8:30 am to 3:30 pm) - States that the area representatives, neighborhood board, area residents, businesses, emergency personnel, Oahu Transit Services, Inc., etc., should be kept apprised of the Project details and status

5.3 Neighborhood Board Presentation

Community outreach efforts to date, as well as notification regarding the HRS § 343 EA scoping and review processes have included the chairperson and members of the Makakilo/Kapolei/Honokai Hale Neighborhood Board as well as neighboring community associations. In parallel with the HRS § 343 environmental review process and in anticipation of the Special Use Permit application, AES planned to provide a presentation to the neighborhood board in Spring 2020. However, due to the emergency proclamation and supplemental orders by the Governor in response to COVID-19, all neighborhood board meetings were suspended through June 2020. Communication with the chairperson of the Makakilo/Kapolei/Honokai Hale Neighborhood Board was maintained through this period, and AES requested to be added to the agenda for the soonest possible neighborhood board meeting. The Makakilo/Kapolei/Honokai Hale Neighborhood Board reconvened on August 26, 2020; the Project was included as Item XIII(7) on the meeting agenda. As part of the meeting, AES representatives provided a presentation regarding the proposed Project and stated that additional updates would be provided over the course of the Project planning and development process; no action was taken by the neighborhood board. A copy of the meeting agenda is included as part of Attachment M; meeting minutes were not yet available at the time the SUP application was filed with DPP.

6 Potential Impacts and Mitigation Measures

Based upon the analysis and findings presented in the Final EA, implementation of the Project is not expected to result in a significant adverse direct, indirect, or cumulative impact on the quality of the environment. The following sections summarize the potential impacts and the key avoidance, minimization, and mitigation measures described in the Final EA that inform and support this conclusion. Additional detail and supporting discussion related to the impact analysis is provided in the Final EA.

6.1 Water Resources

The Project has been designed to avoid surface water features within the Project area to the maximum extent practicable. The only direct impacts to surface water features would be associated with construction of a single crossing over the tributary to Kaloʻi Gulch that runs through the central portion of the Project area to allow for access between the solar arrays; it is anticipated that the crossing would involve installation of a box culvert. As this feature has been determined to be non-jurisdictional, construction of the road crossing would not require authorization under the Clean Water Act. Regardless, the crossing would be designed to have as small of a footprint as possible and to sufficiently convey flows during and following rain events.

To minimize the potential for indirect impacts (such as changes in drainage patterns, increased volume or velocity of stormwater runoff, and/or discharge of pollutants to downstream waters), the Project would incorporate LID design techniques (specifically, Site Design Strategies) to maintain hydrologic and hydraulic functions and reduce the potential for erosion within the Project area. The Site Design Strategies would consist of conserving natural areas, including soils and vegetation, minimizing soil compaction, and minimizing disturbance to the natural drainages, such that the Project would not significantly alter the existing drainage patterns within the Project area.

The Project would increase the amount of impervious surface within the Project area, which would increase stormwater runoff.[19] Based on the permanent Project footprint (as listed in Table 2), it is expected that impervious surfaces would increase by approximately 2.2 acres across the overall Project area. Other than the area occupied by the support foundations for the racking system, the ground beneath the solar photovoltaic modules would be maintained as a natural, pervious surface that is able to absorb and infiltrate stormwater. Disturbances to vegetated areas around the solar modules would be mitigated through hydroseeding, such that erosion would not be expected to occur downgradient of the modules. To further minimize the potential for stormwater-related impacts, the Project would also

[19] The City and County of Honolulu's Rules Relating to Water Quality define an impervious surface as "a surface covering or pavement of a developed parcel of land that prevents the land's natural ability to absorb and infiltrate rainfall/ storm water. Impervious surfaces include, but are not limited to rooftops, walkways, patios, driveways, parking lots, storage areas, impervious concrete and asphalt, and any other continuous watertight pavement or covering."

incorporate stormwater retention measures during and post-construction to retain and treat stormwater within the Project area.

Construction of the Project could temporarily increase sediment and other pollutants (for example, trace oil, grease, and fuel) in stormwater runoff, which could affect water quality in downstream waters. Prior to construction of the Project, an Erosion and Sediment Control Plan (ESCP) would be prepared and submitted for approval in accordance with the requirements of the City and County of Honolulu's Rules Relating to Water Quality. In addition, a Stormwater Pollution Prevention Plan (SWPPP) would be prepared as part of the application for Notice of General Permit Coverage for construction-related stormwater runoff, pursuant to National Pollution Discharge Elimination System (NPDES) regulations. The ESCP and SWPPP would identify BMPs including erosion prevention, sediment control, and good housekeeping measures that would be implemented to prevent and minimize discharge of pollutants to downstream waters; the specific BMPs that are expected to be included in the ESCP and SWPPP are detailed in Section 3.3.2.2 of the Final EA. The measures would be inspected by a designated ESCP Coordinator on a regular basis, with documentation of the inspection results and implementation of necessary corrective actions.

In addition to the construction BMPs, permanent features would be installed to provide long-term retention and biofiltration of stormwater within the Project area. Specifically, infiltration trenches would be installed in areas with increased impervious surfaces associated with the Project facilities and would be designed to retain and allow for infiltration or evapotranspiration of stormwater, as needed to reduce peak flows to pre-development values. The size and design of the trenches would be based on site-specific conditions as well as the requirements of the City and County of Honolulu's Rules Relating to Water Quality and Storm Drainage Standards; additional detail regarding the quantification of stormwater runoff and sizing of the infiltration trenches is provided in the Stormwater Management Design Memo contained in Attachment N.[20] A Storm Water Quality Strategic Plan detailing the permanent stormwater design strategies, including the infiltration trenches, would be developed and submitted to DPP for approval prior to construction. The post-construction BMPs would be inspected during and following installation by a Certified Water Pollution Plan Preparer, with proper documentation of the inspection results and implementation of necessary corrective actions.

Implementation of BMPs, which would be detailed as part of an approved ESCP, SWPPP and Storm Water Quality Strategic Plan, would minimize the potential for discharge of sediment and other pollutants in stormwater runoff, such that significant water quality impacts to downstream waters are not anticipated. Accordingly, it is expected that the Project would be in compliance with the City and County of Honolulu's Rules Relating to Water Quality and Storm Drain Standards, as well as the State's

[20] The current stormwater management design is based on an approximately 60 percent level of design. The calculations will be refined through the final design process. Any refinements are expected to be relatively minor, such that the calculations and resulting stormwater management features would not substantively differ from those described. The final stormwater management design will be submitted to DPP as part of the Storm Water Quality Strategic Plan.

water quality standards, which establishes basic water quality criteria and requires that water quality be maintained to protect existing uses as specified in HAR § 11-54.

6.2 Biological Resources

6.2.1 Vegetation

Direct impacts to vegetation would occur primarily as a result of clearing and ground disturbance during construction. However, as described above, the Project area has been extensively disturbed as part of previous agricultural operations, with existing vegetation largely comprised of non-native species. No federally or state listed endangered, threatened, or candidate plant species have been identified within the Project area, and no portion of the Project area has been designated as critical habitat for any listed plant species. The three indigenous plant species that occur within the Project area - hoary abutilon, ʻilima and ʻuhaloa - are common throughout the Hawaiian Islands. The endemic wiliwili tree occurs within the tributary to Kaloʻi Gulch along the southern boundary of the Project area; however, this species would not be directly impacted by the Project because no ground disturbance would occur within the gulch.

Following construction, all temporarily disturbed areas would be revegetated to stabilize soil and prevent erosion. It is anticipated that revegetation would involve application of hydroseeding using a suitable mix of native and/or non-invasive grass species. In addition to revegetation of temporarily disturbed areas, landscaping would also be installed to provide visual buffering of Project equipment from adjacent areas to the extent practicable. As discussed in Section 3.3.4, landscaping would incorporate suitable plant material in key locations and would include native species that are ecologically and culturally appropriate for this location, as practicable.

Ground disturbance, as well as the movement of construction and operation equipment and personnel in the Project area, could also indirectly impact vegetation through the introduction or spread of invasive species. To minimize the potential for introduction and spread of invasive species, the following measures would be implemented:

- Construction equipment, materials and vehicles arriving from outside of the island of Oʻahu would be washed and/or visually inspected (as appropriate) for excessive debris, plant materials, and invasive or harmful non-native species before transportation to the Project area; import of materials that are known or likely to contain seeds or propagules of invasive species would be prohibited.
- Due to concerns with spreading the fungal pathogen responsible for Rapid ʻŌhiʻa Death, no plants, clothing, or gear sourced from Hawaiʻi Island would be permitted for use within the Project area. All other equipment, tools, or vehicles sourced from Hawaiʻi Island would follow established Rapid ʻŌhiʻa Death decontamination protocols.
- Offsite sources of revegetation materials (such as seed mixes, gravel, and mulches) would be certified as weed-free or inspected before transport to the Project area.

- All areas that are hydroseeded would be monitored for six months after hydroseeding to identify invasive plants that establish from seeds inadvertently introduced as part of the seed mix; all invasive plants identified within the hydroseeded areas would be removed.

Following construction, little to no ground disturbance is anticipated during Project operations. Vegetation within the Project area would be routinely managed either through grazing animals and/or mechancial means. Operations staff and agricultural partners would actively monitor the vegetation to ensure the cover is sufficient for erosion control while ensuring an adequate food supply for livestock. Decommissioning of the Project, at the end of its useful life, would involve removal of the Project facilities and returning the site to its existing condition (or similar), including revegetation with a suitable mix of species.

6.2.2 Wildlife

The Project area has been extensively disturbed by previous agricultural activities, which has reduced the presence of native wildlife and their suitable habitats. Nearly all of the wildlife observed during the biological survey are non-native species. Although not observed, several threatened and endangered wildlife species could occur within or traverse over the Project area; as discussed in Section 2.6.2.1, these species include ʻōpeʻapeʻa or Hawaiian hoary bat, pueo or Hawaiian short-eared owl, and Hawaiian seabird and waterbird species.

The measures listed below would be implemented to avoid and minimize potential Project-related impacts to wildlife, including federally and state-listed species. These measures incorporate recommendations provided by USFWS and DOFAW in response to a request for input regarding potential species occurrence and measures to avoid and minimize impacts to those species; copies of the correspondence from USFWS and DOFAW are contained in Attachment O.

- No trees or shrubs greater than 15 feet tall would be disturbed, trimmed or removed during the Hawaiian hoary bat birthing and pupping season (June 1 through September 15).
- Any fences that are erected as part of the Project would not have barbed wire to prevent entanglements of the Hawaiian hoary bat, unless required for safety and security purposes (e.g., surrounding the electrical substation).
- A wildlife education and observation program (WEOP) would be implemented for all construction and regular on-site staff. Staff would be trained to identify listed species that may be found on-site (including Hawaiian hoary bat, pueo, Hawaiian seabirds and waterbirds) and to take appropriate steps if these species are observed. If a federally or state-listed species is observed to be impacted by the Project, a systematic post-construction monitoring program would be developed and implemented, as appropriate.
- Speed limits would be established and enforced within the Project area and along the access road.

- Construction activities would be restricted to daylight hours as much as possible during the seabird peak fallout period (September 15–December 15) to avoid the use of nighttime lighting that could attract seabirds.
- Should nighttime construction be required during the seabird peak fallout period, a biological monitor would be present in the construction area from approximately 0.5-hour before sunset to 0.5-hour after sunrise to watch for the presence of seabirds. Should a seabird (or other listed species) be observed and appear to be affected by the lighting, the monitor would notify the construction manager to reduce or turn off construction lighting until the individual(s) move out of the area.
- Any on-site lighting would be fully shielded, triggered by motion detector, and fitted with light bulbs having a correlated color temperature of four thousand Kelvin or less, to the extent possible. Lighting would also be directed away from the solar arrays to minimize the potential for reflection and would only be used when necessary.
- Construction of overhead lines would be minimized to reduce the collision risk for seabird species.
- Prior to clearing vegetation within the Project area, pre-construction pueo surveys would be conducted by a qualified biologist following the Pueo Project survey protocol. If a ground nest or an owl nesting on the ground is observed, an approximately 50-foot buffer would be established and marked in the field. In accordance with existing protocol for UH West Oʻahu, a designated UH West Oʻahu representative would be contacted immediately, and that representative would provide notification to DOFAW. No vegetation clearing would occur until pueo nesting ceases.
- If a live pueo is observed on-site by Project staff all activities within 50 feet of the bird would cease, and the bird would not be approached.
- No rodent baiting would occur as part of the Project to prevent secondary poisoning from toxins in pueo prey.
- No surface water features would be created by the Project during construction or operation to avoid attracting waterbirds to areas with sub-optimal habitat.

With implementation of these measures, the Project would not be expected to result in significant adverse impacts to wildlife, including federally and state-listed species. If circumstances arise which indicate an increased potential for the Project to adversely affect listed species, USFWS and DOFAW would be further consulted in compliance with the Endangered Species Act and HRS § 195D, respectively.

6.3 Historic Properties

As detailed in the AIS Report (Attachment F), the historic properties documented within the Project area as part of the AIS were assessed based on criteria specified in HAR § 13-284-6. The historic irrigation and

plantation infrastructure (SIHP # 50-80-08-5593) was assessed as significant because it has yielded information on land utilization and agricultural history of the ʻEwa Plain. Based on the condition and context of the plantation infrastructure remnants, no further work is recommended for those portions of SIHP # 50-80-08-5593 within the Project area; sufficient information regarding the location, extent, function, and age of the remnant infrastructure has been generated as part of the current AIS to mitigate any adverse effect resulting from the Project. The Waiahole Ditch System (SIHP # 50-80-09-2268) was also assessed as significant because it has yielded information on the agricultural history of the area and contributed greatly to the development and evolution of the ʻEwa Plain throughout its history. However, within the Project area, the historic property only retains sufficient integrity of location, which is also diminished in portions of the Project area due to erosion and neglect. While there are some portions that retain some integrity of design, materials, and workmanship within the Project area, this integrity is very diminished. While the overall ditch is significant, the remnant portion of SIHP # 50-80-09-2268 within the Project area does not retain sufficient integrity to be considered significant; therefore, no further work is recommended. This conclusion is consistent with the conclusions of the Dega et al. 1998 study, which was accepted by SHPD.

As shown on the site plan (Drawing C3 in Attachment H), portions of these features fall within the Project area. Implementation of the Project would affect those portions within the Project area; the portions that are not affected by the proposed improvements would be kept intact. Based on the conclusions regarding the significance and documentation to date, pursuant to HAR § 13-284-7 and subject to review and concurrence by SHPD, the effect determination for the Project is “no historic properties affected” with a recommendation for no further historic preservation work. AES intends to obtain SHPD’s acceptance of the AIS and concurrence with the effect determination prior to the Planning Commission hearing for the Special Use Permit application.

6.4 Cultural Resources

Based on information gathered as part of the community consultation for the CIA, participants provided input regarding potential Project-related impacts to cultural resources. Mr. Shad Kāne stated he is not in opposition to the Project, noting that the Project area has been previously disturbed by sugarcane production.

Ms. Lynette Paglinawan expressed concern regarding the effects of the Project on the ao kuewa, the realm of the homeless spirits. Based on input provided by Ms. Paglinawan, it is understood that “the area from Waimānalo Gulch over to Kapolei to the location of UHWO was known by very early residents there to be the place where ao kuewa, wandering spirits, congregated from makai to mauka up Pālehua and especially near the cluster of wiliwili trees in Kaupeʻa.” Ms. Paglinawan stated that the development of the moku of ʻEwa including the ahupuaʻa of Honouliuli resulted in the displacement of the ao kuewa, noting that “we destroyed the habitat of the ao kuewa which is the wiliwili trees.” She expressed her concerns regarding the effect of the Project on the ao kuewa, which she believes are attracted to energy. She also expressed her concerns of the effect of the spirits on the solar panels, noting “that’s high energy. It will be like going to the game room.” Ms. Paglinawan stated that the Project should be

mindful of the locations of ancient trails, as these are still used by spirits to travel from mauka to makai within Honouliuli Ahupuaʻa. Ms. Paglinawan also recommended planting "a wall of trees" surrounding the Project area as restitution to the spirits who may be displaced by the Project; she also noted that planting of "a wall of trees" around the Project area would have other benefits including the production of oxygen and providing a habitat for Native Hawaiian birds. Finally, Ms. Paglinawan expressed concern regarding psychological impacts for the people that encounter the spirits, noting trauma on workers at the UH West Oʻahu, as well as families who live in the area. She was particularly concerned for the children who encounter these spirits, noting her belief that children "see many more things than adults do." As described in Section 3.3.4, landscaping for the Project would incorporate suitable plant material in key locations and would include native species that are ecologically and culturally appropriate for this location. Ms. Paglinawan's recommendations to plant trees around the Project area as restitution to the spirits that may be displaced was considered as part of this effort.

Mr. Tom Berg expressed concern for the pueo and ōpeʼapeʼa, stating that the Project will "encroach on prime pueo habitat, considered to be graded A+ - 'a ten' - when it comes to the degree of pueo habitat in use on this project site." Mr. Berg expressed concern that the "property in question will not receive the proper protocol to conclude no endangered species inhabit the area." He recommended that "a thorough and complete protocol is adopted to repeat the inventory exercise for pueo and ʻōpeʻapeʻa over the course of a calendar year would be in order so the Project does not inadvertently contribute to more endangered species habitat loss." He also recommended consulting with Dr. Melissa Price and Dr. Javier Cotín (The Pueo Project) and Afsheen Siddiqi (DOFAW) regarding pueo survey protocol. In addition, Mr. Berg also expressed his concern for the possible negative aspects of lighting operations at an adjacent parcel which may reflect off of a solar panel into "the flight patterns of migrating birds and the ʻōpeʻapeʻa and pueo in particular need to be addressed." Consistent with the recommendations provided, both Dr. Melissa Price (Pueo Project researcher) and Afsheen Siddiqi (DOFAW biologist) were consulted and surveys were conducted for pueo following the Pueo Project survey protocol (Price and Cotín, 2018). Focused surveys were not conducted for the Hawaiian hoary bat; however, potentially suitable foraging was noted as part of the general biological survey. Although neither pueo nor Hawaiian hoary bat were observed within the Project area, both could potentially occur and have been previously documented in proximity to the Project area. Recommended avoidance and minimizations measures identified by USFWS and DOFAW, as well as input from Pueo Project researchers, have been incorporated into the Project. With implementation of the avoidance and minimization measures listed in Section 6.2.2, the Project would not be expected to significantly affect either pueo or the Hawaiian hoary bat.

As previously discussed, no historic trails are known to be extant within the Project area. As such, development of the Project area would not be expected to impact traditional Hawaiian trails or access to upland resources.

6.4.1 Ka Paʻakai Analysis

In Ka Paʻakai v. Land Use Commission, 94 Hawaiʻi 31, 74, 7 P.3d 1068, 1084 (2000), the Court held the following analysis be conducted:

- The identity and scope of valued cultural, historical, or natural resources in the petition area, including the extent to which traditional and customary native Hawaiian rights are exercised in the project area;
- The extent to which those resources–including traditional and customary native Hawaiian rights–will be affected or impaired by the proposed action; and
- The feasible action, if any, to be taken by the Land Use Commission to reasonably protect native Hawaiian rights if they are found to exist.

As described above, no cultural resources, practices, or beliefs have been identified as existing within the Project area, nor is there any indication that traditional or customary Native Hawaiian rights are currently being exercised within any portion of the Project area. Although traditional Hawaiian trails were used to travel across the ahupua‘a and for access to the nearby uplands, none of these trails are believed to be have been located within the Project area.

Based on information gathered from the cultural and historical background, and the community consultation, culturally significant resources have been identified elsewhere within Honouliuli Ahupua‘a. Although not within the Project area, documentation and testimony indicates traditional or customary Native Hawaiian rights are possessed and are currently being exercised within Honouliuli Ahupua‘a by ahupua‘a tenants who are descendants of Native Hawaiians who inhabited the Hawaiian Islands prior to 1778 (Hawai‘i State Constitution, Article XII, Section 7). While no cultural resources, practices, or beliefs were identified as currently existing within the Project area, Honouliuli Ahupua‘a maintains a rich cultural history in the exercising of traditional or customary Native Hawaiian rights. The Project is not expected to affect or impair traditional and customary Native Hawaiian rights exercised elsewhere in Honouliuli Ahupua‘a; therefore, no action needs to be taken to reasonably protect native Hawaiian rights as a result of the Project. Additional detail supporting the Ka Pa‘akai Analysis is provided in the CIA Report (Attachment G).

6.5 Agricultural Resources

As previously described, the area within and surrounding the Project area was previously cultivated as part of an extensive sugar cane and pineapple plantation that extended across O‘ahu’s ‘Ewa Plain. Since closure of the plantation in the 1990s, the Project area has not been cultivated and has been used intermittently for cattle grazing. While the Project would result in a change in the primary land use to accommodate the solar energy generation and storage components, the Project area would also be made available for compatible agricultural uses, including beekeeping and cattle production and grazing. As described in Section 3.2, use of the Project area for other agricultural uses, such as crop cultivation, is not feasible due to the arid conditions, lack of infrastructure, and insufficient water for irrigation.

As described in Section 2.4.3 and as shown on Figure 10, the Project equipment would occupy areas designated as having LSB Class B, D, and E soils. The Project would not involve construction of any facilities in areas designated as having LSB Class A soils. Table 5 provides the approximate acreage of

each LSB soil class within the permanent footprint of the Project facilities, as well as the approximate acreage of each LSB soil class within the overall Project area. As shown, the Project facilities would permanently occupy only a fraction of the overall Project area, with less than five percent of the Project area's LSB Class B soils and less than one percent of the Project area's LSB Class D and E soils within the permanent Project footprint. No portion of the Project area has been designated as IAL.

Table 5. Project Acreage by LSB Soil Classification

Area	LSB Soil Class (acres)					Total Area (acres)
	A	B	C	D	E	
Permanent Footprint of Project Facilities[1,2]	0.0	2.04	0.0	0.15	0.003	2.2
Overall Project Area	0.0	47.7	0.0	36.0	13.1	96.8
Percentage of Project Area Occupied by Project Footprint	0.0%	4.3%	0.0%	0.4%	0.02%	2.3%

[1] Additional detail regarding calculation of the permanent project footprint is provided as part of Table 2.

[2] The area occupied by the Project components are calculated based on a 60 percent level of design. These dimensions used for these calculations will be refined through the final design process; in particular, refinements are anticipated based on Hawaiian Electric's technical review and the equipment procurement process. Any refinements are expected to be relatively minor, such that the resulting calculations would not substantively differ from those reported above.

As of 2018, a total of approximately 127,698 acres on O'ahu (or approximately 33 percent of the island) were designated within the State agricultural district (DBEDT, 2019b). A recent USDA census indicates that approximately 71,795 acres on O'ahu are occupied by farmland, with approximately 23,067 acres of crops (USDA, 2019). These data suggest that an extensive amount of land within the agricultural district on the island of O'ahu are fallow or are otherwise not actively used for agricultural purposes. This trend is evident in the general vicinity of the Project area, with a substantial amount of available agricultural land that is currently unused, including areas within the broader UH West O'ahu Mauka Lands property.

Given the lack of infrastructure, insufficient water for irrigation and associated site constraints, and that the Project area would be made available for ongoing compatible agricultural uses, implementation of the Project would not have a significant adverse impact on agricultural production. Rather, it would balance the state's renewable energy and agricultural needs, and would allow for productive, sustainable use of the land. The Project area would comprise less than 10 percent of the overall 991-acre UH West O'ahu Mauka Lands property and would not preclude future agricultural activities from occurring on the remainder of this land. The permanent footprint of the Project facilities would occupy a small fraction of the Project area, with the remaining area available for compatible agricultural uses. Furthermore, at the end of the Project's operational life, the facilities would be decommissioned, and the Project area would be returned to its existing condition (or comparable), thereby maintaining the potential for a full range of future agricultural activities.

6.6 Visual Resources

Short-term visual effects would occur during construction of the Project as a result of construction activities on the site and the presence of equipment and crews. As described in Section 3.3, construction activities associated with the solar and battery storage facilities would include clearing portions of the Project area, grading and stockpiling soil, trenching for installation of electrical wiring and collector lines, excavation for the equipment pads and substation foundation, delivery and installation of the Project components, and installation of service roads and perimeter fencing. These activities would be visible to varying degrees from surrounding locations, including nearby roadways (such as H-1 Freeway, Farrington Highway, Kualakaʻi Parkway, Kunia Road and local streets), as well as from surrounding residential neighborhoods and public spaces. In many areas, intervening structures and vegetation screen views toward the Project area, such that resulting views are either fragmented or blocked; however, unobstructed views occur in some locations. For example, travelers along H-1 Freeway, Farrington Highway and Kualakaʻi Parkway would have unobstructed views within the foreground as they approach the Project area; residents around the perimeter of nearby neighborhoods, particularly those located on the lower slopes of the Waiʻanae Mountains with an elevated viewing position, would also have clear views toward the Project area. Construction activities would be visible from these locations but would be seen in the context of surrounding development including high-voltage transmission lines, Makakilo Quarry and the in-progress rail transit system. Furthermore, visual impacts associated with construction activities would be short-term, as construction equipment and crews would be removed from the Project area once construction is complete.

During the 25-year lifetime of the Project, visual effects associated with operation and maintenance of the Project would result from the visibility of the above-ground Project components, including the solar photovoltaic modules, battery units and associated electrical equipment, substation and interconnection facilities, and perimeter fencing. Based on a viewshed analysis, it is anticipated that views would be primarily from areas southeast, east and northeast of the Project area. Overall, the solar photovoltaic modules are expected to be the most visually prominent component of the Project. The regular geometric forms and strong horizontal and vertical lines associated with the modules would contrast with the organic forms and natural colors of the existing landform and vegetation; in some cases, this effect would be diminished by the geometric shape of nearby agricultural fields. The dark, bluish-gray color of the modules would be set against the dull green and brown hues of the surrounding vegetation; in addition, the color contrast associated with the modules would vary throughout the day as the sun moves across the sky. Although the modules would contrast with elements of the existing landscape, their overall visual effect would vary depending on the extent of visibility, distance of the viewer, and the surrounding context of other existing modifications to the natural landscape. For example, it is anticipated that contrast would be stronger for viewers located within approximately one mile and with unobstructed views of the Project area. Contrast is anticipated to be weaker for viewers that are located at a greater distance (as texture and color become muted and less detailed) and in areas that are screened by topography and/or structures associated with intervening residential and commercial development.

In addition to the contrast added by the solar photovoltaic modules, the substation and interconnection facilities would introduce vertical and geometric structures into the landscape; the substation equipment would generally consist of open metal structures and the interconnection equipment would include three 60-foot-tall wood poles. Similarly, the perimeter fence would add an additional vertical element to the Project area. These features would also contrast with the surrounding natural environment, though they are not likely to be as prominent as the solar arrays and would be smaller than existing transmission lines, streetlight poles, and other structures throughout the region.

As described above, the Project would be visible to varying degrees from surrounding locations; the most prominent views are expected to be from segments of nearby roadways approaching the Project area and from some residences along the perimeter of nearby neighborhoods. Views from the Makakilo neighborhood, located to the southwest, are generally limited to residences located along the northeastern perimeter of the neighborhood who have elevated unobstructed views to the northeast; these views would be partially blocked by intervening topography. From residential areas located to the south and east, views toward the Project area are dominated by the broader Waiʻanae mountain range; the Project area would be located on the lower slopes of the mountains and in many cases would be screened by intervening development and/or vegetation. Where visible, the Project would be seen in the context of other man-made modifications, including residential and commercial structures, high-voltage transmission lines and structures, roadways, Makakilo Quarry and the in-progress rail transit system. Following the 25-year operational period, the Project would be decommissioned, which would include removal of all equipment associated with the Project and returning the Project area to substantially the same condition as existed prior to Project development, as required under HRS § 205-4.5(a)(21).

6.6.1 Important Public Views and Vistas

Important public views and vistas in the Project vicinity are identified in Table 3-2 of the ʻEwa Development Plan; these include views of the Waiʻanae Mountains from H-1 Freeway between Kunia Road and Kaloʻi Gulch and from Kunia Road, and general mauka and makai views (DPP, 2013). General mauka and makai views include those from locations such as public spaces and facilities, including public parks, public institutions, and public transportation facilities such as public roadways, highways, and public transit facilities (e.g., the in-progress Honolulu Rail Transit system). Given the setting of the Project, public spaces, parks and institutions are generally located such that views would be relatively distant and at least partially blocked by intervening topography and structures. The most prominent views of the Project from public facilities would be along roadways and transportation systems proximate to the Project area, including Kualakaʻi Parkway, Farrington Highway and pockets of the H-1 Freeway, as well as the nearby segment of the rail transit system. In all cases, views of the Project would be set amongst a range of man-made modifications (including residential and commercial structures, high-voltage transmission lines and structures, roadways, and Makakilo Quarry), with the Project components located on the lower mountain slopes such that they would not block or otherwise substantially degrade mauka views of the Waiʻanae Mountains.

From the segment of H-1 Freeway between Kunia Road and Kaloʻi Gulch (as identified in the ʻEwa Development Plan), the majority of views toward the Project area are screened by topography and/or vegetation along the edge of the highway. The exception is a short stretch near Kaloʻi Gulch, where there is a break in the vegetation and travelers (eastbound and westbound) would have unobstructed views toward the Project as they pass the Project area. However, these views are expected to be very brief as travelers would only be adjacent to the Project area for a short distance, and their attention would likely be directed toward the road ahead. Furthermore, the viewplanes in this area are dominated by broader landscape views of the Waiʻanae Mountains and Pacific Ocean; the Project would be located on the lower slopes of the Waiʻanae Mountains and would not obstruct broader landscape views due to the low profile of the solar photovoltaic modules.

The segment of Kunia Road identified in the ʻEwa Development Plan has relatively open views toward the Waiʻanae Mountains as the road parallels existing agricultural fields. Northbound travelers would be parallel to the Project at the far southern end of Kunia Road (near the H-1 Freeway interchange), and views would most likely be focused toward the northwest along the full extent of the Waiʻanae mountain range. If northbound travelers were to look directly west, views toward the Project area would be partially screened by intermittent vegetation along the edge of Kunia Road. Furthermore, any visible portions of the Project would be seen at a distance of approximately 2 miles; at this distance, the solar arrays may be distinguishable, but would be muted and less detailed. For southbound travelers, views would similarly be focused toward the Waiʻanae Mountains or south toward the ocean. Although the Project area is within the viewplane, it is partially screened by existing topography and is at a distance of approximately 2 to 3 miles. Furthermore, visible portions of the Project would be seen in the context of other development, including a high-voltage transmission and distribution lines and surrounding commercial development.

Typical views from the segments of H-1 Freeway and Kunia Road identified in the ʻEwa Development Plan are shown on Figure 14 (Attachment A). As shown in these photographs and as described above, views toward the Project area would be at least partially blocked by existing topography, vegetation and intervening structures located along the roadway corridors; views of the broader Waiʻanae Range would not be affected, such that the Project would not be expected to substantially degrade these viewplanes.

6.6.2 Visual Effects at Representative Viewpoints

Based on the results of the viewshed analysis, specific locations for further assessment of potential visibility were identified; these locations are referred to as representative viewpoints. Photographs of the Project area were taken from the representative viewpoints and were used to prepare photographic simulations to illustrate potential views of the Project. Seven representative viewpoints were initially selected for development of panoramic simulations; an additional six single-frame simulations were subsequently developed for viewpoints requested by DPP. The simulations allow for a comparison of the existing landscape and the expected landscape once the Project is constructed. The simulations are presented in Figure 15 (Attachment A); a detailed discussion of the simulation from each representative viewpoint is provided in Section 3.8.2.2 of the Final EA.

As shown in the visual simulations, the Project would be visible to varying degrees from surrounding areas during its 25-year operational period, Areas from which the Project would be most visible include segments of nearby roadways, including H-1 Freeway, Farrington Highway and Kualakaʻi Parkway. Although travelers along these roadways have relatively open views of the Waiʻanae Mountains views as they approach the Project area, views of the Project area are partially obstructed by roadways, rail transit facilities, transmission lines, streetlights and road signs, and vegetation. Features that are visible in the vicinity of the Project area include the former mill building, which is an abandoned structure associated with the historic irrigation and plantation infrastructure within and near the Project area. Once constructed, the geometric form and bluish-gray color of the solar modules would contrast with the surrounding muted green and brown hues of the surrounding vegetation. The scale, form and color of the solar photovoltaic modules would attract viewers' attention, but the contrast would be diminished by the surrounding development and existing man-made features. Given the low profile of the solar arrays relative to the broader context of the Waiʻanae Mountains, the Project would not dominate landscape views nor would it block views of other features in the surrounding landscape, including the former mill building. Although the Project components would introduce an additional visual element, they would be seen in the context of the surrounding development and would not substantially change the overall viewshed. Of all the roadways approaching the Project area, the Project facilities would be most readily visible from the north-bound lanes of Kualakaʻi Parkway, given the orientation of the roadway relative to the Project area. However, in all cases, the visual impacts from these roadways would be short term because travelers would only be approaching the Project area for a limited time and their focus would likely be on the road ahead.

6.6.3 Glare Analysis

In addition to introducing new elements into the visual landscape, the Project also has the potential to produce glare.[21] In general, solar modules are designed to absorb rather than reflect sunlight and incorporate a surface material that allows sunlight to pass with minimal reflection. The modules also have an anti-reflective coating that further reduces reflectivity. Regardless, solar facilities still have the potential to result in some degree of glare.

To evaluate the potential for glare associated with the Project, a glare analysis was conducted using the Solar Glare Hazard Analysis Tool (SGHAT) software through an online tool (GlareGauge) developed by Sandia National Laboratories and hosted by ForgeSolar. A total of three glare analyses were conducted for the Project. The first two analyses included three segmented traffic routes (H-1 Freeway, Farrington

[21] As an industry standard, the term "glint and glare" analysis is typically used to describe an analysis of potential ocular impacts to defined receptors. As a point of clarification, ForgeSolar defines glint and glare in the following statement: "Glint is typically defined as a momentary flash of bright light, often caused by a reflection off a moving source. A typical example of glint is a momentary solar reflection from a moving car. Glare is defined as a continuous source of bright light. Glare is generally associated with stationary objects, which, due to the slow relative movement of the sun, reflect sunlight for a longer duration." Based on the ForgeSolar definitions of glint and glare and the stationary nature of the solar photovoltaic modules (fixed tilt), the potential reflectance from the Project is referred to as glare.

Highway, and Kualaka'i Parkway) and three observation points from the surrounding community (to the west, south and east); Analysis 1 represents the point of view from an average first floor residential/ commercial structure and typical commuter car, while Analysis 2 represents the point of view from an average second floor residential/commercial structure and typical semi-tractor-trailer truck. The third analysis included 14 final approach flight paths and two air traffic control towers (ATCTs) associated with Kalaeloa Airport (John Rodgers Field; JRF), Daniel K. Inouye International Airport (Honolulu International; HNL) and Wheeler Army Airfield (HHI). The location of each of these receptors is shown in Figures 16 and 17 (Attachment A).

The results of the analysis indicate that none of the residential/commercial observation points would experience glare as a result of the Project. As summarized in Table 6, Analysis 1 and 2 predicted that a limited amount of green glare (the least severe type of glare) would occur at two segments along Farrington Highway (Farrington-1 and Farrington-2) and at two segments along H-1 Freeway (H1-2 and H1-3) southeast of the Project area. In addition, a very limited amount of yellow glare (85 combined annual minutes) was predicted along one segment of H-1 Freeway (HI-3). In addition, Analysis 3 predicted a limited amount of green glare along three of the final approach paths and the ATCT for Daniel K. Inouye International Airport, located approximately eight miles east of the Project. A detailed discussion of the results is provided in the Glare Analysis Report, contained in Attachment P.

Table 6. Summary of Predicted Glare at Defined Receptors

Receptor[1]	Type of Glare	Annual Minutes[2]	Minutes Per Day	Time of Day	Time of Year
Farrington-1	Green	1,608	Less than 15 min.	6:00 - 7:00 pm	April to May; mid-July to mid-September
Farrington-2	Green	4,840	Less than 15 min.	6:00 - 7:00 pm	April to mid-September
H1-2	Green	118	Less than 15 min.	6:00 - 7:00 pm	April to mid-May; August to mid-September
H1-3	Green	2,624	Less than 15 min.	6:00 - 7:00 pm	April to May; July to mid-September
H1-3	Yellow	50	Less than 5 min.	6:00 - 7:00 pm	Mid-May to mid-July
HNL RWY 22L	Green	847	Less than 10 min.	6:00 - 7:00 pm	Mid-April to May; mid-August to September
HNL RWY 22R	Green	866	Less than 10 min.	6:00 - 7:00 pm	Mid-April to May; mid-August to September
HNL RWY 26L	Green	2,149	Less than 10 min.	6:00 - 7:00 pm	Mid-May to August
HNL ATCT	Green	749	Less than 10 min.	6:00 - 7:00 pm	Mid-May to August

[1] The location of each receptor is shown in Figures 16 and 17.

[2] The annual minutes shown for each roadway segment is based on the results of Analysis 2 (the point of view from an average second floor residential/commercial structure and typical semi-tractor-trailer truck); these results are greater than those for Analysis 1 (the point of view from an average first floor residential/commercial structure and typical commuter car).

It is important to note that the GlareGauge model is conservative in that it does not account for varying ambient conditions (i.e., cloudy days, precipitation), atmospheric attenuation, intervening topography not located within the defined array layouts, or screening by existing or proposed vegetation and structures (including fences or walls). In the case of this Project, Pu'u Kapuai and other topographic

features associated with the Wai'anae Mountains are located to the west and northwest of the Project and may shade the Project from the sun's position during the evening hours at certain times of the year. In addition, an existing berm and vegetation is located along portions of the northern side of H-1 Freeway, which would be expected to at least partially screen Project views from vehicular traffic along the modeled segments of H-1 Freeway (see Figure 14; Attachment A); views of portions of the Project from vehicular traffic along the modeled segments of Farrington Highway may also be intermittently screened by vegetation and other existing features.

As summarized in Table 6, occurrences of glare resulting from the Project are expected to be limited; any glare experienced would occur intermittently in the evening hours and would not occur for a period longer than 15 minutes. Furthermore, based on the conservative nature of the model, the results may predict glare at locations where glare will not actually be experienced, such that actual glare conditions are likely to be less than predicted. For these reasons, glare impacts associated with the Project are expected to be minimal. The glare analysis results are further discussed relative to applicable Federal Aviation Administration (FAA) requirements in Section 6.10.2.1.

6.7 Air Quality

Construction of the Project would result in short-term impacts to air quality, primarily as a result of vehicle exhaust emissions and fugitive dust particles from disturbed soils. Vehicle exhaust emissions would be generated by heavy construction equipment operating within the Project area, trucks delivering construction materials and Project components to the site, and vehicles used by construction workers commuting to and from the Project area. These activities would result in emissions of air pollutants including CO_2, nitrogen oxides, sulfur oxides, PM_{10}, and $PM_{2.5}$. In comparison to overall emissions in the region, these contributions are relatively small and would not be expected to affect attainment of the federal or state ambient air quality standards.

State law (HAR § 11-60.1, Air Pollution Control) requires that the best practical operation or treatment be implemented during construction activities such that there is not discharge of visible fugitive dust beyond the property lot line. To comply with these requirements and to minimize any other adverse effects on air quality, the BMPs listed below would be implemented (in addition to those discussed in Section 6.1).

- All construction vehicles and equipment would be properly maintained according to manufacturer's specifications.
- To the extent feasible, off-road and portable diesel-powered equipment, including but not limited to bulldozers, graders, cranes, loaders, scrapers, backhoes, generator sets, compressors, auxiliary power units, would be fueled with motor vehicle diesel fuel.
- The number of vehicles accessing and moving within the project area would be limited to the extent possible. Vehicles speed on unpaved roads within the Project area would be limited to 25 miles per hour or less.

- Vehicles and equipment would not be allowed to idle for extended periods of time (i.e., more than 20 minutes).
- All trucks hauling soil or other loose materials would be covered.
- Water trucks or sprinkler systems (with no chemical additives) would be used to control fugitive dust within the Project area.
- Carpooling among construction workers would be encouraged to minimize construction-related traffic and associated emissions.

As previously described, areas that have been temporarily disturbed would be revegetated, and the vegetation would be actively monitored and maintained at levels necessary to minimize the potential for erosion and fugitive dust. Operation of the Project would result in minor emissions associated with vehicle exhaust and fugitive dust from vehicles and equipment used to perform operation and maintenance activities, as well as those associated with compatible agricultural activities. None of the equipment associated with the solar arrays, battery units and ancillary facilities (e.g., inverters and control equipment, transformers, switches, etc.) emit air pollutants of any kind. Consequently, it is anticipated that emissions associated with Project operations and maintenance would be very low. At a broader scale, the Project would provide a net air quality benefit by replacing energy generated by burning fossil fuels with renewable energy, thereby reducing emissions of greenhouse gases.

6.8 Noise

As detailed in Section 3.10 of the EA, construction of the Project would generate noise that exceeds the ambient levels and has the potential to cause a temporary and short-term disturbance to noise sensitive receptors. Reasonable efforts would be made to minimize the noise levels associated with Project construction to the extent practicable, including measures such as those listed below. If necessary, a noise permit would be obtained during construction to allow for exceedances of the maximum permissible sound levels.

- Construction activities would not occur between 7:00 pm and 7:00 am on weekdays or Saturday, or at any time on Sunday within 500 feet of an occupied residence.
- Construction site and access road speed limits would be established and enforced during the construction period.
- Electrically-powered equipment will be used instead of pneumatic or internal combustion powered equipment, where feasible.
- Material stockpiles and mobile equipment staging, parking, and maintenance areas would be located as far as practicable from noise-sensitive receptors.
- The use of noise-producing signals, including horns, whistles, alarms, and bells would be for safety warning purposes only.

- No Project-related public address or music system would be audible at any adjacent receptor.
- All noise-producing construction equipment and vehicles using internal combustion engines would be equipped with mufflers, air-inlet silencers where appropriate, and any other shrouds, shields, or other noise-reducing features in good operating condition that meet or exceed original factory specification. Mobile or fixed "package" equipment (e.g., arc-welders, air compressors) will be equipped with shrouds and noise control features that are readily available for that type of equipment.

During operations, the principal sources of noise associated with the Project would be the electrical components of the inverters, the step-up transformer within the substation, and cooling-ventilation fans associated with transformers and battery storage. The solar modules would not be within 100 feet of the property line, nor would they be expected to generate low-level sound beyond the Project area. The solar array inverters and transformers are generally considered a low-level source of noise, limited to daytime hours when the solar arrays are generating electricity. After sunset, when the modules no longer receive solar radiation, the inverters would not produce noise; the transformers would be energized but likely operating under low noise condition using natural draft cooling (i.e., fans would not be running due to lower nighttime heat loads). Operational noise associated with the Project is not expected to significantly impact any noise sensitive receptors, especially in the context of the industrial and agricultural activities in the Project vicinity. Any operational noise associated with the Project is expected to be below the maximum permissible sound levels.

6.9 Hazardous Materials

A Phase I Environmental Site Assessment was conducted for the Project area in March 2019. The results of this effort indicated that no hazardous materials are known to be present within the Project area. It was noted that based on the historical use of the property as part of a sugar cane and pineapple plantation, environmentally persistent agricultural chemicals may have been applied and thus may be present in surface and shallow subsurface soils at the site. It was also noted that the concrete irrigation flume located in the central portion of the property includes caulking, which could possibly contain asbestos. In the event the concrete irrigation flume is removed from the Project area, the caulking would be sampled to determine whether asbestos-containing material is present prior to removal. If asbestos is present, the Asbestos Abatement Office in the DOH Indoor and Radiological Health Branch would be contacted and the appropriate abatement protocols would be implemented in accordance with applicable regulations.

No extremely hazardous materials as defined by 40 CFR 355 (*List of Extremely Hazardous Substances and Their Threshold Planning Quantities*) would be produced, used, stored, transported, or disposed as part of the Project. Construction and operations activities would require the use of some hazardous materials, such as fuels (e.g., gasoline and diesel fuel) and lubricants, which could adversely affect the environment if accidentally released. However, only a limited amount of these materials would be present onsite and BMPs would be implemented to avoid and minimize potential impacts; BMPs would

include proper storage procedures (including secondary containment), routine inspection of vehicles and equipment for leaks, fueling and vehicle maintenance in offsite facilities or designated areas with secondary containment (with use of spill pads), and proper waste collection and disposal methods.

During the operational phase of the Project, oil-based products would be stored within the Project area, as the transformers use oil for insulation and cooling. Transformer oil is typically mineral oil or seed oil that is considered nontoxic and a non-hazardous substance; it does not contain polychlorinated biphenyls or compounds listed as extremely hazardous under 40 CFR 355. Transformers at the substation would be ground-mounted units constructed on concrete pads with secondary spill containment traps designed to minimize the possibility of accidental leakage. Furthermore, a Spill Prevention Control and Countermeasure (SPCC) Plan would be prepared, in accordance with the requirements of 40 CFR 112 (*Oil Pollution Prevention*). The plan would identify all oil storage containers, secondary containment and oil spill controls, inspection and testing protocols, training procedures, security measures, emergency response and notification procedures, key Project and regulatory contacts, and reporting requirements. Given the relatively small quantities and nature of the oil-based products, combined with secondary containment and other procedures that would be established as part of the SPCC Plan, the potential for oil-related spills and the associated effects are expected to be minimal.

As described in Section 3.1.2, the Project would include a battery energy storage system with a total of ten 1,300-kilowatt lithium-ion battery units. Each battery unit would incorporate multiple layers of protection to avoid failures and to contain potential hazardous substances. Specific features would include integrated monitoring and circuit protection, a self-contained heating ventilation air cooling system, and a fire detection and clean agent suppression system specifically designed for lithium-ion battery energy storage systems. Specific safety controls would include:

- Batteries would be stored in completely contained, leak-proof containers;
- Temperature/smoke/fire sensors, alarms, and aerosol fire extinguishing systems would be installed in every battery container;
- Each battery container would be controlled by remote power disconnect switches; and
- Battery system would undergo qualification testing prior to commercial operation.

In the event a lithium-ion battery requires replacement, the battery system would be disconnected and de-energized to allow for battery removal and replacement; the old battery would be properly packaged and transported to an approved recycling facility. All stages of this process would be conducted in accordance with all relevant regulatory requirements in place at the time of replacement. In particular, transportation of the lithium-ion batteries would be conducted in accordance with U.S. Department of Transportation Pipeline and Hazardous Material Administration regulations, including 49 CFR 173.185 (*Lithium Cells and Batteries*). This regulation includes requirements related to testing, proper packaging (such that the batteries are completely enclosed and are separated from contact from other equipment, devices, or conductive materials), and safety measures (including those related to preventing rupture, external short circuits, and reverse current flow).

As part of the decommissioning process, removal and treatment of the battery system would be conducted in the same manner as described above for battery replacement during the operational phase. Adherence to the applicable regulatory requirements would minimize potential hazards related to use, handling, transport, and disposal of batteries throughout Project operations and decommissioning.

6.10 Transportation and Traffic

6.10.1 Roadways

The Project is not expected to involve construction or improvements within any state or county roadway. However, the roadway network would be used by construction workers and for equipment deliveries to the Project area. During construction, the anticipated number of workers expected to be at the Project site each day ranges from 10 to 160 workers, with a daily average of approximately 55 workers over the course of the construction phase. An estimated 500 tractor trailer loads would make deliveries to the Project site over the course of the construction phase.

Based on the results of the TIAR (see Attachment Q), Project construction is not expected to measurably affect the overall level of service at the signalized intersections adjacent to the Project area. However, recognizing that construction could result in minor, localized impacts to traffic and the roadway network, a TMP would be prepared prior to construction. The TMP would describe the potential impacts to the surrounding roadway network and would detail the measures that would be implemented to avoid, minimize and mitigate potential impacts based on Complete Streets principles; it is expected that the measures would include those listed below. The TMP would be submitted to the Hawai‘i Department of Transportation (DOT), the City and County of Honolulu Department of Transportation Services, and DPP for review and approval prior to construction.

- Delivery of construction materials and equipment using oversized trucks would occur during off-peak traffic hours. Other deliveries of construction materials and equipment would be timed to occur during off-peak traffic hours to the extent practicable.
- If any construction projects are planned to occur on nearby properties during the same time frame, the timing of deliveries would be coordinated to minimize traffic-related impacts.
- Notification regarding the status of Project construction and potential traffic impacts would be provided to area representatives, the neighborhood board, area residents and businesses, emergency personnel (fire, ambulance, and police), and public transit services (TheBus and TheHandi-Van), as appropriate.
- If Project vehicles result in damage to an existing roadway or sidewalk, the roadway or sidewalk will be promptly repaired in accordance with current design standards and Americans with Disabilities Act requirements.
- Existing pedestrian, bicycle and vehicle access/crossings shall be maintained with the highest safety measures during construction. If it is determined that roadway, sidewalk or crosswalk

closures are necessary, alternate routes would be provided for vehicles, pedestrians, and bicyclists that are safe and clearly marked.

Once operational, it is anticipated that the Project would have 1-2 employees regularly visiting the site for operations activities. As such, Project operations would not be expected to measurably impact traffic on roads surrounding the Project area.

6.10.2Airports

The nearest airport to the Project area is Kalaeloa Airport (JRF), approximately 3.6 miles to the south. The Daniel K. Inouye International Airport (HNL), the state's largest airport, is located approximately 8 miles southeast of the Project area (DOT, 2019).

FAA requires that land uses adjacent to or in the immediate vicinity of an airport be compatible with normal airport operations, including land and takeoff of aircraft (FAA Order 5190.6B). In response to this mandate, the State of Hawai'i Office of Planning issued a Technical Assistance Memorandum (TAM-2016-1) to provide guidance for development and activities that may pose potential hazards including attraction of hazardous wildlife, glint/glare hazard or an aerial obstruction hazard. This guidance identifies solar photovoltaic panels as one of the many land use practices that may present a hazard to existing flight paths; specific concerns related to solar photovoltaic facilities are identified as:

- Potential glare and glint caused by parabolic troughs and heliostats that might cause temporary loss of vision to pilots on arrival or departure, or to Air Traffic Control personnel in the control tower;
- Electromagnetic interference with on-and off-airport radar systems that may pick up a false signal from the metal components of the mirrors with impacts that can vary based on solar tracking activity;
- Physical penetrations of navigable airspace from power towers that extend into Part 77 imaginary surfaces, terminal instrument procedures (TERPS) surfaces, or the path of radio emitting navigational aids; and
- Thermal plumes emitted by the power tower that produce unexpected upward moving air columns into navigable air space.

The Project would not include parabolic troughs, heliostats, mirrors or power towers, such that none of the identified concerns would occur as a result of the Project. However, TAM-2016-1 recommends filing Form 7460-1 with the FAA pursuant to CFR Title 14 Part 77.9 if the Project is within 3 nautical miles of an airport or has a footprint approaching 1 acre.

6.10.2.1 Glare

According to 78 FR 63276, the FAA has determined that "glint and glare from solar energy systems could result in an ocular impact to pilots and/or air traffic control facilities and compromise the safety of the air transportation system." The FAA Notice Criteria Tool (NCT) reports whether a proposed structure is in proximity to a jurisdictional air navigation facility and if formal submission to the FAA Obstruction

Evaluation Group (OEG) under CFR Title 14 Part 77.9 (Safe, Efficient Use, and Preservation of the Navigable Airspace) is recommended. The NCT also identifies final approach flight paths that may be considered vulnerable to a proposed structure's impact on navigation signal reception. The NCT was utilized to determine if the Project is located within an FAA-identified impact area based on the Project boundaries and height above ground surface. The FAA NCT Report stated that a formal filing with the FAA OEG is recommended, and referenced Kalaeloa Airport (JRF), Daniel K. Inouye International Airport (Honolulu International, HNL), and Wheeler Army Airfield (HHI). Based on this information, these three airport facilities were included in the SGHAT analysis conducted for the Project.

As described in Section 6.6.3, the SGHAT analysis included 14 final approach flight paths and two ATCTs associated with Kalaeloa Airport, Daniel K. Inouye International Airport and Wheeler Army Airfield. The results of the analysis indicate that no glare would be experienced at Kalaeloa Airport or Wheeler Army Airfield. A limited amount of green glare was predicted for three of the final approach paths and the ATCT for Daniel K. Inouye International Airport; these results are summarized in Table 6, with additional detail provided in the Glare Analysis Report (Attachment P). As the Daniel K. Inouye International Airport is located approximately 8 miles from the Project area and the potential occurrence of glare is extremely limited (less than 10 minutes per day during certain months of the year), the Project is not expected to significantly impact airport facilities as a result of glare.

As recommended by the NCT, the Project was formally filed with the FAA OEG to confirm these conclusions; on June 9, 2020, FAA OEG issued a determination of No Hazard to Air Navigation for the Project (see Attachment P). Once the Project is operational, in the unlikely event that it is determined that the Project is creating a hazardous condition for pilots, AES would immediately mitigate the hazard upon notification by FAA and/or DOT Airports Division.

6.10.2.2 Radio Frequency Interference

Solar photovoltaic systems have also been known to emit radio frequency interference to aviation-dedicated radio signals, disrupting the reliability of air-to-ground communications. The Federal Communications Commission (FCC) regulates radio frequency (RF) devices contained in electronic-electrical products that are capable of emitting radio frequency energy by radiation, conduction, or other means. These products have the potential to cause interference to radio services operating in the radio frequency range of 9 kHz to 3000 GHz. All RF devices used for the Project would comply with FCC regulations and would operate only in designed frequency bands. No interference with aviation communication frequency is expected. In the unlikely event of an unexpected radio frequency interference situation and notification by either FAA or DOT Airports Division, the Project's wireless communication system would be disabled and investigated to ensure it does not create a hazardous condition.

6.11 Natural Hazards

Natural hazards that can affect O'ahu include flooding, tsunami inundation, and wildfire. As previously described in Section 4.3, the Project area is not located within a flood hazard zone or a tsunami

evacuation zone; therefore, it is extremely unlikely that conditions associated with flood or tsunami inundation would occur within the site, nor would the Project contribute to increased risk of flooding or inundation.

Wildfires in Hawai'i are predominantly caused by human activity, with most fires originating near roadways; other contributing factors include the prevalence of non-native vegetation and climate change. To avoid and minimize the potential for wildfire as a result of Project implementation, as well as the spread of wildfire from surrounding areas, the Project would incorporate multiple layers of fire prevention and suppression measures. It is being designed in accordance with the National Fire Protection Association (NFPA) 1 and National Electric Code (NEC) requirements for fire prevention for large-scale solar facilities, including installation of fire breaks throughout the Project area. Vegetation within the Project area would be managed with livestock to control combustible materials, while still providing enough ground cover to prevent erosion. Dedicated operations and maintenance staff would proactively monitor the vegetation growth. All electrical wiring would be elevated or enclosed, thus preventing interaction between circuits and flammable materials. Battery systems would be fully contained within temperature-controlled, leak-proof containers; each container would be fully equipped with temperature/smoke/fire sensors and alarms, remote controlled disconnects and a clean agent fire suppression system. Remote monitoring staff would be alerted in the event of a system issue. As previously discussed, the access and service roads used for the Project would provide the required clearance and turning radius needed for emergency response vehicles, in accordance with the fire code. The Honolulu Fire Department was initially consulted as part of the pre-assessment scoping process and consultation will continue throughout the design of the Project, with on-site training and orientation prior to commercial operation.

6.12 Public Facilities and Services

6.12.1 Police, Medical and Fire Protection Services

Consistent with requirements articulated by the Honolulu Fire Department, the existing access roads as well as service roads within the Project area would be able to accommodate fire apparatus and would meet the relevant specifications identified in the fire code; it is anticipated that the Project does not need to provide water supply for fire flow as no occupied buildings would be constructed within the Project area. Furthermore, as discussed above, the Project would incorporate multiple layers of fire prevention and suppression measures. As previously noted, the Honolulu Fire Department has been and will continued to be consulted throughout the Project development process, with on-site training and orientation prior to commercial operation. The design drawings for the Project will also be submitted to DPP for review and approval prior to construction. As such, the Project is not expected to increase the need for fire response or otherwise impact fire protection services; no mitigation is proposed.

Similarly, the Project is not expected to interrupt, increase the demand for, or otherwise affect police or emergency medical services. During construction, the Project area would be staffed with security personnel on an as-needed basis to protect equipment and machinery used to construct the Project.

This would be in addition to the 24-hour security that controls entry to the UH West O'ahu Mauka Lands property. During operations, the facilities would be adequately secured and are not expected to require additional security on a regular basis. A surveillance system at key areas (such as the substation and PCS pads) would be incorporated and additional security measures (such as fence-top deterrents) would be added if the need arises. As such, the Project is not expected to impact police services.

6.12.2 Educational Facilities

The Project would not impact existing educational facilities, nor would it increase the need for educational facilities. Although located on the UH West Oʻahu Mauka Lands property, the Project would not impact the campus; furthermore, the Project would be consistent with their long-range land use plan for UH West Oʻahu. As such, no mitigation is proposed.

6.12.3 Recreational Facilities

There are no existing recreational areas within or immediately surrounding the Project area. As such, the Project would not affect existing recreational facilities and no mitigation is proposed.

6.13 Economic Resources

Overall, Project implementation would positively contribute to Hawaiʻi's economy by providing jobs and other forms of economic activity. Jobs directly related to construction and operation of the solar facilities would be considered "green jobs," which are generally defined as jobs related to preserving or restoring the environment (U.S. Bureau of Labor Statistics, 2020). The economic activity associated with the Project was modeled using IMPLAN, a commercially available economic modeling package widely used to assess the economic impacts of renewable energy and many other types of projects. Economic impacts were assessed in terms of employment, labor income, and economic output, with separate analyses presented for the construction and operation phases. The results of the analysis are summarized below; additional details are provided in the EA.

It is estimated that construction of the Project would directly employ an average of 55 onsite workers, including technicians, laborers, foremen, equipment operators, and construction managers for the solar photovoltaic modules, battery energy storage system and other renewable energy equipment. AES is deeply committed to promoting local job opportunities in Hawaiʻi. It is anticipated that approximately 75 percent of these positions (or a total of approximately 41 jobs) would be filled by Hawaiʻi residents and would result in an estimated $6.6 million in related payroll (labor income). The remaining jobs are expected to require specialty trade and/or professional staff that would be brought to Hawaiʻi for the Project; in many cases, these staff would serve to train the local workforce and commission certain components per manufacturer requirements. Construction of the Project would also support employment, labor income, and economic output in other sectors of the state economy, with indirect impacts estimated to support approximately 38 jobs and induced impacts estimated to support a further 38 jobs.[22] It is estimated that

[22] Indirect impacts relate to workers directly employed elsewhere in Hawaiʻi that would provide Project-related technical services, such as engineering design and permitting, and expenditures on goods and services by those

construction of the Project would support a total of 118 jobs in the state of Hawai‘i and approximately $11.3 million in labor income, with total economic output of approximately $20.2 million.

Once operational, the Project would continue to contribute to the state economy over its 25-year lifespan. AES expects to employ an in-state workforce of 5 employees to oversee operations and maintenance of their Hawai‘i portfolio, including the Project. Operation and maintenance of the Project would also support employment, labor income, and economic output in other sectors of the state economy. It is estimated that the Project would support approximately 7.6 total (direct, indirect, and induced) jobs in Hawai‘i and approximately $0.7 million in labor income, with total economic output of approximately $1.2 million. Estimated indirect and induced impact estimates include the impacts of Project-related payments to UH, which would potentially support employment at the university, as well as elsewhere in the statewide economy. In addition, the Project will support additional economic benefits associated with the compatible agricultural activities. These estimated annual impacts would be expected to occur each year that the Project operates.

As part of decommissioning, the Project would directly employ workers from Hawai‘i, as well as support additional secondary (indirect and induced) benefits elsewhere in the regional economy. In-state expenditures on equipment and material recycling/salvage and disposal, and per diem expenditures by workers on lodging and food, as well as spending on household goods and services by workers living in the area would all support additional economic activity elsewhere in the state economy. Economic impacts related to decommissioning are expected to be broadly similar to those anticipated during construction.

suppliers. Induced impacts are generated by household spending associated either directly or indirectly with the proposed facility (e.g., use of income to purchase groceries and other household goods and services).

7 Land Use Commission Guidelines

The State Land Use Commission has adopted guidelines for determining an "unusual and reasonable use" under HAR § 15-15-95(b). These guidelines are bulleted in bold below, followed by a discussion of how the Project meets each guideline.

(1) The use shall not be contrary to the objectives sought to be accomplished by chapters 205 and 205A, HRS, and the rules of the commission;

The Hawai'i State Land Use Law (HRS § 205) established the State Land Use Commission and granted the authority to classify all lands in the state into one of four land use districts: urban, rural, agricultural, and conservation. The Project is located entirely on land that is classified within the agricultural district. HRS § 205 specifies the uses that are permitted within the State agricultural district, with consideration given to the LSB classification system.

HRS § 205-2(d) specifies that the agricultural district shall include:

> *(6) Solar energy facilities; provided that:*
>
> *(A) This paragraph shall apply only to land with soil classified by the land study bureau's detailed land classification as overall (master) productivity rating class B, C, D, or E; and*
>
> *(B) Solar energy facilities placed within land with soil classified as overall productivity rating class B or C shall not occupy more than ten per cent of the acreage of the parcel, or twenty acres of land, whichever is lesser, unless a special use permit is granted pursuant to section 205-6;*

HRS § 205-4.5(a) further restricts uses for solar energy facilities on Class B or C soils to include the following:

> *(21) Solar energy facilities on lands with soil classified by the land study bureau's detailed land classification as overall (master) productivity rating B or C for which a special use permit is granted pursuant to section 205-6; provided that:*
>
> *(A) The area occupied by the solar energy facilities is also made available for compatible agricultural activities at a lease rate that is at least fifty per cent below the fair market rent for comparable properties;*
>
> *(B) Proof of financial security to decommission the facility is provided to the satisfaction of the appropriate county planning commission prior to date of commencement of commercial generation; and*
>
> *(C) Solar energy facilities shall be decommissioned at the owner's expense according to the following requirements:*
>
> *(i) Removal of all equipment related to the solar energy facility within twelve months of the conclusion of operation or useful life; and*

(ii) Restoration of the disturbed earth to substantially the same physical condition as existed prior to the development of the solar energy facility.

As shown in Figures 5 and 10 (Attachment A), the Project area is entirely within the State agricultural district and is designated as having LSB Class B, D, and E soils. As listed in Table 5, the Project area includes approximately 48 acres of Class B soils, approximately 36 acres of Class D soils, and approximately 13 acres of Class E soils. The Project would not involve construction of any facilities on land designated as having LSB Class A soils.

Pursuant to HRS § 205-4.5(a)(21), the Project would be a permitted use with issuance of a Special Use Permit. This document has been prepared as part of the application for a Special Use Permit; as described throughout this document, the Project would comply with the provisions of HRS § 205-4.5(a)(21) as follows:

- **Compatible agricultural activities:** Along with the solar and storage facilities, the Project area would be made available for compatible agricultural activities at a lease rate at least 50 percent below fair market rent. Based on an assessment of agricultural activities that could be conducted in parallel with the solar energy facilities in the Project area, the most promising options include honey production and/or cattle grazing and production. These activities are compatible with solar energy production, well-suited to the site-specific conditions, and require minimal water resources. As described further in Section 3.2.2, facilities and equipment to support the agricultural activities, such as beekeeping stations, cattle trap areas and water troughs, would be installed as part of the Project. In the event that the agricultural activities outlined above are determined to not be viable or an agriculture partner ceases operations or an interest in partnering, AES would seek other potential partners for similar agricultural activities and would continue to make the Project area available at a lease rate that is at least fifty percent below fair market rent for comparable properties.
- **Decommissioning:** Based on the approved PPA, the Project is expected to have an operational life of approximately 25 years. At that point in time, the facility may be re-powered under a re-negotiated PPA (with subsequent permits/approvals) or decommissioned. Decommissioning would involve removal of all equipment associated with the Project within 12 months of ceasing operations, and returning the Project area to substantially the same physical condition as existed prior to Project development. A detailed discussion of decommissioning is provided in Section 3.5, with the decommissioning plan included as Attachment L.
- **Proof of Financial Security:** In accordance with the requirements of HRS § 205-4.5(a)(21), financial assurance for decommissioning would be provided to the City and County of Honolulu Planning Commission prior to the commencement of commercial generation. The financial security would be in the form of a parent guaranty or letter of credit, with the security to remain in place for the duration of the Project.

As further discussed in Section 10, no portion of the Project area has been designated or identified as IAL and therefore the Project would comply with HRS § 205 (Part III). The Project would also comply with the objectives and policies of HRS § 205A, as further discussed in Section 8.1.

(2) The proposed use would not adversely affect surrounding property;

The Project area is located in the ʻEwa District, approximately 3 miles northeast of Kapolei. Based on its designation in the City and County of Honolulu's General Plan and ʻEwa Development Plan as the island's secondary urban center, much of the growth on Oʻahu has been focused in this region. Large scale development of the City of Kapolei started in the 1990s, and has included a wide range of commercial, residential, industrial and government facilities.

The Project would be located within the southwestern portion of the 991-acre UH West Oʻahu Mauka Lands property, which was historically part of an extensive agricultural plantation, but has been fallow and intermittently used for cattle grazing since the 1990s. The lands immediately surrounding the Project area, which are also part of the UH West Oʻahu Mauka Lands property, would continue to be used for cattle grazing and would not be affected by construction or operation of the solar and storage facilities. Other surrounding uses beyond the adjacent lands include the former Honouliuli Internment Camp site (approximately 1 mile to the northeast) and Makakilo Quarry (approximately 0.6 mile to the southwest); the residential community of Makakilo is located just north of the quarry, with the closest residential structure approximately 0.3 mile from the Project area. As discussed in Section 6.6, the Project would be visible to varying degrees from surrounding areas; however, it would not obstruct or impede views of the Waiʻanae Mountains, Pacific Ocean or other scenic resources. The Project facilities would introduce new visual elements within the landscape, but these would be seen in the context of other development including high-voltage transmission lines, commercial and residential structures, the rail transit system, Makakilo Quarry and other man-made features.

Construction of the solar and storage facilities would involve a variety of ground disturbing activities, such as site preparation and grading, equipment installation (e.g., driving support posts), and trenching for the underground collection lines. Use of heavy equipment and earthmoving operations conducted as part of these activities would generate noise, as well as temporary fugitive dust and internal combustion engine emissions, resulting in temporary and localized impacts to air quality. BMPs would be implemented to minimize the noise and emission levels, and in general, the impacts are expected to be temporary, intermittent, and localized in nature. Similarly, construction and operation of the Project would require a variety of truck deliveries and other vehicle trips; however, these are not expected to measurably affect traffic levels; in addition, BMPs would be implemented to avoid, minimize and mitigate potential impacts based on Complete Streets principles. Overall, none of these impacts would be expected to alter the character of the surrounding areas in a manner that would result in significant adverse effects.

(3) The proposed use would not unreasonably burden public agencies to provide roads and streets, sewers, water drainage and school improvements, and police and fire protection;

As noted above, Project traffic is not expected to measurably affect local roads and streets, nor would it require any school improvements. No connection to the domestic water or sanitation system would be required. Overall, the Project would not require improvements or otherwise burden public infrastructure.

The Project would incorporate multiple layers of fire prevention and suppression measures, and no occupied buildings would be constructed within the Project Area. As such, the Project is not expected to unreasonably burden fire protection services. During construction, the Project area would be staffed with security personnel on an as-needed basis. During operations, the facilities would be adequately secured and are not expected to require additional security on a regular basis. Therefore, the Project is also not expected to unreasonably burden police services.

(4) Unusual conditions, trends, and needs have arisen since the district boundaries and rules were established; and

As discussed in Section 1.1, the State of Hawai‘i has established an RPS, as codified in HRS § 269-92, which specifies that electric utility companies in Hawai‘i must use renewable energy for the equivalent of 30 percent of net electricity sales by 2020, 40 percent by 2030, seventy percent by 2040, and 100 percent by 2045. As of the third quarter of 2019, approximately 25 percent of Hawaiian Electric’s electrical energy sales on O‘ahu were generated by renewable energy sources (Hawaiian Electric, 2019b).

The Project area is well suited for solar energy generation as it includes undeveloped land with relatively flat to moderate slopes that can accommodate the solar modules and battery storage facilities, existing access roads that can be traversed by construction equipment, and the ability to interconnect with the existing Hawaiian Electric grid onsite. The Project would help to meet the state’s need for renewable energy by providing up to 12.5 MW of solar energy and 50 MWh of battery storage, which is enough to provide electricity for approximately 4,600 homes (based on average energy use). In doing so, it would directly contribute to the state’s renewable energy goals, fulfilling approximately 0.5 percent of Hawaiian Electric’s RPS (Hawaiian Electric, 2019b).

It is recognized that these site attributes are also valuable for agricultural purposes, and it is understood that there is a need to balance agricultural and renewable energy production. By making the Project area available for compatible agricultural activities at a lease rate below fair market rent, the Project seeks to balance these uses.

(5) The land upon which the proposed use is sought is unsuited for the uses permitted within the district.

As discussed in Section 3.2, agricultural activities in the Project area are highly constrained by site-specific factors, particularly the lack of infrastructure and insufficient water for irrigation. However, the Project area would be used in a manner that balances both agriculture and renewable energy needs. The Project is consistent with the underlying objectives of HRS § 205, in that it would support and subsidize compatible agricultural activities (such as honey production and cattle grazing) and would implement decommissioning provisions in which the land would be returned to substantially the same condition as existed prior to Project development, thus allowing for the full range of future agricultural uses.

8 Consistency with State and County Plans and Programs

The application for a Special Use Permit requires that the project demonstrate consistency with the State's Coastal Zone Management policies and objective (HRS § 205A) and the Hawai'i State Plan (HRS § 226), as well as the City and County's General Plan and the applicable Development Plan or Sustainable Communities Plan. Consistency with these plans and programs is summarized below.

8.1 Coastal Zone Management Program (HRS § 205A)

Under the authority of the federal Coastal Zone Management Act (16 U.S.C. 1451-1456), the Hawai'i Coastal Zone Management (CZM) Program was enacted as HRS § 205A and is administered by the Hawai'i Department of Business, Economic Development and Tourism (DBEDT) Office of Planning. The purpose of the Hawai'i CZM program is to provide for the effective management, beneficial use, protection, and development of the coastal zone. It is designed to integrate decisions made by state and county agencies to provide greater coordination and compliance with existing laws and rules. The CZM area encompasses the entire state. The objectives of the Hawai'i CZM Program are listed in Table 7, with a brief statement regarding the consistency of the Project with each of the objectives and associated policies.

Table 7. Project Consistency with the Objective and Policies of the Hawai'i CZM Program

Objectives and Policies	Assessment of Consistency
Recreational Resources: Provide coastal recreational opportunities accessible to the public.	The Project area does not support coastal nor any other type of recreational resources; the nearest coastal recreational areas are approximately 4 miles west and 5 miles south of the Project area. The Project would not impair access to the shoreline, degrade the quality of coastal waters, or otherwise affect coastal recreational opportunities.
Historic Resources: Protect, preserve, and where desirable, restore those natural and manmade historic and prehistoric resources in the coastal zone management area that are significant in Hawaiian and American history and culture.	An AIS was conducted for the Project, including detailed background research and a 100 percent pedestrian inspection of the Project area. The AIS identified two historic properties within the Project area, consisting of irrigation and plantation infrastructure and a remnant portion of the Waiahole Ditch. The Draft AIS Report was submitted and is pending SHPD review in compliance with HRS § 6E and HAR § 13-284. Implementation of the Project would affect portions of these historic properties within the Project area; the portions that are not affected by the proposed improvements would be kept intact. Based on the conclusions regarding significance and documentation to date, pursuant to HAR § 13-284-7 and subject to review and concurrence by SHPD, the effect determination for the Project is "no historic properties affected" with a recommendation for no further historic preservation work. AES intends to obtain SHPD's review of the AIS and concurrence with the effect determination prior to the Planning Commission hearing for the Special Use Permit application.
Scenic and Open Space Resources: Protect, preserve, and where desirable,	Within the Project area, the solar photovoltaic and storage facilities would have a very small permanent footprint; the surrounding portions of the Project area would be maintained as open space. The Project would be visible to varying

Objectives and Policies	Assessment of Consistency
restore or improve the quality of coastal scenic and open space resources.	degrees from surrounding areas; however, it would not obstruct or impede views of the Wai‘anae Mountains, Pacific Ocean or other scenic resources. The Project facilities would introduce new visual elements within the landscape, but these would be seen in the context of other development including high-voltage transmission lines, commercial and residential structures, the rail transit system, Makakilo Quarry and other man-made features.
Coastal Ecosystems: Protect valuable coastal ecosystems, including reefs, from disruption and to minimize adverse impacts on all coastal ecosystems.	The Project would be located inland and would not involve work within or near coastal ecosystems. Ground disturbance during construction could temporarily increase the amount of sediment and other pollutants in stormwater runoff, which could affect water quality in receiving waters. However, BMPs would be implemented such that no adverse impacts to coastal ecosystems are anticipated.
Economic Uses: Provide public or private facilities and improvements important to the State’s economy in suitable locations.	The Project is not a coastal-dependent development. It would involve construction and operation of a solar energy generation facility in an inland location, within the State agricultural land use district. Based on the soil classification (LSB Class B, D and E), the Project is permitted within the State agricultural land use district use with issuance of an Special Use Permit, assuming compliance with the provisions related to decommissioning, proof of financial security, and making the Project area available for compatible agricultural activities at a lease rate below fair market rent. Activities that would be conducted pursuant to these requirements are described in Section 7.
Coastal Hazards: Reduce hazard to life and property from tsunami, storm waves, stream flooding, erosion, subsidence, and pollution.	The Project area is not within a tsunami or floodplain zone and is not subject to coastal hazards. The Project would be designed and constructed in compliance with all applicable Federal, State, and local environmental protection, design, and building standards and regulations, including the Federal Flood Insurance Program, and would not contribute to coastal flooding.
Managing Development: Improve the development review process, communication, and public participation in the management of coastal resources and hazards.	Outreach and consultation was initiated with Project stakeholders early in the Project development process. In parallel, an EA was prepared to disclose the potential impacts of the Project; the environmental review process included opportunities for public review and comment, pursuant to HRS § 343 and HAR § 11-200.1. The discretionary permitting process will also include opportunities for public participation.
Public Participation: Stimulate public awareness, education, and participation in coastal management.	The Project does not contain a public participation component for programmatic coastal management issues. Project-specific input has and will continue to be sought through the permitting and Project development process.
Beach Protection: Protect beaches for public use and recreation.	The Project would be located inland and would not involve placement of any structures within the shoreline setback area or otherwise affect erosion or natural shoreline processes.
Marine Resources: Promote the protection, use, and development of marine and coastal resources to assure their sustainability.	The Project would not be located near the shoreline and would not directly or indirectly affect any marine resources.

Key components of the Hawai‘i CZM Program include (1) regulation of development within the SMA, a designated area extending inland from the shoreline, (2) restrictions within the shoreline setback area, which serves as a buffer against coastal hazards and erosion and to protect viewplanes, and (3) a Federal Consistency provision, which requires that federal activities, permits, and financial assistance be consistent with the enforceable policies of the Hawai‘i CZM program, to the maximum extent

practicable. The Project area is not within either the SMA or the shoreline setback area, nor would it involve a federal activity or permit requiring federal consistency review.

8.2 Hawai‘i State Planning Act (HRS § 226)

The Hawai‘i State Planning Act (HRS § 226) is a broad policy document relating to the statewide planning system, including all activities, programs and decisions made by local and state agencies. It is intended to “improve the planning process in this state, to increase the effectiveness of government and private actions, to improve coordination among different agencies and levels of government, to provide for wise use of Hawai‘i’s resources and to guide the future development of the state” (HRS § 226-1). The State Plan serves as written guide for the long-range development of the state by describing the desired future for the residents of Hawai‘i and providing a set of goals, objectives, and policies that are intended to shape the general direction of public and private development. Part I of the State Plan lists the state’s long-range goals, objectives, policies and priorities. Part II establishes a statewide planning system to coordinate and implement the State Plan. Part III establishes priority guidelines to address areas of statewide concern.

The stated goals of the state plan relate to a strong viable economy, a desired physical environment, and individual and family well-being (HRS § 226-4). Overall, the Project supports these goals; in particular, it would serve to provide a clean source of renewable energy that reduces the use of fossil fuels to meet the state’s energy needs, while providing environmental and human health benefits. Consistency of the Project with the specific objectives and policies in the Hawai‘i State Plan is summarized in Table 8. Consistency of the Project with the specific relevant priority guidelines in the Hawai‘i State Plan is summarized in Table 9. Relevant state functional plans are discussed in the following subsection.

Table 8. Project Consistency with the Objective and Policies of the Hawai‘i State Planning Act

Objectives	Assessment of Consistency
Population: It shall be the objective in planning for the State's population to guide population growth to be consistent with the achievement of physical, economic, and social objectives contained in this chapter.	The Project would not have any effect on population growth.
Economy - In General: Planning for the State's economy in general shall be directed toward achievement of the following objectives: (1) Increased and diversified employment opportunities to achieve full employment, increased income and job choice, and improved living standards for Hawai‘i’s people, while at the same time stimulating the development and expansion of economic activities capitalizing on defense, dual-use, and science and technology assets, particularly on the neighbor islands where employment opportunities may be limited. (2) A steadily growing and diversified economic base that is not overly dependent on a few industries and includes the development and expansion of industries on the neighbor islands.	The Project would be consistent with the objectives and policies for this theme, particularly the following policies: (7) Expand existing markets and penetrate new markets for Hawai‘i's products and services. (12) Encourage innovative activities that may not be labor-intensive, but may otherwise contribute to the economy of Hawai‘i. The Project would contribute to Hawai‘i’s growing renewable energy market and would provide employment opportunities for Hawai‘i residents in the innovative renewable energy field, particularly during construction; although operations would not include many labor-intensive activities, the Project would positively contribute to Hawai‘i’s economy.

Objectives	Assessment of Consistency
Economy – Agriculture: Planning for the State's economy with regard to agriculture shall be directed towards achievement of the following objectives: (1) Viability of Hawai'i's sugar and pineapple industries. (2) Growth and development of diversified agriculture throughout the State. (3) An agriculture industry that continues to constitute a dynamic and essential component of Hawai'i's strategic, economic, and social well-being.	The Project would be consistent with the objectives and policies for this theme, particularly the following policies: (2) Encourage agriculture by making the best use of natural resources. (12) In addition to the State's priority on food, expand Hawai'i's agricultural base by promoting growth and development of flowers, tropical fruits and plants, livestock, feed grains, forestry, food crops, aquaculture, and other potential enterprises. The Project would seek to balance agricultural and renewable energy needs. Specifically, it would support and subsidize compatible agricultural activities (such as honey production and cattle grazing) and would implement specific decommissioning provisions in which the land would be returned to substantially the same condition as existed prior to development of the solar facilities, thus allowing for a full range of future agricultural uses.
Economy – Visitor Industry: Planning for the State's economy with regard to the visitor industry shall be directed towards the achievement of the objective of a visitor industry that constitutes a major component of steady growth for Hawai'i's economy.	The Project would not have any effect on the economy as related to the visitor industry.
Economy – Federal Expenditures: Planning for the State's economy with regard to federal expenditures shall be directed towards achievement of the objective of a stable federal investment base as an integral component of Hawai'i's economy.	The Project would not involve any federal expenditures.
Economy - Potential Growth and Innovative Activities: Planning for the State's economy with regard to potential growth and innovative activities shall be directed towards achievement of the objective of development and expansion of potential growth and innovative activities that serve to increase and diversify Hawai'i's economic base.	The Project would be consistent with the objectives and policies for this theme, particularly the following policies: (1) Facilitate investment and employment growth in economic activities that have the potential to expand and diversify Hawai'i's economy, including but not limited to diversified agriculture, aquaculture, renewable energy development, creative media, health care, and science and technology-based sectors. (8) Accelerate research and development of new energy-related industries based on wind, solar, ocean, underground resources, and solid waste. The Project would contribute to and further diversify Hawai'i's economy through the growing renewable energy market.
Economy - Information Industry: Planning for the State's economy with regard to telecommunications and information technology shall be directed toward recognizing that broadband and wireless communication capability and infrastructure are foundations for an innovative economy and positioning Hawai'i as a leader in broadband and wireless communications and applications in the Pacific Region.	The Project would not have any effect on the economy as related to telecommunication and information technology.
Physical Environment - Land-based, Shoreline, and Marine Resources: Planning for the State's physical environment with regard to land-based, shoreline, and marine resources shall be directed towards achievement of the following objectives:	The Project would be consistent with the objectives and policies for this theme, particularly the following policies: (3) Take into account the physical attributes of areas when planning and designing activities and facilities.

Objectives	Assessment of Consistency
(1) Prudent use of Hawai‘i’s land-based, shoreline, and marine resources. (2) Effective protection of Hawai‘i’s unique and fragile environmental resources.	(4) Manage natural resources and environs to encourage their beneficial and multiple use without generating costly or irreparable environmental damage. (8) Pursue compatible relationships among activities, facilities, and natural resources. The Project area has been extensively modified by previous agricultural operations and is dominated by non-native species. Regardless, the Project has been designed to minimize ground disturbance and maintain ample, natural open space surrounding the Project facilities. Impacts to natural resources would be avoided and minimized to the extent possible through implementation of BMPs.
Physical Environment - Scenic, Natural Beauty, and Historic Resources: Planning for the State's physical environment shall be directed towards achievement of the objective of enhancement of Hawai‘i’s scenic assets, natural beauty, and multi-cultural/historical resources.	The Project would be consistent with the objectives and policies for this theme, particularly the following policies: (1) Promote the preservation and restoration of significant natural and historic resources. (3) Promote the preservation of views and vistas to enhance the visual and aesthetic enjoyment of mountains, ocean, scenic landscapes, and other natural features. An AIS was conducted for the Project; historic properties within the Project area include plantation-era infrastructure and a remnant section of the Waiahole Ditch. Implementation of the Project would affect portions of these historic properties within the Project area; the portions that are not affected by the proposed improvements would be kept intact. The Project would be visible to varying degrees from surrounding areas; however, it would not obstruct or impede views of the Wai‘anae Mountains, Pacific Ocean or other scenic resources. The Project facilities would introduce new visual elements within the landscape, but these would be seen in the context of other development including high-voltage transmission lines, commercial and residential structures, the rail transit system, Makakilo Quarry and other man-made features.
Physical Environment - Land, Air, and Water Quality: Planning for the State's physical environment with regard to land, air, and water quality shall be directed towards achievement of the following objectives: (1) Maintenance and pursuit of improved quality in Hawai‘i’s land, air, and water resources. (2) Greater public awareness and appreciation of Hawai‘i’s environmental resources.	The Project would be consistent with the objectives and policies for this theme, particularly the following policies: (3) Promote effective measures to achieve desired quality in Hawai‘i’s surface, ground, and coastal waters. (4) Encourage actions to maintain or improve aural and air quality levels to enhance the health and well-being of Hawai‘i’s people. BMPs would be implemented as part of the Project to avoid and minimize impacts to water quality and air quality. Once operational, the Project would provide a net benefit by replacing energy generated by burning fossil fuels with renewable energy, thereby reducing emissions of greenhouse gases.
Facility Systems – In General: Planning for the State's facility systems in general shall be directed towards achievement of the objective of water, transportation, waste disposal, and energy	The Project would be consistent with the objectives and policies for this theme, particularly the following policies:

Objectives	Assessment of Consistency
and telecommunication systems that support statewide social, economic, and physical objectives.	(2) Encourage flexibility in the design and development of facility systems to promote prudent use of resources and accommodate changing public demands and priorities. (3) Ensure that required facility systems can be supported within resource capacities and at reasonable cost to the user. The Project would help to meet the state's need for renewable energy by providing up to 12.5 MW of solar energy and 50 MWh of battery storage. Based on the 25-year fixed-price PPA, the energy produced by the Project would be sold at a price that is less than the current cost of fossil fuel power and would help to hedge long-term price volatility. The Project would also help to improve electric grid stability by enabling Hawaiian Electric to utilize stored solar energy to meet peak demand. The Project area would be made available for compatible agriculture activities, such as honey production and cattle grazing/production, contributing to agricultural production while requiring minimal water resources.
Facility Systems – Solid and Liquid Wastes: Planning for the State's facility systems with regard to solid and liquid wastes shall be directed towards the achievement of the following objectives: (1) Maintenance of basic public health and sanitation standards relating to treatment and disposal of solid and liquid wastes. (2) Provision of adequate sewerage facilities for physical and economic activities that alleviate problems in housing, employment, mobility, and other areas.	The Project would be consistent with the objectives and policies for this theme, particularly the following policies: (2) Promote reuse and recycling to reduce solid and liquid wastes and employ a conservation ethic. Construction and operation of the Project would generate very little waste. At the end of operations, the Project would be decommissioned, including removal of all Project equipment from the Project area. It is anticipated that most materials would be either salvaged or recycled. Only a small portion of the Project equipment would be disposed of as solid waste; these materials would be disposed of at authorized sites in accordance with applicable laws.
Facility Systems – Water: Planning for the State's facility systems with regard to water shall be directed towards achievement of the objective of the provision of water to adequately accommodate domestic, agricultural, commercial, industrial, recreational, and other needs within resource capacities.	The Project would not have any effect on facility systems related to water.
Facility Systems – Transportation: Planning for the State's facility systems with regard to transportation shall be directed towards the achievement of the following objectives: (1) An integrated multi-modal transportation system that services statewide needs and promotes the efficient, economical, safe, and convenient movement of people and goods. (2) A statewide transportation system that is consistent with and will accommodate planned growth objectives throughout the State.	The Project would not have any effect on facility systems related to transportation.
Facility Systems – Energy: Planning for the State's facility systems with regard to energy shall be directed toward the achievement of the following objectives, giving due consideration to all: (1) Dependable, efficient, and economical statewide energy systems capable of supporting the needs of the people;	The Project would be consistent with the objectives and policies for this theme, particularly the following policies: (1) Support research and development as well as promote the use of renewable energy sources The Project would help to meet the state's need for renewable energy by providing up to 12.5 MW of solar energy and 50

Objectives	Assessment of Consistency
(2) Increased energy security and self-sufficiency through the reduction and ultimate elimination of Hawai'i's dependence on imported fuels for electrical generation and ground transportation; (3) Greater diversification of energy generation in the face of threats to Hawai'i's energy supplies and systems; (4) Reduction, avoidance, or sequestration of greenhouse gas emissions from energy supply and (5) Utility models that make the social and financial interests of Hawai'i's utility customers a priority.	MWh of battery storage, which is enough electricity for approximately 4,600 homes on O'ahu (based on average energy use). The Project is expected to offset the use of approximately 545,794 barrels of fuel and 64 tons of coal and would decrease greenhouse gas emissions by approximately 244,394 tons over its lifetime (Hawaiian Electric, 2019b).
Facility Systems – Telecommunications: Planning for the State's telecommunications facility systems shall be directed towards the achievement of dependable, efficient, and economical statewide telecommunications systems capable of supporting the needs of the people.	The Project would not have any effect on facility systems related to telecommunications.
Socio-Cultural Advancement - Housing: Planning for the State's socio-cultural advancement with regard to housing shall be directed toward the achievement of the following objectives: (1) Greater opportunities for Hawai'i's people to secure reasonably priced, safe, sanitary, and livable homes, located in suitable environments that satisfactorily accommodate the needs and desires of families and individuals, through collaboration and cooperation between government and nonprofit and for-profit developers to ensure that more rental and for sale affordable housing is made available to extremely low-, very low-, lower-, moderate-, and above moderate-income segments of Hawai'i's population. (2) The orderly development of residential areas sensitive to community needs and other land uses. (3) The development and provision of affordable rental housing by the State to meet the housing needs of Hawai'i's people.	The Project would not have any effect on housing.
Socio-Cultural Advancement – Health: Planning for the State's socio-cultural advancement with regard to health shall be directed towards achievement of the following objectives: (1) Fulfillment of basic individual health needs of the general public. (2) Maintenance of sanitary and environmentally healthful conditions in Hawai'i's communities. (3) Elimination of health disparities by identifying and addressing social determinants of health.	The Project would not have any effect on health.
Socio-Cultural Advancement – Education: Planning for the State's socio-cultural advancement with regard to education shall be directed towards achievement of the objective of the provision of a variety of educational opportunities to enable individuals to fulfill their needs, responsibilities, and aspirations.	The Project would not have any effect on education.

Objectives	Assessment of Consistency
Socio-Cultural Advancement – Social Services: Planning for the State's socio-cultural advancement with regard to social services shall be directed towards the achievement of the objective of improved public and private social services and activities that enable individuals, families, and groups to become more self-reliant and confident to improve their well-being.	The Project would not have any effect on social services.
Socio-Cultural Advancement – Leisure: Planning for the State's socio-cultural advancement with regard to leisure shall be directed towards the achievement of the objective of the adequate provision of resources to accommodate diverse cultural, artistic, and recreational needs for present and future generations.	The Project would not have any effect on leisure activities.
Socio-Cultural Advancement – Individual Rights and Personal Well-Being: Planning for the State's socio-cultural advancement with regard to individual rights and personal well-being shall be directed towards achievement of the objective of increased opportunities and protection of individual rights to enable individuals to fulfill their socio-economic needs and aspirations.	The Project would not have any effect on individuals' rights and personal well-being.
Socio-Cultural Advancement – Culture: Planning for the State's socio-cultural advancement with regard to culture shall be directed toward the achievement of the objective of enhancement of cultural identities, traditions, values, customs, and arts of Hawai'i's people.	The Project would not have any effect on culture.
Socio-Cultural Advancement – Public Safety: Planning for the State's socio-cultural advancement with regard to public safety shall be directed towards the achievement of the following objectives: (1) Assurance of public safety and adequate protection of life and property for all people. (2) Optimum organizational readiness and capability in all phases of emergency management to maintain the strength, resources, and social and economic well-being of the community in the event of civil disruptions, wars, natural disasters, and other major disturbances. (3) Promotion of a sense of community responsibility for the welfare and safety of Hawai'i's people.	The Project would not have any effect on public safety.
Socio-Cultural Advancement – Government: Planning the State's socio-cultural advancement with regard to government shall be directed towards the achievement of the following objectives: (1) Efficient, effective, and responsive government services at all levels in the State. (2) Fiscal integrity, responsibility, and efficiency in the state government and county governments.	The Project would not have any effect on government.

Table 9. Project Consistency with the Priority Guidelines of the Hawai'i State Planning Act

Priority Guidelines	Assessment of Consistency
Economic Priority Guidelines	
(a) To stimulate economic growth and encourage business expansion and development to provide needed jobs for Hawai'i's people and achieve a stable and diversified economy	The Project would be consistent with these guidelines, particularly the following: (1) Seek a variety of means to increase the availability of investment capital for new and expanding enterprises (A)(i) Encourage investments which reflect long-term commitments to the State (A)(iii) Diversify the economy The Project would be part of the growing renewable energy industry in Hawai'i, helping to both diversify Hawai'i's economy and provide valuable job opportunities to residents. The power generated by the Project would be sold to Hawaiian Electric under a new 25-year PPA.
(b) To promote the economic health and quality of the visitor industry	The Project would not have any effect on the visitor industry.
(c) To promote the continued viability of the sugar and pineapple industries	The Project would not have any effect on the sugar and pineapple industries.
(d) To promote the growth and development of diversified agriculture and aquaculture	The Project would be consistent with these guidelines, particularly the following: (7) Encourage the development and expansion of agricultural and aquacultural activities which offer long-term economic growth potential and employment opportunities. The Project would support and subsidize agricultural activities that are compatible with the solar facilities (such as honey production and cattle grazing).
(e) Water use and development	The Project would not have any effect on water use and development.
(f) Energy use and development	The Project would be consistent with these guidelines, particularly the following: (1) Encourage the development, demonstration, and commercialization of renewable energy sources The Project would help to meet the state's need for renewable energy by providing up to 12.5 MW of solar energy and 50 MWh of battery storage. It would also meet the needs of Hawaiian Electric's system by allowing energy to be stored and dispatched at times of higher demand and offset night-time fossil fuel generation.
(g) To promote the development of the information industry	The Project would not have any effect on the information industry.
Population Growth and Land Resources Priority Guidelines	
(a) To effect desired statewide growth and distribution	The Project would not have any effect on statewide growth and distribution.
(b) Regional growth distribution and land resource utilization	The Project would be consistent with these guidelines, particularly the following: (2) Make available marginal or nonessential agricultural lands for appropriate urban uses while maintaining agricultural lands of importance in the agricultural district. (9) Direct future urban development away from critical environmental areas or impose mitigating measures so that negative impacts on the environment would be minimized. The Project area has been extensively modified by past agricultural activities and is dominated by non-native species. Impacts to natural resources within or near the Project area would be avoided and minimized through the implementation

Priority Guidelines	Assessment of Consistency
	of BMPs. Although the Project area is within the agricultural district, agricultural activities are highly constrained by site-specific factors, particularly the lack of available infrastructure and insufficient water for irrigation. Consistent with the requirements of HRS § 205, the Project would support and subsidize compatible agricultural activities (such as honey production and cattle grazing) and would implement specific decommissioning provisions in which the land would be returned to substantially the same condition as existed prior to Project development, thus allowing for the full range of future agricultural uses.
Crime and Criminal Justice Priority Guidelines	
In the area of crime and criminal justice	The Project would not have any effect on crime and criminal justice.
Affordable Housing Priority Guidelines	
Provision of affordable housing	The Project would not have any effect on affordable housing.
Quality Education Priority Guidelines	
To promote quality education	The Project would not have any effect on quality education.
Sustainability Priority Guidelines	
To promote sustainability	The Project would be consistent with these guidelines, particularly the following: (1) Encouraging balanced economic, social, community, and environmental priorities (2) Encouraging planning that respects and promotes living within the natural resources and limits of the State (3) Promoting a diversified and dynamic economy (4) Encouraging respect for the host culture (5) Promoting decisions based on meeting the needs of the present without compromising the needs of future generations The Project would help to meet Hawai'i's economic, social, community and environmental priorities by providing clean, renewable solar energy with minimal adverse effects on the environment. In addition to helping meet the state's renewable energy goals, the Project would also contribute to economic and social welfare by creating local employment opportunities, providing a source of revenue for the state, helping to hedge against long-term volatility in energy prices, and improving stability of the electric grid.
Climate Change Adaptation Priority Guidelines	
To prepare the State to address the impacts of climate change, including impacts to the areas of agriculture; conservation lands; coastal and nearshore marine areas; natural and cultural resources; education; energy; higher education; health; historic preservation; water resources; the built environment, such as housing, recreation, transportation; and the economy	The Project would be consistent with these guidelines, particularly the following: (10) Encourage planning and management of the natural and built environments that effectively integrate climate change policy The Project would involve generation and storage of clean, renewable solar energy, thus contributing to Hawai'i's renewable energy goals. The solar energy from the Project would replace a portion of electricity that is currently generated by burning fossil fuels, thus reducing greenhouse gas emissions.

8.2.1 Functional Plans

In addition to establishing goals, objectives, and policies for the State of Hawai'i, HRS § 226 also directs state agencies to prepare state functional plans for statewide priority issues. A total of 13 functional plans have been developed related to: agriculture, conservation lands, education, employment, energy, health, higher education, historic preservation, housing, human services, recreation, tourism and transportation. The plans most relevant to the Project are the agriculture and energy state plans; a brief discussion of the Project's consistency with each of these plans follows.

Agriculture Functional Plan. The agriculture functional plan describes the vision of agriculture in Hawai'i as having (a) growth and size of the sugar industry determined by optimal economic efficiency; (b) continued growth in pineapple production with more growth expected in production of fresh pineapple; and (c) greatest growth in diversified crops and products (DOA, 1991). The plan outlines actions directed at the factors and conditions that are key to achieving this vision; these relate to industry research and development, agricultural pests and the environment, land and water, and services and infrastructure. The plan identifies objectives, policies and priority actions relative to each of these issues. The majority of these relate to the broader agricultural industry and thus are not applicable to the Project; however, the Project would be consistent with the following:

- ***Policy H(1):*** *Provide suitable public lands at a reasonable cost and with long-term tenure for commercial agricultural purposes*
- ***Action H(2)(c):*** *Administer land use district boundary amendments, permitted land uses, infrastructure standards, and other planning and regulatory functions on important agricultural lands and lands in agricultural use, so as to ensure the availability of agriculturally suitable lands and promote diversified agriculture.*

The Project is located within the State agricultural land use district; no portion of the Project area has been designated or identified as IAL. As discussed in Section 7, pursuant to HRS § 205-4.5(a)(21), the Project is permitted within the State agricultural land use district with approval of a Special Use Permit by the Land Use Commission, and compliance with the provisions related to decommissioning, proof of financial security, and making the Project area available for compatible agricultural activities at a lease rate below fair market rent. As noted earlier and described in more detail in Section 3.2.2, the Project area would be made available for compatible agricultural activities, such as honey production and cattle grazing and production. The Project also incorporates specific decommissioning requirements in which the land would be returned to substantially the same condition as existed prior to Project development, thus allowing for the full range of future agricultural uses. As the solar facilities are a permitted land use in the agricultural district and the compatible agricultural activities would be supported and subsidized over the 25-year Project term, the Project is consistent with the agriculture functional plan.

Energy Functional Plan. The energy functional plan describes an overall objective of achieving dependable, efficient and economical statewide energy systems capable of supporting the needs of the people and increasing energy self-sufficiency. The plan specifically identifies the need to reduce

dependence on imported fossil fuels such as oil and the state's vulnerability to supply disruptions (DBEDT, 1991). The plan establishes policies and actions to promote energy conservation and efficiency, displace fossil fuel consumption, support public education and legislation on energy, improve the development and management of energy, and assist with energy emergency preparedness. The following polices and actions are applicable to the Project:

- ***Policy B(1):*** *Displace oil and fossil fuel consumption through the application of appropriate alternate and renewable energy resources and technologies.*
- ***Action B(1)(l):*** *Expand upon the existing 20 kW photovoltaic utility-scale application*[23]

The Project would provide up to 12.5 MW of solar energy and 50 MWh of battery storage, which is enough electricity for approximately 4,600 homes on O'ahu (based on average energy use), thus offsetting the use of approximately 545,794 barrels of fuel and 64 tons of coal (Hawaiian Electric, 2019b). It is directly responsive to the need for development of renewable energy sources and displacement of fossil fuel consumption; as such, the Project is consistent with the Energy State Functional Plan.

8.3 O'ahu General Plan

The City and County of Honolulu's General Plan is a policy guidance document that presents the long-range objectives for the island of O'ahu. It is the foundation of a comprehensive planning process that addresses the physical, cultural, social, economic and environmental concerns, and is intended to provide direction for future growth on O'ahu. It presents objectives regarding the desired conditions over a 20-year planning horizon, as well as broad policies to meet those objectives and guide all levels of government, private enterprise, neighborhood and citizen groups, organizations, and individual citizens.

The General Plan was adopted in 1977 and has been subsequently updated through a series of amendments. The most recent updates were completed in December 2017 and the Proposed Revised Plan is currently in the process of being adopted. The proposed revised plan was first introduced by the City Council on April 27, 2018 as Resolution 18-093, and was re-introduced by the City Council on February 13, 2020 as Resolution 20-44; the current General Plan (1992, amended in 2002) will remain in effect until the proposed revised plan is adopted by the City Council. The Proposed Revised General Plan carries forward the basic themes and directions for growth as contained in the 1992 General Plan, and continues to focus on critical issues such as regional population, economic health, and affordable housing, while also introducing additional topics such as climate change, sea level rise and sustainability. A total of 11 areas of concern are addressed in the proposed revised plan: population, economy, natural environment and resource stewardship, housing and communities, transportation and utilities, energy, physical development and urban design; public safety and community resilience, health and education, cultural and recreation, and government operations and fiscal management (DPP, 2017b).

23 The application referred to in this action is a 20kW PVUSA system on Maui that was designed to demonstrate photovoltaics in a utility setting.

Overall, the proposed Project is consistent with the various objectives and policies contained in the proposed revised General Plan. The proposed Project would not impact objectives and policies related to population, housing and communities, transportation and utilities, public safety and community resilience, health and education, and government operations and fiscal management. As a result, these objectives and policies are not discussed further. The proposed Project is consistent with the applicable objectives and policies of the City and County of Honolulu's General Plan described below.

Economy

Objective A ***To promote economic opportunities that enable all the people of O'ahu to attain meaningful employment and a decent standard or living.***

Policy 1 *Support a strong, diverse and dynamic economic base resilient to changes in global conditions.*

Policy 3 *Pursue opportunities to grow and strategically develop non-polluting industries such as trade, communications, media, medical, life sciences, and technology in appropriate locations that contribute to O'ahu's long-term environmental, economic, and social sustainability.*

Objective C ***To ensure the long-term viability and continued productivity of agriculture on O'ahu.***

Policy 2 *Support agricultural diversification to help strengthen the agricultural industry and to make more locally grown food available for local consumption.*

Policy 6 *Promote small-scale farming activities and other operations, such as truck farming, flower growing, aquaculture, livestock production, taro growing, and subsistence farms.*

Policy 7 *Encourage landowners to actively use agricultural lands for agricultural purposes.*

Policy 12 *Provide plans, incentives, and strategies to ensure the affordability of agricultural land for farmers.*

Discussion: The Project would be part of the growing renewable energy industry in Hawai'i, helping to both diversify Hawai'i's economy and provide valuable job opportunities to residents, particularly short-term jobs during construction. It would generate clean, renewable solar energy and would help to meet the state's need for renewable energy by providing up to 12.5 MW of solar energy and 50 MWh of battery storage, which is enough electricity for approximately 4,600 homes on O'ahu (based on average energy use). The Project is expected to offset the use of approximately 545,794 barrels of fuel and 64 tons of coal and would decrease greenhouse gas emissions by approximately 244,394 tons over its lifetime (Hawaiian Electric, 2019b). Furthermore, the Project would seek to balance agricultural and renewable energy needs. Specifically, it would support and subsidize compatible agricultural activities (such as honey production and cattle grazing) and would implement specific decommissioning provisions in which the land would be returned to substantially the same condition as existed prior to development of the solar facilities, thus allowing for the full range of future agricultural uses.

Natural Environmental and Resource Stewardship

Objective A ***To protect and preserve the natural environment.***

Policy 1 *Protect O'ahu's natural environment, especially the shoreline, valleys, ridges, and watersheds, from incompatible development.*

Policy 4 *Require development projects to give due consideration to natural features and hazards such as slope, inland and coastal erosion and flood hazards, water-recharge areas, and existing vegetation, as well as to plan for coastal hazards that threaten life and property.*

Policy 6 *Design and maintain surface drainage and flood-control systems in a manner which will help preserve natural and cultural resources.*

Policy 7 *Protect the natural environment form damaging levels of air, water, and noise pollution.*

Policy 8 *Protect plants, birds, and other animals that are unique to the State of Hawai'i and O'ahu, and protect their habitats.*

Policy 12 *Plan and prepare for the impacts of climate change on the natural environment, including strategies of adaptation.*

Objective B ***To preserve and enhance natural landmarks and scenic views of O'ahu for the benefit of both residents and visitors as well as future generations.***

Policy 1 *Protect the Island's significant natural resources: its mountains and craters; forests and watershed areas; marshes, rivers, and streams; shorelines, fishponds, and bays; and reefs and offshore islands.*

Policy 2 *Protect O'ahu's scenic views, especially those seen from highly developed and heavily traveled areas.*

Policy 3 *Locate and design public facilities, infrastructure, and utilities to minimize the obstruction of scenic views.*

Discussion: The Project area has been extensively modified by previous agricultural operations and is dominated by non-native species. The Project has been designed to minimize ground disturbance and maintain ample, natural open space surrounding the facilities. Impacts to natural resources would be avoided and minimized to the extent possible through implementation of BMPs. LID design measures would be incorporated to maintain permeability throughout the Project area while also minimizing the potential for erosion; the Project would also incorporate stormwater retention BMPs during and post-construction to retain and treat stormwater within the Project area.

Although the Project components would be visible from surrounding areas, the Project would not obstruct views of the mountains, ocean or other scenic resources. Landscaping would be installed to provide visual buffering of Project equipment from adjacent areas to the extent practicable. It is anticipated that the landscaping would incorporate suitable plant material in key locations and would include native species that are ecologically and culturally appropriate for this location.

Energy

Objective A ***To increase energy self-sufficiency and maintain an efficient, reliable, resilient, and cost-efficient energy system.***

Policy 1 *Encourage the implementation of a comprehensive plan to guide and coordinate energy conservation and renewable energy development and utilization programs.*

Policy 2 *Support and encourage programs and projects, including economic incentives, regulatory measures, and educational efforts, which will reduce O'ahu's dependence on fossil fuels as its primary source of energy.*

Policy 7 *Manage our resources and the development of our communities in line with the long-term goals of net zero to net positive performance in areas of energy, carbon emissions, waste streams, all utilities, and food security.*

Policy 9 *Consider health, safety, environmental, cultural, and aesthetic impacts, as well as resource limitations, land use patterns, and relative costs in all major decisions on renewable energy.*

Objective B ***To conserve energy through the more efficient management of its use and through more energy-efficient technologies.***

Policy 5 *Encourage the implementation of an adaptable and reliable electrical grid, energy transmission, energy storage, and energy generation technologies.*

Objective C ***To foster an ethic of energy conservation that inspires residents to engage in sustainable practices.***

Policy 4 *Provide communities with timely, relevant, and accurate information concerning renewable energy facilities proposed in their area.*

Discussion: The Project would help to meet the state's goal of 100 percent renewable energy sources by 2045 by providing up to 12.5 MW of solar energy and 50 MWh of battery storage, which is enough electricity for approximately 4,600 homes on O'ahu (based on average energy use). The Project is expected to offset the use of approximately 545,794 barrels of fuel and 64 tons of coal and would decrease greenhouse gas emissions by approximately 244,394 tons over its lifetime (Hawaiian Electric, 2019b). Through Project-specific outreach efforts, as well as the HRS § 343 environmental review process, the public has been informed of the proposed renewable energy facility and provided opportunities for input at various stages, including the pre-assessment consultation process and the Draft EA 30-day public comment period. Additional opportunities for input will occur through the discretionary permitting process.

Physical Development and Urban Design

Objective A ***To coordinate changes in the physical environment of O'ahu to ensure that all new developments are timely, well-designed, and appropriate for the areas in which they will be located.***

Policy 10 *Discourage uses which are major sources of noise, air, and light pollution.*

Policy 11 *Encourage siting and design solutions that seek to reduce exposure to natural hazards, including those related to climate change and sea level rise.*

Policy 13 *Promote opportunities for the community to participate meaningfully in planning and development processes, including new forms of communication and social media.*

Discussion: The Project would be designed to minimize impacts related to noise, air, and light pollution during construction and operation, and is not anticipated to be a major source of these pollutants. The Project would not be located in a sea-level rise exposure area, flood hazard zone, or tsunami evacuation zone, and would not be expected to increase exposure to natural hazards. Once constructed, the Project would generate clean renewable energy which would replace the burning of fossil fuel for production of electricity, thus offsetting greenhouse gas emissions and providing a beneficial impact relative to climate change. As noted above, the HRS § 343 environmental review and discretionary permit processes include opportunities for meaningful community input.

Culture and Recreation

Objective B ***To protect, preserve, and enhance O'ahu's cultural, historic, architectural, and archaeological resources.***

Policy 2 *Identify and, to the extent possible, preserve and restore buildings, sites, and areas of social, cultural, historic, architectural, and archaeological significance.*

Discussion: An AIS was conducted for the Project, including detailed background research and a 100 percent pedestrian inspection of the Project area (see Attachment F). The AIS identified two historic properties within the Project area, consisting of irrigation and plantation infrastructure and a remnant portion of the Waiahole Ditch. The Draft AIS Report was submitted to SHPD in compliance with HRS § 6E and HAR § 13-284 on February 5, 2020; SHPD's review and acceptance of the AIS Report is pending. Implementation of the Project would affect portions of these historic properties within the Project area; the portions that are not affected by the proposed improvements would be kept intact. Based on the conclusions regarding significance and documentation to date, pursuant to HAR § 13-284-7 and subject to review and concurrence by SHPD, the effect determination for the Project is "no historic properties affected" with a recommendation for no further historic preservation work. AES intends to obtain SHPD's acceptance of the AIS and concurrence with the effect determination prior to the Planning Commission hearing for the Special Use Permit application.

8.4 'Ewa Development Plan

The City and County of Honolulu's General Plan requires that community development plans be adopted by the City Council for each judicial district. These development plans are intended to provide detail for the elements presented in the General Plan and emphasize those elements most relevant to the issues and conditions of the specific area plan in order to guide public policy, infrastructure investment and land use decision making over the next 25 years. The 'Ewa Development Plan was originally adopted by

the City Council in 1997 and was most recently revised in 2013 (Ordinance 13-26). The revised plan maintains the vision for protecting agricultural land, open space and natural, historic, and cultural resources; developing a secondary urban center around the City of Kapolei; building master planned residential communities that support walking, biking, and transit use; and providing adequate infrastructure to serve both existing and planned development (DPP, 2013).

The key elements of the vision for development of ‘Ewa include (1) community growth boundary; (2) retention of agricultural lands; (3) open space and greenways; (4) Kalaeloa Regional Park; (5) secondary urban center; (6) master planned residential communities; (7) communities designed to support non-automotive travel; (8) conservation of natural resources; (9) preservation and enhancement of historic and cultural resources; and (10) phased development. The community growth boundary is intended to give long-range protection from urbanization for prime agricultural land and for preservation of open space while providing adequate land for urban development. The proposed Project is located outside the community growth boundary and as a non-urban land use, it would be consistent with this demarcation. Specific policies and guidelines that are applicable to the Project include the following:

3.1 Open Space Preservation and Development

3.1.1 General Policies

- *Use open space to:*
  - *Provide long-range protection for diversified agriculture on lands outside the Community Growth Boundary*
  - *Protect scenic views and natural, cultural, and historic resources*
  - *Preserve natural gulches and ravines as drainageways and stormwater retention areas*

3.1.3 Guidelines

3.1.3.2 Natural Gulches and Drainageways

- *Where practical, retain drainageways as natural or man-made vegetated channels rather than concrete channels.*

Discussion: As defined in the Open Space Map for the ‘Ewa Development Plan, the Project would be located in an area that is generally identified as a combination of Preservation and Agricultural Areas, interspersed with natural drainageways/gulches. The plan defines Agricultural Areas as “land with agricultural value by virtue of current agricultural use or high value for future agricultural use.” Preservation Areas are defined as “lands with natural, cultural or scenic resource value.” Examples of Preservation Areas include lands necessary for protecting watersheds, water resources and water supplies; lands necessary for the conservation, preservation and enhancement of sites with scenic, historic, archaeological or ecological significance; and lands with topography, soils, climate or other related environmental factors that may not be normally adaptable or presently needed for urban, rural or agricultural use.

Although historically used for cultivation of sugar cane, the Project area has been fallow for an extended period of time with intermittent cattle grazing. Its current use for agricultural purposes is constrained by the site conditions, lack of infrastructure, and insufficient water for irrigation. In addition to providing clean, renewable energy, the Project area would also be made available for compatible agricultural uses at a lease price well below market value and would provide support facilities for compatible activities, such as beekeeping and cattle grazing, thus contributing to diversified agriculture in the ʻEwa District. As part of the decommissioning plan, the site would be restored to existing conditions at the end of the Project, such that the full range of potential agricultural uses would be preserved for future generations.

The Project would be visible to varying degrees from surrounding areas; however, it would not obstruct or impede views of the Waiʻanae Mountains, Pacific Ocean or other scenic resources. The Project facilities would introduce new visual elements within the landscape, but these would be seen in the context of other development including high-voltage transmission lines, commercial and residential structures, the rail transit system, Makakilo Quarry and other man-made features. Significant views and vistas that are identified in the ʻEwa Development Plan (Table 3.2 of the ʻEwa Development Plan) include views of the Waiʻanae Range from H-1 Freeway between Kunia Road and Kaloʻi Gulch and from Kunia Road, as well as general mauka and makai views. As discussed in Section 6.6, the Project area is located on the lower slopes of the Waiʻanae Range and views of the Project area from the H-1 Freeway and Kunia Road would be at least partially blocked by existing topography, vegetation and intervening structures located along the roadway corridors; views of the broader Waiʻanae Range would not be affected, such that the identified viewplanes would not be substantially degraded.

The Project area includes tributaries to Kaloʻi Gulch, which run along the southern boundary and through the central portion of the Project area. These features are typically dry and only carry water during and immediately following rain events. The Project has been designed to avoid these features to the maximum extent practicable. The only direct impacts would be associated with construction of a road crossing to allow for access between the various solar arrays. The crossing would be designed to have as small of a footprint as possible and to maintain unobstructed flows following rain events. As such, the Project would not significantly affect the form or function of the tributaries to Kaloʻi Gulch.

As the Project would balance renewable energy and agricultural needs, while also maintaining elements of open space and natural drainageways within the Project area, it is expected to be consistent with the relevant designations in the ʻEwa Development Plan.

3.4 Historic and Cultural Resources

3.4.1 General Policies

- *Preserve significant historic features from the plantation era and earlier periods.*
- *Vary the treatment of sites according to their characteristics and potential value.*
- *Retain significant vistas whenever possible.*

3.4.2 Guidelines

3.4.2.5 Native Hawaiian Cultural and Archaeological Sites

- *Require preservation in situ for those features that the State Historic Preservation Officer has recommended for such treatment.*

Discussion: An AIS was conducted for the Project, including detailed background research and a 100 percent pedestrian inspection of the Project area. The AIS identified two historic properties within the Project area, consisting of irrigation and plantation infrastructure and a remnant portion of the Waiahole Ditch. The Draft AIS Report was submitted and is pending review by SHPD in compliance with HRS § 6E and HAR § 13-284. Implementation of the Project would affect portions of these historic properties within the Project area; the portions that are not affected by the proposed improvements would be kept intact. Based on the conclusions regarding significance and documentation to date, pursuant to HAR § 13-284-7 and subject to review and concurrence by SHPD, the effect determination for the Project is "no historic properties affected" with a recommendation for no further historic preservation work. AES intends to obtain SHPD's acceptance of the AIS and concurrence with the effect determination prior to the Planning Commission hearing for the Special Use Permit application.

As discussed above, the Project would be visible to varying degrees from surrounding areas and would introduce new visual elements within the landscape, but would be seen in the context of other development including commercial and residential structures, the rail transit system, high-voltage transmission lines, Makakilo Quarry and other man-made features. The Project would not obstruct or impede views of the Waiʻanae Mountains, Pacific Ocean or other scenic resources. Similarly, the Project would not block views of surrounding features including those of the former mill building, which is an abandoned structure associated with the irrigation and plantation infrastructure within and near the Project area. Although the Project components would be visible beyond the mill building, they would be seen in the context of the surrounding development and would not substantially degrade the existing viewshed.

3.5 Natural Resources

3.5.1 General Policies

- *Require surveys for proposed new development areas to identify endangered species habitat, and require appropriate mitigations for adverse impacts on endangered species due to new development.*
- *Reduce light pollution's adverse impact on wildlife and human health and its unnecessary consumption of energy by using, where sensible, fully shielded lighting fixtures using lower wattage.*

Discussion: A biological resources survey was conducted to characterize the existing habitat and assess the potential for state or federally listed threatened, endangered, or otherwise rare plants or animals to occur within the Project area. In general, the biological resources in the Project area have been extensively modified by previous agricultural use and the introduction of invasive species, which has resulted in a reduction of the number and abundance of native species and habitats suitable for native species. No federally or state listed plants were documented within the Project area. Although no federally and state listed wildlife species have been observed or documented within the Project area,

several could occur within or traverse over the Project area. As discussed in Section 6.2.2, species-specific measures, as recommended by USFWS and DOFAW, would be implemented to avoid and minimize potential impacts. These measures would include requiring lighting to be shielded or directed downward and fitted with light bulbs having a correlated color temperature of four thousand Kelvin or less to minimize the attractiveness to seabirds.

9 Compliance with the Land Use Ordinance

The City and County of Honolulu's Land Use Ordinance (LUO) (Revised Ordinances of Honolulu Chapter 21) regulates land use by identifying the uses that are considered appropriate in each zoning district and the minimum standards and conditions that must be met if those uses are to be permitted. The purpose of the LUO is to regulate land use in a manner that will encourage orderly development in accordance with adopted land use policies, including the O'ahu General Plan and community development plans.

The Project area is located within the AG-1 (Restricted Agriculture) zoning district. The purpose of the AG-1 Restricted Agricultural zoning district is to conserve and protect important agricultural lands for agricultural functions. Agricultural districts are specifically addressed in Section 21-3.50-4 of the LUO, which refers to Table 21-3 (Master Use Table) for permitted uses and structures. Based on DPP's *Solar Farm Guidelines*, the Project is considered a "Type B utility installation," as it requires a Special Use Permit (DPP, 2019). According to the Master Use Table, Type B utility installations are permitted with issuance of a conditional use permit (CUP) minor permit in the AG-1 zoning district. A CUP minor would be requested from DPP for the Project following approval of the State Special Use Permit.

9.1.1 District Development Standards (LUO Article 3)

Article 3 of the LUO identifies the district development standards for the various zoning districts. Section 21-3.50-4 addresses the development standards for the agricultural district (with specific standards listed in Table 21-3.1 of the LUO). As listed in Table 10, the Project is expected to comply with the development standards for the AG-1 zoning district; compliance with the maximum height requirements is discussed below as part of the general development standards.

Table 10. Development Standards for the Restricted Agricultural (AG-1) District

LUO Standard		LUO Provision (AG-1 District)	Assessment of Project
Minimum lot area		5 acres	Approximately 861 acres
Minimum lot width/depth		150 feet	>150 feet
Yards:	Front	15 feet	>15 feet
	Side and rear	10 feet	>10 feet
			The nearest Project structure is approximately 400 feet from the lot boundary
Maximum building area (percent of zoning lot)[1]		For non-agricultural structures, 10 percent of zoning lot	Approximately 4.5 percent
Maximum height		15 - 25 feet[2]	See Section 9.1.2

[1] The LUO defines "building area" as the total area of a zoning lot covered by structures and covered open areas. It is assumed that the total area of Project structures is equivalent to the total area, as calculated in Table 2.

[2] Per Section 21-3.50-4(c), the maximum height may be increased from 15 to 25 feet if height setbacks are provided. Any portion of a structure exceeding 15 feet shall be set back from every side and read buildable area boundary line one feet for each two feet of additional height above 15 feet.

9.1.2 General Development Standards (LUO Article 4)

Article 4 of the LUO identifies the general development standards that must be met for any use or site, irrespective of the zoning district in which it is located. The general development standards that could apply to the Project include those related to height (Section 21-4.60), landscaping, screening and buffering (Sections 21-4.70 and 4.70-1), and outdoor lighting (Section 21-4.100); these are discussed below. There are no non-conforming lots or structures.

- **Heights:** Section 21-4.60 specifies that all structures shall fall within a building height envelope at a height specified by the LUO or as specified on the zoning maps. As discussed above, Section 21-3.50-4 specifies that the maximum height in the AG-1 zoning district is 25 feet, provided that the portion of the structure that exceeds 15 feet has a setback of one foot for every two feet of additional height (see Table 10). The solar photovoltaic and battery energy storage equipment would not exceed the standards related to maximum height and height setbacks.

  Pursuant to Section 21-4.60(c)(4), utility poles and antennas are exempted from zoning district height limits; it is specified that utility poles shall not exceed 500 feet from existing grade, and antennas associated with utility installations shall not exceed 10 feet above the governing height limit. It is anticipated that the electrical equipment for the substation and interconnection facilities would qualify as utility poles, and pursuant to Section 21-4.60(c)(4)(A) are subject to a height limit of 500 feet from existing grade. This equipment would range in height up to 40-60 feet, and therefore is expected to be in compliance with the height standards.

- **Landscaping, Screening and Buffering:** The development standards for a Type B utility installation require the development of a landscape plan, which emphasizes visual buffering from adjacent streets and highways, as further discussed in Section 9.1.3. As described in Section 3.3.4, the Project would incorporate landscaping in key locations, as shown in Attachment K. The general development standards identify additional landscaping, screening and buffering requirements. Specifically, Section 21-4.70 requires landscaping and screening of parking lots, automobile service stations, service and loading spaces, trash enclosures, utility substations and rooftop machinery in certain zoning districts; pursuant to Section 21-4.70(f), landscaping around utility substations is required in the country, residential, apartment, apartment mixed use and resort districts. Section 21-4.70-1 identifies other requirements for screening and buffering in specific zoning districts . As these additional landscaping, screening or buffering requirements do not apply to the AG-1 district, they are not expected to apply to the Project.

- **Outdoor Lighting:** Section 21-4.100 requires that for any commercial, industrial, or outdoor recreational development, lighting is shielded with full cut-off fixtures to eliminate direct illumination to any adjacent country, residential, apartment, apartment mixed use, or resort zoning district. If it is determined that lighting is needed at the substation, all fixtures would be fully shielded and directed downward, and fitted with light bulbs having a correlated color temperature of four thousand Kelvin or less.

9.1.3 Specific Development Requirements (LUO Article 5)

Article 5 of the LUO identifies the specific use development standards for particular conditions use categories. Relative to the proposed Project, it is expected that the development standards for Type B utility installations as provided in Section 21-5.650 will apply to the solar facilities. These standards are listed in Table 11.

Table 11. Development Standards for Type B Utility Installations

LUO Standard	LUO Provision	Project Consistency
Landscape Plan (Section 21-5.650(a)(1))	All requests for Type B utility installations shall be accompanied by a landscape plan which shall be approved by the director. Special emphasis shall be placed on visual buffering for the installation from adjacent streets and highways.	Landscaping would be installed to provide visual buffering of Project equipment from adjacent areas to the extent practicable. As described in Section 3.3.4, the landscape plan includes clustering of primarily native plant material along the eastern boundary of the Project area facing the H-1 Freeway and Farrington Highway. The landscaping plan is included in Attachment H, with additional supporting information provided in Attachment K.
Utility Installations for Telecommunications (Section 21-5.650(a)(2))	Type B utility installations for telecommunications shall provide fencing or other barriers to restrict public access within the area exposed to a power density of 0.1 milliwatt/cm2 for all associated antennas involving radio frequency (RF)or microwave transmissions.	The Project is not a telecommunication project; however, a chain-link fence would be installed around the perimeter of the Project as well as additional fencing around the substation to maintain site security.
Antenna Heights (Section 21-5.650(a)(3))	In residential districts where utility lines are predominantly located underground, antennas shall not exceed the governing height limit.	The Project area is not within a residential district.

9.1.4 Off-Street Parking and Loading (LUO Article 6)

Article 6 of the LUO identifies the off-street parking and loading requirements, which are intended to minimize street congestion and traffic hazards, and to provide safe and convenient access to residences, businesses, public services and places of public assembly. Table 21-6.1 specifies that the off-street parking requirements for utility installations (Type A or B) shall be determined by the director.

Normal operation of the Project would not require onsite staff; as such, the facility would not be manned. Period maintenance and inspection of the facilities would occur and would require employees to drive to various locations throughout the Project area. As such, no centralized parking facilities are planned.

10 Compliance with HRS § 205, Part III

HRS § 205 (Part III) establishes the basis for designation of IAL to conserve and protect agricultural lands, promote diversified agriculture, increase agricultural self-sufficiency, and assure the availability of agriculturally suitable lands. HRS § 205-42 defines IALs as lands that "(1) are capable of producing sustained high agricultural yields when treated and managed according to accepted farming methods and technology; (2) contribute to the State's economic base and produce agricultural commodities for export or local consumption; or (3) are needed to promote the expansion of agricultural activities and income for the future, even if currently not in production."

HRS § 205 identifies specific standards and criteria for the identification of IALs and establishes three processes by which IALs may be designated: (1) identification and designation of public lands per HRS § 205-44.5; (2) voluntary petition by a landowner per HRS § 205-45; and (3) mandatory identification of potential IALs by each county per HRS § 205-47.

No portion of the Project area has been designated or identified as IAL. As public lands are defined to exclude lands to which the University of Hawaii holds title (in accordance with HRS § 171-2), the UH West O'ahu Mauka Lands property is not subject to the IAL designation process established under HRS § 205-44.5, nor has the University of Hawai'i voluntarily petitioned for these lands to be designated as IAL pursuant to HRS § 205-45. With respect to the county-led process required under HRS § 205-47, the Project area was not included in the City and County of Honolulu's recommendation of lands for IAL designation per Resolution No. 18-233, CD1, FD1 (Honolulu City Council, 2019), as this process specifically excluded state-owned land. As such, the Project would comply with HRS § 205 (Part III).

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Attachment A
Project Figures

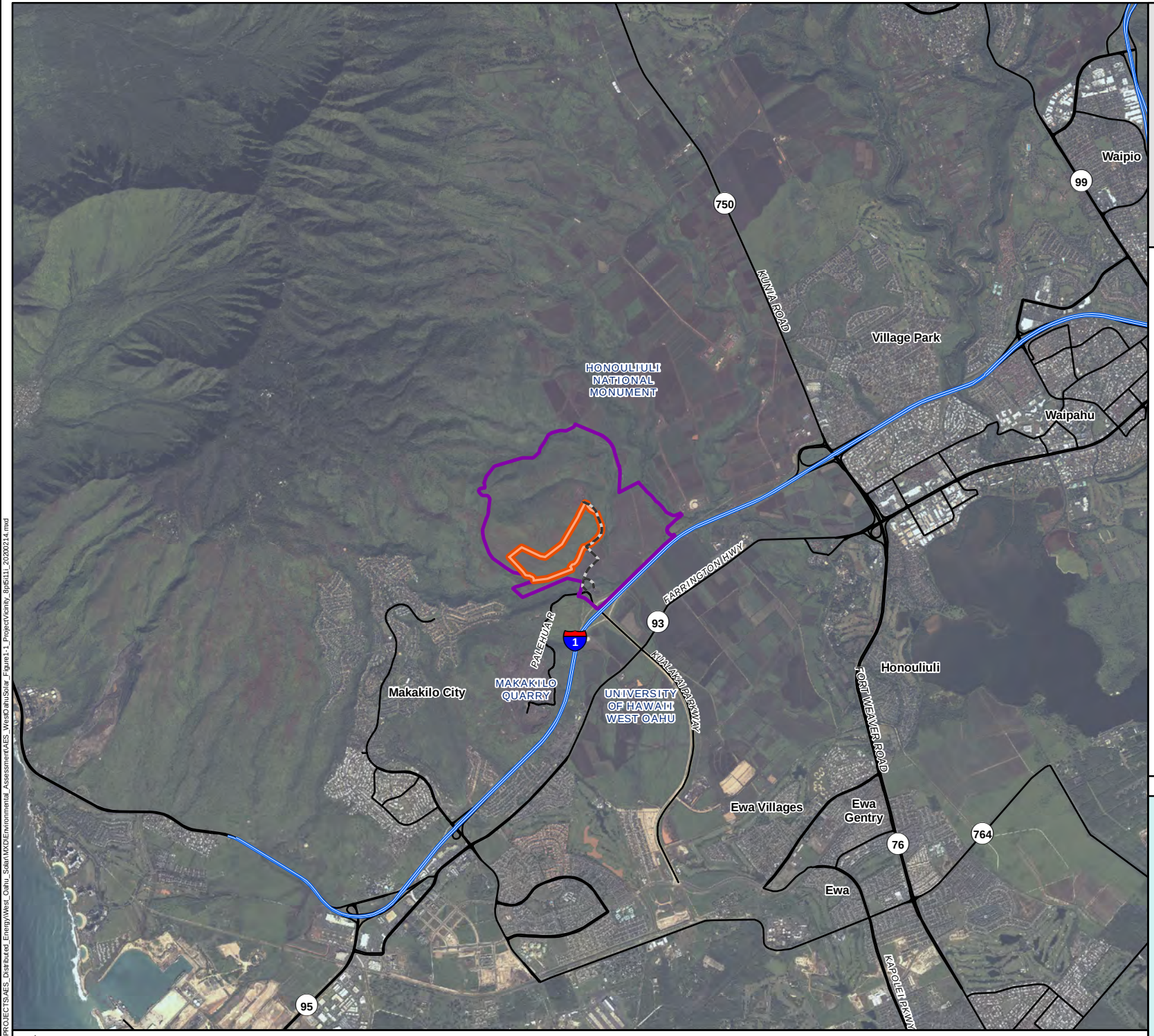


Figure 1

West Oahu Solar Plus Storage Project

AES Distributed Energy

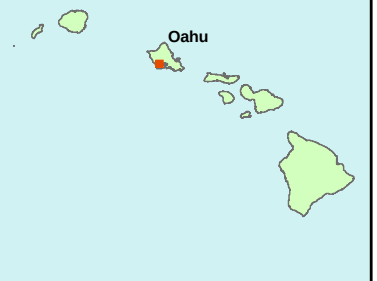
Project Vicinity

HONOLULU COUNTY, HI

- Project Area
- Property Boundary
- Existing Access Road
- Interstate Highway
- Roadway

TETRA TECH

Reference Map



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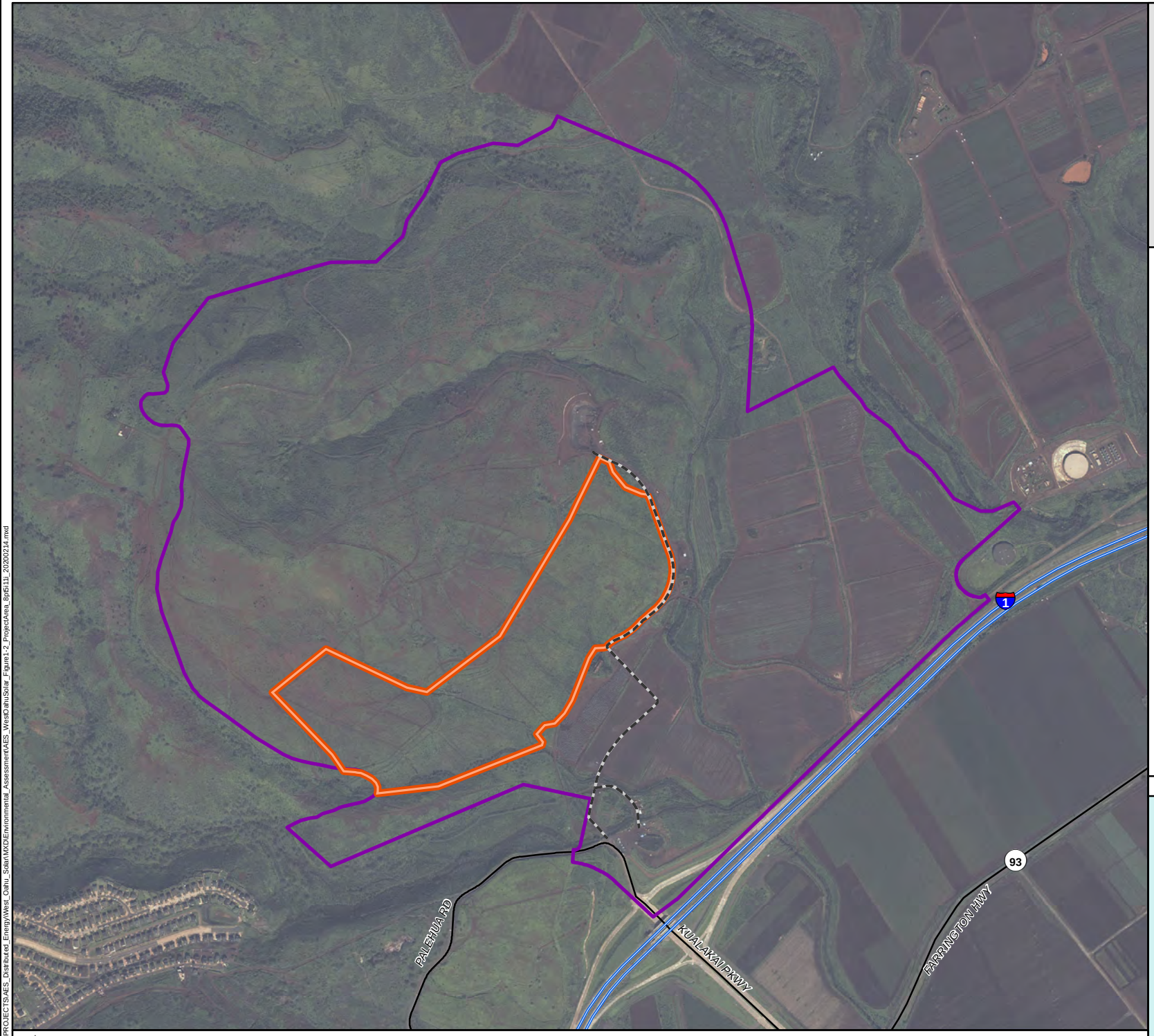


Figure 2

West Oahu Solar Plus Storage Project

AES Distributed Energy

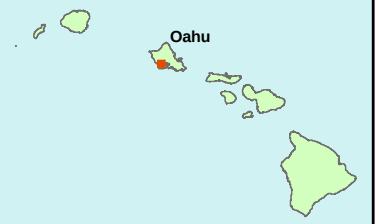
Project Area

HONOLULU COUNTY, HI

- Project Area
- Property Boundary
- Existing Access Road
- Interstate Highway
- Roadway

TETRA TECH

Reference Map



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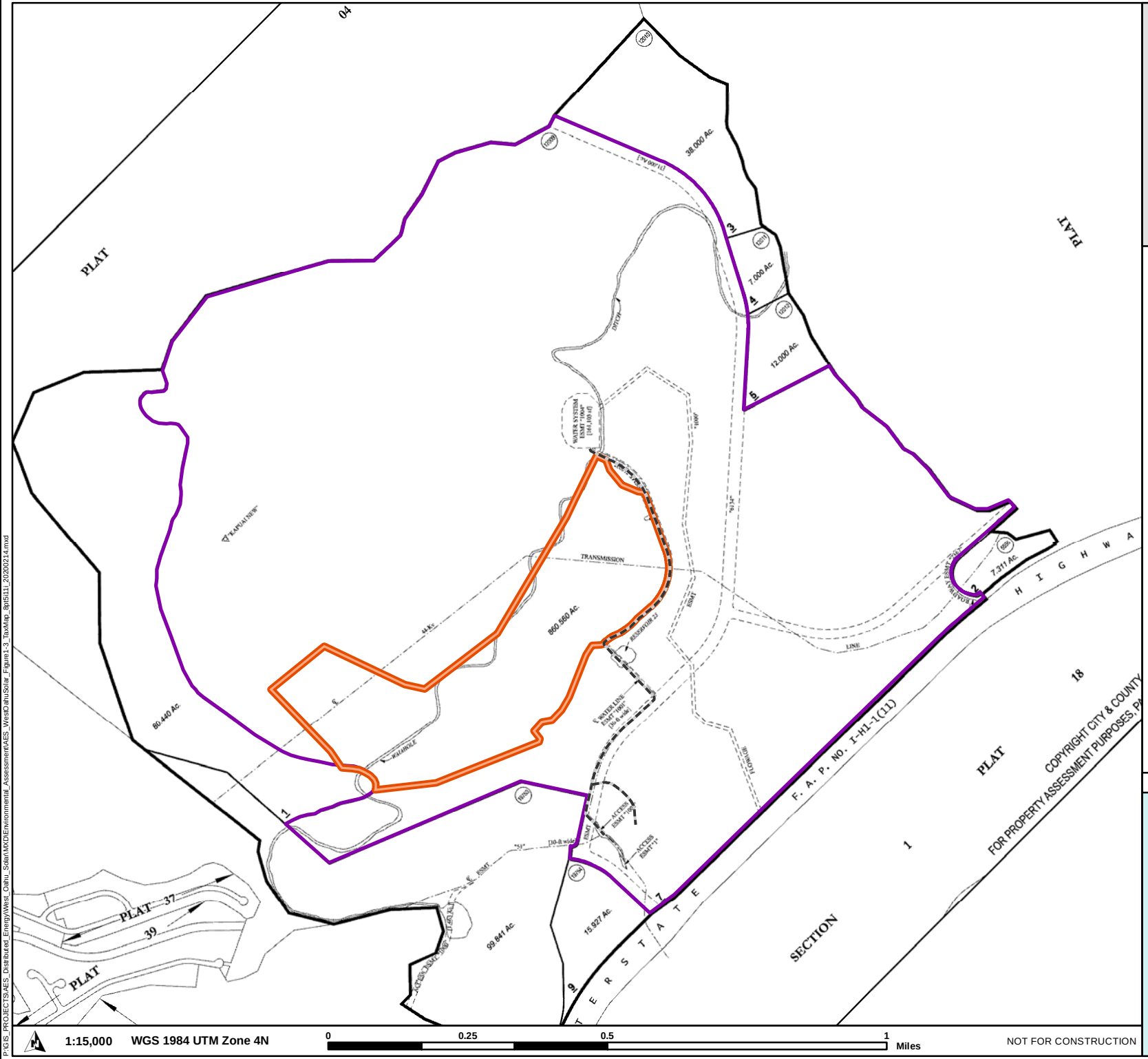


Figure 3

West Oahu Solar Plus Storage Project

AES Distributed Energy

Tax Map

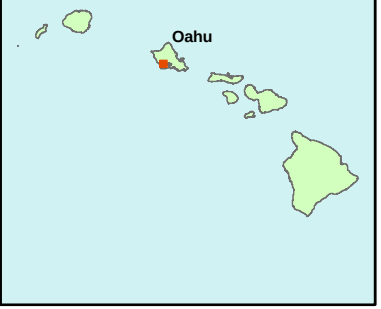
HONOLULU COUNTY, HI

Project Area
Property Boundary
Existing Access Road

Source:
City and County of Honolulu
All Rights Reserved 2016
Zone 9, Section 2, Plat 002

TETRA TECH

Reference Map



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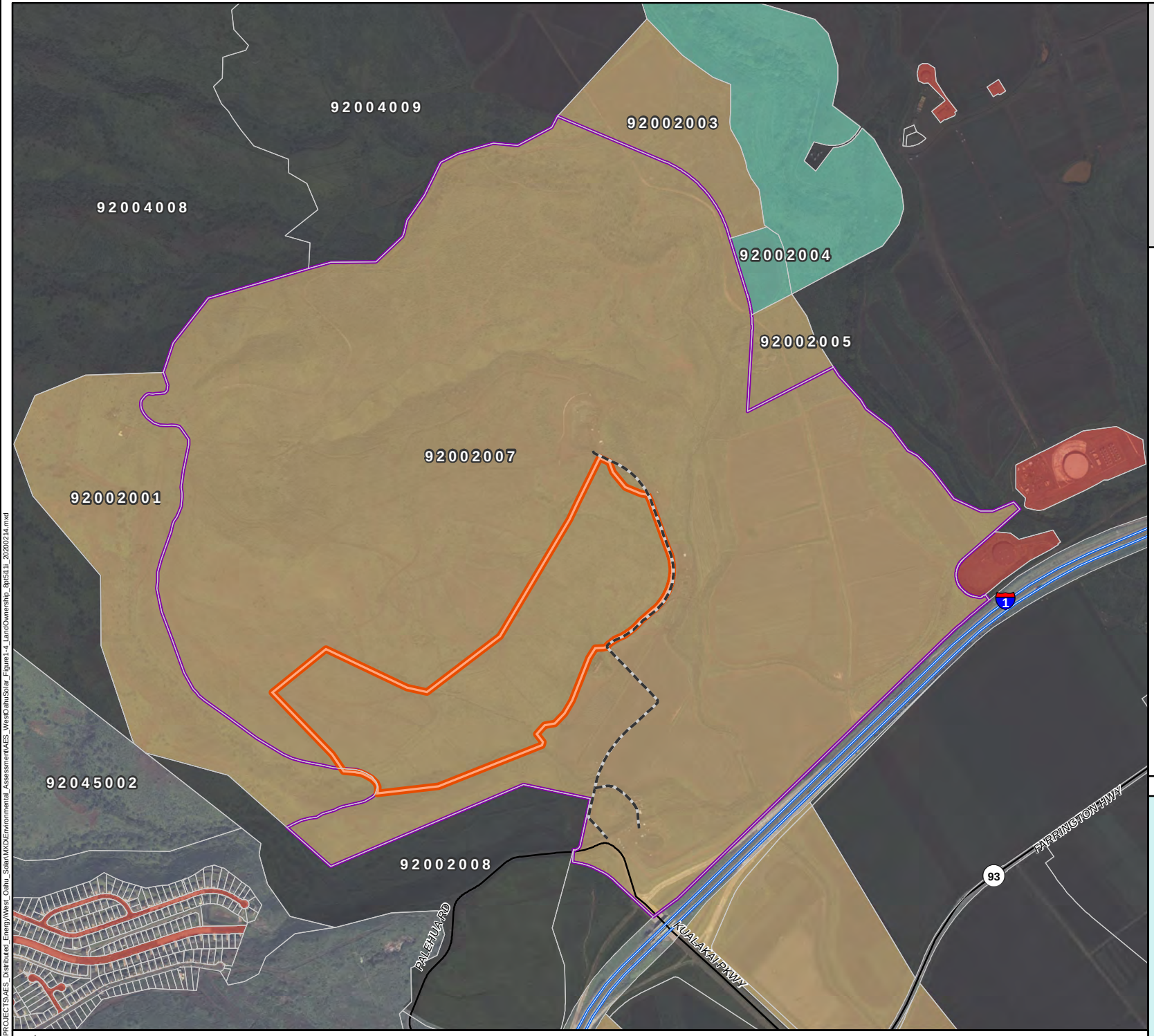

Figure 4

West Oahu Solar Plus Storage Project

AES Distributed Energy

Land Ownership

HONOLULU COUNTY, HI

- Project Area
- Property Boundary
- Existing Access Road
- TMK Boundary
- Interstate Highway
- Roadway

Land Ownership

- County
- Federal
- State
- Private (Large Land Owner)
- Private (Other)

TETRA TECH

Reference Map

1:15,000 WGS 1984 UTM Zone 4N

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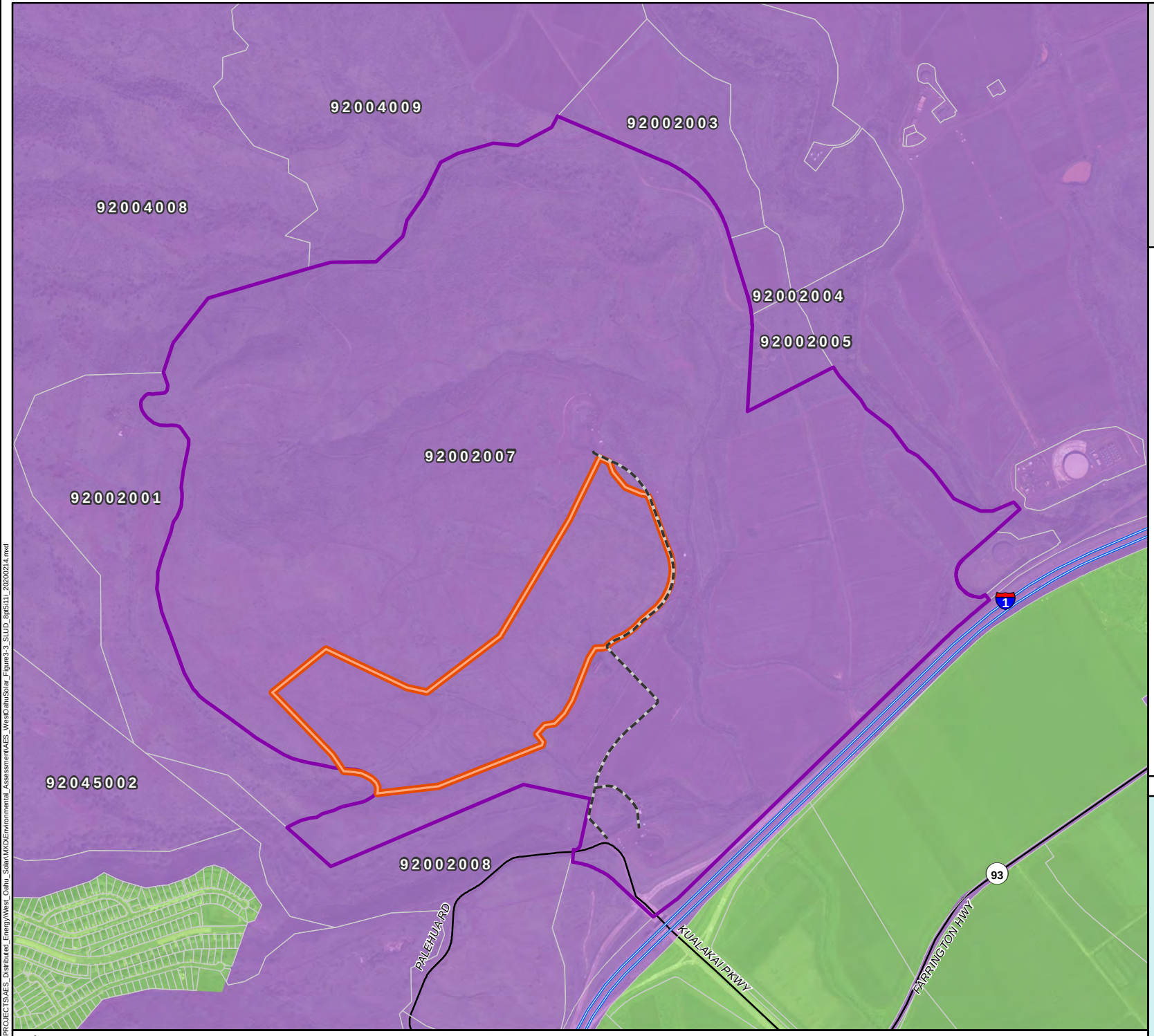

Figure 5

West Oahu Solar Plus Storage Project

AES Distributed Energy

State Land Use Districts

HONOLULU COUNTY, HI

- Project Area
- Property Boundary
- Existing Access Road
- TMK Boundary
- Interstate Highway
- Roadway

State Land Use

- Agricultural Land Use District
- Urban Land Use District

TETRA TECH

Reference Map

1:15,000 WGS 1984 UTM Zone 4N

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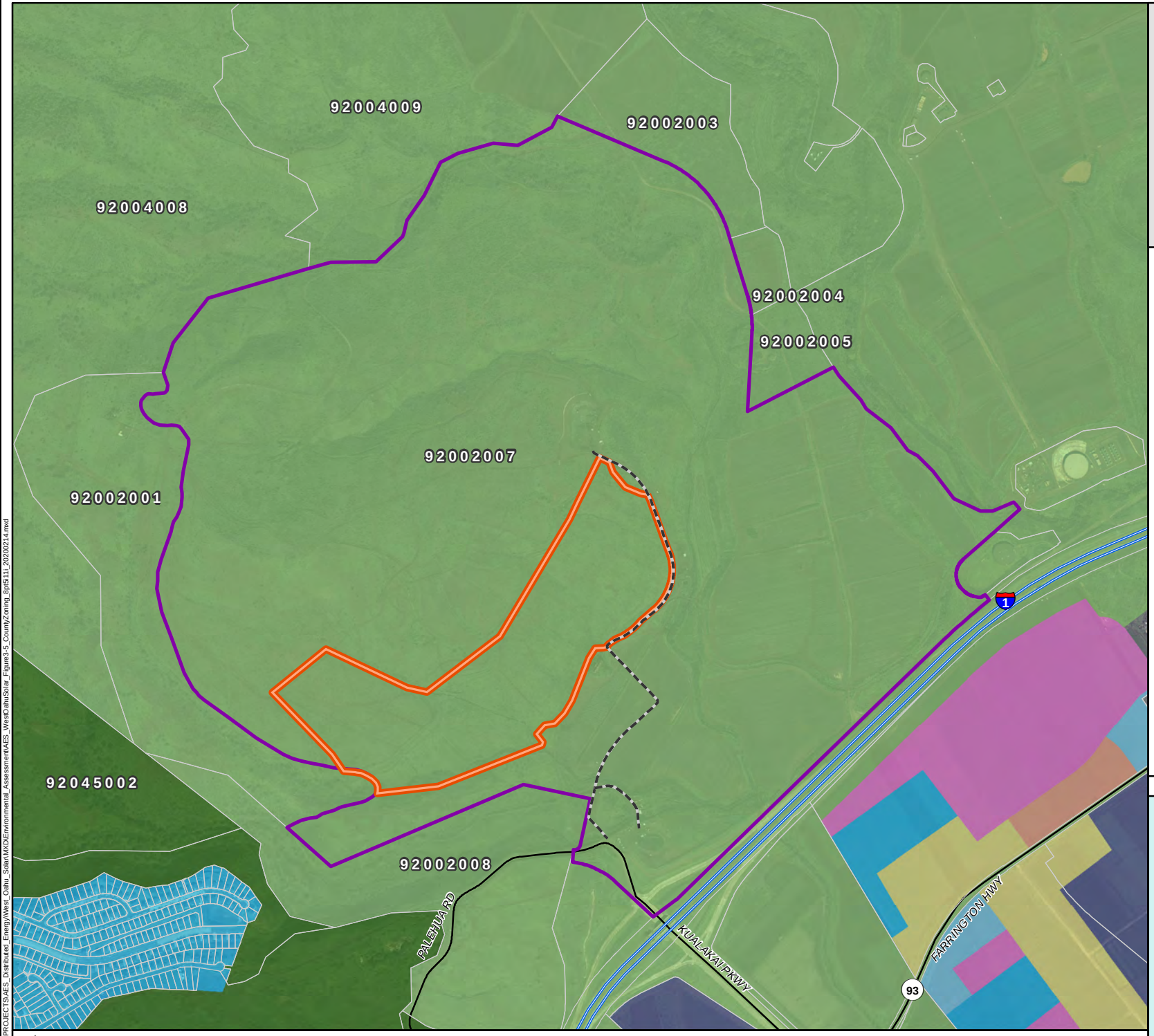

Figure 6

West Oahu Solar Plus Storage Project

AES Distributed Energy

County Zoning

HONOLULU COUNTY, HI

- Project Area
- Property Boundary
- Existing Access Road
- TMK Boundary
- Interstate Highway
- Roadway

Zoning Classes

- Low- and Medium-Density Apartment District
- Restricted Agriculture District
- General Agriculture District
- Medium-density Apartment Mixed Use District
- Neighborhood Business District
- Community Business/ Community Business Mixed Use District
- General Preservation District
- Residential District

TETRA TECH

Reference Map

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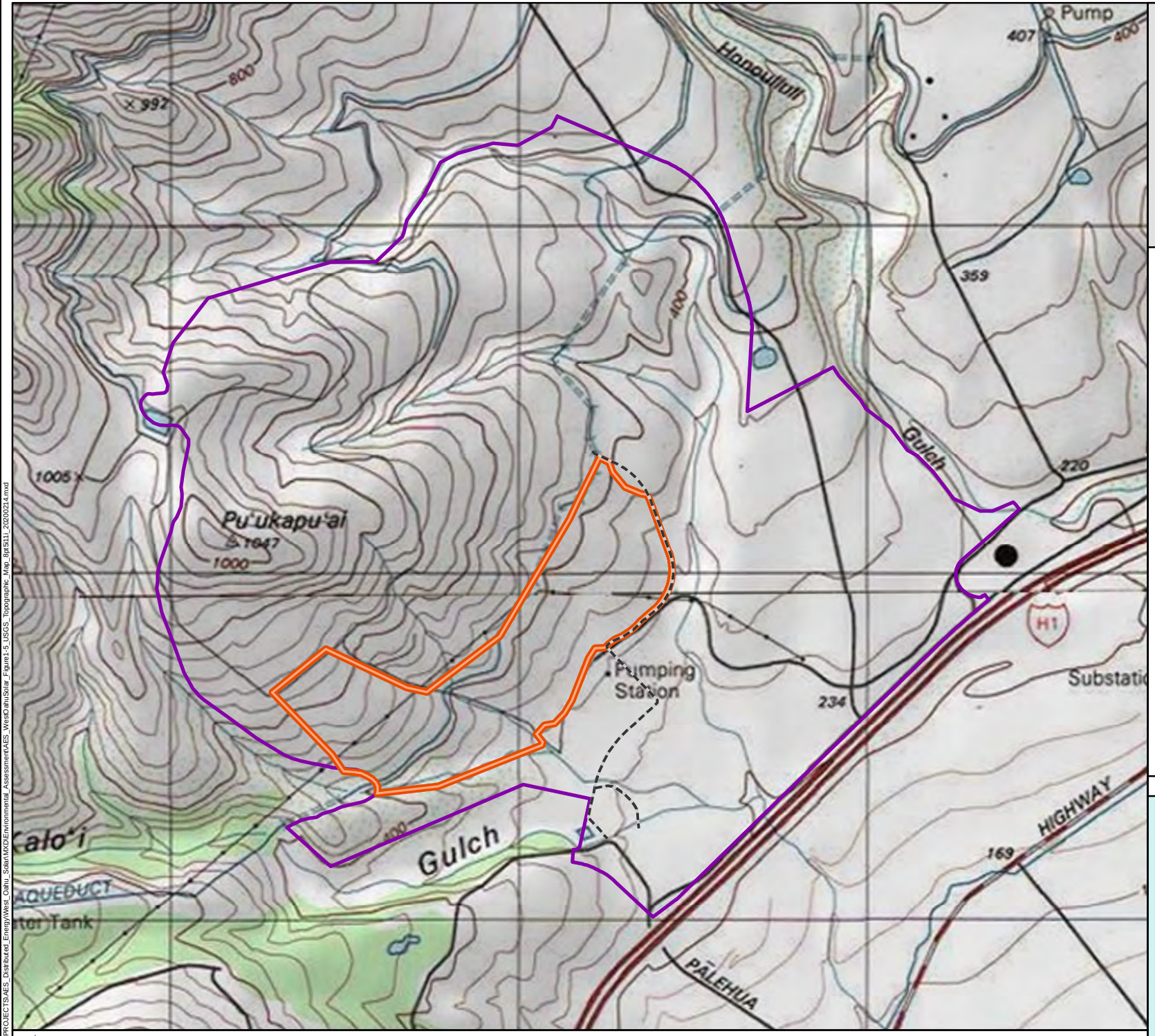


Figure 7

West Oahu Solar Plus Storage Project

AES Distributed Energy

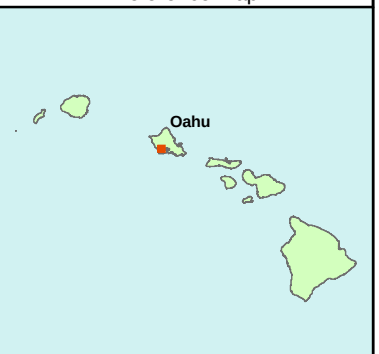
USGS Topographic Map

HONOLULU COUNTY, HI

- Project Area
- Property Boundary
- Existing Access Road

TETRA TECH

Reference Map



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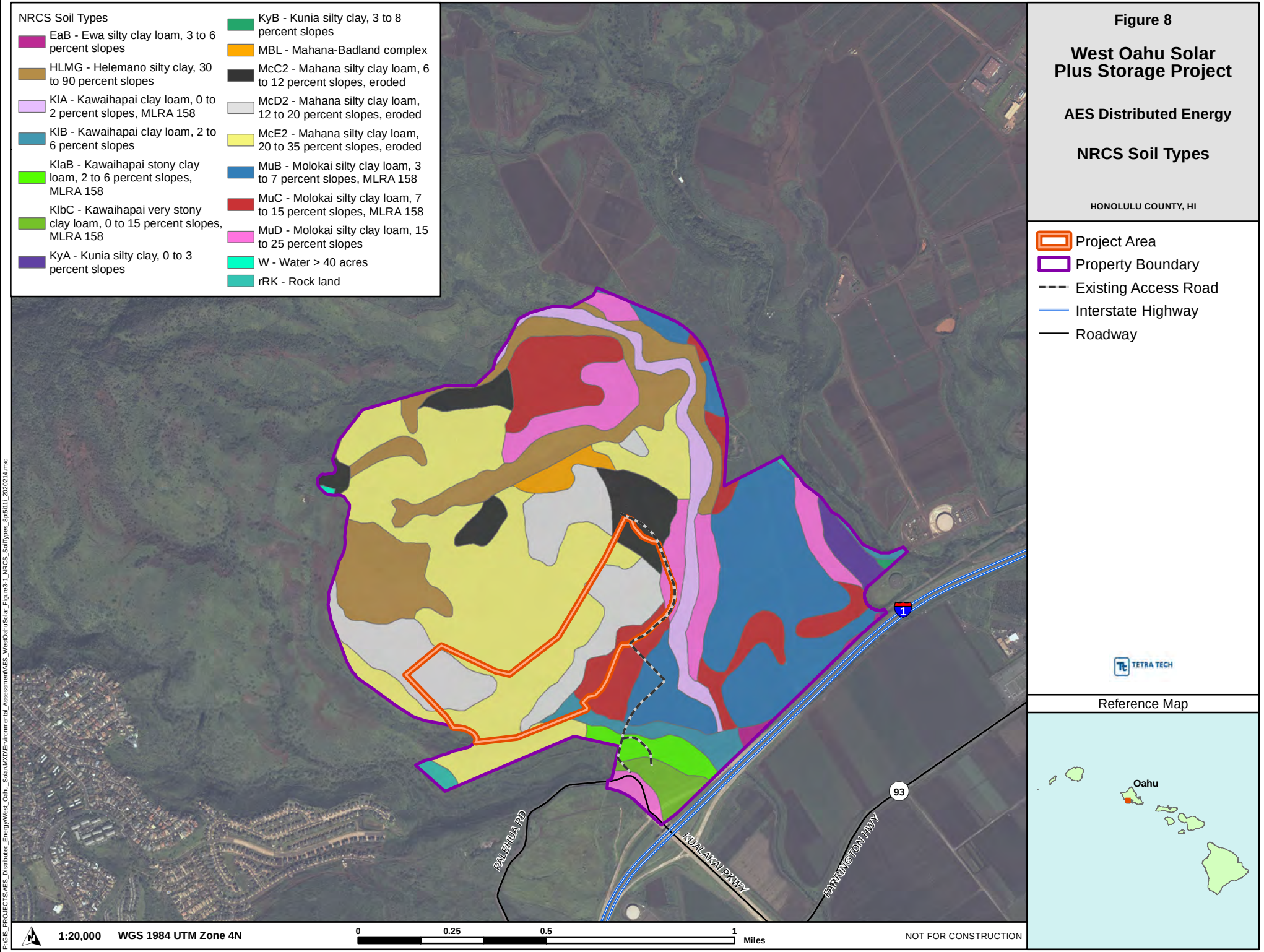

Figure 8

West Oahu Solar Plus Storage Project

AES Distributed Energy

NRCS Soil Types

HONOLULU COUNTY, HI

- Project Area
- Property Boundary
- Existing Access Road
- Interstate Highway
- Roadway

TETRA TECH

Reference Map

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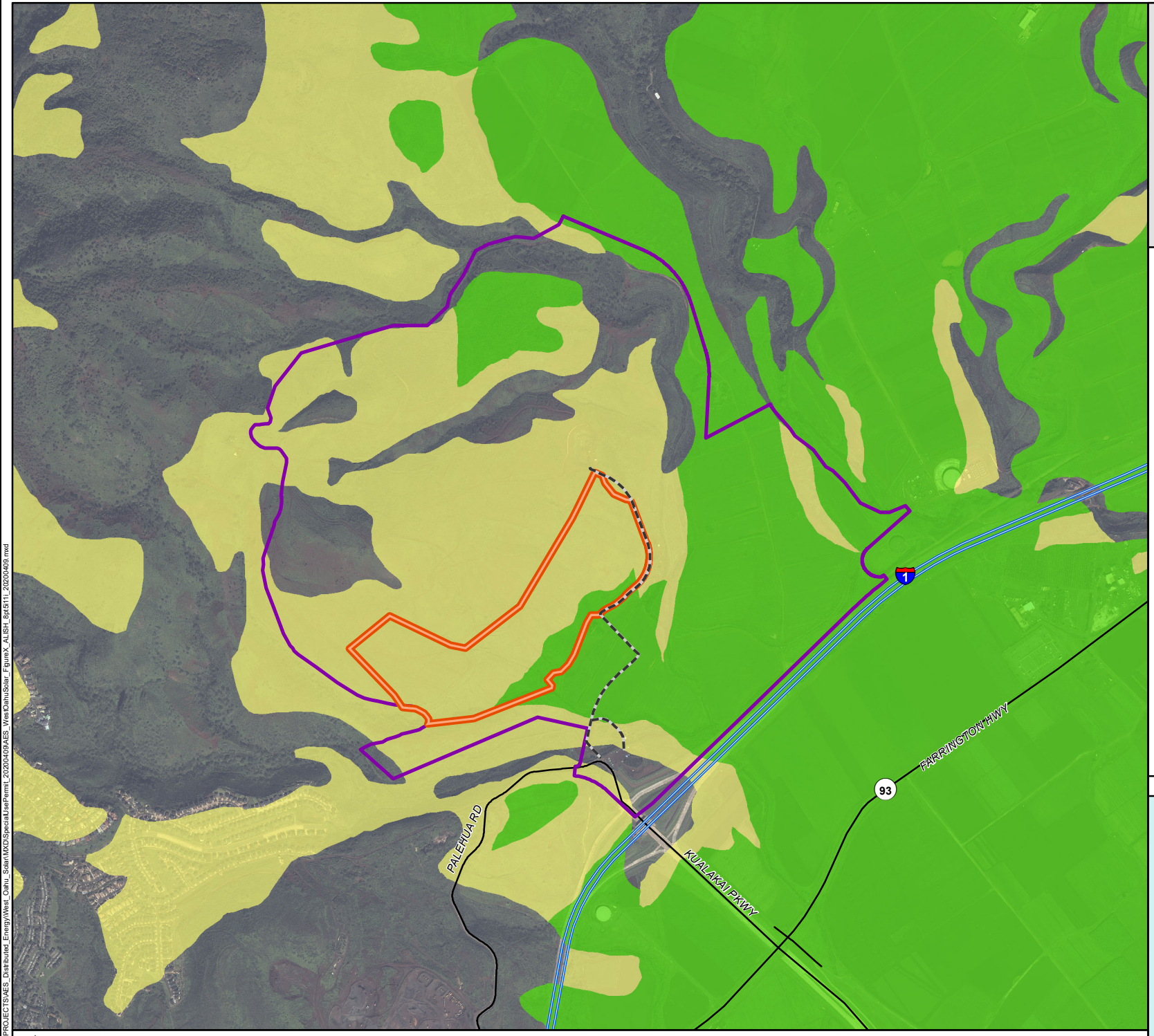


Figure 9

West Oahu Solar Plus Storage Project

AES Distributed Energy

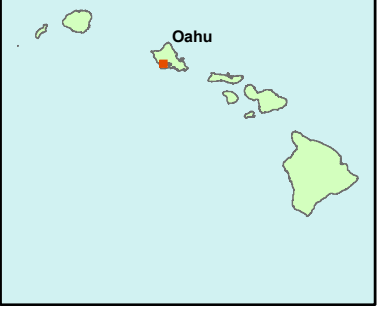
Agricultural Lands of Statewide Importance

HONOLULU COUNTY, HI

- Project Area
- Property Boundary
- Existing Access Road
- Interstate Highway
- Roadway
- Prime Lands
- Other Lands

TETRA TECH

Reference Map



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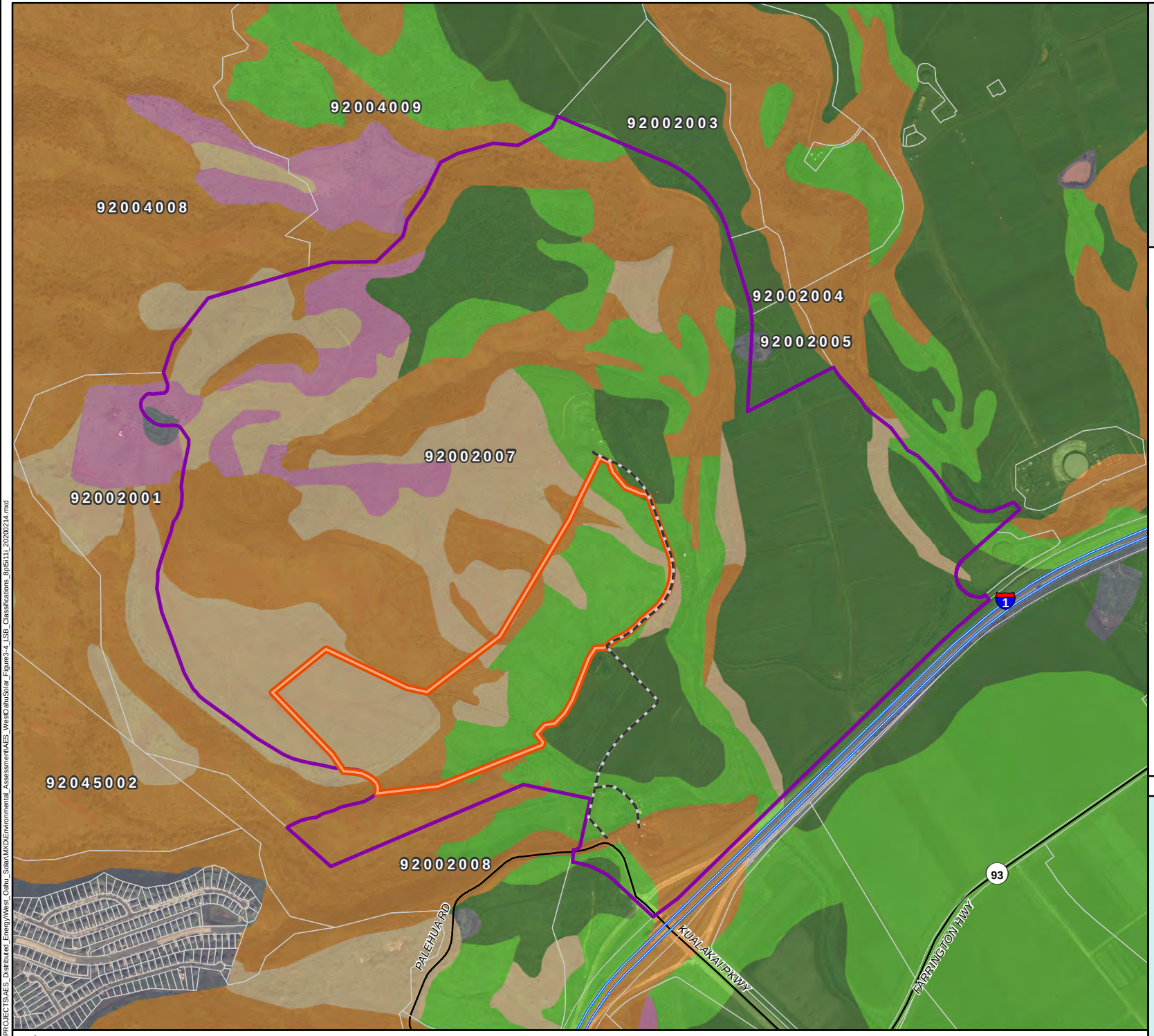

Figure 10

West Oahu Solar Plus Storage Project

AES Distributed Energy

Land Study Bureau Classification

HONOLULU COUNTY, HI

- Project Area
- Property Boundary
- Existing Access Road
- TMK Boundary
- Interstate Highway
- Roadway

Land Study Bureau Classes

- A
- B
- C
- D
- E

TETRA TECH

Reference Map

1:15,000 WGS 1984 UTM Zone 4N

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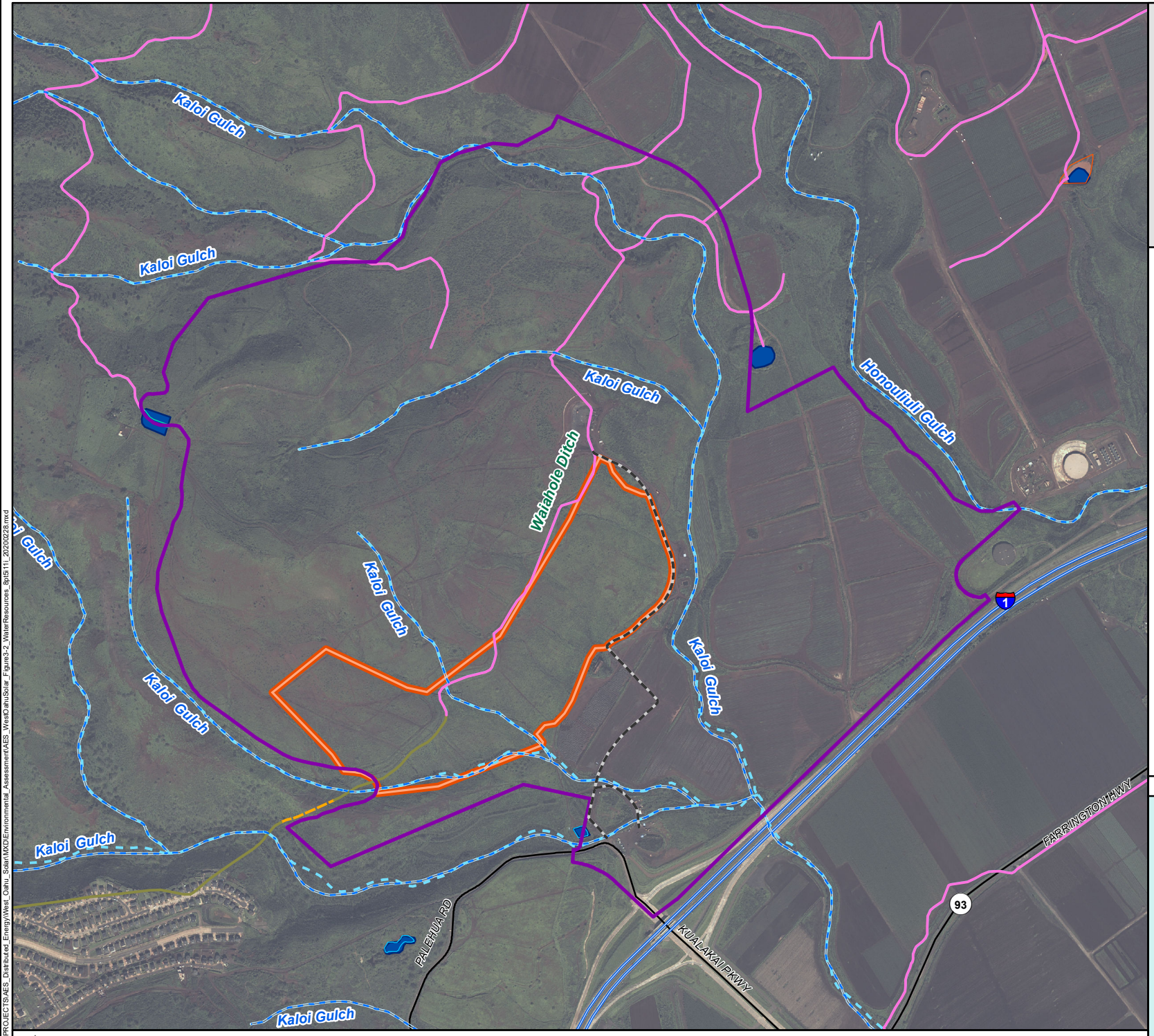


Figure 11

West Oahu Solar Plus Storage Project

AES Distributed Energy

Water Resources

HONOLULU COUNTY, HI

- Project Area
- Property Boundary
- Existing Access Road
- Interstate Highway
- Roadway
- Non-Perennial Stream (State of Hawaii Division of Aquatic Resources)

National Wetland Inventory

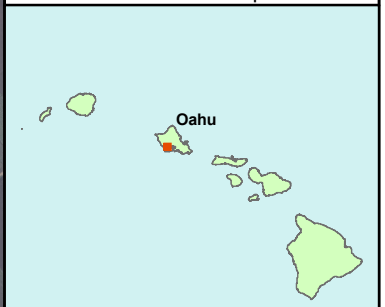
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Riverine

National Hydrography Dataset

- Waterbody
- Canal/Ditch
- Pipeline (Surface Aqueduct)
- Pipeline (Underground Aqueduct)
- Intermittent Stream

TETRA TECH

Reference Map



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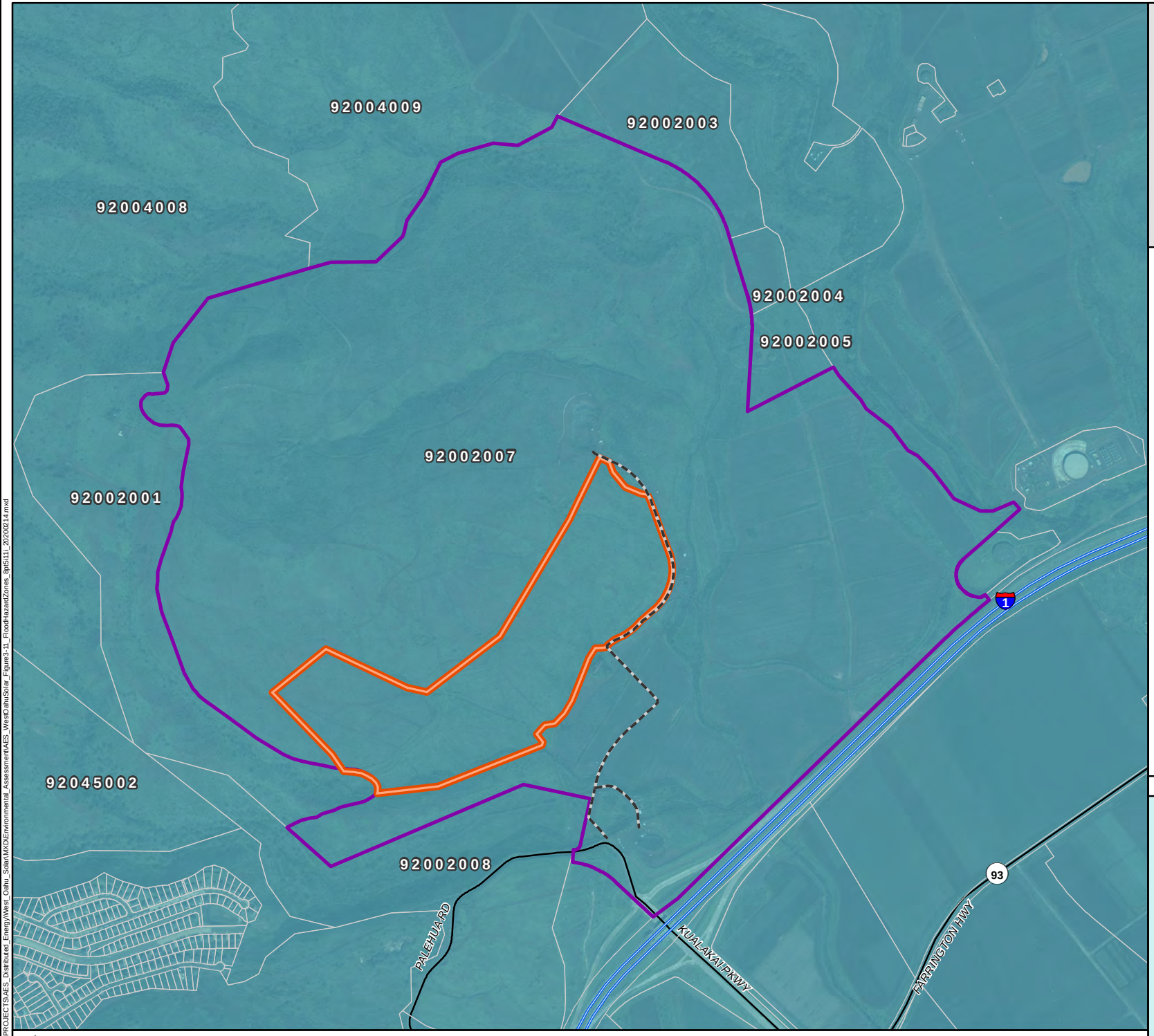

Figure 12

West Oahu Solar Plus Storage Project

AES Distributed Energy

Flood Hazard Zones

HONOLULU COUNTY, HI

- Project Area
- Property Boundary
- Existing Access Road
- TMK Boundary
- Interstate Highway
- Roadway
- Flood Hazard Zone D (FEMA)

TETRA TECH

Reference Map

1:15,000 WGS 1984 UTM Zone 4N

0 0.25 0.5 1 Miles

NOT FOR CONSTRUCTION

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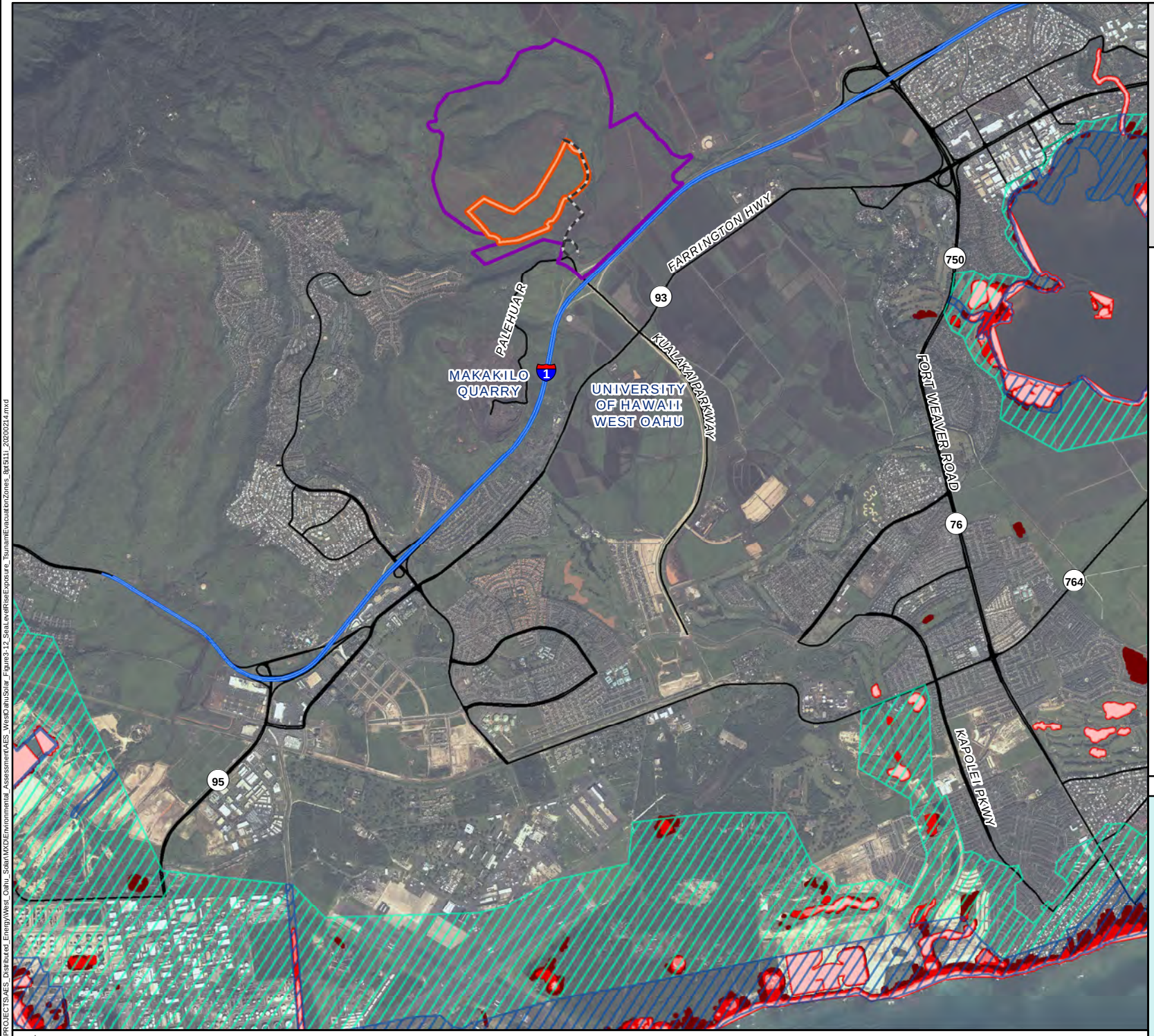


Figure 13

West Oahu Solar Plus Storage Project

AES Distributed Energy

Sea Level Rise Exposure and Tsunami Evacuation Zones

HONOLULU COUNTY, HI

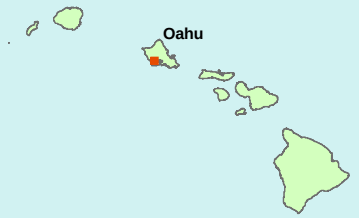
- Project Area
- Property Boundary
- Existing Access Road
- Interstate Highway
- Roadway
- Extreme Tsunami Evacuation Zone
- Tsunami Evacuation Zone

Sea Level Rise Exposure Areas

- 0.5 feet
- 1.1 feet
- 2.0 feet
- 3.2 feet

TETRA TECH

Reference Map



1:50,000 WGS 1984 UTM Zone 4N

0 0.25 0.5 1 Miles

NOT FOR CONSTRUCTION

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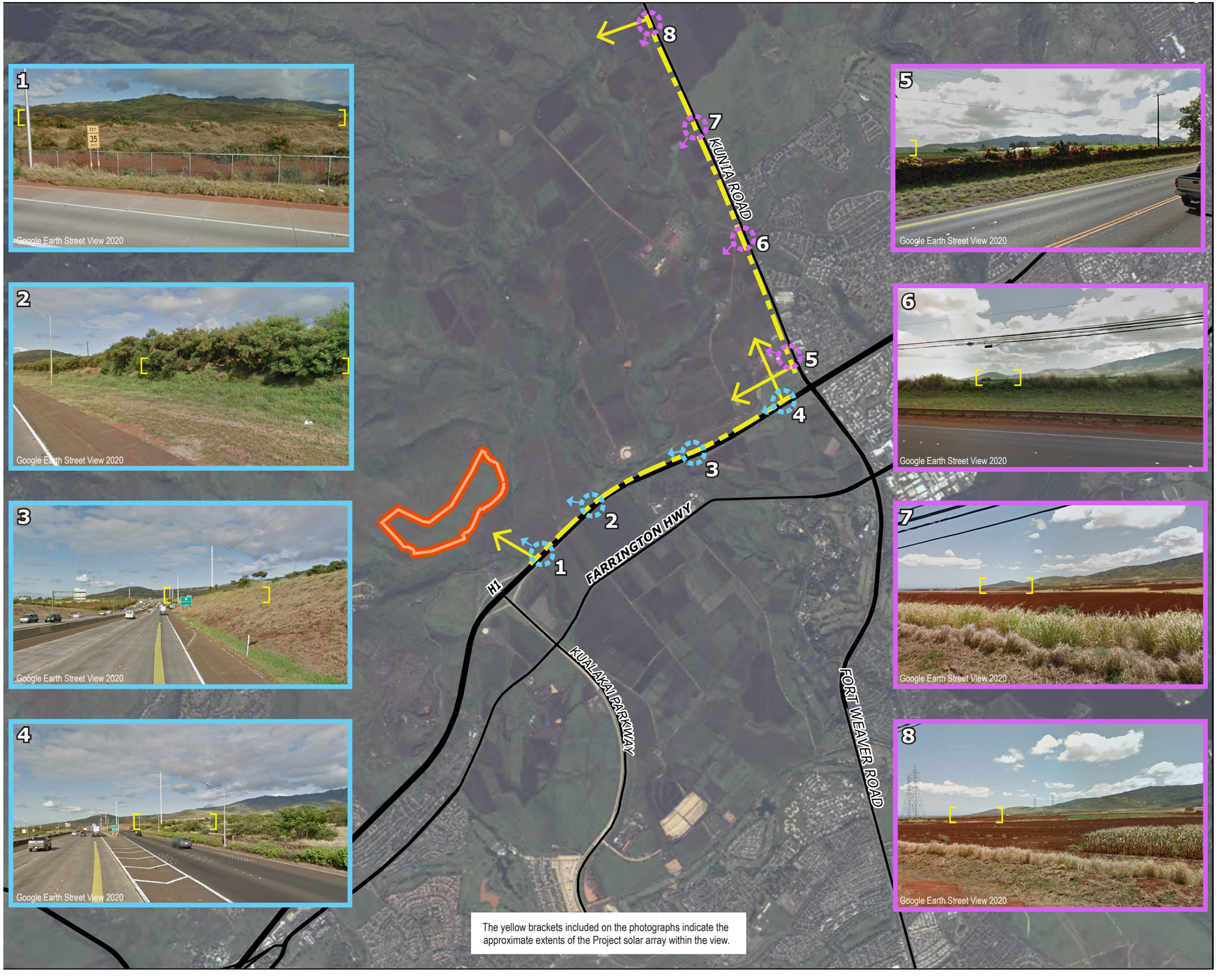
Figure 14

West Oahu Solar Plus Storage Project

AES Distributed Energy

Representative Views from Identified Viewplanes

HONOLULU COUNTY, HI



Project Area

Identified Viewplane in Ewa Development Plan

TETRA TECH

Reference Map

1:200,000 WGS 1984 UTM Zone 4N

0 0.5 1 2 3 4 Miles

NOT FOR CONSTRUCTION

P:\GIS_PROJECTS\AES_Distributed_Energy\West_Oahu_Solar\MXD\Environmental_Assessment\AES_WestOahuSolar_Figure2-9_ForInDesign_11x17i_20200221.mxd

FIGURE 15

West O'ahu Solar Plus Storage Project

PANORAMIC PHOTO SIMULATION

Representative Viewpoint 01

Farrington Highway

Existing Conditions

Simulated Conditions

VICINITY MAP

Photograph Information

Time of photograph: 8:40 a.m.
Date of photograph: 11/15/2019
Weather condition: Partly Cloudy
Viewing direction: Northwest
Latitude: 21.368050° N
Longitude: -158.050300° W
Photo Location: The photo was taken from along Farrington Highway approximately 4500 feet southeast of the Project.

AES

FIGURE 15

West O'ahu Solar Plus Storage Project

PANORAMIC PHOTO SIMULATION

Representative Viewpoint 02

Kualakai Parkway

Mile Marker 1.5

Existing Conditions

Simulated Conditions

VICINITY MAP

Photograph Information

Time of photograph: 9:45 a.m.
Date of photograph: 11/15/2019
Weather condition: Partly Cloudy
Viewing direction: Northwest
Latitude: 21.355490° N
Longitude: -158.050200° W
Photo Location: The photo was taken from along Kualakai Parkway approximately 7250 feet southeast of the Project.

AES

FIGURE 15

West O'ahu Solar Plus Storage Project

PANORAMIC PHOTO SIMULATION

Representative Viewpoint 03

Kualakai Parkway

Mile Marker 0.5

Existing Conditions

Simulated Conditions

VICINITY MAP

Photograph Information

Time of photograph: 5:15 p.m.
Date of photograph: 11/15/2019
Weather condition: Mostly Cloudy
Viewing direction: North northeast
Latitude: 21.343980° N
Longitude: -158.052700° W
Photo Location: The photo was taken from along Kualakai Parkway approximately 2 miles southeast of the Project.

AES

FIGURE 15

West O'ahu Solar Plus Storage Project

PANORAMIC PHOTO SIMULATION

Representative Viewpoint 04

Geiger Community Park

Existing Conditions

Simulated Conditions

VICINITY MAP

Photograph Information

Time of photograph: 11:00 a.m.
Date of photograph: 11/15/2019
Weather condition: Partly Cloudy
Viewing direction: Northwest
Latitude: 21.332410° N
Longitude: -158.026900° W
Photo Location: The photo was taken from Geiger Community Park approximately 3.5 miles southeast of the Project.

AES

FIGURE 15

West O'ahu Solar Plus Storage Project

PANORAMIC PHOTO SIMULATION

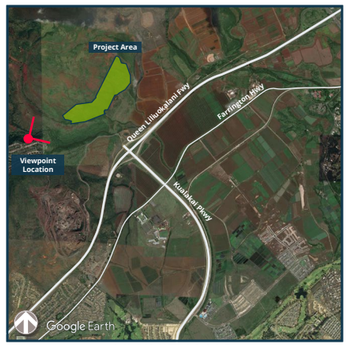
Representative Viewpoint 05

Makakilo Neighborhood

Near Luawainui Street and Punawainui Street

Existing Conditions

Simulated Conditions



VICINITY MAP

Photograph Information

Time of photograph: 3:05 p.m.
Date of photograph: 11/15/2019
Weather condition: Partly Cloudy
Viewing direction: Northeast
Latitude: 21.367980° N
Longitude: -158.074300° W
Photo Location: The photo was taken from the Makakilo neighborhood approximately 2200 feet southwest of the Project.

AES

FIGURE 15

West O'ahu Solar Plus Storage Project

PANORAMIC PHOTO SIMULATION

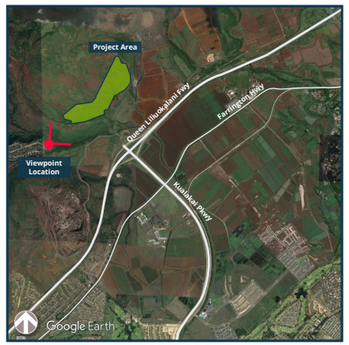
Existing Conditions

Simulated Conditions

Representative Viewpoint 06

Makakilo Neighborhood

Near End of Punawainui Street



VICINITY MAP

Photograph Information

Time of photograph: 3:15 p.m.
Date of photograph: 11/15/2019
Weather condition: Partly Cloudy
Viewing direction: Northeast
Latitude: 21.366740° N
Longitude: -158.071300° W
Photo Location: The photo was taken from the Makakilo neighborhood approximately 1600 feet southwest of the Project.

AES

FIGURE 15

West O'ahu Solar Plus Storage Project

PANORAMIC PHOTO SIMULATION

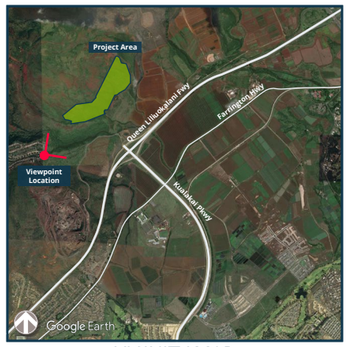
Representative Viewpoint 07

Makakilo Neighborhood

Near End of Pueonani Street

Existing Conditions

Simulated Conditions



VICINITY MAP

Photograph Information

Time of photograph: 3:10 p.m.
Date of photograph: 11/15/2019
Weather condition: Partly Cloudy
Viewing direction: Northeast
Latitude: 21.365770° N
Longitude: -158.072000° W
Photo Location: The photo was taken from the Makakilo neighborhood approximately 2000 feet southwest of the Project.

AES

Existing Conditions

Simulated Conditions

FIGURE 15

West O'ahu Solar Plus Storage Project

PHOTO SIMULATION

Representative Viewpoint 08

Makakilo Neighborhood

Mauka End of Makakilo Drive

VICINITY MAP

Photograph Information

Time of photograph: 10:20 a.m.
Date of photograph: 05/22/2020
Weather condition: Partly Cloudy
Viewing direction: Northwest
Latitude: 21.366237° N
Longitude: -158.071975° W
Photo Location: The photo was taken 1800 feet southwest of the Project.
Photograph provided by City & County of Honolulu Department of Planning and Permitting.

AES

Existing Conditions

Simulated Conditions

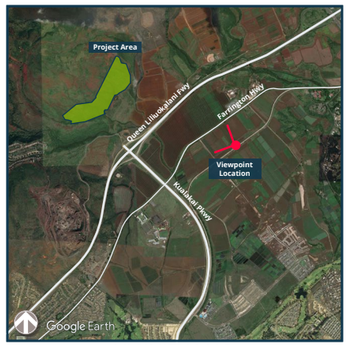
FIGURE 15

West O'ahu Solar Plus Storage Project

PHOTO SIMULATION

Representative Viewpoint 09

Honouliuli Transit Station



VICINITY MAP

Photograph Information

Time of photograph: 9:10 a.m.
Date of photograph: 05/21/2020
Weather condition: Partly Cloudy
Viewing direction: Northwest
Latitude: 21.367001° N
Longitude: -158.045514° W
Photo Location: The photo was taken from the Honouliuli Transit Station approximately 1 mile southeast of the Project. Photograph provided by City & County of Honolulu Department of Planning and Permitting.

AES

FIGURE 15

West O'ahu Solar Plus Storage Project

PHOTO SIMULATION

Representative Viewpoint 10

Pedestrian Bridge at Keone'ae Transit Station

Existing Conditions

Simulated Conditions

VICINITY MAP

Photograph Information

Time of photograph: 8:10 a.m.
Date of photograph: 05/22/2020
Weather condition: Clear
Viewing direction: Northwest
Latitude: 21.358494° N
Longitude: -158.051338° W
Photo Location: The photo was taken from the pedestrian bridge over Kualakai Parkway approximately 1 mile southeast of the Project.
Photograph provided by City & County of Honolulu Department of Planning and Permitting.

AES

Existing Conditions

Simulated Conditions

FIGURE 15

West O'ahu Solar Plus Storage Project

PHOTO SIMULATION

Representative Viewpoint 11

Kualakai Parkway & Farrington Highway

VICINITY MAP

Photograph Information

Time of photograph: 7:22 a.m.
Date of photograph: 05/22/2020
Weather condition: Clear
Viewing direction: Northwest
Latitude: 21.361916° N
Longitude: -158.055321° W
Photo Location: The photo was taken from along Kualakai Parkway approximately 4600 feet southeast of the Project. Photograph provided by City & County of Honolulu Department of Planning and Permitting.

AES

FIGURE 15

West O'ahu Solar Plus Storage Project

PHOTO SIMULATION

Representative Viewpoint 12

Kualakai Parkway
Mile Marker 2.3

Existing Conditions

Simulated Conditions

VICINITY MAP

Photograph Information

Time of photograph: 7:40 a.m.
Date of photograph: 05/22/2020
Weather condition: Clear
Viewing direction: Northwest
Latitude: 21.364071° N
Longitude: -158.057414° W
Photo Location: The photo was taken from along Kualakai Parkway approximately 3500 feet southeast of the Project. Photograph provided by City & County of Honolulu Department of Planning and Permitting.

AES

FIGURE 15

West O'ahu Solar Plus Storage Project

PHOTO SIMULATION

Representative Viewpoint 13

H-1 Freeway at Kualakai Parkway

Existing Conditions

Simulated Conditions

VICINITY MAP

Photograph Information

Time of photograph: 7:50 a.m.
Date of photograph: 05/22/2020
Weather condition: Partly Cloudy
Viewing direction: North-northwest
Latitude: 21.366336° N
Longitude: -158.060247° W
Photo Location: The photo was taken from the H-1 Freeway bridge over Kualakai Parkway approximately 2000 feet southeast of the Project. Photograph provided by City & County of Honolulu Department of Planning and Permitting.

AES

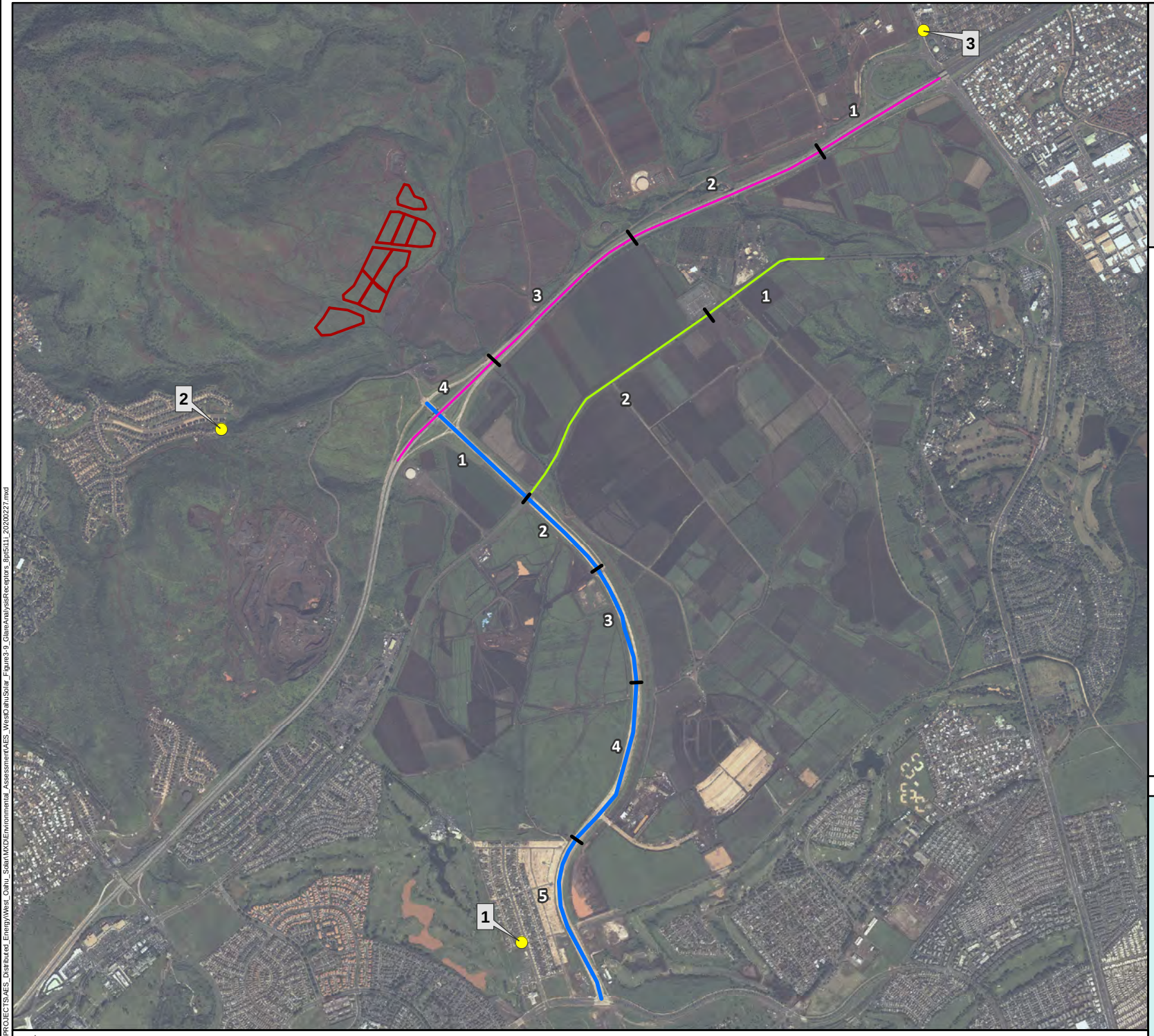


Figure 16

West Oahu Solar Plus Storage Project

AES Distributed Energy

Glare Analysis Receptors

HONOLULU COUNTY, HI

Project Layout (Solar Arrays)

Observation Point

Road Segments

Farrington Highway

H-1 Freeway

Kualakai Parkway

TETRA TECH

Reference Map

1:30,000 WGS 1984 UTM Zone 4N

0 0.25 0.5 1 Miles

NOT FOR CONSTRUCTION

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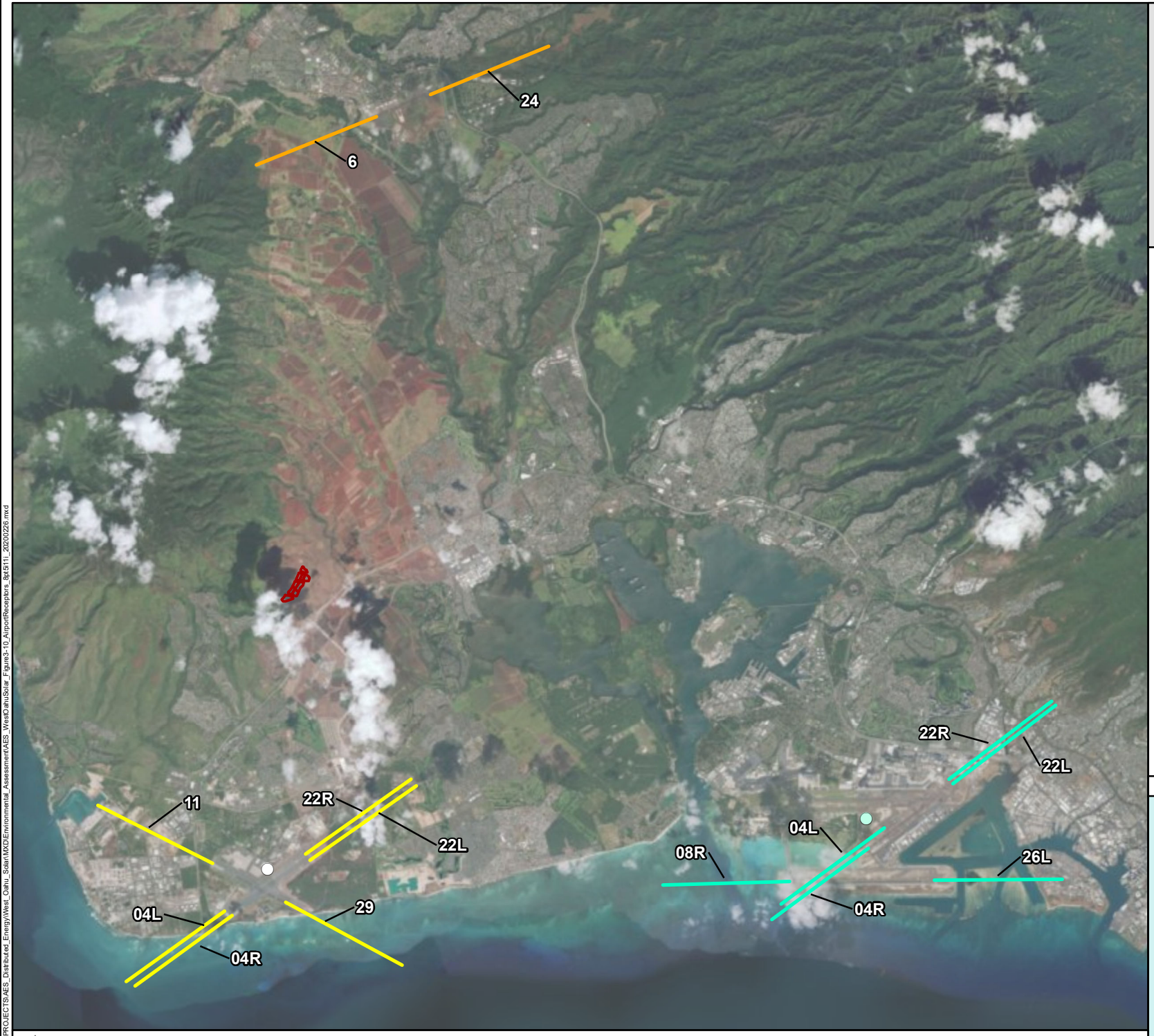

Figure 17

West Oahu Solar Plus Storage Project

AES Distributed Energy

Airport Receptors

HONOLULU COUNTY, HI

Project Layout (Solar Arrays)

Honolulu International Airport (HNL)

Final Approach

Air Traffic Control Tower

Kalaeloa Airport (JRF)

Final Approach

Air Traffic Control Tower

Wheeler Army Airfield

Final Approach

TETRA TECH

Reference Map

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Attachment B
Option Agreement to Grant System Easement (redacted)

Option Agreement to Grant System Easement
University of Hawaii/AES West Oahu Solar, LLC
UH West Oahu Mauka Lands

THIS OPTION AGREEMENT TO GRANT SYSTEM EASEMENT ("***Agreement***"), made and entered into as of August 30, 2019 ("***Effective Date***"), by and between the **UNIVERSITY OF HAWAI'I**, the state university and a body corporate of the State of Hawai'i, whose business address is 2444 Dole Street, Bachman Hall, Honolulu, Hawai'i 96822 ("***UH***") and AES West Oahu Solar, LLC, a Delaware limited liability company, whose business address is c/o AES Distributed Energy, Inc., 282 Century Place, Suite 2000, Louisville, Colorado 80027 ("***AES***") (UH and AES, each a "***Party***", and collectively, the "***Parties***").

RECITALS

WHEREAS, UH is the owner of those certain parcels of land located mauka of the University of Hawai'i West Oahu ("***UHWO***") campus, 91-1001 Farrington Highway, Kapolei, Hawai'i 96707, consisting of approximately 991 acres, designated as Tax Map Key Nos. 9-2-002:001, 003, 005, and 007 ("***Property***"), which are more particularly described in Exhibit 1 attached to the System Easement (as defined herein); and

WHEREAS, on or around March 12, 2018, the UH and AES entered into that Binding Letter of Intent and Option Agreement ("***LOI***") Regarding Hawaiian Electric Company, Inc. ("***HECO***") Request for Proposals ("***RFP***") for the Supply of Qualified Renewable Energy under HECO's Renewable Dispatchable Generation Power Purchase Agreement ("***RDG PPA***"); and

WHEREAS, pursuant to the LOI, in the event AES was awarded the RDG PPA under the RFP, the UH and AES agreed to negotiate a long term agreement for the use of a portion of the Property, consisting of approximately 80 acres ("***Premises***" or the "***Exclusive Area***"), which are more particularly described in Exhibit 2 attached to the System Easement (as defined herein); and

WHEREAS, AES has informed the UH that it has been awarded the RDG PPA under the RFP to develop, install, maintain, and operate an electricity generation project using a solar photovoltaic and battery energy storage system at the Premises of 12.5 MW AC solar plus 50 MWh battery energy storage system, with 1st year delivered power of 27,571 MWh ("***System***"), which System is further described in Exhibit 3 and Exhibit 4 attached to the System Easement (as defined herein); and

WHEREAS, UH and AES are preparing to enter into a Grant of System Easement Agreement ("***System Easement***") under which AES will have the right to develop, construct, install, operate, maintain, repair, and replace the System upon and/or remove the System from the Easement Area; and

WHEREAS, AES will be required to meet certain conditions and complete performing certain obligations before UH will be obligated to grant the System Easement to AES and before AES will be entitled to obtain the System Easement from UH; and

WHEREAS, this Agreement is intended to set forth and describe the conditions that AES must satisfy and the obligations AES must complete in order to obtain the System Easement from UH; and

WHEREAS, as part of the AES Preconditions (defined in Paragraph II below), AES will file such petitions with the Assistant Registrar of the Land Court of the State of Hawaii ("***Land Court***") and take such other action as may be necessary to designate the Exclusive Area as an easement, together with a non-exclusive access easement ("***Access Easement***") over specified areas of the Property ("***Access Easement Area***") and the non-exclusive easement to run and operate utilities ("***Utility Easement***") over specified areas of the Property ("***Utility Easement Area***") (with the Exclusive Area, Access Easement Area, and the Utility Easement Area comprising the "***Easement Area***"), including, without limitation, completing all survey and mapping work to prepare the required property descriptions and maps to support the filing of such petitions with the Land Court; and

WHEREAS, AES requires entry onto the Property, including the portions that will comprise the Easement Area, including the Access Easement Area and the Utility Easement Area, in order to complete its investigative studies and its due diligence efforts; and

WHEREAS, UH is willing to allow AES and its employees, consultants, contractors, agents, representatives, and any person or entity acting on behalf of AES (collectively the "***AES Agents***") to enter onto the Property to perform and complete its investigative studies and due diligence efforts, upon the terms and conditions described herein; and

WHEREAS, UH and AES desire to enter into this Agreement to describe the AES Preconditions that are to be satisfied and completed in order for UH to grant to AES the System Easement (including the Access Easement and the Utility Easement).

AGREEMENT

I. Preconstruction Right of Entry

1. Use Area. AES and the AES Agents will be permitted to enter upon and temporarily use certain portions of the Property, including the Easement Area, from and after Effective Date, as more particularly described on the map attached hereto as Exhibit A and incorporated herein by reference (the "***Use Area***"). AES shall not use any other portion of the Property outside of the Use Area without obtaining UH's prior written approval.

2. Purpose of use. AES and UH acknowledge and agree that AES will be entering and temporarily using the Use Area for the purpose of conducting feasibility and investigative studies, physical inspections, testing, measuring, and other due diligence efforts, including, without limitation, for the purposes of conducting geological, engineering, soil tests, archaeological and/or environmental studies or reports, investigating the grading, drainage and utility requirements necessitated by AES' proposed development, construction, and operation of the System, and reviewing and evaluating any conditions of approval imposed by HECO and/or the City or any other governmental entity or agency relating to AES' proposed development, construction, and/or operation of the System (collectively the "***Due Diligence***"). AES shall pay for all costs and expenses relating to and/or associated with the performance and completion of the Due Diligence and UH shall not be responsible for any such costs and expenses. As the Due Diligence may involve invasive testing (such a soil borings), Due Diligence activity is anticipated to or could result in damage to a portion of the Property and/or the Use Area or any facilities, structures, improvements, utility lines or facilities, walls, fences, paths, roadways, or items within the Use Area (collectively "***UH Facilities***") situated within the Use Area. AES shall thereafter remove all trash, debris, and materials from the Use Area and the Property and repair any and all damage and restore the Use Area and the UH Facilities to the condition they were in prior to the start of the Due Diligence.

3. Grant of entry UH hereby grants AES and the AES Agents the non-exclusive right to enter and access the Use Area for purposes of conducting and completing the Due Diligence ("***Authorized Activity***"). For purposes of this Agreement, the Use Area shall also cover any areas on the Property that might be affected by AES' Due Diligence and/or Authorized Activity, such as Property areas adjacent to the Due Diligence that might be affected by the Due Diligence. UH hereby grants AES access to the Use Area to conduct the Authorized Activity in accordance with the schedules to be approved by UH.

    a. No unreasonable interference. AES' access and use of the Use Area shall not unreasonably interfere with UH's operation of the Property, including any access to the Use Area or the Property by UH or others authorized by UH. UH shall not unreasonably interfere with AES's Authorized Activity.

    b. Site Specific Conditions and General Terms and Conditions. In conducting the Authorized Activity, AES shall perform and comply and shall ensure that the AES Agents perform and comply with all of the Site Specific Conditions described in Exhibit B (the "***Site Specific Conditions***") and the General Terms and Conditions described in Exhibit C (the "***General Terms and Conditions***"), both of which are attached hereto and incorporated herein by reference.

4. Use time. AES and AES Agents are hereby authorized to access and use the Use Area for the Due Diligence and the Authorized Activity beginning on Effective Date, and ending on that date that is two (2) years from the Effective Date ("***Term***"), unless this Agreement is extended by mutual written agreement up to one (1) additional year for a total Term of three (3) years or sooner terminated. Notwithstanding the foregoing, if AES is unable to obtain all governmental approvals and permits and any HECO and State of Hawaii Public

Utilities Commission approvals that may be necessary to develop, construct, and install the System, AES may automatically extend the Term for the one (1) additional year for a total Term of three (3) years by providing thirty (30) days written notice to UH prior to the expiration of the Term. If the Term is extended for one (1) additional year for a total Term of three (3) years, AES shall pay to UH [redacted] during the extended period.

5. Use fees. [redacted]

6. AES representation. AES hereby confirms that all information contained in this Agreement is true and correct. If UH discovers or learns that any such information is not true and correct in any material respects, UH may: (a) immediately terminate this Agreement, (b) hold AES responsible for all applicable fees and charges, including, without limitation, any cleanup and restoration charges, and (c) require AES to meet all of AES' obligations under this Agreement (such as AES' obligation to indemnify, defend, and hold harmless UH, obtain insurance, and clean up and restore the Use Area).

7. AES obligation to maintain. At all times herein, AES shall, and will ensure that the AES Agents shall, maintain and keep the Use Area in a strictly clean, sanitary and orderly condition.

8. [Reserved].

9. AES shall implement precautions. In its entry and use of the Use Area, AES shall use and implement and ensure that the AES Agents use and implement appropriate precautions and measures to minimize inconveniences to surrounding properties, residents, landowners, and the public in general, including, without limitation, implementing such preventative measures and best management practices to prevent or minimize adverse impacts and damage to the Use Area, the Property, and surrounding or nearby properties.

10. AES responsible for addressing/resolving Adverse Impacts. AES will be responsible and will ensure that the AES Agents shall be responsible, all at no cost to UH, for preventing, mitigating, and remediating (and compensating UH as appropriate for), to UH's reasonable satisfaction, all adverse impacts to UH, the Use Area, the Property, and UH operations, resulting from or attributable to entry onto the Use Area or the Property by AES and/or the AES Agents and/or the Due Diligence or the Authorized Activity (collectively the "***Adverse Impacts***").

    (a) AES implementation of mitigation measures. AES will be responsible and shall ensure that the AES Agents are responsible, at AES' or their sole cost and expense, for implementing all management/operations/actions/improvements that are necessary to mitigate and resolve any impacts to the Use Area, the Property, and/or UH operations as a result of or attributable to the Due Diligence or the Authorized Activity.

    (b) Types of mitigation measures. Such mitigation measures may include, without limitation: (i) scheduling adjustments to prevent or minimize the Adverse Impacts; (ii) dust control measures (such as erecting screens and frequent watering); (iii) sound mitigation measures (such as baffling, noise barriers, dampening of construction vehicles and equipment); (iv) access control measures (such as fencing, barriers, gated entry and exit points, and guard stations); (v) security control measures (such as security patrols, security lighting, and camera/video and motion sensor systems); and (vi) traffic control measures (such as traffic control officers, flagmen, police officers during peak traffic times, directory, warning, and caution signage/lights, and temporary traffic signals).

    (c) AES responsible for claims. AES shall, and will ensure that AES Agents shall, indemnify, defend (with counsel reasonably acceptable to UH), hold harmless, and insure UH against such Adverse Impacts, including any claims, demands, suits, actions, causes of action, injunctions, judgments, penalties, fines, assessments, liens, losses, liabilities, damages, costs, and expenses (including Attorneys' Fees and Costs (as defined herein)), arising out of or relating to any act or omission by AES or AES Agents in connection with implementing or failing to implement any reasonably necessary mitigation measures to mitigate any Adverse Impacts, including, without limitation, repairing any damage caused by or attributable to the Due

Diligence.

(d) Attorneys' Fees and Costs. As used in this Agreement, ***"Attorneys' Fees and Costs"*** means and includes all reasonable attorneys' fees of outside legal counsel, expert witness fees and costs, discovery and pretrial costs, costs incurred in the investigation, prosecution, or defense of any action, costs for research relating to settlement or resolution, costs of implementing preventive measures necessary to protect and preserve the position of UH and/or UH's officers, employees, agents, representatives, and any person acting on behalf of UH (hereafter collectively the "***UH Agents***") with regard to any such claim or action, and all other reasonable fees and costs incurred or imposed upon UH or the UH Agents in connection with such claim or action.

(e) AES to ensure performance by AES Agents. AES shall be responsible and liable for the acts or omissions of the AES Agents, as though such acts and omissions were AES' own acts or omissions. AES, on behalf of itself and the AES Agents, including all who perform any activities in connection with the Due Diligence or within the vicinity of the Use Area or the Property, acknowledges and promises that AES will ensure that all of the AES Agents will be bound to perform and comply with all of the terms and conditions of this Agreement when performing any Due Diligence and/or work affecting or potentially affecting the Use Area or the Property. The failure of the AES Agents to perform or comply with any of the terms and conditions of this Agreement shall constitute a breach or default under this Agreement, entitling UH to exercise such rights and resort to such remedies as are available under this Agreement and by law.

(f) AES to accept Use Area "As Is". AES, on behalf of itself and the AES Agents agrees that UH is making available the Use Area to AES and the AES Agents on an "As Is With All Faults" basis, in its existing content and state of condition, except as modified by the election of UH in its sole discretion. AES and UH acknowledge and agree that UH is allowing AES, under the Agreement, to inspect and examine the Use Area and make its own determination regarding whether the condition of the Use Area is suitable for the construction and operation of the System. AES, on behalf of itself and the AES Agents, further agrees that UH shall not be liable for any latent, patent, or other defects in, on, or under the Use Area.

(g) UH may cure AES' failure to perform. If AES fails to properly perform and comply with or fails to ensure that any of the AES Agents properly performs and complies with any of its or their obligations under this Agreement, within a period of thirty (30) days (or such longer time period as may be agreed upon between UH and AES) after AES receives written notice from UH of such failure by AES and/or the AES Agents, UH may (but shall not be obligated to), at its option, and in addition to all other remedies which may be available to UH, perform and comply with any obligations that AES and/or the AES Agents have failed to perform or comply with and AES shall, and will ensure that the AES Agents shall immediately upon demand from UH, reimburse UH for the full cost of such performance and compliance, plus an additional ten percent (10%) to cover UH's administrative overhead costs.

11. AES responsible for Project costs. All costs associated with the Due Diligence and the Authorized Activity and use of the Use Area by AES and/or the AES Agents shall be the responsibility of AES. UH shall not be responsible for any of such costs.

12. AES responsible for pollution control. AES shall maintain and employ and ensure that the AES Agents maintain and employ debris, pollution and contamination control measures, safeguards and techniques to prevent debris, pollution or contamination to the ocean waters, streams, waterways, and/or the Use Area or the Property resulting from the Due Diligence, Authorized Activity, and/or use of the Use Area by AES or the AES Agents. AES shall take and ensure that the AES Agents shall take immediate corrective action in the event of such pollution or contamination to immediately remove the cause of such pollution or contamination, and shall immediately clean the Use Area, affected portions of the Property, and adjacent and nearby areas and waters of such pollutant or contaminant and shall restore to UH's satisfaction the areas affected by such pollution or contamination, including, without limitation, the Use Area, all at the cost and expense of AES and/or the AES Agents and at no cost to UH.

13. AES to employ BMPs. AES shall employ and ensure that the AES Agents shall employ best management practices during the Due Diligence, if appropriate, in its use of the Use Area to avoid having silt or dirt enter any drainage system, stream, or waterway, including any adjacent or nearby waterways, the ocean, or other bodies of water.

14. AES discovery of historic properties. In the event any historic properties or burial sites, as defined in Section 6E-2, Hawaii Revised Statutes, are found or discovered on any portion of the Easement Area or the Property, AES shall and will cause the AES Agents and the AES Assignees to: (1) immediately stop all work relating to any portions of the Easement Area or the Property upon which such a find or discovery is or has been made, (2) implement measures and take action to protect the find or discovery, and (3) contact the Historic Preservation Division of the State of Hawai'i Department of Land and Natural Resources (hereafter the "***Historic Preservation Division***") in compliance with Chapter 6E, Hawaii Revised Statutes (hereafter "***HRS***"). Neither AES, the AES Agents, nor the AES Assignees shall recommence the Authorized Activity, particularly the System construction work relating to the Easement Area and/or the Property upon which such find or discovery is made unless and until the Historic Preservation Division allows further Authorized Activity, particularly the System construction work to proceed in compliance with HRS Chapter 6E. AES shall and will cause the AES Agents, and the AES Assignees to, comply with HRS Chapter 6E, HRS and the National Historic Preservation Act (16 U.S.C. 440, et seq), and all other Federal and State laws pertaining to the protection of archaeological, historical, and cultural resources, including HRS Chapter 6E. AES and UH acknowledge and agree that during the conduct of the Due Diligence or the Authorized Activity, AES may discover historic properties and/or human remains (as defined in Section 6E-2, Hawai'i Revised Statutes) on, within, or under the Use Area and/or the Easement Area. If such discovery occurs, AES and UH acknowledge and agree that AES has agreed to accept the Use Area and the Easement Area in its "as is" condition with no representations or warranties from UH. In no event or way whatsoever shall UH be obligated to remediate or share in the cost to protect and/or relocate any such historic properties and/or human remains, including implementing any mitigation or other protective measures required by the Historic Preservation Division or obtain any associated governmental approvals in order to allow AES, the AES Agents, and/or the AES Assignees to enter or use or occupy the Use Area, the Easement Area, or any portion of the Property or complete, operate, maintain, or remove the System.

15. AES may be subject to additional conditions. UH reserves the right to impose additional, but reasonable terms and conditions as UH deems necessary in connection with the Due Diligence, the Authorized Activity, and use of the Use Area by AES and/or the AES Agents.

16. AES' use may be terminated. This Agreement and AES's right to enter and use the Use Area is revocable and terminable by UH at any time upon thirty (30) days prior written notice for any material breach of terms and conditions herein by AES and/or the AES Agents, past any applicable cure period as set forth in this Agreement, all at UH's reasonable discretion.

17. [Reserved].

18. Cooperation. AES shall be responsible for obtaining, at AES' sole cost and expense and at no cost to UH, all governmental approvals necessary to conduct and complete the Due Diligence and the construction and operation of the System and enter and use the Use Area. AES will, at its sole cost, fully cooperate and ensure that the AES Agents shall fully cooperate with UH in the preparation and processing of any applications for governmental approvals which UH may be required to submit in connection with the use and operation of the Property. AES shall be obligated, at AES' cost, to promptly and timely join in and execute and ensure that the AES Agents promptly and timely join in and execute appropriate applications, requests, and other similar documents.

19. Binding effect. The term "UH" as used herein shall mean the UNIVERSITY OF HAWAI'I and its successors and assigns and the term "AES" as used herein shall mean AES West Oahu Solar, LLC and its successors and permitted assigns, such as each of the approved AES Assignees. This Agreement shall be binding upon and inure to the benefit of the parties and their legal representatives, successors, and permitted assigns.

20. Notice. All notices, request, demands, and other communications hereunder shall be in writing and shall be deemed given if personally delivered or mailed, certified mail, return receipt requested, sent by overnight carrier, or sent by email or similar electronic transmission (with proof of receipt or transmission) to the following numbers or addresses, as appropriate:

To AES:

[redacted]

To UH:

[redacted]

All notices, demands, and requests that may or are required to be given hereunder by either UH or AES shall be in writing and shall be (A) personally delivered to the receiving party at the addresses noted above, or (B) sent by registered or certified mail, return receipt requested, postage prepaid, addressed as set forth above, or (C) transmitted by an internationally recognized courier service, such as Federal Express, addressed as set forth above. Notices, demands, and requests shall be deemed served or given for all purposes hereunder at the time such notice, demand, or request is personally delivered or delivered by internationally recognized courier service, or three (3) days following such mailing thereof, as the case may be.

21. Site Specific Conditions and General Terms and Conditions. AES acknowledges and agrees that AES shall be bound by and shall perform and comply with all of the terms and conditions contained in Exhibit B (Site Specific Conditions) and Exhibit C (General Terms and Conditions) attached hereto and incorporated herein by reference.

II. Preconditions to UH Issuance of System Easement.

All of the following are preconditions and obligations that AES must fully satisfy and fulfill, in UH's reasonable discretion, by the end of the Term, as may be extended as described in paragraph I.4 above, before UH will be obligated to issue to AES the System Easement (collectively, the "***AES Preconditions***"):

1. AES to provide Easement Plan and Petition to Designate Easements. AES will provide UH with a proposed plan for the designation of easements (the "***Easement Plan***"), showing the proposed designation of easements within the Property to create at least the following separate, non-overlapping easements: (a) the Exclusive Easement, (b) the Access Easement, and (c) the Utility Easement (collectively, the "***Easements***"):

a. Exclusive Easement. The Exclusive Area will be approximately sixty (60) to eighty (80) acres, with the area to be precisely set at the time UH will issue the System Easement based on an ALTA survey to be completed by AES at its cost and the mutual agreement of the Parties and will be more particularly shown on the map to be attached as Exhibit 2 to the System Easement and is preliminarily depicted on Exhibit A attached hereto and incorporated herein by reference.

b. Access Easement. The Access Easement Area will consist of approximately 9,600 linear feet and its location, alignment, and route will be more particularly shown on the map to be attached as Exhibit 2 to the System Easement and is preliminarily depicted on Exhibit A attached hereto and incorporated herein by reference.

c. Utility Easement. The Utility Easement Area will consist of approximately two (2) acres and its location, alignment, and route will be more particularly shown on the map to be attached as Exhibit 2 to the System Easement and is preliminarily depicted on Exhibit A attached hereto and incorporated herein by reference.

2. AES obligation to designate Easements. AES agrees to use its commercially reasonable efforts to: (a) obtain final approval from the City and County of Honolulu ("***City***") for the designation of the Easements within the Property to create the Easements and Easement Area ("***City Approval***") and (b) cause the approved map and legal descriptions of the Easements and Easement Areas to be recorded or filed in the Land Court ("***Land Court Order***"). AES shall pay for any and all costs and expenses to obtain the City Approval and the Land Court Order, including, without limitation, any surveying, mapping, engineering, and legal fees and costs associated with the preparation of necessary applications for City Approval and petitions to obtain the Land Court Order.

3. AES to confirm Utility Easement requirements. AES shall confirm with HECO the requirements for the Utility Easement in connection with the development, construction, and operation of the System. AES acknowledges and agrees that UH, upon terms and conditions acceptable to UH, will grant the Utility Easement to AES, and will permit AES to thereafter grant a sub-easement directly to HECO as needed in connection with the development, construction, and operation of the System, provided that AES' grant of the sub-easement to HECO does not: (a) impose any conditions and/or obligations that are binding upon UH and/or (b) require UH to perform and/or comply with any such conditions or obligations.

4. UH cooperation with designation of Easements. In connection therewith, UH agrees to reasonably cooperate and subject to the UH Limitations (as defined herein) execute any and all necessary applications, consents,

approvals and instruments required by the City or the Land Court, including, without limitation, an application for easement designation approval, as well as any and all petitions to the Land Court, to obtain the City Approval and the Land Court Order. UH agrees, subject to the UH Limitations, to consent to any reasonable modifications to the Easement Plan, the Easements, and/or the Easement Area (collectively the "***Plan Modifications***") as may be required by the City or the Land Court provided that with respect to the Plan Modifications and any conditions and/or obligations relating thereto: (i) UH receives prior written notice before they become effective, (ii) they are not inconsistent with the terms of this Agreement and/or any Applicable Laws (as defined herein), and (iii) they do not impose any material additional cost, expense, or liability upon UH or require UH to waive or release any rights, powers, authorities, or claims that UH may have or acquire.

5. AES failure or inability to obtain City Approval or Land Court Order. If AES fails or is unable to obtain the City Approval and/or the Land Court Order within twenty four (24) months of the Effective Date herein, or fails to provide UH with the Easement Plan within ninety (90) days of the Effective Date herein, all as UH may reasonably determine, UH may terminate this Agreement upon thirty (30) days prior written notice to AES ("***Early Termination Date***"). Upon such termination by UH, from and after the Early Termination Date, both UH and AES will have no further obligations and be discharged and released from any further performance under this Agreement provided that AES will continue to be responsible for performing its surviving obligations, particularly its obligations herein to: (a) indemnify, defend, and hold harmless UH and the UH Agents, (b) clean up, repair, and restore the Easement Area and any other affected portions of the Property, and (c) remove and remediate any environmental conditions within the Easement Area , the Property, and/or any other affected areas involving the presence, discharge, escape, release, generation, and/or use of Hazardous Materials (as defined herein). To the extent that AES fails or is unable to timely obtain the City Approval and/or the Land Court Order, AES shall be responsible for reimbursing to UH any and all costs and expenses, including, without limitation, Attorneys' Fees and Costs, incurred or payable by UH in connection with the performance of UH's obligations under this Agreement. Such reimbursable costs to UH shall include all costs incurred or payable by UH related to UH's review of applications, maps, petitions, property descriptions, and associated documents prepared and/or submitted to the City and/or the Land Court.

6. AES to complete review of Property related documents. Within ninety (90) days of the Effective Date herein, UH will provide to AES all maps, grading plans, surveys, conditions of approval, licenses, permits, studies, reports, encumbrances, leases, contracts, easements, use agreements and other documents relating to the Property (collectively the "***Property Documents***") that are in UH's possession. AES shall be deemed to have completed its review and evaluation of the Property Documents after the expiration of one hundred eighty (180) days from UH's provision of the Property Documents to AES.

7. AES to obtain UH prior written approval for any AES assignment of interests.

a. AES Assignment. AES shall not assign or otherwise transfer any interest, right, or obligation under this Agreement ("***AES Assignment***") without UH's prior written consent, provided, that if AES is not in default or breach of this Agreement and/or the RDG PPA, UH shall not unreasonably withhold its consent to the AES Assignment if UH has been provided with sufficient proof (in UH's reasonable discretion) that the proposed AES assignee ("***AES Assignee***"): (a) has comparable experience and expertise in operating and maintaining and comparable qualifications to operate and maintain photovoltaic solar systems comparable to the System and providing services comparable to those contemplated by the RDG PPA between HECO and AES and the Easements between UH and AES and (b) has the financial capability, capacity, creditworthiness, and credit rating to maintain the System and provide the services contemplated by the RDG PPA in the manner required by the RDG PPA and to develop, construct, and operate the System in the manner required by the Easements. For purposes of this Agreement, each AES Assignee will be considered one of the AES Agents.

(1) AES Assignee. AES may make the AES Assignment to a qualified AES Assignee, as UH reasonably determines, who may be: (a) a person or entity directly or indirectly controlling, controlled by or under common control with AES, (b) a third party or parties in connection with a collateral assignment of rights, mortgage or pledge or any person or entity providing equity, debt or other financing for the System (collectively the "***Lenders***"), (c) any present or future purchaser of the power generated by the System under the RDG PPA, (d) any person or entity succeeding to all or substantially all of AES' assets, or (e) a successor entity in a merger or acquisition transaction.

(2) AES Assignee must assume/perform all AES obligations under this Agreement. Each AES Assignment must be in writing and signed by each AES Assignee, who must assume and commit to performing and perform all AES obligations under the AES Assignment and this Agreement.

(3) AES remains responsible. Notwithstanding each AES Assignment and/or UH's written consent thereto, AES will remain responsible for performing all obligations under this Agreement and will not be released and/or discharged from such obligations and/or responsibility with respect to the portion of the Easement Area transferred, whether or not the AES Assignee effectively assumes and/or performs the obligations under this Agreement pertaining to the transferred Easement Area.

(4) AES Assignment to Lenders. UH hereby expressly consents to AES making an AES Assignment: (a) to an affiliate of AES through which AES is obtaining capital financing for the System from one or more Lenders and (b) collaterally assigning this Agreement to the Lenders, provided that Lenders: (i) perform or expressly commit in writing to perform AES' obligations under this Agreement, (ii) attorns to and recognizes UH's rights under this Agreement and as to the Easement Area and the Property, and (iii) agrees not to seek to place UH in default or otherwise terminate UH's rights under this Agreement. In connection with any such AES Assignment, UH agrees to execute a consent to assignment in customary form and reasonably acceptable to UH and the Lenders, which consent will not be unreasonably withheld. UH acknowledges that AES may obtain construction and long-term financing or other credit support from Lenders in connection with the development, construction, installation, ownership, operation, maintenance, repair, improvement, upgrade, renovation, replacement, removal and security of the System. UH and AES agree in good faith to consider and to negotiate changes or additions to this Agreement that may be reasonably requested by the Lenders; provided, that such changes do not alter the fundamental economic terms of this Agreement as reasonably determined by UH.

(5) Lenders protections. UH, upon providing AES with written notice of (a) default under this Agreement, (b) termination of this Agreement or (c) a matter on which UH may predicate or claim a default, shall at the same time provide a copy of such notice to any Lenders that has delivered to UH a notice countersigned by AES that sets forth the Lenders' identity and address for notices (collectively the "Confirmed Lenders"). UH shall not be obligated to issue a notice of AES default to any Lender who has not qualified as a Confirmed Lender. Lenders may become Confirmed Lenders by transmitting written notice to UH countersigned by AES, all in accordance with the requirements of this paragraph 7a(5). AES and UH acknowledge and agree that UH's notice for AES default shall be valid if sent to AES and all Confirmed Lenders. After such notice has been given to such Lenders, such Lenders shall have the same period as is given AES (plus, in each instance, an additional sixty (60) days) to remedy, commence remedying or cause to be remedied the defaults or acts or omissions which are the subject matter of such notice specified in any such notice. UH shall accept such performance by or at the instigation of such Lenders as if the same had been undertaken by AES. UH and AES authorize Lenders to take any such action at Lenders' option and hereby authorize entry upon the Property by the Lenders for such purposes, provided that AES shall release and discharge UH from any and all liability and/or claims that AES may have relating to UH accepting any performance from and/or by the Lenders in curing or remedying any AES default and AES shall indemnify, defend, and hold harmless UH against any and all claims and actions that might arise relating to such performance by the Lenders, including, without limitation, any claims connected with any dispute or disagreement between AES and the Lenders.

(6) UH protections. UH shall be protected and shall incur no liability in acting or proceeding in good faith upon any such approved AES Assignment and any written notice and direction by or from the Lenders which UH shall in good faith believe (i) to be genuine and (ii) a copy of which to have been delivered to UH. UH shall be under no duty to make any investigation or inquiry as to any statements contained or matters referred to in any such notice or direction by or from the Lenders, but may accept and rely upon them as conclusive evidence of the truth and accuracy of such statements.

b. UH Transfer. UH is not required to obtain AES' consent before UH sells, conveys, leases, assigns, or otherwise transfers (collectively a "***UH Transfer***") portions of the Easement Area and/or the Property to an assignee or transferee subject to the provisions of this Agreement that may affect the portion of the Easement Area and/or the Property transferred.

(1) UH Assignee's rights and obligations. In making such UH Transfer, UH may elect to require the assignee or the transferee (hereafter collectively the "***UH Assignee***") to assume and be responsible for

performing all of UH's obligations under this Agreement with respect to the interest in or portion of the Easement Area or the Property acquired by the UH Assignee and as enumerated in transaction documents between UH and the UH Assignee. If UH makes such election, the UH Assignee shall be entitled to AES' compliance with the terms of this Agreement with respect to the transferred portion of the Easement Area and/or the Property.

(2) AES may review assignment documents. UH and AES acknowledge and agree that AES does not have the right to approve or consent to the UH Transfer to the UH Assignee, provided, that AES may review the provisions of the transactional documents relating directly to an assignment of rights under this Agreement if UH assigns any interest in or under this Agreement.

(3) UH released upon UH Transfer. Upon and to the extent of each UH Transfer, and from and after the effective date of the UH Transfer by UH to the UH Assignee, UH will be released and discharged from any further obligation or responsibility to AES with respect to the portion of the Easement Area or the Property transferred, whether or not the UH Assignee assumes the obligations under this Agreement pertaining to the transferred Easement Area or the Property.

(4) UH/AES responsible for remainder. Even if UH transfers a portion of the Easement Area or the Property to the UH Assignee as part of the UH Transfer, UH and AES shall remain responsible to each other for all obligations with respect to the portions of the Easement Area not yet transferred by UH as part of the UH Transfer.

8. AES has complied with all applicable Environmental Laws. AES is in compliance with all applicable Environmental Laws (as defined in paragraph 9e (Hazmat definition) of Exhibit C (General Terms and Conditions) herein) including, without limitation, conducting an environmental assessment in compliance with HRS Chapter 343 covering AES' proposed construction, operation, maintenance, repair and removal of the System and the issuance of the System Easement by UH to AES.

9. AES has obtained all HECO and governmental approvals. AES has obtained, at no cost to UH, any and all governmental approvals and permits and any HECO and State of Hawaii Public Utilities Commission ("***PUC***") approvals that may be necessary to develop, construct, and install the System, and to allow UH, without cost, risk, or adverse impacts to UH, to grant to AES the System Easement over the Easement Area, which will include the Exclusive Easement, the Access Easement, and the Utility Easement.

10. AES and AES Assignees are in compliance. Neither AES nor any of the AES Assignees shall be in breach or default of this Agreement, including but not limited to, performing and complying with AES obligations contained in Section I (Preconstruction Right of Entry), such as the Site Specific Conditions and the General Terms and Conditions.

11. AES has submitted traffic mitigation plans. AES shall have provided UH with AES' written traffic mitigation plans addressing the expected traffic impacts arising from the Due Diligence, the Authorized Activity, and/or any Adverse Impacts attributable thereto. AES shall consider and implement any reasonable comments on such plans submitted by UH.

12. AES has not materially adversely affected UH's existing use/access. AES shall verify and certify that UH's right to use and use of roads, easements, and utility facilities are not materially adversely affected by the Due Diligence or the Authorized Activity, except as otherwise agreed in writing by the parties from time to time. AES shall ensure that at all times UH and its invitees shall have reasonable access from and to all roadways, driveways, and parking areas within the Property, except as otherwise agreed in writing by the parties from time to time.

13. AES has implemented mitigation measures to resolve Adverse Impacts. AES and all of the AES Assignees shall have implemented, at no cost to UH, all management actions, operations, actions, improvements that are or were necessary to mitigate and resolve any and all of the Adverse Impacts, including obtaining all governmental approvals or permits and HECO approvals that are or were necessary to have implemented any required or recommended measures to mitigate the Adverse Impacts and allow UH operations to continue, as may be minimally modified to address any Adverse Impacts.

14. AES Agents bound. AES shall have caused the AES Assignees and the AES Agents to covenant and commit, to perform all obligations under this Agreement, including providing to UH sufficient assurance that AES incorporated into any agreements between AES and the AES Assignees and AES and the AES Agents such provisions from this Agreement as were necessary for AES to comply with its obligations under this Agreement.

15. AES inspection/investigation completed. AES shall have completed and caused the AES Assignees and the AES Agents to have completed all of the Due Diligence, including, without limitation, completing all inspections, examinations, investigations, studies, and testing of the Easement Area and the Property and the evaluation of the condition, status, and title to the Property and the Easement Area.

16. AES Certification. Before UH shall be obligated to grant the System Easement to AES (which will include the Exclusive Easement, the Access Easement, and the Utility Easement), AES shall and will ensure that any AES Assignee shall certify in writing to UH that AES and/or the AES Assignees, as of the date of certification, have fully satisfied and fulfilled each of the AES Preconditions.

17. Title Policy. Title Guaranty of Hawaii, LLC shall issue or be committed to issue to AES, at AES's expense, an ALTA owner's title policy, together with such endorsements thereto as AES shall require, in such amount as AES shall require, insuring the interests of AES in the System Easement.

III. UH Obligation to Issue System Easement to AES

1. UH to issue if/when AES meets Preconditions Deadline. Once AES fully satisfies and fulfills all of the AES Preconditions and certifies in writing to UH that AES has fully satisfied and fulfilled all of the AES Preconditions by the end of the Term ("***Preconditions Deadline***"), UH will issue the System Easement to AES, substantially in the form attached hereto as Exhibit D and incorporated herein by reference, which grant shall include UH granting the Exclusive Easement, the Access Easement, and the Utility Easement. UH will also execute, notarize and deliver a memorandum of the System Easement substantially in the form attached to the System Easement.

2. Key terms of System Easement. To the extent that AES fully satisfies and fulfills all of the AES Preconditions by the Preconditions Deadline and UH is obligated to issue the System Easement to AES, AES and UH agree that in addition to the System Easement being substantially in the form attached hereto as Exhibit E, the System Easement shall contain at least the following terms and conditions:

a. Easement Area. The Exclusive Area will be approximately sixty (60) to eighty (80) acres, with the area to be precisely set at the time UH will issue the System Easement based on an ALTA survey to be completed by AES at its cost and the mutual agreement of the Parties and will be more particularly shown on the map to be attached as Exhibit 2 to the System Easement and is preliminarily shown on Exhibit A attached hereto and incorporated herein by reference.

b. Authorized Activity. AES shall use the Exclusive Area only for the Authorized Activity (as defined in the attached System Easement) and for no other purpose or activities without UH's prior written approval, which shall not be unreasonably withheld, conditioned, or delayed.

c. Term. The term of the System Easement shall commence on the effective date of the System Easement and shall continue for twenty-five (25) years from the Commercial Operation Date (as defined in the attached System Easement and the RDG PPA) of the System ("***Easement Term***"), unless sooner terminated as hereinafter provided. AES shall have two (2) options to extend the Easement Term by five (5) years each.

d. Rent. [redacted]

(2) [redacted]

e. Construction. Construction and installation of all System Improvements (as defined in the attached System Easement) shall be: (i) at AES' sole cost and expense; (ii) performed by contractors properly licensed in the State of Hawaii who are obligated via written agreement with AES to construct and install the System Improvements; (iii) in compliance with all Applicable Laws (as defined in the attached System Easement), including any applicable county building codes; (iv) in compliance with all government approvals and permits, (v) performed only after AES installs and/or implements all required Mitigation Measures (as defined in the attached System Easement); and (vi) in compliance with the System Plans (as defined in the attached System Easement) submitted to UH by AES.

f. Operation/maintain. AES shall perform the Maintenance Work (as defined in the attached System Easement), at its sole cost. AES shall, with respect to UH Facilities and UH Research (all as defined in the attached System Easement) repair or replace any damaged portions and restore the Exclusive Area. AES and UH acknowledge and agree that AES shall repair and restore, at AES' cost, the Access Easement Area to its condition existing as of the System Easement effective date, promptly after System construction is completed, and maintain and keep the Access Easement Area in condition suitable for its required access during the Easement Term, at AES's cost, provided that AES will not be responsible for repairing any damage caused by others. AES shall pay to UH its pro rata share of any maintenance costs for the Access Easement Area, as reasonably determined in good faith by UH and AES.

g. Removal and restoration. Upon expiration or termination of the System Easement, UH may require AES to remove or cause the removal of all System Improvements, all at their sole cost and expense, and restore the Exclusive Area to a condition substantially similar to that which existed as of the System Easement effective date, reasonable wear and tear excepted. AES shall complete such removal of the System Improvements in accordance with the provisions contained in the attached System Easement.

h. Security Deposit. AES shall pay to UH a security deposit, or provide a letter of credit the terms of which are reasonably acceptable to UH, in the amount of [redacted] "***Security Deposit***").

i. Compliance with Applicable Laws. AES shall comply and shall ensure that the AES Agents comply with all Applicable Laws and shall be responsible for obtaining all necessary governmental and other approvals necessary to establish, develop, construct, install, operate, maintain, repair, improve, upgrade, renovate, replace, remove, and secure the System Improvements, including, without limitation, all land use, subdivision, easement, and construction approvals from the City and County of Honolulu and subdivision and easement approvals from the Office of the Assistant Registrar of the Land Court of the State of Hawaii.

j. AES Guarantee. [redacted]

3. UH no longer obligated to issue if Preconditions Deadline not met. If AES fails or does not otherwise meet the Preconditions Deadline, UH will not be obligated to issue or grant the System Easement to AES, unless UH and AES mutually agree to extend or modify the Preconditions Deadline.

IV. Other Provisions

1. Confidentiality. From time to time, AES may provide or disclose to UH information that AES may claim is either confidential or proprietary (collectively "***AES Confidential Information***") which AES shall clearly mark and separate from the non-confidential information. The AES Confidential Information shall not include information already known to UH, that is or becomes generally known or available to the public through no fault of UH, and/or that is disclosed to UH by a person or entity not under a confidentiality obligation. AES may orally request that UH keep such AES Confidential Information confidential if such information is not in a written format, and in such case shall identify and confirm such AES Confidential Information in writing to UH no later than fifteen (15) days after such disclosure. If the AES Confidential Information is in a written format, AES shall label, clearly mark, separate, and segregate such information as either confidential or proprietary.

a. UH will not disclose without AES permission. UH will not disclose AES Confidential Information without first obtaining AES permission unless (and to the extent that) UH is required to disclose any or all portions of the AES Confidential Information pursuant to any applicable public disclosure and open governmental records laws, including, without limitation, Chapter 92F, Hawaii Revised Statutes (collectively the "***Public Disclosure Laws***").

b. UH subject to Public Disclosure Laws. UH, as an agency of the State of Hawai'i, is subject to and must comply with all applicable Public Disclosure Laws. Under such Public Disclosure Laws, there is a presumption that all government records are subject to disclosure, unless and to the extent that one of the statutory disclosure exemptions are deemed to apply.

c. UH cannot guarantee confidentiality. As a result, UH agrees to reasonably preserve and protect the confidentiality of information obtained from AES during the term of this Agreement in the same or similar manner as UH preserves and protects UH's own information of similar form or nature; provided, however, AES acknowledges and agrees that in light of UH's obligations to comply with applicable public disclosure and open governmental records laws, UH cannot covenant or guarantee that any information that AES designates as proprietary or as AES Confidential Information and submits to UH will be kept confidential by UH in all situations and that UH may be required under such laws to publicly disclose such information submitted by AES.

d. UH to notify AES of requests to disclose records. UH understands AES' concern about not publicly disclosing any AES Confidential Information. In recognition of AES' concern, UH is willing to promptly use reasonable efforts to notify AES in writing if and when UH receives a notice or request to disclose any records relating to this Agreement, including any of the Due Diligence performed or to be performed by AES.

e. AES may take further protective action. After receiving such notice or otherwise becoming aware of a disclosure request, AES may, at its sole cost and expense and at no cost to UH, take such further action as it may deem necessary, including seeking a protective or other order that would limit, restrict, or prohibit disclosure of any records relating to this Agreement.

f. UH may disclose to government agencies/bodies. Notwithstanding UH's agreement to notify AES of any notice or request to disclose records relating to the Agreement, UH may, if required by law, disclose the Agreement, any of the terms contained therein, any supporting, backup, or related documents, and/or any portion of AES Confidential Information that UH deems responsive any request from federal, state, or county government agencies or bodies, including the Hawai'i State Legislature, without first notifying AES.

g. UH response procedure. The parties have agreed to the following procedure for responding to any requests to inspect or disclose any AES Confidential Information:

(1) Prompt notice. UH will use reasonable efforts to promptly notify AES upon receipt of a disclosure request.

(2) AES opportunity to challenge. After receiving UH's notice, AES may initiate or file a court or other challenge to limit, restrict, or prevent disclosure.

(3) AES responsible for costs. AES shall and will ensure that the AES Agents and AES Assignees shall be responsible for all costs and fees associated with such challenge.

(4) AES to reimburse UH. AES will reimburse UH for reasonable costs incurred by UH in cooperating with AES' efforts to limit, restrict, or prevent disclosure.

(5) AES to indemnify, defend UH. AES will indemnify, defend, and hold harmless UH from any costs and/or liability arising out of AES' efforts to limit, restrict, or prevent disclosure

h. Disclosure to HECO and PUC. AES may submit a fully executed copy of this Agreement to HECO or the PUC; provided that all confidential information, as reasonably determined by the Parties, is redacted from the copy of the Agreement shared with HECO or the PUC.

2. Brokers. UH represents that UH did not retain or use a broker in connection with this Agreement or the granting of the Easements. AES acknowledges that AES does not have any liability or obligation to pay any fees or commissions to any broker, finder or agent payable hereunder. AES shall indemnify, defend and hold harmless UH from the claims of any broker(s), representatives, employees, agent(s) or other intermediary(ies) claiming to have represented AES or otherwise to be entitled to compensation hereunder. This paragraph shall survive the expiration or the earlier termination of this Agreement.

3. Dispute resolution. If any disputes arise between UH and AES concerning any aspect of this Agreement, AES and UH will use their best efforts to address and resolve such disputes and the Parties agree to negotiate face-to-face within thirty (30) days of receipt of a letter describing the nature of the dispute and referencing this paragraph of this Agreement. The meeting will be held on the island of Oahu, Hawaii at the place of business of the Party receiving the letter unless the Parties mutually agree to meet at another place. In the event the matter is not resolved by negotiation within thirty (30) days of this initial negotiation meeting, the Parties shall engage a mediator and attempt to mediate the dispute. The Parties agree to try in good faith to settle the dispute by mediation under the mediation rules of a mutually acceptable alternative dispute resolution firm, before resorting to litigation. If the dispute is not resolved by mediation within sixty (60) days of the initial mediation meeting or such further time as the Parties may agree to, or if a Party does not cooperate with mediation, any Party may commence a legal action in the First Circuit Court, State of Hawaii, located in the City. The Parties will equally share the cost of the mediator services and the mediation sessions but each Party will bear the cost and expense of making its presentation to the mediator.

4. AES Default/UH Remedies.

a. Types of AES Defaults. The occurrence at any time of the following events shall constitute an "***AES Default***":

(1) Failure to Perform Obligations. AES's failure to timely perform or cause to be performed any obligation required to be performed by AES under this Agreement or any other agreement or commitment with UH, including, without limitation, the failure of any certification, representation and warranty set forth herein or otherwise delivered by or on behalf of AES to be true and correct at any time; provided, however, that if such failure by its nature can be cured, then AES shall have a period of sixty (60) days after receipt of written notice from UH of such failure of AES to perform its obligations and cure the AES Default.

(2) Failure to Obtain Sufficient Funding. AES's failure to obtain or caused to be obtained sufficient funding to complete the Due Diligence and/or the Authorized Activity, particularly any portion within or affecting the Use Area or the Property and AES fails to submit to UH documentation showing or proving, to UH's reasonable satisfaction, that AES has obtained or has caused to be obtained a commitment (within sixty (60) days of the Effective Date) to furnish sufficient funding to complete the Due Diligence and/or the Authorized Activity with respect to the Use Area or the Property.

(3) AES fails to timely complete Due Diligence. AES's failure to complete the Due Diligence upon the Use Area by the end of the Term, as may be extended from time to time upon UH's consent, which consent shall not be unreasonable withheld, delayed, or conditioned ("***Completion Deadline***"), or at any time AES fails to

submit to UH written evidence or documentation sufficient to show or prove, to UH's reasonable satisfaction, that AES will complete the Due Diligence and the Authorized Activity by no later than the Completion Deadline.

(4) AES Bankruptcy Actions. (a) AES admits in writing its inability to pay their debts generally as they become due; (b) AES files a petition or answer seeking reorganization or arrangement under the federal bankruptcy laws or any other applicable law or statute of the United States of America or any State, district, or territory thereof; (c) AES makes an assignment for the benefit of creditors; (d) AES consents to the appointment of a receiver of the whole or any substantial part of its assets; (e) AES has a petition in bankruptcy filed against it, and such petition is not dismissed within 120 days after the filing thereof; (f) a court of competent jurisdiction enters an order, judgment, or decree appointing a receiver of the whole or any substantial part of AES' assets, and such order, judgment or decree is not vacated or set aside or stayed within sixty (60) days from the date of entry thereof; or (g) under the provisions of any other law for the relief or aid of debtors, any court of competent jurisdiction shall assume custody or control of the whole or any substantial part of the assets of AES and such custody or control is not terminated or stayed within sixty (60) days from the date of assumption of such custody or control (collectively "***AES Bankruptcy Actions***").

(5) Abandonment. When AES shall abandon, desert, or vacate the Use Area and/or the Property, or any relevant portions thereof, or discontinues conducting the Due Diligence and/or the Authorized Activity on or at the Use Area and/or the Property.

(6) Suspension. The happening of any act that results in the suspension or revocation by any governmental authority or HECO of any of AES' rights, powers, licenses, permits, or authorities, including any governmental or HECO approvals, necessary for the conduct and operation of AES' business for a period of more than sixty (60) consecutive days.

(7) Liens. Any Liens (as defined herein) are filed against or affecting the Use Area and/or the Property because of any act or omission of AES, AES Assignees, and/or AES Agents and such Liens are not removed or enjoined or a bond or other security for satisfaction of such Liens is not posted within sixty (60) days.

(8) Insurance Default. AES fails to obtain or keep in force or cause to be obtained or kept in force any insurance coverage identified in paragraph 2 (Insurance) of the General Terms and Conditions (Exhibit C) herein at all times that such insurance policy or policies is/are required to be obtained and/or kept in force or caused to obtained and kept in force hereunder.

b. Notice of default. If AES defaults on or otherwise fails to perform any of their material obligations under this Agreement, UH shall issue a written notice of default to AES in accordance with paragraph I.20 (Notice) of the Agreement.

c. Time to cure defaults. Any and all defaults or failures to perform contained in such notice of default must be resolved and remedied to UH's reasonable satisfaction expeditiously (with special efforts made by AES whenever there is any hazard to health or safety arising out of a AES Default), but not later than sixty (60) days of the date of UH's written notice to AES. In cases when, through no fault of AES, it is not possible to cure a AES Default within sixty (60) days of UH's notice of default, then AES's obligations under this paragraph III.4 (AES Defaults/UH Remedies) shall be deemed satisfied if AES commences, within sixty (60) days of the notice of default, efforts necessary to cure the AES Default as soon as reasonably possible and diligently continues such efforts until the AES Default is cured or resolved to UH's reasonable satisfaction. If AES fails to cure the AES Default or either fails to perform within the required time period or fails to immediately pay to UH said costs and expenses incurred by UH (plus 10% for UH's administrative overhead) in performing said cure or remedy, UH may by written notice immediately terminate AES's rights under this Agreement which shall be effective upon AES's receipt or imputed receipt of such notice.

d. UH remedies upon AES Default. All UH remedies described herein shall be cumulative and not exclusive and UH may pursue one or more of such remedies.

(1) Termination of AES Rights. If an AES Default has occurred and is continuing, then, unless AES shall cure the AES Default before the end of the applicable cure period (if any), UH may terminate AES's rights under this Agreement and pursue all other applicable remedies for claims arising out of the AES Default.

(2) Suspension of AES's rights to use. If an AES Default has occurred and is continuing, then, unless AES shall cure the AES Default before the end of the applicable cure period (if any), UH may suspend AES's rights under this Agreement and any other agreement relating to the Authorized Activity and pursue all other applicable remedies for claims arising out of the AES Default.

(3) Other Rights and Remedies. If any AES Default has occurred, whether or not UH has terminated AES' rights under this Agreement, UH may continue to hold AES responsible for any damages arising from such AES Default and enforce any and all obligations of AES under this Agreement, including, without limitation, obligations regarding insurance, coordination, compliance with Applicable Laws, hazardous materials, liens, surrender, clean up, restoration, remediation, default, funding limitations, litigation, assignment, and representations.

e. Survival of obligations. Any termination or cancellation of this Agreement, in whole or in part, shall not relieve AES of any of its obligations contained in this Agreement that are intended to survive the expiration or termination of this Agreement, including, without limitation, the following AES obligations that are intended to survive the expiration or termination of this Agreement: obligations regarding insurance, coordination, compliance with Applicable Laws, hazardous materials, liens, surrender, clean up, restoration, remediation, default, funding limitations, litigation, assignment, and representations.

f. Accrued obligations. AES's obligations that AES was required to perform and/or complete prior to any termination or expiration of this Agreement, including, without limitation, the obligation to fully and properly address and mitigate all Adverse Impacts and comply with the Site Specific Conditions, shall survive the expiration or earlier termination of this Agreement.

5. UH Limitations.

a. UH Not Authorized to Indemnify. AES acknowledges and agrees that UH, as an agency of the State of Hawai'i, is not authorized to indemnify AES in any way, including against any claims for bodily injury, wrongful death and/or property damage by any person or entity. Notwithstanding anything to the contrary contained in this Agreement, UH shall have no contractual duty to indemnify, defend, or hold harmless AES, the AES Agents, the AES Assignees, and/or any other person or entity under any circumstances arising out of or related to this Agreement or AES's entry onto or temporary use of the Use Area and/or the Property. In each instance in this Agreement where UH is or may be obligated to indemnify, defend, or hold harmless AES, the AES Agents, the AES Assignees, and/or any other person or entity, such obligations shall be deemed null and void and such contrary indemnity, defense, and hold harmless obligations and provisions shall be deemed to be superseded by this provision, and of no force or effect.

b. UH Not Responsible for Others. Notwithstanding anything to the contrary contained in this Agreement, AES acknowledges that UH can only be held responsible for the actions of UH and UH's officers and employees, and AES shall not hold UH responsible for any actions or omissions of any other person or entity, including any person or entity who (except for UH's officers and employees) could be deemed to be UH Agents. In each instance in this Agreement where UH is obligated to assume responsibility for the actions or omissions of any person or entity other than UH's officers or employees, such obligations shall be deemed null and void and such contrary UH responsibility obligations or provisions shall be deemed to be superseded by this provision, and of no force or effect. AES acknowledges that this provision, in itself, shall not constitute or be interpreted to be any type of indemnification, defense, or hold harmless obligation of UH.

c. Subject to Funding. To the extent that UH is: (1) obligated to perform under this Agreement, (2) obligated to make any payments under this Agreement, or (3) deemed liable under this Agreement, UH's liability and obligation and ability to perform under this Agreement, particularly to pay any amount of monies, is limited to that which is permitted by law and is subject to the precondition that funds are properly appropriated, allotted, and otherwise properly made available for the purpose of such performance or to cover such liability.

(1) Minimum Conditions. At a minimum, the following conditions must be satisfied in order for funding to be made properly available: (a) the Hawaii State Legislature shall have appropriated sufficient funding to satisfy such obligations or liabilities; (b) the Governor of the State of Hawaii shall have authorized the use of such funds for satisfying such obligations or liabilities; and (c) the satisfaction of conditions, if any, imposed by the Hawaii State Legislature and/or the Governor on the use of such funds.

(2) UH to Seek Funding. UH shall use reasonable good faith efforts to have funds properly appropriated, allotted, or made available for such purposes (including, without limitation, obtaining legislative and Governor's authorizations for use of such funds) and to satisfy any such conditions in a timely manner.

(3) Qualifies All UH's Obligations. Notwithstanding anything to the contrary contained in this Agreement, this provision shall apply to and qualify each and every UH obligation to perform under this Agreement.

d. Subject to UH Limitations. Subparagraphs IV.5.a *(UH not Authorized to Indemnify)*, IV.5.b *(UH not Responsible for Others)* and IV.5.c *(Subject to Funding)* are referred to collectively herein as the "***UH Limitations***." Notwithstanding and superseding anything to the contrary contained in this Agreement (and any exhibits or appendices attached hereto), AES acknowledges and agrees that any and all of UH's obligations, duties, responsibilities, and liabilities under this Agreement and UH's liability for and/or ability to perform such obligations, duties, and responsibilities hereunder (including any that are intended to survive and/or survive the expiration or termination of this Agreement) are expressly subject to and limited by the UH Limitations.

6. No Partnership. It is expressly understood and agreed by and between UH and AES that UH shall in no way be nor for any purpose become or be construed to become a partner of AES in the conduct of AES' business, or otherwise, or a joint venturer or a member of a joint enterprise with AES or to have a principal/agent or employer/employee relationship, and UH does not assume responsibility for AES' conduct or performance under this Agreement. UH and AES acknowledge and agree that there are no third-party beneficiaries to this Agreement.

7. Entire Agreement. UH and AES agree that this Agreement, the proposed System Easement, and any memorandum or short form of the System Easement contain all of the agreements, promises and understandings between UH and AES as to the Easement Area. No oral agreements, promises or understandings shall be binding upon UH and AES in any dispute, controversy or proceeding at law. Any addition, variation or modification to this Agreement shall be void and ineffective unless made in writing and signed by UH and AES.

[Remainder of page intentionally left blank]
[Signature page to follow]

8.

IN WITNESS, WHEREOF, AES and the UH have, by their duly authorized officers, duly executed and entered into this Agreement as of the Effective Date.

AES:

AES WEST OAHU SOLAR, LLC,
a Delaware limited liability company

By _____

Print Name: Woody Rubin

Title: President

UH:

UNIVERSITY OF HAWAI'I, the state university and a body corporate of the State of Hawai'i

By _____
David Lassner
Its President

By _____
Jan S. Gouveia
Its Vice President for Administration

Recommend Approval:

By _____
Manette K. P. Benham
Chancellor
University of Hawaii – West Oahu

Approved as to Form:

Office of University General Counsel

_____
Bruce Y. Matsui
Associate General Counsel

8.

IN WITNESS, WHEREOF, AES and the UH have, by their duly authorized officers, duly executed and entered into this Agreement as of the Effective Date.

AES:

AES WEST OAHU SOLAR, LLC,
a Delaware limited liability company

By_____
Print Name: _____
Title: _____

UH:

UNIVERSITY OF HAWAI'I, the state university and a body corporate of the State of Hawai'i

By_____
David Lassner
Its President

By_____
Jan S. Gouveia
Its Vice President for Administration

Recommend Approval:

By _____
Manette K. P. Benham
Chancellor
University of Hawaii – West Oahu

Approved as to Form:

Office of University General Counsel

_____
Bruce Y. Matsui
Associate General Counsel

8.

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AES:

AES WEST OAHU SOLAR, LLC,
a Delaware limited liability company

By_____
Print Name: _____
Title: _____

UH:

UNIVERSITY OF HAWAI'I, the state university and a body corporate of the State of Hawai'i

By_____
David Lassner
Its President

By_____
Jan S. Gouveia
Its Vice President for Administration

Recommend Approval:

By_____
Manette K. P. Benham
Chancellor
University of Hawaii – West Oahu

Approved as to Form:

Office of University General Counsel

_____
Bruce Y. Matsui
Associate General Counsel

EXHIBIT A
Use Area

Use Area is defined as the green area identified in the figure below.

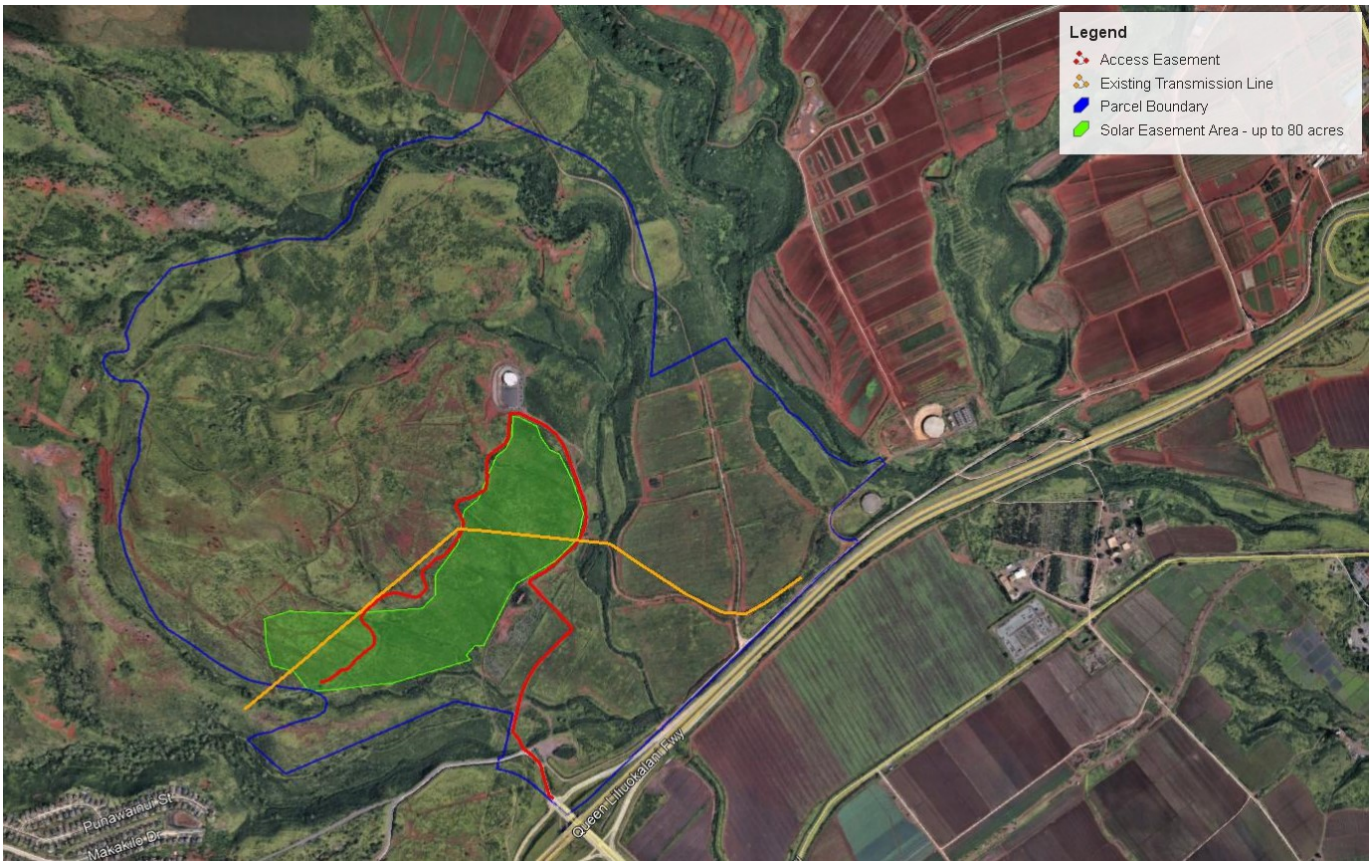

EXHIBIT B
Site Specific Conditions

1. **Due Diligence**. AES shall be permitted to conduct the following Due Diligence activities on, within, adjacent to, and/or involving the Use Area and the Property (as marked on the map attached hereto as Exhibit A):

   a. Soil test boring locations. For the Due Diligence that involves invasive investigation and testing, such as soil test boring work, AES must obtain UH's prior written approval before commencing any such invasive investigation and testing, such as the soil test boring work, including, without limitation, obtaining UH's prior written approval for extent, manner, and locations of all areas within which such invasive investigation and testing work is to be conducted, such as the soil test boring locations and the volume and extent of the drilling, excavation, and soil displacement work. UH's written approval shall not be unreasonably withheld.

   b. Soil backfill. Upon completion of any soil test boring work, AES shall and will ensure that the AES Agents and AES Assignees fill in any holes, boreholes, depressions, cavities, pits, and voids created by such soil test boring work (collectively the "***Holes***") with soil material from the area in and around the Holes, provided that the use of such soil material does not create separate Holes that need to be filled. To the extent that there is insufficient soil material under these conditions to fill in the Holes, AES shall be permitted to place import soil material to fill in the Holes, in quality and quantities reasonably acceptable to UH.

   c. Sampling and testing of imported soil. AES shall and will ensure that the AES Agents and AES Assignees shall conduct sampling and testing of all soil brought in or imported to fill Holes within the Use Area and/or the Property and perform or have performed an analysis of the results of such sampling and testing to determine the extent that any such soil may be contaminated with any Hazardous Materials (as defined herein). Such sampling, testing, and analysis shall be conducted and/or performed using methods that are acceptable to UH, particularly the UHWO Environmental Health and Safety Office.

   d. Sufficiently compact Holes. AES shall and will ensure that the AES Agents and AES Assignees adequately and sufficiently compact the backfill or soil material placed in any of the Holes created by AES, the AES Agents, and/or the AES Assignees during the Due Diligence, particularly within the Use Area and any other affected portions of the Property. If requested by UH, AES will permit UH to review the results of the backfill density tests by or from AES, the AES Agents, and/or the AES Assignees.

   e. Traffic management plan. AES shall submit to UH for UH's review and approval a traffic management plan that mitigates and manages traffic impacts arising from and/or attributable to the Due Diligence and the Authorized Activity on, within, or involving the Use Area and/or the Property.

   f. Replacing UH Facilities. AES acknowledges that UH may have some improvements comprising portions of UH Facilities and trees within the Use Area, including fences, barriers, and utility systems. To the extent that any portion of said improvements and/or trees, particularly any fences, barriers, and/or utility systems are removed or destroyed in connection with the Due Diligence or Authorized Activity, AES shall replace and/or ensure that the AES Agents and AES Assignees replace any said improvements and/or trees so removed or destroyed, with improvements and trees to UH's reasonable satisfaction.

   g. Damage repair. AES shall promptly maintain and repair and ensure that the AES Agents and AES Assignees shall promptly maintain and repair any damage to UH Facilities (including any improvements, fences, barriers, and utility systems), trees, the Use Area, and/or the Property, to the extent caused by AES, the AES Agents, and/or the AES Assignees in connection with the Due Diligence or the Authorized Activity.

   h. Other permitted Due Diligence. Subject to this paragraph 1, the Due Diligence that AES is authorized to perform under this Agreement shall include conducting any and all feasibility and investigative studies, physical inspections, testing, measuring, and other due diligence efforts, conducting geological,

engineering, soil tests, archaeological and/or environmental studies or reports, investigating the grading, drainage and utility requirements necessitated by AES' proposed development, construction, and operation of the System, and reviewing and evaluating any conditions of approval imposed by HECO and/or the City or any other governmental entity or agency relating to AES' proposed development, construction, and/or operation of the System.

2. **Third Party Rights**. At all times, including but not limited to when accessing the Use Area and/or the Property and in performing any Due Diligence, AES shall honor and shall cause the AES Agents and the AES Assignees to honor the rights of, the holders of easements (including but not limited to easements for drainage, sewer lines, fuel lines, and water lines) on or under the Use Area and/or the Property and users of utility facilities affected by the Due Diligence on or within the Use Area and/or the Property. Without limiting the generality of the foregoing, AES shall be responsible and shall cause the AES Agents and the AES Assignees to be responsible for the following:

   a. Ensure no adverse drainage impacts. AES shall ensure and shall cause the AES Agents and the AES Assignees to ensure that the Due Diligence on or within the Use Area and/or the Property does not cause adverse drainage impacts at, within, under, or affecting the Use Area and/or the Property, including but not limited to, implementing measures to: (1) ensure that no additional runoff over and above any UH drainage system capacity is directed onto, across, or through the Use Area and/or the Property into any such existing drainage system, including any and all portions thereof such as drainageways, swales, intakes, tunnels, and/or pipelines and (2) decrease the risk of ponding or flooding because of the Due Diligence on or within the Use Area and/or the Property.

   b. Ensure no adverse fuel line impacts. AES shall ensure and shall cause the AES Agents and the AES Assignees to ensure that the Due Diligence on or within the Use Area and/or the Property does not cause adverse impacts with respect to existing fuel lines within, under, or affecting the Use Area and/or the Property.

   c. Ensure no adverse sewer system impacts. AES shall ensure and shall cause the AES Agents and the AES Assignees to ensure that the Due Diligence does not cause adverse impacts with respect to existing sewer lines facilities, and/or systems within, under, or affecting the Use Area and/or the Property.

   d. Ensure no impact to aquifer or other underground water resources. AES shall ensure and shall cause the AES Agents and the AES Assignees to ensure that the Due Diligence does not cause any adverse impacts to water or groundwater resources in, on, under the Use Area and/or the Property, including, ensuring that no work (including, any excavation, trenching, boring, drilling, grading, pile driving and other earth or soil movement or relocation work) adversely affects the groundwater aquifer or other water resources in, on, under the Use Area and/or the Property.

3. **Coordination Meetings**. AES shall facilitate and coordinate the scheduling of meetings with and cause the AES Agents and the AES Assignees to participate in the meetings among AES and UH, to be held on a reasonably periodic basis for the duration of the Due Diligence. AES shall notify UH in writing of the schedule for such meetings. As mutually agreed upon between AES and UH, AES shall ensure that UH is provided updates to the Due Diligence plan.

4. **Security**. Security for the Due Diligence shall be the responsibility of AES, the AES Agents, and/or the AES Assignees. AES shall cooperate and shall cause the AES Agents and the AES Assignees to cooperate with UH to enable UH to meet and satisfy all Applicable Laws, including satisfying all higher-education crime reporting requirements pursuant to the Clery Act.

5. **Irrigation and Water Lines**. AES shall verify and require that the AES Agents and the AES Assignees verify the location of all irrigation and water lines that may be situated on, within, under, and/or crossing the Use Area and/or the Property or the portions thereof affected by the Due Diligence and obtain UH's prior written approval for all plans to: (a) interrupt or temporarily stop water flow and (b) install temporary or permanent lines, pumps, facilities, equipment, and/or systems to continue to furnish water service to the Use Area and/or the Property at the same levels as existed prior to the commencement of the Due Diligence.

6. **Electrical and Communication Lines**. AES shall verify and require that the AES Agents and the AES Assignees verify the location of all electrical and communication lines that may be situated on, within, under, and/or crossing the Use Area and/or the Property, or portions thereof affected by the Due Diligence and obtain UH's prior written approval for all plans to: (a) interrupt or temporarily stop electrical or communication service and (b) install temporary or permanent lines, boosters, facilities, equipment, and/or systems to continue to furnish electrical and communication service to the Use Area and/or the Property at the same levels as existed prior to the commencement of the Due Diligence.

7. **Sewer and Drainage Lines**. AES shall verify and require that the AES Agents and the AES Assignees verify the location of all sewer and drainage lines that may be situated on, within, under, and/or crossing the Use Area and/or the Property or portions thereof affected by the Due Diligence and obtain UH's prior written approval for all plans to: (a) interrupt or temporarily stop or divert sewage or drainage flow and (b) install temporary or permanent lines, pumps, facilities, equipment, and/or systems to continue to handle the sewage and/or drainage flow to, through, and across the Use Area and the Property at the same capacity levels as was handled prior to the commencement of the Due Diligence.

8. **Existing Utility Lines.** With respect to paragraph 5 (Irrigation and Water Lines), paragraph 6 (Electrical and Communication Lines), and paragraph 7 (Sewer and Drainage Lines), UH will disclose to AES all information that UH may have with respect to any existing irrigation, water, electrical, communication, sewer, and drainage lines and facilities (collectively the "***Utility Lines***") on or within the Use Area. AES and UH acknowledge and agree, however, that UH does not have comprehensive information regarding the underground conditions and/or the Utility Lines within or under the Use Area from the time that UH acquired the Property from the State of Hawaii who at that time had recently accepted transfer of the Property from the Trustees of the Will and the Estate of James Campbell, Deceased ("***Campbell Estate***"). Campbell Estate may have permitted or installed Utility Lines under or within the Property. AES and UH acknowledge and agree that while UH will disclose to AES any information it may have with respect to the Utility Lines, UH does not have detailed maps showing the location of all such Utility Lines. To the extent UH does not inform AES of Utility Lines that UH had actual knowledge of and AES can prove that UH had such actual prior knowledge, AES will not be responsible for any damages AES may cause to such Utility Lines. AES and UH acknowledge and agree that UH shall not be responsible for any damages to any person or entity arising from AES' actions and/or omissions relating to any Utility Lines.

End of Exhibit B

EXHIBIT C
General Terms and Conditions

1. Indemnify and defend UH. As a condition to UH's grant of permission to AES to use the Use Area to conduct the Due Diligence and the Authorized Activity herein, at all times AES shall indemnify, defend with counsel reasonably acceptable to UH, and hold harmless UH, the UH's officers, employees, agents, representatives, and any person acting on behalf of UH (hereafter collectively the "***UH Agents***"), and ensure that the AES Agents and the AES Assignees shall indemnify, defend with counsel reasonably acceptable to UH, and hold harmless UH and the UH Agents, from and against any claims, demands, suits, actions, causes of action, judgments, injunctions, orders, rulings, directives, penalties, assessments, liens, liabilities, losses, damages, costs, and expenses (including the fees and costs of counsel reasonably acceptable to UH), by whomsoever incurred, sustained, or asserted, including, without limitation, claims for property damage, personal injury, bodily injury, death, lost revenues and other economic loss, and/or environmental damage, directly or indirectly arising from or connected with any of the following:

    a. Act or omission. Any act, omission, or exercise of rights or privileges under this Agreement by AES or any of AES' officers, employees, contractors, consultants, agents, representatives, and any person or entity acting on behalf of AES (collectively the "***AES Agents***").

    b. Casualty. Any accident, fire or other casualty on or involving the Use Area and/or the Property attributable to the acts or omissions of AES, the AES Agents, and/or the AES Assignees.

    c. Violation. Any violation or alleged violation by AES, the AES Agents, and/or the AES Assignees of any Applicable Laws (including, without limitation, Environmental Laws), arising from events, occurrences, or incidents at, on, within, or attributable to the use of the Use Area and/or the Property.

    d. Loss. Any loss or theft whatsoever of any property placed or stored by AES, the AES Agents, and/or the AES Assignees on or near the Use Area and/or the Property.

    e. Liens. Any Liens (as defined herein) that may be filed against any portion of the AES' Due Diligence or UH's interest in the Use Area and/or the Property, including, without limitation, AES' obligation to complete any action, proceedings, and/or processes necessary to fully waive, discharge, and release any Liens, all at AES' sole cost and expense.

    f. Misrepresentation. Any material misrepresentation or inaccuracy in any representation or warranty by AES, the AES Agents, and/or the AES Assignees under this Agreement.

    g. Challenge. Any challenge to the authority of AES, the AES Agents, and/or the AES Assignees to negotiate, enter into, execute, or perform obligations under this Agreement.

    h. Failure to perform. Any failure by AES, the AES Agents, and/or the AES Assignees in whole or in part, to fully and properly perform any of the terms and conditions contained in this Agreement, including, without limitation, the breach or default by AES, the AES Agents, and/or the AES Assignees in the performance of any of said terms and conditions of this Agreement.

    i. Removal. Any enforcement by UH of any provision of this paragraph 1 (Indemnify and defend UH) and any costs reasonably incurred in duly removing AES, the AES Agents, and/or the AES Assignees from the Use Area and/or the Property or restoring the same as provided herein.

    j. UH enforcement. Any actions by UH or others to enforce the terms and conditions of this Agreement, including the performance of any of the obligations of AES, the AES Agents, and/or the AES Assignees hereunder.

2. Insurance. AES shall, at no cost to UH, procure and maintain, or cause to be procured and maintained, the following insurance described below, which shall insure against loss arising from the operations of AES and all AES Agents and AES Assignees performing work on behalf of AES under this Agreement, during the entire term of this Agreement, issued by an insurance company or companies authorized to do business in the State of Hawai'i and reasonably satisfactory to UH:

a. Required Insurance Coverage.

(1) Commercial General Liability. Commercial general liability insurance covering claims with respect to injuries or damages to persons or property sustained as a result of the activities performed under this Agreement, including any of the AES Agents (such as AES' contractors), and the AES Assignees within, on, or about the Use Area and/or the Property, with minimum combined single limits of liability (written on an occurrence form) no less than the following:

General Liability

General Aggregate	$3,000,000.00
Products/Completed Operations Aggregate	$3,000,000.00
Personal/Advertising Injury	$3,000,000.00
Each Occurrence	$3,000,000.00

Such limits may be achieved through the use of umbrella/excess liability insurance sufficient to meet the requirements of this paragraph 2 (Insurance) above for the Use Area and/or the Property. Said policy or policies shall cover the Use Area and the Property, the conduct of the Due Diligence and the Authorized Activity therein, and all of the activities and operations of AES, the AES Agents, and the AES Assignees under this Agreement on, about and with respect to the Use Area and/or the Property.

(2) Automobile Insurance. Automobile Liability Insurance to include coverage for any owned (if AES has owned Autos), non-owned, or hired automobiles with limits of not less than the following

Automobile Liability

Bodily Injury – Per Person	$1,000,000.00
Bodily Injury – Per Accident	$1,000,000.00
Property Damage – Each Accident	$1,000,000.00

In the event there is a change in Hawai‘i law regarding financial responsibility and insurance requirements of automobile owners or users which make this requirement obsolete, UH shall have the right to impose a new requirement consistent with the then Applicable Laws.

(3) Workers' Compensation & Employer's Liability Insurance. Workers' compensation insurance as required by statute with respect to work performed in, on, involving, or in connection with the Use Area and/or the Property and employer's liability insurance with limits not less than:

Employers Liability

Bodily Injury – Each Accident	$500,000.00

Disease – Policy Limit	$500,000.00
Disease – Each Employee	$500,000.00

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AES shall ensure that the AES Agents (including the AES contractors) and the AES Assignees obtain workers compensation and employer's liability insurance with the limits described herein to cover the work performed in connection with the Due Diligence and/or the Authorized Activity by their respective employees on or involving the Use Area and/or the Property.

b. Common provisions. Each insurance policy that AES, the AES Agents, and/or the AES Assignees are obligated to obtain under this Agreement shall be subject to the following:

(1) Notice of change. Should any of the insurance policies be materially changed from the coverages and/or limits required herein, or cancelled before the expiration date thereof, AES shall provide UH with immediate notice of such changes. AES shall provide UH notice of (a) any act or omission by AES, the AES Agents, and/or the AES Assignees that would allow the insurer to terminate or modify any of the insurance coverage within two (2) business days of such act or omission (including, but not limited to, failure to renew an insurance policy or pay a required premium therefor) and (b) notice of cancellation, limitation in scope, material change, or non-renewal by the insurer within two (2) business days of receipt.

(2) Insurance obtained by UH shall apply in excess of AES insurance. Any insurance maintained by UH will apply in excess of, and not contribute with, insurance provided by AES, the AES Agents, and/or the AES Assignees under this Agreement.

(3) UH as additional insured. AES shall name UH, the UH Agents, and those persons or entities identified in writing from time to time by UH to AES, the AES Agents (including the AES contractors) and/or the AES Assignees, as additional insured on the insurance policies for all insurance coverage obligated to be obtained under this Agreement, except for Workers' compensation and employer's liability insurance.

(4) Waiver of subrogation endorsement. All insurance required under this Agreement will contain a waiver of subrogation endorsement in favor of UH.

(5) UH not required to pay premiums. AES, the AES Agents, and the AES Assignees shall be solely responsible for the costs of procuring and maintaining the insurance coverage described in this Agreement and shall not charge UH or expect UH to pay any portion of the premiums or charges to obtain the insurance coverage required under this Agreement.

(6) Acceptable deductibles. The terms and amounts of any deductibles for the insurance policies required under this Agreement must be reasonable and acceptable to UH based upon the type of insurance involved and the nature of the Authorized Activity, use of the Use Area by AES, the AES Agents, and/or the AES Assignees, and/or the conduct of activities on or within the Use Area by AES, the AES Agents, and/or the AES Assignees.

(7) AES to ensure compliance. AES shall ensure that the AES Agents and the AES Assignees obtain the insurance coverages required paragraph 2a (Required Insurance Coverage) herein and that they comply with the provisions as described in paragraph 2b (Common provisions), paragraph 2c (Deposit insurance certificates), paragraph 2d (UH may cure failure to obtain/maintain insurance), paragraph 2e (Lapse in insurance constitutes a breach), paragraph 2f (Insurance shall not limit AES liability), and paragraph 2g (UH may adjust insurance requirements) herein.

c. Deposit insurance certificates. AES shall (a) deposit with UH, on or before the Effective Date of this Agreement, certificates of insurance necessary to satisfy UH that the insurance provisions of this Agreement have been fully complied with and (b) keep such insurance in effect and the certificates therefor on deposit with UH during the entire Term of this Agreement.

d. UH may cure failure to obtain/maintain insurance. Upon failure by AES, the AES Agents (including the AES contractors), and/or the AES Assignees to provide and maintain the insurance required herein after a ten (10) day prior written notice to comply from UH, UH may, but shall not be required to, procure such insurance at the sole cost and expense of AES, the AES Agents, and/or the AES Assignees, and AES, the AES Agents, and/or the AES Assignees shall be obligated, upon demand from UH, to immediately reimburse UH for the cost thereof plus ten percent (10%) for UH's administrative overhead.

e. Lapse in insurance constitutes a breach. Any lapse in, or failure by AES to procure, maintain, and keep in full force and effect or cause the AES Agents (including the AES contractors) or the AES Assignees to procure, maintain, and keep in full force and effect such insurance coverage as is required under this Agreement, at any time during and throughout the Term of this Agreement, shall be a breach of this Agreement and UH may terminate the rights of AES, the AES Agents (including the AES contractors), and the AES Assignees to access and/or use the Use Area and/or the Property.

f. Insurance shall not limit AES liability. The procuring of such required policy or policies of insurance shall not be construed to limit AES' liability hereunder or to fulfill the indemnification provisions and requirements of this Agreement. Notwithstanding said policy or policies of insurance, AES shall be responsible for complying with AES' obligations under paragraph 1 (Indemnification by AES) herein.

g. UH may adjust insurance requirements. UH may, upon reasonable notice and reasonable grounds, increase or change the form, type, coverage, or coverage limits of the insurance required hereunder, in which event AES shall obtain such required insurance. UH requirements shall be reasonable and shall be designed to provide protection from and against the kind and extent of risks that exist at the time a change in insurance is required.

h. UH may scale back insurance requirements. AES may request a scale back or waiver of some of the insurance requirements hereunder as it may apply to "non-major" AES Agents. AES would be required to submit such scale back requests to the University with written justification. The University will consider each AES request on a case by case basis and may, in UH's sole discretion, grant, deny, and/or modify, in whole or in part, any such scale back request., including, but not limited to, denying such request because UH considers the AES Agents involved to be a significant or major AES Agent.

3. Comply with Applicable Laws. In using the Use Area, AES shall, and shall ensure that the AES Agents and the AES Assignees shall, comply with all applicable laws, statutes, ordinances, rules, regulations, orders, and directives of any federal, state, or county governments (collectively "***Applicable Laws***"), including all laws relating to Hazardous Materials (as defined herein), and all applicable UH rules, policies, procedures, and guidelines provided by UH to AES relating to the use of the Use Area and the Property.

4. AES responsibility for AES Agents and AES Assignees. AES shall be responsible for the conduct of all of those involved with AES' use of the Use Area and the conduct of the Authorized Activity, including, without limitation, the AES Agents and the AES Assignees and their officers, employees, contractors, consultants, suppliers, vendors, agents, representatives, and all those assisting with and/or participating in the Due Diligence, the Authorized Activity, and the AES, AES Agents, and the AES Assignees activities or use of the Use Area.

5. Maintenance of Use Area. To the extent that the Authorized Activity involves the use of any UH Facilities or access through any portion of the Property, AES shall, at its sole cost and expense, keep and maintain and ensure that the AES Agents and the AES Assignees keep and maintain, the Use Area, the portions of the

Property used by AES, the AES Agents, and/or the AES Assignees or affected by the Authorized Activity and any UH Facilities used or affected in good condition and repair during the term of this Agreement, normal wear and tear excepted. AES may not construct or install and shall ensure that the AES Agents and the AES Assignees do not construct or install any short term improvements or structures within the Use Area and/or the Property, without first obtaining the UH's prior written approval for all plans, specifications, drawings, and schedules for such improvements and structures. AES understands that AES, the AES Agents, and the AES Assignees will not be permitted to construct any permanent or long term improvements or structures without UH's prior written approval and the granting of an appropriate property or other interest from UH. AES, the AES Agents, and/or the AES Assignees shall bear and pay for all costs associated with the construction and installation of any improvements or structures, including any Due Diligence, and UH shall not be required to pay for any such costs. AES shall not have the right to connect and will ensure that the AES Agents and the AES Assignees do not connect to any of UH's utility, sewer, or drainage lines or facilities without first obtaining the UH's prior written approval and only if AES, the AES Agents, and/or the AES Assignees bear the entire cost of such connections, including installing such meters and measuring devices to ensure that UH does not incur any cost or expense relating to AES', the AES Agents', and/or the AES Assignees' connection to or use of UH's utility, sewer, and/or drainage lines and facilities.

6. AES Responsibility for Cleanup. Upon the expiration or sooner termination of this Agreement or at the end of the Due Diligence and the Authorized Activity, whichever event occurs first, AES shall be responsible, at AES' sole cost and expense, for completing and ensuring that the AES Agents and the AES Assignees complete the following: (a) removing and disposing of all trash, debris, and rubbish generated from or by the Due Diligence and/or the Authorized Activity or AES', the AES Agents', and/or the AES Assignees' use of the Use Area, (b) removing all equipment, utility lines, sewer lines and components, temporary structures, devices, tools, and other personal property (collectively the "***Personal Property***") (or to the extent such removal may be directed by UH) and (c) cleaning up and restoring the Use Area to the condition it was in before AES', AES Agents', or AES Assignees' use of the Use Area, subject to ordinary wear and tear and in accordance with the guidelines furnished by UH.

   a. AES failure to clean up. If AES fails to remove and/or clean up and restore the Use Area and/or the Property or fails to cause the AES Agents and/or the AES Assignees to complete any such required removal and/or clean up and restoration of the Use Area and/or the Property, to the same condition as required hereunder, as determined by UH, UH may complete such restoration, removal, and clean-up, at the cost and expense of AES, the AES Agents, and/or the AES Assignees, which amount AES, the AES Agents, and/or the AES Assignees shall immediately pay to UH upon demand by the UH plus ten percent (10%) for UH's administrative overhead.

   b. AES failure to remove Personal Property. In the event AES fails to timely remove or fails to cause the AES Agents and AES Assignees to timely remove the Personal Property from the Use Area and/or the Property, UH may, but shall not be obligated to do either of the following, all without incurring any cost or liability to AES, the AES Agents, and/or the AES Assignees: (i) remove the Personal Property, and treat the Personal Property as abandoned and dispose of the same, or (ii) store the Personal Property at the sole cost and expense of AES, the AES Agents, and/or the AES Assignees, which amount AES, the AES Agents, and/or the AES Assignees shall immediately pay to the UH upon demand by UH, plus ten percent (10%) for UH's administrative overhead.

7. AES Responsibility for Damage. AES, the AES Agents, and/or the AES Assignees shall be responsible, at their sole cost and expense, for repairing any damage to the Use Area and/or the Property that is caused by or attributable to the Due Diligence, the Authorized Activity, and/or the use of the Use Area and/or the Property by AES, the AES Agents, and/or the AES Assignees, including any damage caused by the AES Agents and/or the AES Assignees.

   a. AES to obtain approval for repairs. In effecting such repairs, AES acknowledges that AES, the AES Agents, and/or the AES Assignees will need to obtain UH's prior written approval for any such repairs (which may need to be coordinated with UH personnel responsible for the maintenance and upkeep of the Use Area and the Property).

b. AES to deposit estimated repair cost. AES, the AES Agents, and/or the AES Assignees may be required to deposit the estimated cost of such repairs with UH before the commencement of any repair work and pay any additional costs incurred upon demand from UH, plus ten percent (10%) to cover UH's administrative overhead. Initial payment to repair any such damages shall be made within fourteen (14) days after the end of the Due Diligence, the Authorized Activity, and/or the term of this Agreement during which such damage occurred or was discovered.

c. UH not responsible for damage or theft. UH shall not be responsible for damage, vandalism or theft to the property of AES, the AES Agents, and/or the AES Assignees including, but not limited to, damage, vandalism or theft of property (such as automobiles and their contents) occurring on or within the Use Area and/or the Property.

8. Termination. [Reserved]

9. Hazardous Materials. AES shall not, and shall ensure and require that the AES Agents and the AES Assignees shall not, cause or permit:(a) the escape, disposal, or release of any Hazardous Materials (as defined herein) except as permitted by law, (b) the storage or use of such Hazardous Materials in any manner not sanctioned by law or the highest standards prevailing in the industry for the storage and use of such Hazardous Materials, or (c) such Hazardous Materials to be brought on or within the Use Area and/or the Property, except to use in the ordinary course of business, and then only after written notice is given to UH of the identity of such Hazardous Materials and upon UH's consent, which consent may be withheld at UH's sole and absolute discretion.

a. Remediate, clean up and restore. In the event that any Hazardous Materials are used, stored, treated, or disposed on or within the Use Area and/or the Property, or handled, discharged, released, or determined to be present on or from the Use Area and/or the Property due to, caused by, or attributable to the acts or omissions of AES, the AES Agents, and/or the AES Assignees, AES, the AES Agents, and/or the AES Assignees shall, at their cost and expense and at no cost to UH, remediate the affected portions of the Use Area and/or the Property, of any such Hazardous Materials, and dispose/remove said Hazardous Materials. In addition, AES, the AES Agents, and/or the AES Assignees agree to restore the affected portions of the Use Area and/or the Property, at their cost and expense and at no cost to UH, to the same condition in which they existed at the commencement of this Agreement, to UH's satisfaction.

b. Failure to remediate and restore. In the event AES, the AES Agents, and/or the AES Assignees fail to remediate and restore the affected portions of the Use Area and/or the Property to the same condition as required hereunder, as determined by UH, after a ten (10) day prior written notice to comply from UH, AES, on behalf of itself and the AES Agents and/or the AES Assignees, agrees that UH may complete such remediation and restoration at the cost and expense of AES, the AES Agents, and/or the AES Assignees, which amount AES, the AES Agents, and/or the AES Assignees shall immediately pay to UH upon demand by UH, plus ten percent (10%) for UH's administrative overhead.

c. Indemnify and defend. AES, the AES Agents, and/or the AES Assignees shall indemnify, defend with counsel reasonably acceptable to UH, and hold harmless UH and the UH Agents from any liability that may arise in connection with, or by reason of, the release or presence of Hazardous Materials or any occurrence involving any Hazardous Materials that may be alleged to be connected to, or related in any way with the Due Diligence, the Authorized Activity and/or use of the Use Area by AES, the AES Agents, and/or the AES Assignees.

d. UH has no obligation to remediate or correct. AES and UH acknowledge and agree that during the conduct of the Due Diligence or the Authorized Activity, AES may discover existing Hazardous Materials conditions on, within, or under the Use Area and/or the Easement Area. If such discovery occurs, AES and UH acknowledge and agree that AES has agreed to accept the Use Area and the Easement Area in its "as is" condition with no representations or warranties from UH. In no way whatsoever shall UH be obligated to remediate or clean up Hazardous Materials in order to allow AES, the AES Agents, the AES Contractors, and/or the AES Assignees to construct, install, operate, maintain, repair, and/or remove the System. Any decision by the University to engage in remediation expenditures

shall be at the sole discretion of the University and AES shall have no right to force the University to remediate Hazardous Materials, even if such Hazardous Materials conditions or environmental issues existed before AES, the AES Agents, the AES Contractors, or the AES Assignees entered the Use Area, the Easement Area and/or the Property.

e. Hazmat definition. **"**Hazardous Materials**"** means any substance, element, compound, mixture or solution: (a) the presence of which requires investigation or remediation under any federal, state or county statute, regulation, ordinance, order, action, and/or policy (collectively the "***Environmental Laws***") or common law; or (b) which is now or at any time hereafter in effect becomes defined as a "hazardous waste," "hazardous substance," pollutant or contaminant under any Environmental Laws; petroleum, fuel oil, sludge, crude oil or residue, trichloropropane; or (c) which is toxic, explosive, corrosive, flammable, infectious, radioactive, carcinogenic, mutagenic, or otherwise hazardous and is or becomes regulated by any governmental authority; or (d) the presence of which causes or threatens to cause a nuisance upon or within the Use Area and/or the Property, or to adjacent properties or poses or threatens to pose a hazard to the health or safety of persons, to property or to the environment.

10. No Liens. AES shall not, and shall ensure that the AES Agents and AES Assignees shall not, commit or suffer any act or neglect whereby any portion of the Use Area and/or the Property, or any part or parts thereof, at any time during the term hereof, shall become subject to any attachment, lien, charge, or encumbrance whatsoever (hereafter collectively the "***Liens***").

    a. AES shall remove Liens. AES shall take and will cause the AES Agents, and/or the AES Assignees to take immediate action to discharge, eliminate, or remove the Liens, including, without limitation, bonding or posting other security until the discharge, elimination, or removal is finally determined and the Liens resolved and discharged.

    b. UH may act if AES fails to timely remove. If UH reasonably determines that AES, the AES Agents, and/or the AES Assignees are not taking timely action or may be unsuccessful in its efforts to discharge, eliminate, or remove the Liens, UH may after a ten (10) day prior written notice to comply to AES, the AES Agents, and/or the AES Assignees: (1) at the sole cost and expense of AES, the AES Agents, and/or the AES Assignees take such action as UH deems necessary, including, without limitation, seeking judicial or administrative action or intervention to discharge, eliminate, and/or remove the Liens and/or (2) treat AES, the AES Agents, and/or the AES Assignees to be in breach or default of this Agreement and terminate the rights of AES, the AES Agents, and/or the AES Assignees under this Agreement. AES shall immediately pay and will ensure that the AES Agents and the AES Assignees immediately pay to UH such costs as may be incurred by UH in discharging, eliminating, and/or removing the Liens (including a ten percent (10%) markup for UH's administrative overhead) upon demand by UH.

11. Dispute resolution. [Reserved]

12. Assignment. [Reserved]

13. Amendment. This Agreement shall not be amended except in writing signed by the parties.

14. Counterparts; facsimile signatures. This Agreement may be executed in counterparts, each of which shall be deemed an original, and said counterparts shall together constitute one and the same agreement, binding all of the parties hereto, notwithstanding all of the parties are not signatory to the original or the same counterparts. For all purposes, including, without limitation, recordation, filing, and delivery of this instrument, duplicate unexecuted pages of the counterparts may be discarded and the remaining pages assembled as one document. The submission of a signature page transmitted by email or facsimile (or similar electronic transmission facility) shall be considered as an "original" signature page for purposes of this Agreement.

15. AES representations. In addition to any other representations and warranties contained in this Agreement, AES hereto represents and warrants to UH as of the Effective Date of this Agreement that:

    a. Duly organized. AES is duly organized, validly existing, and in good standing in the jurisdiction of its organization.

b. Full right and authority. AES has the full right and authority and has taken all requisite corporate or other action to enter into, execute, deliver, and perform its obligations under this Agreement.

c. Has obtained all requisite approvals. AES has obtained all approvals and consents that are necessary to fully authorize and empower AES to validly enter into this Agreement and has obtained or shall timely obtain all approvals and consents that are necessary to perform all of the obligations of AES under this Agreement.

d. Agreement is a binding obligation. AES represents and warrants that this Agreement constitutes a legal, valid, and binding obligation enforceable against AES in accordance with its terms, except as may be limited by applicable bankruptcy, insolvency, reorganization, moratorium, and other similar laws now or hereafter in effect relating to creditors' rights generally.

e. No litigation or investigation. There is no litigation, action, proceeding or investigation pending or, to the best of AES' knowledge, threatened before any court or other governmental authority by, against, or involving any of AES' business or assets that would affect AES' ability to carry out AES' obligations under this Agreement.

f. No other breach. Neither the execution and delivery of this Agreement by AES nor AES' compliance with any of the terms and conditions of this Agreement will result or results in a condition or event that would constitute (or that upon notice or lapse of time or both would constitute) an event of default under any material contractual obligation of AES in any other agreement to which AES is a party.

16. Force Majeure.

a. Obligations. During the duration of the Force Majeure Events (as herein defined), neither party shall be liable for any failure, delay, or interruption in performing its obligations hereunder due to causes or conditions beyond its reasonable control, including (but without limitation thereto) strikes, boycotts, picketing, slow-downs, work stoppages, or labor troubles of any other type, restrictions or requirements imposed by any present or future Applicable Laws; or by priorities, rationing, curtailment, or shortage of labor or materials, or by war, acts of terrorism, or any matter or thing resulting therefrom, or by embargoes, acts of God, severe weather or climatic conditions (such as storms, hurricanes, typhoons, earthquakes, tornadoes, volcanic eruptions, earth movements, tsunamis, and floods), acts of the public enemy, acts of superior governmental authority, riots, rebellion, sabotage, or by any other cause or causes beyond the reasonable control of the parties (collectively the "***Force Majeure Events***").

b. Not excused from performance. AES, however, shall not be excused from performing its obligations under this Agreement, if and to the extent that AES was provided access to the Use Area during the term of this Agreement, in which case AES will be responsible: (1) for the payment of amounts due to UH and (2) to perform AES' obligations under this Agreement

17. Severability. If any provision of this Agreement or the application thereof to any person, entity, or circumstance shall, to any extent, be deemed invalid, void, or unenforceable by a court of competent jurisdiction, the remainder of this Agreement, or the application of such provision to persons, entities, or circumstances other than those as to which it is invalid, void, or unenforceable, shall not be affected thereby, and each other provision of this Agreement shall be valid and enforceable to the full extent permitted by law.

18. Governing Law; Jurisdiction. This Agreement shall be governed by, interpreted, construed, and enforced in accordance the laws of the State of Hawai`i, without regard for choice of law rules. UH and AES agree that the State of Hawaii First Circuit Court, which covers the area of the Property, shall have jurisdiction over this matter to enforce the terms of this Agreement and each of the Parties expressly subjects itself to the jurisdiction of such First Circuit Court.

19. Waiver. Any waiver of the terms, conditions, or provisions of this Agreement or a party's rights or remedies under this Agreement must be in writing to be effective. Failure, neglect, or delay by a party to enforce the terms, conditions, or provisions of this Agreement or such party's rights or remedies at any time, will not be construed as a waiver of such party's rights under this Agreement and will not in any way affect the validity

of the whole or any part of this Agreement or prejudice such party's right to take any subsequent action. No exercise or enforcement by any party of that party's rights or remedies under this Agreement will preclude the enforcement by such party of any of its other rights or remedies that are available under this Agreement or by law.

20. Cross-Default. AES' failure to comply with this Agreement shall constitute a breach by AES under any other agreements with UH. AES' failure to comply with any other agreement or commitment made by AES to UH shall constitute a breach and default by AES under this Agreement. Without limiting the UH's remedies under any agreements with AES, UH shall have the right to terminate any or all of its obligations to AES and AES' rights under any agreements with UH, including this Agreement, if AES shall breach any AES' obligations and/or commitments made by AES to the UH.

21. No property interest transferred. AES, on behalf of itself and the AES Agents and the AES Assignees, understands and agrees that neither AES, the AES Agents, nor the AES Assignees are acquiring any property interest of any kind in the Use Area and/or the Property or the right to enter and use the Use Area beyond that which is specifically permitted hereunder with respect to the conduct of the Due Diligence and/or the Authorized Activity within the Use Area during the term of this Agreement. AES is not entitled to, and the UH is not obligated to grant to AES, any rights to use the Use Area beyond the term of this Agreement.

EXHIBIT D

Grant of System Easement Agreement

GRANT OF SYSTEM EASEMENT AGREEMENT

by and between

THE UNIVERSITY OF HAWAII,
the state university and body corporate of the State of Hawaii,

and

AES WEST OAHU SOLAR, LLC,
a Delaware limited liability company.

Dated _____

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GRANT OF SYSTEM EASEMENT AGREEMENT
UNIVERSITY OF HAWAII
AES WEST OAHU SOLAR, LLC

THIS GRANT OF SYSTEM EASEMENT AGREEMENT ("***Agreement***") is made and entered into as of _____ ("***Effective Date***"), by and between the UNIVERSITY OF HAWAI'I, the state university and a body corporate of the State of Hawai'i, whose business address is 2444 Dole Street, Bachman Hall, Honolulu, Hawai'i 96822 ("***UH***" or "***University***"), and AES WEST OAHU SOLAR, LLC, a Delaware limited liability company, whose business address is c/o AES Distributed Energy, Inc., 282 Century Place, Suite 2000, Louisville, Colorado 80027 ("***AES***") (UH and AES may be referred to collectively as "***Parties***" or individually as "***Party***").

RECITALS

WHEREAS, the University is the owner of those certain parcels of land located mauka of the University of Hawai'i West Oahu ("***UHWO***") campus, 91-1001 Farrington Highway, Kapolei, Hawai'i 96707, consisting of approximately 991 acres, designated as Tax Map Key Nos. 9-2-002:001, 003, 005, and 007 ("***Property***"), which are more particularly described in Exhibit 1 attached hereto; and

WHEREAS, on or around March 12, 2018, the University and AES entered into that Binding Letter of Intent and Option Agreement ("***LOI***") Regarding Hawaiian Electric Company, Inc. ("***HECO***") Request for Proposals ("***RFP***") for the Supply of Qualified Renewable Energy under HECO's Renewable Dispatchable Generation Power Purchase Agreement ("***RDG PPA***"); and

WHEREAS, pursuant to the LOI, in the event AES was awarded the RDG PPA under the RFP, the University and AES agreed to negotiate a long term agreement for the use of a portion of the Property, consisting of approximately eighty (80) acres ("***Exclusive Easement Area***"), which are more particularly described in Exhibit 2 attached hereto; and

WHEREAS, AES was awarded the RDG PPA under the RFP to install, maintain, and operate an electricity generation project using solar photovoltaic plus battery energy storage at the Easement Area of up to 12.5 MW AC ("***System***"), which System is further described in Exhibit 3 and Exhibit 4 attached hereto; and

WHEREAS, AES has requested that the University grant to AES an easement for the development, construction, installation, operation, maintenance, repair, improvement, upgrade, renovation, replacement, removal, and security of the System (collectively the "***System Easement Purposes***"), including non-exclusive access and utility placement and easement rights, all in the form of an easement for a term of years ("***System Easement***"); and

WHEREAS, the System Easement to be granted to AES will include the following components: (a) an easement for AES' exclusive use of a portion of the Property ("***Exclusive Easement***") which covers the Exclusive Easement Area upon which AES may develop, construct, operate, maintain, repair, improve, upgrade, renovate, replace, remove, and secure the System ("***Exclusive Easement Area***"), (b) a non-exclusive easement consisting of approximately 9,600 linear feet over a portion of the Property ("***Access Easement***") which covers an area over

which AES may access the Exclusive Easement Area ("***Access Easement Area***") and (c) an exclusive easement consisting of approximately two (2) acres in favor of AES over a portion of the Property ("***Utility Easement***") which covers an area over which utilities supporting the System will be situated ("***Utility Easement Area***") (the Exclusive Easement Area, the Access Easement Area, and the Utility Easement Area shall be collectively known as the "***Easement Area***" and are shown on the maps attached hereto as Exhibit 2 and incorporated herein by reference);

WHEREAS, pursuant to that certain Option Agreement to Grant System Easement dated _____, 2019, between the University and AES, the University is permitting AES to conduct inspections, investigations, testing, and other due diligence work, describing the preconditions that AES must fully satisfy and fulfill before the University is obligated to grant AES the System Easement (collectively the "***AES Preconditions***"); and

WHEREAS, one of the AES Preconditions is AES applying, petitioning for, and obtaining approval of the System Easement application and plans from the City and County of Honolulu and the System Easement petition and maps from the Assistant Registrar of the Land Court of the State of Hawai'i, both of which will confirm and designate the Easement Area; and

WHEREAS, given the mutual desire and commitment to renewable energy sources and sustainability, the University has agreed to grant to AES the System Easement over the Easement Area (consisting of the Exclusive Easement, the Access Easement, and the Utility Easement) affecting the Property to enable AES to develop, construct, install, operate, maintain, repair, improve, upgrade, renovate, replace, remove and secure the System on the terms and conditions contained herein.

NOW, THEREFORE, in consideration of the mutual covenants and promises set forth herein, and other good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, the Parties hereby agree as follows:

AGREEMENT

1. Grant of Easement. The University does hereby grant unto AES the right, in the nature of an exclusive easement over, under, above, upon, through and within the Easement Area, for the term set forth below, upon the terms and conditions described below (which shall constitute the Exclusive Easement portion of the System Easement) to be exercised and enjoyed by AES solely for the System Easement Purposes described herein;

Under this System Easement, AES may permit its officers, employees, agents, representatives, contractors, consultants, subcontractors, vendors, suppliers, customers, guests, invitees designees, and any person or entity acting on behalf of AES (collectively the "***AES Agents***") to enter into the Exclusive Easement Area to perform and complete AES' obligations under this Agreement and System Easement, subject to AES' obligations and covenants to be responsible and liable for the acts and omissions of the AES Agents in connection with the Easement Area, the System Easement, and this Agreement;

TOGETHER WITH nonexclusive easements for access purposes (which shall constitute the Access Easement portion of the System Easement) and an exclusive easement in favor of AES for utility purposes (which shall constitute the Utility Easement portion of the

System Easement) over, under, above, upon, through and within the Access Easement Area and the Utility Easement Area, respectively, for the term set forth below, to be exercised and enjoyed by AES and the AES Agents solely for the purposes described herein below;

TO HAVE AND TO HOLD the same unto AES and its respective successors and permitted assigns, during the term of this Agreement, unless sooner terminated pursuant to the terms set forth herein.

SUBJECT, HOWEVER to: (a) the University's reservation of the right to grant easements, access, use, and other rights to third parties over and across the Easement Area, provided that such easements, access, and other rights do not unreasonably interfere with AES' use of the Easement Area for the Authorized Activity and are located outside of the fenced area surrounding the System; and (b) AES' satisfaction of all Entry Preconditions (as hereinafter defined).

2. Authorized Activity. AES shall use the Easement Area for the development, installation, construction, operation, maintenance, repair, improvement, upgrade, renovation, replacement, removal, and security of the System pursuant to HECO's RFP and the RDG PPA and any lawful purpose necessary and incidental thereto (collectively the "***Authorized Activity***"). AES shall not use the Easement Area for any other activities without the prior written approval of the University, which shall not be unreasonably withheld, conditioned, or delayed. AES shall ensure that the Authorized Activity does not unreasonably interfere with the activities of the University or other authorized users of the Property. AES shall not permit any waste, nuisance, or unlawful activities on or within the Easement Area, provided that AES and the University understand that AES and the AES Agents during construction could create situations where on-site waste is generated or associated nuisances could or might occur. AES and the University agree that AES shall and will require the AES Agents, at its or their cost, to promptly remove any such waste generated and stop or mitigate any nuisances, including mitigating any Adverse Impacts resulting from or attributable to the waste generation and/or nuisances.

3. Term. The term of this Agreement shall commence on the Effective Date and shall continue for twenty-five (25) years from the Commercial Operation Date (as defined in the RDG PPA) of the System ("***Term***"), unless sooner terminated as hereinafter provided. AES shall have two (2) options to extend the Term of this Agreement by five (5) years each. AES shall exercise each option by providing the University with written notice at least ninety (90) days prior to end of the Term or any extended Term. Any extension of the Term shall be in writing based upon the same terms and conditions herein, as the same may be amended, except as to Rent, which shall be set by mutual written agreement of the Parties, and such other reasonable terms and conditions as the University may modify or require.

4. Acceptance of Easement Area. AES has examined and knows of the condition of the Easement Area and agrees to accept the Easement Area in its "as is with all faults" condition, in its existing form, content, and state of condition. AES agrees that the University shall not be liable for any latent, patent, or other defects in, on, or under the Easement Area. AES taking possession of the Easement Area shall be conclusive evidence that the Easement Area was in good and satisfactory condition when AES took possession. AES agrees that it is not relying upon any representations or warranties of any kind whatsoever, express or implied, from the University as to any matters concerning the Easement Area, including, without limitation:

a. Physical Condition. The quality, nature, adequacy, and physical condition and aspects of the Easement Area including topography, slopes, depressions, holes, drainage, vegetation, and landscaping.

b. Soils. The quality, nature, adequacy and physical condition of soils, geology, and potential for earth movement.

c. Groundwater. The presence or impact of any groundwater on, upon, or under the Easement Area.

d. Utilities. The existence, quality, nature, adequacy, and physical condition of utilities servicing the Easement Area.

e. Development Potential. The development potential of the Easement Area and the use, habitability, merchantability, or fitness, suitability, value, or adequacy of the Easement Area for any particular purpose.

f. Zoning. The zoning or other legal status of the Easement Area or any other public or private restrictions on the use of the Easement Area.

g. Compliance. The compliance of the Easement Area or any operations thereon with any applicable codes, laws, statutes, rules, regulations, ordinances, covenants, conditions, and restrictions of any governmental, or quasi-governmental entity or any other person or entity.

h. Hazardous Materials. Subject to the terms of the Hazardous Materials (as defined herein) provision herein, the presence of Hazardous Materials on, under, or about the Easement Area or the Property.

i. Title and Encumbrances. Any agreements or documents affecting the Easement Area, including covenants, conditions, restrictions, and other encumbrances or matters or documents of record or of which AES has or should have knowledge.

5. Compliance with Applicable Laws. AES shall comply and shall ensure that the AES Agents comply with all Applicable Laws (as defined herein) and shall be responsible for obtaining all necessary governmental and other approvals necessary to establish, develop, construct, install, operate, maintain, repair, improve, upgrade, renovate, replace, remove, and secure the System Improvements, including, without limitation, all land use, subdivision, easement, and construction approvals from the City and County of Honolulu ("***City***") and subdivision and easement approvals from the Office of the Assistant Registrar of the Land Court of the State of Hawaii ("***Land Court***"). "***Applicable Laws***" means all: (a) federal, state, county, and local laws, statutes, ordinances, codes, rules, and regulations; (b) standards, directives, interpretations and conditions of approval mandated by any governmental agencies, departments, commissions, boards, bureaus, or instrumentalities of the United States, the State of Hawai'i, and any political subdivisions thereof (including any legislative or judicial bodies) (hereafter collectively the "***Governmental Authority***"); (c) permits and approvals issued by any Governmental Authority; and (d) legislative, administrative, or judicial orders, decrees, requirements, rulings or judgments, which now or in the future may be applicable to the

Easement Area, the Property, the University, AES, and/or the AES Agents, and/or to any use relating to the Easement Area or the Property.

6. Compliance with AES Covenants. AES shall be in full compliance and will ensure that the AES Agents are in full compliance at all times with the provisions of this Agreement, including, without limitation, the following covenants (hereafter collectively the "***AES Covenants***"):

a. Keep University informed of System Plans. AES shall keep the University informed of the plans, schedules, and other documents relating to the design, construction, installation, and operation of the System (collectively the "***System Plans***"), and as more particularly described in paragraph 14 below, including the impacts of design, construction, operation, maintenance, repair, alteration, renovation, improvement, upgrade, expansion, and replacement of the System and/or buildings, facilities, and structures installed or completed as part of the System on or in portions of the Property or the Easement Area (collectively the "***System Improvements***") and the impacts upon the Easement Area, the Property, and any University improvements, structures, facilities, equipment, appurtenances, utility lines or facilities, walls, fences, paths, roadways, or items within the Easement Area and/or the Property (collectively the "***UH Facilities***") and University operations.

b. AES responsible to address University issues. AES shall be responsible, at no cost to the University, for addressing and resolving reasonable issues and concerns noted by the University with respect to the System Plans and the System Improvements and their potential impacts upon the Easement Area, the Property, the UH Facilities, and/or the University operations, to the University's reasonable satisfaction, such as implementing such measures that may be necessary to (1) adequately address the University's reasonable issues and concerns, or (2) allow the University to, without cost, risk, or adverse impacts to the University, grant AES entry onto and use of the Easement Area and the Property.

c. AES responsible for addressing/resolving Adverse Impacts. AES will be responsible, at no cost to the University, for avoiding, mitigating, and remediating all material adverse impacts to the University, the Easement Area, the Property, the UH Facilities, and the University's operations resulting from entry onto and use of the Easement Area and the Property by AES and the AES Agents, the Authorized Activity, and/or the System Improvements, including material adverse impacts resulting from the planning, design, construction, operation, maintenance, repair, alteration, renovation, improvement, upgrade, expansion, and/or replacement thereof (collectively the "***Adverse Impacts***").

(1) AES to implement mitigation measures. AES shall implement, at AES's cost, such measures as may be necessary to mitigate and/or resolve the Adverse Impacts, including, without limitation, implementing measures to prevent AES, the AES Agents, the Authorized Activity, and/or the System Improvements from: (a) adversely affecting the University's use of and/or construction, maintenance, and operations upon, at, or around the Easement Area and/or the Property, (b) interfering with the free and safe flow of vehicular, bicycle and pedestrian traffic in and around the Easement Area and the Property outside of the fenced in area within the Easement Area, (c) interfering with the University's existing uses of, at, and/or around the Easement Areas and the Property, (d) interfering with drainage, sewer, water,

electricity, communications, and utility systems and any other infrastructure serving or within the Easement Area or the Property, and (e) violating any Applicable Laws.

(2) AES to indemnify/defend University against Adverse Impacts. AES shall, at no cost to the University, indemnify, defend (with counsel reasonably acceptable to the University), and hold harmless the University from and against any and all claims, actions, judgments, liabilities, losses, damages, costs, and expenses arising from or attributable to Adverse Impacts and AES's failure to fully address and/or resolve any Adverse Impacts; except to the extent that such claims, actions, judgments, liabilities, losses, damages, costs, and expenses are caused by the University and the University's employees, agents, representatives, contractors, consultants, vendors, invitees, and any person acting for or on the University's behalf (collectively the "***UH Agents***").

d. Compliance with Site Specific Conditions. AES shall, at no cost to the University, and to the University's reasonable satisfaction, satisfy, meet, and fulfill all site specific conditions listed and described in Exhibit 5 attached hereto and incorporated herein by reference (collectively the "***Site Specific Conditions***").

e. Compliance with Existing Conditions. AES shall comply with all existing deeds, easements, restrictions, permits, land use approvals, environmental impact statements, conditions, covenants, leases, licenses, and other encumbrances affecting the Easement Area. Without limiting the generality of the foregoing, AES shall comply with, and shall ensure that AES Agents comply with, all applicable land use conditions, regulations, and the State of Hawaii Department of Land and Natural Resources take license terms calling for the protection and replanting of the plant *abutilon menziesii*.

f. Compliance with UH Rules.

(1) Rules and Regulations. The University may from time to time adopt, amend, or implement such reasonable policies, procedures, rules, or regulations (collectively the "***UH Rules***") as the University deems necessary or desirable for the use or operation of the Easement Area and/or the Property, including, without limitation, UH Rules governing the AES Work (as defined herein) and/or matters which may be of benefit to or protection of the University or any other of the University's tenants or occupants of properties in and around the Easement Area and/or the Property; provided, however, that the UH Rules shall not be inconsistent with the terms, covenants, and conditions of this Agreement, shall not conflict with AES' ability to develop and construct the System and engage in the Authorized Activity as described in this Agreement, and to the extent that there is an inconsistency, then the terms, covenants, and conditions of this Agreement shall control. AES shall and will ensure that the AES Agents observe and comply with all of the UH Rules, as the same may be amended from time to time.

(2) Compliance with Pueo Protocol. AES shall, and shall ensure that AES Agents, in connection with or during the exercise of the rights granted to AES under this Agreement, comply with applicable protocol established by the University for the pueo (Hawaiian owl), including, without limitation, the Protocol for Pueo Ground Nest Discovery adopted by UHWO ("***Pueo Protocol***"). If a pueo nest is discovered at or within the Easement Area during the term of this Agreement in connection with or during the exercise of rights

granted to AES under this Agreement, AES and the AES Agents shall notify the University in accordance with the applicable Pueo Protocol.

g. AES to obtain all governmental approvals. AES shall, at its sole cost and expense, obtain any governmental permits or approvals necessary to construct, install, operate, maintain, repair, improve, upgrade, renovate, replace, remove, and/or secure the System on or within the Easement Area, including, without limitation, any land use, subdivision, easement, or construction approvals from the City.

h. AES to provide sufficient assurance of performance. AES shall, and shall cause the AES Agents to perform and comply with, all obligations under this Agreement and from time to time upon the University's request provide to the University sufficient assurance that AES will, and shall cause the AES Agents to perform and carry out all such required obligations, to the University's reasonable satisfaction.

i. AES to ensure performance by AES Agents. AES shall be responsible, at no cost to the University, for ensuring that the AES and the AES Agents, in the performance of any Authorized Activity (including construction and installation of the System Improvements) and any other work in connection with the Authorized Activity, perform and comply with the AES Covenants in favor of the University contained in this Agreement. AES shall incorporate into any agreements between or involving AES and the AES Agents such provisions from this Agreement as may be necessary for AES to comply with its obligations under this Agreement.

j. University may cure AES's failure to perform. If AES fails to properly perform and comply with any portion of the AES Covenants hereunder, within a period of thirty (30) days after AES receives written notice from the University of such failure by AES, or such further time as may be agreed upon between the University and AES, the University may (but shall not be obligated to), at its option, and in addition to all other remedies which may be available to the University, perform and comply with such portion of the AES Covenants that AES has failed to perform or comply with and the cost thereof shall be paid by AES to the University upon demand from the University.

7. Entry Preconditions. Prior to entry onto the Easement Area, AES shall certify in writing that it has fulfilled each of the entry preconditions described below ("***Entry Preconditions***") and obtain the University's written concurrence that such Entry Preconditions have been satisfied:

a. Notice to Occupants. AES shall notify the University and other authorized users of the Property in writing of AES' proposed entry onto the Easement Area for System Easement Purposes and the scope of work to be performed for the System.

b. Submission of Traffic Mitigation Plans. AES shall provide the University with written traffic mitigation plans addressing expected traffic impacts from the construction, installation, and operation of the System.

c. No Impact on Existing Access and Use. AES shall ensure that it does not adversely impact reasonable access to and from the Property for the University and other authorized users of the Property.

d. Address Concerns. AES shall address and resolve any and all of the University's reasonable issues and concerns relating to the System Plans, the System Improvements and their potential impacts on the Easement Area, the Property, the UH Facilities, and/or the University operations.

e. Implement Mitigation Measures. AES shall implement, at no cost to the University, such measures as may be reasonably required by the University to mitigate any Adverse Impacts arising from or related to AES' design, construction, installation, and/or operation of the System and System Improvements (collectively the "***Mitigation Measures***").

f. Submit System Plans to the University. AES shall submit to the University any and all System Plans (inclusive of all as-built construction plans for the System Improvements).

g. Obtain Government Approvals. AES shall obtain, at no cost to the University, all governmental approvals and permits that may be necessary to construct, install, and operate the System.

h. Ensure AES Agents Comply. AES shall ensure that all AES Agents entering or working on or within the Easement Area comply with any and all of AES' obligations with respect to the use of the Easement Area.

i. Obtain Sufficient Funding. AES shall submit to the University written evidence sufficient to demonstrate, in the University's reasonable discretion, that AES has sufficient funding to complete the construction, installation, and operation of the System and the System Improvements.

8. Termination. In addition to the Agreement termination rights and processes for both parties that are contained in paragraph 11 (Termination) of the General Conditions (Exhibit 6), either Party may terminate this Agreement upon: (a) the other Party's breach or default hereunder that remains uncured after sixty (60) days written notice to the breaching or defaulting Party; (b) the failure of the Parties to agree upon the Rent to be payable and any other terms during any renegotiation period that remains unresolved after sixty (60) days written notice (should the Parties fail to agree upon the Rent under this paragraph 8(b), the Agreement shall terminate upon the expiration date of the then applicable Term); (c) the condemnation of the Easement Area, as hereinafter set forth; or (d) termination of the RDG PPA; provided that AES shall have one hundred and eighty (180) days from the date of University's written termination notice to enter into another agreement to sell and deliver electrical power generated from the System to any third party on terms substantially similar to the terms of the terminated RDG PPA. The Parties may also mutually agree in writing to terminate this Agreement at any time.

9. Rent.

10. Security Deposit.

11. Educational Program. AES shall reasonably cooperate with the University in establishing educational programs and opportunities for University students regarding the System, including without limitation, providing informational material, educational and training sessions, internship and employment opportunities, and supervised access to the Easement Area that does not compromise the safety, security, or operation of the System. Costs for any cooperation by AES under this paragraph 11 shall be capped at [redacted] ("***Education Program Limit***"), provided that the University and AES will mutually agree on what costs and expenses may be credited against the Education Program Limit.

12. Taxes and Assessments. AES shall pay when due all taxes, rates, assessments, duties, and other charges of any kind related to this Agreement and/or AES's use of the Easement Area hereunder, whether the same is assessed to or payable by the University or AES, including, without limitation, the Hawaii State Excise Tax (AES shall pay to the University an amount in addition to the Rent amount equivalent to the Hawai'i State Excise Tax so that the University will receive the full amount of Rent owed hereunder net of the Hawai'i State General Excise Tax), use taxes, real property taxes, and any conveyance taxes.

13. Utilities. AES shall be responsible, at AES's sole cost and expense, for all utilities and utility connections serving the Easement Area, including, without limitation, water, gas, heat, electricity, power, air conditioning, telephone, cable, internet, and other communications and telecommunication services and other services such as the handling of wastewater, sewage, and garbage (collectively the "***Utilities***"). AES shall obtain the University's prior written consent, which shall not be unreasonably withheld, for the installation of all Utilities. AES shall ensure the Utilities do not cause interference with any of the University's utilities and shall dismantle and remove, at AES's sole cost, any Utilities that cause such interference. The University shall not be liable to AES for, and AES hereby expressly waives and releases the University from, any claims or damages resulting from the failure or delay/interruption in the construction, installation, operation, and/or provision of the Utilities. At AES's request from time to time, the University agrees, to the extent permitted by Applicable

Laws and subject to and limited by the University Limitations (as defined herein), to cooperate reasonably with AES and any providers of utility services in arranging for such services to be extended to the Easement Area for AES' benefit.

14. System Improvements. AES shall obtain the University's prior written approval, which approval shall not be unreasonably withheld, conditioned, or delayed, to construct or install any System Improvements upon and within the Easement Area, including, without limitation, any facilities, structures, buildings, conduits, pipelines, appurtenances, and Utilities comprising, relating to, and/or supporting the System.

a. System Plans. AES shall submit to the University the System Plans, which shall be prepared by an architect or engineer properly licensed in the State of Hawaii, setting forth the design, location, specifications, drawings, permitting requirements, cost estimates, financing, schedules, timelines, and other information relevant to the construction or installation of the System Improvements. The System Plans shall include a description of the infrastructure to be constructed and installed upon and within the Easement Area for the System, including access to, from, and within the Easement Area, which AES shall provide at its own cost. The University shall not unreasonably withhold, condition, or delay approval of the System Plans.

b. Requirements. The construction and installation of all System Improvements shall be: (i) at AES' sole cost and expense; (ii) performed by contractors properly licensed in the State of Hawaii who are obligated via written agreement with AES to construct and install the System Improvements; (iii) in compliance with all Applicable Laws, including any applicable county building codes; (iv) in compliance with all government approvals and permits, (v) performed only after AES installs and/or implements all required Mitigation Measures; and (vi) in compliance with the System Plans submitted to the University by AES.

c. Completion. AES shall certify in writing to the University completion of the System Improvements in compliance with the System Plans submitted to the University by AES and all requirements described in paragraph 14b (Requirements) above. AES shall provide the University with one (1) complete set of as-built drawings covering the System and all System Improvements containing the stamp of a licensed architect or engineer and one (1) complete set in Computer Aided Design (CAD) format.

d. Ownership. Title to the System Improvements shall remain in AES during the Term and upon termination of this Agreement. Upon termination of this Agreement, AES shall, at its sole cost and expense, remove all System Improvements, or any portion thereof, and restore the Easement Area to its original condition, reasonable wear and tear excepted, within six (6) months after termination of this Agreement. The University shall not be required to compensate AES for any of the System Improvements.

15. Maintenance and Repair. AES shall, at its sole cost and expense, maintain and keep in good repair and safe condition during the Term of this Agreement the Exclusive Easement Area and the Utility Easement Area, the System Improvements, and the Utilities, with AES also obligated to perform and complete structural repairs and repairs necessitated by natural wear, decay, or damage by the elements or other casualty with the Exclusive Easement Area and the Utility Easement Area (collectively the "***Maintenance Work***"). AES and the University acknowledge and agree that AES: (a) has inspected the condition of the Access Easement Area,

(b) understands that AES will be the primary user of the Access Easement Area, (c) shall repair and restore, at AES' cost, the Access Easement Area to its condition existing as of the Effective Date, promptly after construction and installation of the System is completed, and (d) maintain and keep the Access Easement Area in condition suitable for its required access during the Term, at AES's cost, provided that if other users, including the University, cause damage to the Access Easement Area, such users and not AES will be responsible for repairing such damage and restoring the Access Easement Area. AES shall pay to the University its pro rata share of any maintenance costs for the Access Easement Area, as reasonably determined in good faith by the University and AES from time to time.

a. University may cure/correct if AES fails to do so. If AES fails to properly perform the Maintenance Work to the satisfaction of the University and fails to cure such failure within sixty (60) days after written notice, the University may, at its option, and in addition to all other remedies available to the University, complete said maintenance and repair and charge AES for the cost of the Maintenance Work, plus ten percent (10%) for the University's administrative overhead.

b. AES to repair damage and restore. If and to the extent that the Property, the Easement Area, and/or any of the UH Facilities, and/or any of the University's agriculturally related operations, including, without limitation, preparing and fertilizing the soil, applying weed and pest control measures, planting and establishment of trees and other flora, the cultivation and harvesting of crops, fruits, vegetables, ornamentals, flowers, and other flora, all on, within, adjacent, or in the vicinity of the Property (collectively the "***UH Research***") are damaged due in whole or in part by the System Improvements, the operation of the System, and/or AES' construction work activities, AES shall be responsible, at its cost, for: (a) replacing any UH Research damaged or destroyed by or attributable to the acts/omissions of AES and/or the AES Agents, (b) repairing any damage including, without limitation, damages to any of the UH Facilities, and (c) restoring the Easement Area and any affected portions of the Property to a condition that is the same or similar to that which existed prior to the damage.

16. Non-Liability of Individuals. No University officer or employee shall be charged personally with any liability under any term, condition, covenant, or provision of this Agreement.

17. Assignment and Transfer Restrictions. AES may not assign, sublet, sublicense, or transfer any rights or interests under this Agreement, or delegate any obligations or duties hereunder (collectively the "***AES Assignment***"), to any person or entity ("***AES Assignee***") without the University's prior written consent, which consent shall be at the reasonable discretion of the University, with the understanding that the University may require AES to comply with certain conditions as part of the University's approval of the AES Assignment to the AES Assignee, including, without limitation, requiring AES and/or the AES Assignee to pay to the University fifty percent (50%) of the consideration that AES is receiving or is to receive for the AES Assignment. The University may withhold its consent to a proposed AES Assignment if, in the University's reasonable discretion, the proposed AES Assignee does not have an equal or greater level of creditworthiness, credit rating, or financial capacity or capability and/or possesses substantially similar experience, expertise, and qualifications as the AES.

a. AES Assignment. AES shall not make any AES Assignment without the University's prior written consent, provided, that if AES is not in default or breach of this Agreement and/or the RDG PPA, the University shall not unreasonably withhold its consent to the AES Assignment if the University has been provided with sufficient proof (in the University's reasonable discretion) that the proposed AES Assignee: (a) has comparable experience and expertise in operating and maintaining and comparable qualifications to operate and maintain photovoltaic solar systems comparable to the System and providing services comparable to those contemplated by the RDG PPA between HECO and AES and the System Easement between UH and AES and (b) has the financial capability, capacity, creditworthiness, and credit rating to maintain the System and provide the services contemplated by the RDG PPA in the manner required by the RDG PPA and to develop, construct, and operate the System in the manner required by the System Easement.

b. AES Assignee. AES may make the AES Assignment to a qualified AES Assignee, as UH reasonably determines, who may be: (a) a person or entity directly or indirectly controlling, controlled by or under common control with AES ("***AES Affiliate***"), (b) any present or future purchaser of the power generated by the System under the RDG PPA, (c) any person or entity succeeding to all or substantially all of AES' assets, or (d) a successor entity in a merger or acquisition transaction (collectively the "***Qualified Assignees***"). AES may make the AES Assignment to a third party or parties in connection with a collateral assignment of rights, mortgage or pledge or any person or entity providing equity, debt or other financing for the System (collectively the "***Lenders***"), without UH's prior written consent, as more particularly described in paragraph 17.g. below. Notwithstanding that AES may make the AES Assignment to one or more Qualified Assignees and/or to the Lenders, AES shall submit the proposed document assigning this Agreement in recordable form to the University, and such information as reasonably required by UH, in order for UH to confirm that any such assignee is one of the Qualified Assignees and/or the Lenders.

c. AES to give University prompt notice. AES shall give the University written notice of any proposed AES Assignment as promptly as reasonably practicable, together with submitting documentation relating to the proposed AES Assignment for the University's review at the same time, provided that AES shall use good faith efforts to so notify the University of any planned, anticipated or impending AES Assignment at least 30-45 days prior to the date the proposed AES Assignment becomes effective.

d. AES Assignee must assume/perform all AES obligations under this Agreement. Each AES Assignment must be in writing and signed by each AES Assignee, who must assume and commit to performing and perform all AES obligations under the AES Assignment and this Agreement.

e. AES remains responsible. No such assignment or transfer by AES pursuant to the foregoing will release or discharge the AES, as assignor, from any delegated duty, obligation, or responsibility under the Agreement nor alter any warranty or maintenance obligation owed by AES with respect thereto, unless specifically stated to the contrary in the University's written consent to the AES Assignment. As AES will not be released or discharged because of any AES assignment or transfer, AES Guarantor's covenant and commitment to perform all AES obligations under this Agreement to the extent that the same are not fully performed by the AES Assignee shall also continue to be in full force and effect, including the AES Guarantor's guarantee that all AES obligations under this Agreement will be fully

performed and completed. Notwithstanding each AES Assignment and/or UH's written consent thereto, AES will remain responsible for performing all obligations under this Agreement and will not be released and/or discharged from such obligations and/or responsibility with respect to the portion of the Easement Area transferred, whether or not the AES Assignee effectively assumes and/or performs the obligations under this Agreement pertaining to the transferred Easement Area.

f. AES Assignment to Lenders. The University hereby expressly consents to AES making an AES Assignment to an AES Affiliate through which AES is obtaining capital financing for the System from one or more Lenders and collaterally assigning this Agreement to the Lenders, provided that Lenders: (a) perform or expressly commit in writing to perform AES' obligations under this Agreement, (b) attorn to and recognizes the University's rights under this Agreement and as to the Easement Area and the Property, and (c) agrees not to seek to place the University in default or otherwise terminate the University's rights under this Agreement. In connection with any such AES Assignment, the University agrees to execute a consent to assignment in customary form and reasonably acceptable to UH and the Lenders, which consent will not be unreasonably withheld. The University acknowledges that AES may obtain construction and long-term financing or other credit support from the Lenders in connection with the development, construction, installation, ownership, operation, maintenance, repair, improvement, upgrade, renovation, replacement, removal and/or security of the System. The University and AES agree in good faith to consider and to negotiate changes or additions to this Agreement that may be reasonably requested by the Lenders; provided, that such changes do not alter the fundamental economic and non-economic terms of this Agreement as reasonably determined by the University.

g. University protections. The University shall be protected and shall incur no liability in acting or proceeding in good faith upon any such approved AES Assignment and any written notice and direction by or from the Lenders which the University shall in good faith believe (i) to be genuine and (ii) a copy of which to have been delivered to the University. The University shall be under no duty to make any investigation or inquiry as to any statements contained or matters referred to in any such notice or direction by or from the Lenders, but may accept and rely upon them as conclusive evidence of the truth and accuracy of such statements.

h. Collateral Assignment by AES.

(1) AES may mortgage AES interest in System Easement. In connection with AES' financing of the System, AES shall have the right, without the University's consent, to mortgage, collaterally assign, or otherwise encumber and grant security interests in all or any part of its interests in this Agreement (which is limited to the interest of an easement holder and does not include any portion of the fee simple interest), or any part or parts thereof, under one or more mortgage(s), and to assign this Agreement, or any part or parts thereof, and any subeasements as collateral security for such mortgage(s).

(2) Mortgagee may take AES Assignment. Any mortgagee, beneficiary, secured party or holder of a mortgage (each, a "***mortgagee***") may (without the prior consent of the University) take or receive an AES Assignment in lieu of foreclosure whether or not permitted by the note or mortgage, but any subsequent assignments by the mortgagee and/or its assignee(s) to non-institutional Lenders must be in accordance with the assignment provisions

of this Agreement. As used herein, "***foreclosure***" means judicial foreclosure, sale under a power of sale or any other remedy provided by law or equity or set forth in the mortgage.

(3) Mortgagee performance of AES obligations. The mortgagee shall not be liable to perform AES' obligations under this Agreement until the mortgagee acquires AES' interest in this Agreement. After acquiring AES' interest in this Agreement and accepting the AES Assignment, the mortgagee shall be liable to perform AES' obligations that arise after the date of such acquisition and acceptance only until the date on which such mortgagee further assigns or transfers the System Easement and/or makes a further AES Assignment as permitted by this Agreement.

(4) Extent of mortgagee responsibility/liability. Any mortgagee acquiring an interest in this Agreement by foreclosure or assignment hereunder shall not: (i) be liable for any damage or other relief attributable to any act or omission or indemnity obligation of any prior holder; (ii) be liable for any damage or other relief attributable to any breach of any representation or warranty contained in this Agreement by AES under this Agreement; and (iii) be bound by any amendment or modification of this Agreement made without the written consent of mortgagee if the mortgagee's consent was required.

(5) University to provide mortgagee with notice of AES default. The University, upon providing AES with written notice of (a) default under this Agreement, (b) termination of this Agreement or (c) a matter on which the University may predicate or claim a default, shall at the same time provide a copy of such notice to any mortgagee that has delivered to the University a notice countersigned by AES that sets forth the mortgagee's identity and address for notices. No such notice by the University to AES shall be deemed to have been duly given unless and until a copy thereof has been so provided to any such mortgagee. After such notice has been given to such a mortgagee, such mortgagee shall have the same period as is given AES to remedy, commence remedying or cause to be remedied the defaults or acts or omissions which are the subject matter of such notice and as specified in any such notice.

(6) Mortgagee efforts to cure or correct default. The University shall accept such performance by or at the instigation of such mortgagee as if the same had been undertaken by AES. The University and AES authorize each mortgagee to take any such action at mortgagee's option and hereby authorize entry upon the Easement Area by the mortgagee for such purposes.

(7) University will not terminate if mortgagee is timely curing default. If prior to the expiration of the applicable grace period, the mortgagee shall cure all monetary breaches and give the University written notice that mortgagee intends to (i) undertake the cure of any non-monetary breaches, violations or failures, or (ii) exercise its rights to acquire the interest of AES in this Agreement by foreclosure or otherwise, and shall immediately commence and then proceed with all due diligence to completion, then the University shall not terminate or take any action to effect a termination of this Agreement or reenter or take possession of the Easement Area so long as the mortgagee is diligently effecting such cure or foreclosure. Notwithstanding the foregoing sentence, the University does not waive its rights under this Agreement or its right to declare any subsequent default hereunder or its right to exercise any rights and remedies under this Agreement, subject to the notice and cure rights of the mortgagee.

(8) University must give mortgagee notice prior to termination. Notwithstanding anything in this Agreement to the contrary, if, pursuant to the provisions of this Agreement or as a matter of law, the University shall have the right to terminate this Agreement, then the University shall take no action to terminate this Agreement without first giving to the mortgagee written notice of such right and sixty (60) days thereafter (a) in the case of a default susceptible of being cured by the mortgagee, to cure such default after obtaining possession or acquiring control of AES, as applicable, or (b) in the case of a default not so susceptible of being cured, to institute, prosecute and complete foreclosure proceedings, acquire control of AES or otherwise acquire AES's interest under this Agreement; provided, however, the mortgagee shall not be obligated to continue such possession or to continue such foreclosure proceedings after such default shall have been cured.

(9) University to issue new System Easement. Upon termination of this Agreement by the University following an uncured default, or upon any acquisition by the mortgagee of AES's interest in this Agreement prior to termination of the Agreement, the University shall enter into a new grant of easement with such mortgagee covering the Easement Area, provided that such mortgagee (a) gives notice of the request for the new grant of easement to the University within thirty (30) days after termination or foreclosure, (b) pays all costs incurred by the University resulting from such default or termination (including but not limited to the University's reasonable attorneys' fees and costs, and further including any costs incurred by the University in drafting a new grant of easement), and (c) cures all defaults under this Agreement, other than those defaults of AES which cannot be cured by mortgagee. The new grant of easement shall be for the remainder of the Term of the terminated or foreclosed Agreement, effective as of the date of termination or foreclosure, at the same Rent, and contain the same covenants, agreements, conditions, provisions, restrictions, and limitations contained in the terminated or foreclosed Agreement (except for those that have already been fulfilled or are no longer applicable).

(10) Parties to execute appropriate amendments to System Easement. The University and AES shall execute any and all reasonable amendments to this Agreement: (a) for the purposes of reasonably implementing the mortgagee protection provisions of this Agreement, or (b) otherwise reasonably requested by any mortgagee. The University shall not have any obligation to execute any amendment to this Agreement which would or may adversely affect any material rights of the University as reasonably determined by the University (including but not limited to any termination, indemnity, removal and assignment rights or duties retained by, enjoyed by or placed upon the University or AES).

(11) No mortgage of the University's fee simple interest in the Easement Area of the Property. Neither AES, the AES Agents, nor the AES Assignees shall have any authority to: (i) mortgage or subordinate the University's fee simple interest in the Easement Area and/or the Property or (ii) otherwise encumber the University's fee simple interest without the University's prior written consent.

(12) University to provide estoppel certificate. The University shall, within ten (10) business days of the request of the mortgagee or prospective mortgagee, provide an estoppel certificate as to any matters reasonably requested by mortgagee, in form and substance acceptable to the University, provided however, AES shall reimburse the University for all reasonable attorneys' fees incurred in connection with the preparation or review of such estoppel certificate.

i. AES transfers rights under RDG PPA. If AES is considering transferring any interest under the RDG PPA to a third party with the intent that AES will no longer remain primarily obligated to perform obligations under the RDG PPA, AES must: (a) by written agreement in a form approved by the University, assign all of its rights and delegate all of its duties under both the RDG PPA and this Agreement to an AES Assignee (who could be a special purpose entity created and wholly-owned by a qualified third party ("***SPE***")) who has experience, expertise, and qualifications substantially similar to that of AES, as determined by the University in its reasonable discretion; (b) ensure that the AES Assignee, including any SPE, has been validly formed or established, is in good standing, and has obtained all required governmental approvals necessary to perform any and all of its obligations under the AES Assignment agreement, the RDG PPA, and this Agreement and present evidence thereof to the University; (c) obtain a guarantor that executes a guarantee committing to perform or have performed the obligations of the AES Affiliate (including the SPE) if and to the extent that the AES Affiliate (such as the SPE) fails to timely perform and complete its obligations under the AES Assignment agreement, the RDG PPA, and/or this Agreement ("***AES Guarantor***"); and (d) enter into an agreement with the AES Assignee (which could be the SPE) , as contractor, to perform all duties and obligations under this Agreement with respect to the planning, design, construction, installation, operation, repair, maintenance, improvement, upgrade, renovation, replacement, removal, and security of the System Improvements. AES will not be released from any liabilities, obligations, duties commitments, or responsibilities arising under this Agreement and shall remain responsible for performing all such obligations, duties, commitments, and responsibilities and covering such liabilities if and to the extent that the AES Assignee (including the SPE) fails to timely perform and complete any required obligations under this Agreement.

j. Subletting or sublicensing. AES shall not sublet, grant a subeasement, or allow a third party to otherwise use or occupy any portion of the Easement Area and/or the Property without the University's prior written consent, which consent will not be unreasonably withheld or delayed, with the understanding that the University may require AES to comply with certain conditions as part of the University's approval of any sublease, subeasement, sublicense, and/or use and occupancy of the Easement Area by a sublessee, sublicensee, subgrantee, user, and/or occupier, including, without limitation, obtaining a University determination that the sublessee, sublicensee, subgrantee, user, and/or occupier has sufficient experience, expertise, qualifications, and financial capability and capacity to properly and efficiently operate a portion of the System and the System Improvements and that the uses proposed by the sublessee, sublicensee, subgrantee, user and/or occupier for the Easement Area are sufficiently related to the System Easement Purposes. The University is not required to approve any sublease, subeasement, sublicense, use and occupancy agreement or other agreement if the University determines that the uses proposed are not sufficiently related to or consistent with the System Easement Purposes. The University will have the right to review the consideration being paid to or realized by AES under any sublease, sublicense, subeasement, use and occupancy agreement or other agreement, including any premiums or similar payments and the rent and/or other amounts charged by AES for the use of the Easement Area and the System Improvements. The University may require AES to remit or pay to the University a portion of such consideration paid to or realized by AES (which could be as much as 50% -75% of any such consideration) that AES is or may be generating from the sublease, subeasement, sublicense, use and occupancy agreement, or other agreement.

k. University transfer. To the extent the University assigns or transfers its interest under this Agreement, (i) the University will require the assignee to assume and be responsible for all of the University's obligations under this Agreement, (ii) such assignee shall be entitled to all of the University's rights and benefits under the Agreement, and (iii) the University shall be released from any duties and responsibilities arising under this Agreement from and after the effective date of the assignment or transfer, it being expressly agreed, however, that such release shall not relieve the University from liability under this Agreement for any acts, omissions, incidents or events occurring prior to the effective date of the assignment or transfer.

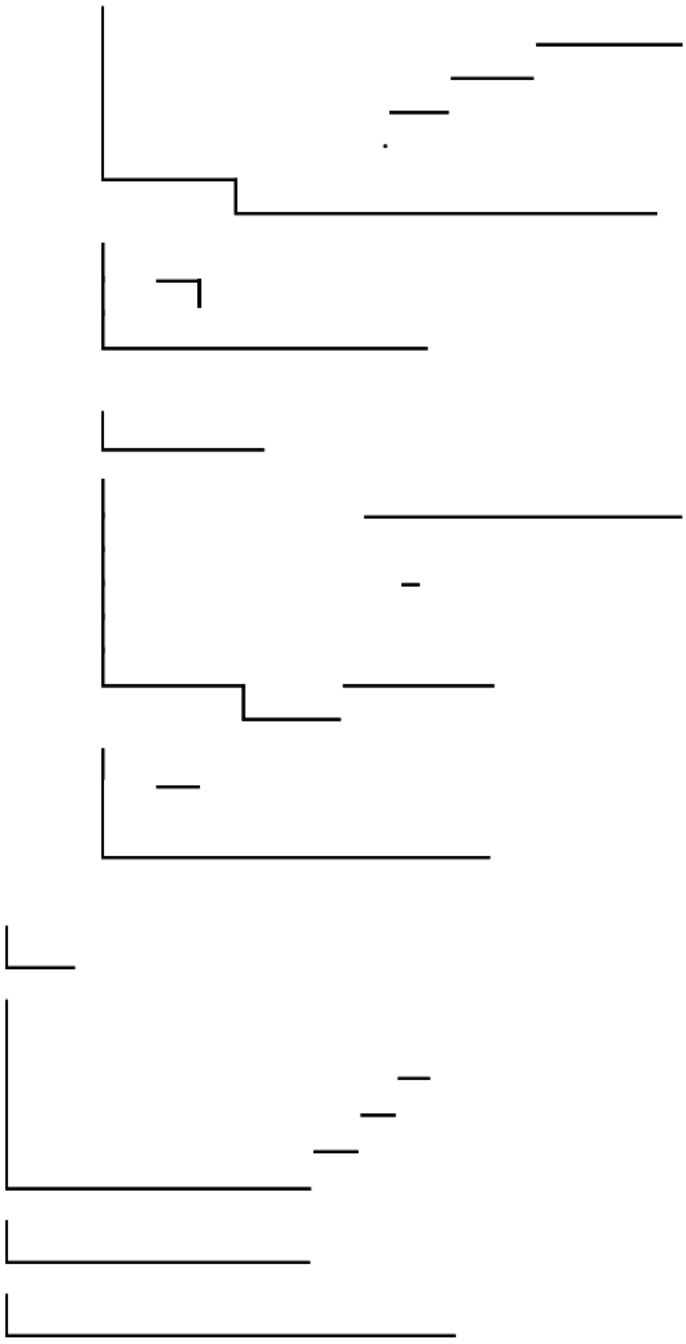
18. Condemnation. In the event the Easement Area or any part thereof shall be taken or condemned by any authority having the power of eminent domain ("***Condemnation Authority***") during the Term of this Agreement, then and in such event, this Agreement shall terminate as of the date AES is required to vacate the Easement Area or the portion required by the Condemnation Authority.

a. Compensation payable by Condemning Authority. All compensation and damages payable for or on account of the Easement Area and/or the Property or for any interest therein shall be payable to and be the sole property of the University, except for the System Improvements, the Utilities, and the System that have been constructed by AES. AES shall be compensated for all System Improvements, the Utilities, and the System constructed by AES; provided, however, that if AES is in breach or default of this Agreement, AES shall not have the right to receive any compensation for any proportionate interest in the System Improvements, the Utilities, and/or the System constructed by AES.

b. Partial condemnation. If only a portion of the Easement Area is condemned by the Condemning Authority and AES elects to continue using the remainder of the Easement Area to conduct the Authorized Activity, this Agreement may continue with respect to the remaining portion of the Easement Area, and the Rent paid hereunder shall be proportionately reduced. If AES elects not to continue using the remainder of the Easement Area to conduct the Authorized Activity, the Parties agree that this Agreement will terminate in accordance with the terms contained in this paragraph 18 (Condemnation).

19. Notices. Any notice, demand, request, consent, approval, or communication that either Party desires or is required to give the other Party shall be in writing and delivered in person, by commercial courier, or by first-class certified mail, return receipt requested, with postage prepaid, to the following:

University:



All notices, demands, requests, and other communications that may or are required to be given hereunder by either AES or the University shall be in writing and shall be (A) personally delivered to the receiving Party at the addresses noted above, (B) sent by registered or certified mail, return receipt requested, postage prepaid, addressed as set forth above, (C) transmitted by an internationally recognized courier service, such as Federal Express, addressed as set forth above, (D) sent by facsimile transmission ("***Fax***") to the Fax number of the receiving Party set forth above, and/or (E) sent by email or similar electronic transmission to the email address of the receiving Party set forth above. Notices, demands, requests, and other communications shall be deemed served or given for all purposes hereunder at the time such notice, demand, request, or communication is personally delivered or delivered by internationally recognized courier service, the sender of the Fax transmission has received confirmation of its

transmission from the sender's fax machine, the sender of the email or similar electronic transmission has received confirmation of its transmission, or three days following such mailing thereof, as the case may be. The University and AES may revise or amend its addresses or designated points of contact by notifying the other Party in writing regarding such revisions or amendments.

20. Surviving Obligations. Termination of this Agreement shall not affect the right of the University to enforce any or all indemnities, representations, warranties, and obligations, as applicable, made by AES and/or the AES Assignees and the guarantee obligations and commitments of the AES Guarantor hereunder. Any termination or cancellation of this Agreement, in whole or in part, shall not relieve: (a) AES and/or the AES Assignees of any of the obligations contained in this Agreement that are intended to survive the expiration or termination of this Agreement, including, without limitation, obligations regarding improvements, indemnity/defense, insurance, coordination, compliance with Applicable Laws, hazardous materials, liens, surrender, default, funding limitations, litigation, assignment, sublicensing, disposition of project improvements, and representations, as applicable or (b) AES Guarantor of any obligations and commitments contained in this Agreement and the AES Guarantor's guarantee agreement ("***AES Guarantee***"), substantially in the form attached hereto as Exhibit 7 (AES Guarantee).

21. Exhibits. All exhibits referred to herein are attached to this Agreement and hereby are deemed incorporated by reference.

22. Counterparts; Electronic Signatures. This Agreement may be executed in counterparts, each of which shall be deemed an original, and said counterparts shall together constitute one and the same agreement, binding all of the Parties hereto, notwithstanding all of the Parties are not signatory to the original or the same counterparts. For all purposes, including, without limitation, recordation, filing, and delivery of this instrument, duplicate unexecuted pages of the counterparts may be discarded and the remaining pages assembled as one document. The submission of a signature page transmitted by facsimile (or similar electronic transmission facility) shall be considered as an "original" signature page for purposes of this Agreement.

23. General Terms. The General Terms and Conditions are attached hereto as Exhibit 6 and made a part of this Agreement.

24. Memorandum of Grant of Easement Agreement. This Agreement shall not be placed of record. The Parties shall execute a Memorandum of System Easement Agreement substantially in the form attached hereto as Exhibit 8, which AES shall record in the Bureau of Conveyances of the State of Hawaii and/or Land Court, as applicable.

[**Signatures are on the next page.**]

IN WITNESS WHEREOF, the undersigned have executed this Agreement as of the Effective Date.

AES:

AES WEST OAHU SOLAR, LLC

By:_____
Name:
Its:

APPROVED AS TO FORM:

Office of the University General Counsel

_____
_____
Associate General Counsel

UNIVERSITY:

UNIVERSITY OF HAWAI‘I:

By:_____
David Lassner
President

Recommend Approval:

By _____
Jan S Gouveia
Vice President for Administration

_____
Maenette Benham
Chancellor
University of Hawai‘i – West Oahu

Exhibit 1
Property

Exhibit 2
Easement Area

Exhibit 3

Photovoltaic or Solar Energy Storage System

[To be Inserted by AES]

Exhibit 4

Site Layout

Exhibit 5

Site Specific Conditions

Capitalized terms used in this Exhibit 5 and not otherwise defined herein shall have the meanings assigned to such terms in the Grant of System Easement Agreement to which this Exhibit 5 is attached.

AES shall comply with, and shall ensure that all AES Agents and AES Assignees comply with, the following:

1. Access to and Use of the Easement Area and the Property. As of the date of this Agreement, the University and its tenants and invitees currently enter and exit the Property via the portion of Kualakai Parkway mauka of the H-1 Interstate Freeway and an unpaved roadway ("***UH Access***"). At some point after this Agreement is signed, AES will be required to share access over the UH Access to and from the Easement Area with the University and its tenants and invitees who desire to access portions of the Property. AES shall ensure that the use of the UH Access by the University and its tenants and invitees is not at any time materially impaired, restricted or otherwise adversely affected by AES', AES Agents', and/or AES Assignees' use of the UH Access. AES acknowledges and agrees the operations of the University and its tenants and invitees within the Property must continue without disruption or interference throughout the Term of this Agreement. AES understands that the University has made no promises concerning the timing or construction of any roadways and/or other infrastructure that are designed to serve areas within the Property.

    a. Improvements to UH Access. Notwithstanding the foregoing, the Parties acknowledge that if AES seeks to improve the UH Access or install other roadways and/or infrastructure during the Term of this Agreement, access over portions of the UH Access areas may be reasonably restricted from time to time for safety and the efficient completion of such improvements, new roadways, and/or infrastructure. The Parties shall cooperate with each other to provide for reasonable access, including alternative routes if necessary and feasible, during times of construction in or affecting UH Access and other areas used for access.

    b. AES to repair damage to UH Access. AES shall and shall ensure that the AES Agents and the AES Assignees promptly maintain and repair all damage to the UH Access to the extent caused by AES, the AES Agents, and/or the AES Assignees. Upon completion of the System construction work on or within the Easement Area and/or the Property, AES shall and shall ensure that the AES Agents and the AES Assignees restore the UH Access to the same or similar condition as existed at the commencement of the System construction work, normal wear and tear excepted.

c. University surveys and testing activities. The University may enter into agreement(s) with one or more third parties who will need access to the Easement Area and the Property for the purpose of conducting surveys and tests, taking samples, planning, conducting studies, installing sewer lines and other infrastructure and improvements, and otherwise engaging in planning and development related activities, and AES shall provide reasonable access during the term of this Agreement. The University will notify AES in writing at least forty eight (48) hours in advance of the requested entry. If AES' operations do not allow immediate University entry, AES and the University shall confer within seven (7) days from the University's initial requested entry date to mutually agree to an entry date. In permitting entry, AES will have an AES Agent or representative accompany the University during the University's entry and may require the University and the University Agents to attend a safety orientation (at AES' discretion) and comply with AES safety protocols. Any damage to the System Improvements caused by the University under this paragraph 1.c. shall be borne by the University. The University will require any third parties retained by the University to assist with the University's entry and inspection of the Easement Area to be responsible for any damage to the System Improvements caused by such third parties under this paragraph 1.c. The University shall require third parties to indemnify AES from all claims for damages occurring within the Easement Area relating to the University's third parties' entrance upon the Easement Area pursuant to this paragraph 1.e.

2. Utilities and Infrastructure. The University and others own or use utility lines and other infrastructure facilities located in and around the Property. Such lines and facilities may include water, sewer, power, communications, drainage and other types of lines, conduits, meters, manholes, equipment, and facilities. Without limiting the generality of the foregoing, AES understands that the U.S. Army may also own communications cables crossing or within the Property.

a. AES to protect all utility lines and facilities. At all times, including but not limited to when accessing the Easement Area and in performing the Authorized Activity and the AES Covenants, AES shall ensure that such lines and facilities, and access thereto, are preserved and protected from the activities of AES, the AES Agents, and the AES Assignees. AES shall be responsible for any damage to or interruption in service arising out of damage caused by AES, the AES Agents, and/or the AES Assignees to the lines and facilities.

b. No AES use without University consent. AES shall ensure that all University lines and facilities shall not be used by AES, the AES Agents, and/or the AES Assignees, without the University's prior written consent. If AES or any of the AES Agents and/or the AES Assignees use any University utility lines or facilities, AES shall be responsible for the payment of all services so used by AES, the AES Agents, and/or the AES Assignees on a sub-metered, or if not sub-metered, on a prorated basis, and AES shall share equitably in the costs relating to any lines and facilities (including but not limited to operating, security, maintenance, permitting, insurance, replacement and repair costs), except that

AES shall be 100% responsible to the University for repairing lines and other facilities damaged by the acts or omissions of AES, the AES Agents, and/or the AES Assignees.

c. Connect System Improvements to utilities. AES shall have the right, at its sole cost and expense, to install and maintain utilities and to improve the present utilities to the Easement Area (including, but not limited to the installation of overhead or underground utility lines, cables, conduits, transformers, wires, meters, monitoring equipment and other necessary equipment to connect the System Improvements to utility sources located outside of the Property).

d. University to grant right to install utilities. The University agrees to grant to AES the right to install such utilities on, over, under and through the Easement Area and/or the Property as necessary for AES to operate the System Improvements, all at AES's sole cost and expense, provided, however: (i) the location of such utilities shall be as reasonably designated by the University and (ii) AES shall cause its use of such utility sources and services to be separately metered and billed directly to AES by the applicable utility provider.

3. AES to furnish Non-Monetary Benefits. In addition to Rent, AES shall provide to the University the following non-monetary benefits in accordance with estimated time frame noted below:

4. Third Party Rights. At all times, including but not limited to when accessing the Easement Area and/or the Property and/or performing the System construction work and the AES Covenants, AES shall honor and reasonably deal with the rights of all third parties, including but not limited to, the present and future holders of easements (including but not limited to easements for drainage, sewer lines, fuel lines, and water lines) on or under the Property and users of utility facilities affected by the System construction work and/or the System Improvements, including but not limited to, any Governmental Authority. Without limiting the generality of the foregoing, AES shall be responsible for the following and for all costs associated with performing and complying with the following:

a. Obtain easement holder consents. AES shall obtain all appropriate consents from the holders of easements and other rights encumbering the Property;

b. Ensure no adverse drainage impacts. AES shall ensure that the Authorized Activity, the System construction work and the System Improvements do not cause adverse drainage impacts at, within, under, or affecting the Property or any other property, including but not limited to, the increased risk of ponding or flooding or exceeding the use of any existing drainage facilities, easements or swales because of the Authorized Activity, the System construction work, and/or the System Improvements;

c. Ensure no adverse sewer line impacts. AES shall ensure that the Authorized Activity, the System construction work, and/or the System Improvements do not cause adverse impacts with respect to existing sewer lines and other sewer facilities within, under, or serving the Property, including the Easement Area. Without limiting the generality of the foregoing, AES shall ensure that no borings, drilling work, earth moving, grading, or ground altering work penetrates, damages, causes breakage or spillage, or otherwise adversely affects the sewer lines and facilities within, under, or serving the Property;

d. Ensure no impact to aquifer or other underground water resources. AES shall ensure that the Authorized Activity, the System construction work and/or the System Improvements do not cause any adverse impacts to water or groundwater resources in, on, under, or around the Property, including, without limitation, ensuring that no borings or drilling work penetrates, damages, or otherwise adversely affects the groundwater aquifer or other water resources in, on, under, or around the Property. AES assumes the risk of additional costs and delays that may arise from dealing with such conditions and shall not interfere with or damage any such water resources;

e. Ensure no adverse fuel line impacts. AES shall ensure that the Authorized Activity, the System construction work, and/or the System Improvements on or within the Easement Area and/or the Property do not cause adverse impacts with respect to existing fuel lines within, under, or affecting the Easement Area and/or the Property.

f. Address adverse impacts. Prior to entering the Easement Area and commencing any System construction work, AES shall address and resolve any Adverse Impacts. In any event, if Adverse Impacts arise from the Authorized Activity, the System construction work, and/or the System Improvements, AES shall immediately undertake all actions either directly or through AES Agents and/or the AES Assignees to (i) address and remediate any impacts and prevent future adverse impacts and (ii) indemnify, defend, hold harmless and relieve the University from such impacts. Such actions shall include but are not limited to AES' reimbursement to the University for costs incurred by the University to deal with such impacts and costs for planning, designing and constructing remedial and mitigation measures and improvements.

5. Construction Management Plan. Prior to entry onto the Easement Area, AES shall provide to the University a construction management plan for all phases of the Authorized Activity affecting the Property, including the construction of the System Improvements ("***Construction Management Plan***"). Such plan shall include the master schedule and phasing of all elements of planning, design, and construction-related activity, and shall include specific milestones and completion dates. AES shall provide

the University with any material amendments to the Construction Management Plan. AES shall comply and ensure that the AES Agents and the AES Assignees comply with the System Plans and the Construction Management Plan. AES shall and will ensure that the AES Agents shall: (a) coordinate all major deliveries of materials, equipment, personnel, and/or supplies to the Easement Area and construction work that is anticipated to have major short term adverse impacts with the University, (b) not cause any unreasonable interference with the operations of the University or other occupants or users of the Property, and (c) give or issue to the University and other occupants or users of the Property at least fourteen (14) days prior written notice of any road closures and/or the implementation of any temporary access or use restrictions and/or detours.

6. Coordination Meetings. AES shall facilitate and coordinate the scheduling of coordination meetings to be held on a weekly bi-weekly basis. AES shall notify the University in writing of the schedule for such meetings. The University shall have the option to send its designee(s) to such meetings.

7. Minimizing and Avoiding Project Impacts. AES shall comply with and implement and shall ensure that the AES Agents and the AES Assignees comply with and implement mitigation measures to address and resolve any Adverse Impacts, including the following measures that are designed to help minimize or avoid any Adverse Impacts:

   a. NPDES compliance. AES shall, at its cost, obtain all required permits and approvals such those required under the National Pollutant Discharge Elimination System ("***NPDES***") and complete and execute any required permissions to discharge stormwater into any of the University MS4 areas (such as the University's MS4 Permission to Discharge).

   b. Sufficiently compact backfill areas. AES shall ensure that the AES Agents and the AES Assignees adequately and sufficiently compact the backfill placed in any areas excavated by AES, the AES Agents, and/or the AES Assignees during the System construction work, particularly in the areas of the Easement Area that the University and the UH Agents may use during the System construction work and continue to use after the System construction work is completed. If requested by the University, AES will permit the University to review the results of the backfill density tests by or from AES, the AES Agents, and/or the AES Assignees.

   c. Handling of excavated and imported soil.

      (1) Soil excavated from the Property. AES shall obtain and ensure that the AES Agents and the AES Assignees obtain the University's prior written approval before excavating soil within the Property and moving it to another location within the Property. The University may require AES, at AES's cost, to sample, test, and characterize such excavated soil prior to the University making its determination as to whether to allow such soil relocation.

(2) Soil exported from the Property. AES shall obtain and ensure that the AES Agents and the AES Assignees obtain the University's prior written approval before excavating soil within the Property and moving it to a location that is outside the Property. The University may require AES, at AES's cost, to sample, test, and characterize such excavated soil, including laboratory analysis in accordance with State Department of Health ("***DOH***") guidelines prior to the University making its determination as to whether to allow such soil to be relocated and/or transported to an off-site location. Proper characterization of the excavated soil is expected to guide the University's decision on final disposition of the excavated soil and AES shall comply and ensure that the AES Agents and the AES Assignees comply with the University's final disposition determination.

(3) Soil imported to the Property. AES shall obtain and ensure that AES Agents and the AES Assignees obtain the University's prior written approval before importing soil from off-site locations into the Property. The University may require AES, at AES's cost, to sample, test, and characterize such imported excavated soil, including laboratory analysis in accordance with DOH guidelines prior to the University making its determination as to whether to allow such soil to be transported into and used within the Property. Proper characterization of the excavated soil is expected to guide the University's decision on final disposition of the imported soil and AES shall comply and ensure that the AES Agents and the AES Assignees comply with the University's final disposition determination.

d. AES to identify water table topography and minimize adverse impacts. AES will be responsible for identifying the underground water table topography and the potential impact of the System construction work on groundwater and spring water flows and implementing measures to mitigate the risks that may arise from any excavation work or activities within the Easement Area and the Property, including the dewatering process. The University and AES acknowledge and agree that the University has informed AES about the existence of wells and water sources in the area of the Easement Area and the Property.

8. AES Responsible for Utility Work. All work related to utilities, including but not limited to water, sewer, electrical, gas, cable, and networking, required during any phase of the construction of the System Improvements on, within, or affecting the Property shall be the responsibility of AES, the AES Agents, and/or the AES Assignees. For the System construction work and for the System Improvements, AES shall obtain water, sewer service, electricity and other utilities directly from the City, HECO and other providers, and shall not obtain such utility services via connections to University utility facilities.

9. Insolation. The University acknowledges and agrees that access to sunlight ("***insolation***") is essential to the value to AES of the interest granted under this Agreement and is a material inducement to AES in entering into this Agreement. Accordingly, the University has agreed to not permit any interference with insolation on and at the Easement Area by not constructing or permitting to be constructed any structure, or planting or permitting to be planted any vegetation on the Property or properties adjacent or nearby to the Property owned or controlled by the University that could adversely affect insolation levels on and at the Easement Area. If any obstruction of sunlight is due to conditions upon or within the Easement Area, AES shall be responsible, at AES' cost, for removing such obstruction to the extent that AES deems necessary. If any foliage growing or existing on or within the Property outside of the Easement Area adversely affects insolation levels on and at the Easement Area, or any activity on or within the Property outside of the Easement Area emits or permits the emission of suspended particulate matter, smoke, fog or steam or other air-borne impediments to insolation on and at the Easement Area, the University may permit AES to enter and access the Property outside of the Easement Area to address these adverse effects upon AES' insolation levels, at AES' sole cost, to the extent that the University deems reasonably necessary and upon such terms and conditions that the University may require. AES shall and will cause the AES Agents and AES Assignees to: (a) obtain the University's prior written approval for each entry onto the Property to perform any such cutting or removal of foliage or address other conditions, (b) submit to the University a full description of the work to be performed, the conditions to be addressed and/or mitigated, and plans and maps showing the location of the foliage that AES will be removing from the Property and/or of the areas upon which conditions should be addressed, all together with proposed work schedules, (c) not unreasonably interfere with the operations of the University and/or other tenant or occupier of any portion of the Property to which AES seeks entry to trim or cut foliage, and (d) repair any damage to the Property caused by AES, the AES Agents and/or the AES Assignees and restore the Property to its original condition just prior to the AES entry.

10. Security. Security for the System construction work during construction shall be the responsibility of AES, the AES Agents, and/or the AES Assignees. AES shall cooperate and shall ensure that the AES Agents and the AES Assignees cooperate with the University to enable the University to meet and satisfy all Applicable Laws, including satisfying all higher-education crime reporting requirements pursuant to the Clery Act.

11. Irrigation and Water Lines. AES shall verify and ensure that the AES Agents and the AES Assignees verify the location of all irrigation and water lines that may be situated on, within, under, and/or crossing the Easement Area and/or the Property or the portions thereof affected by the System construction work and obtain the University's prior written approval, which shall not be unreasonably withheld, conditioned, or delayed, for all plans to: (a) interrupt or temporarily stop water flow and (b) install temporary or permanent lines, pumps, facilities, equipment, and/or systems to continue to furnish water service to the Easement Area and/or the Property at the same levels as existed prior to the commencement of the System construction work.

12. Electrical and Communication Lines. AES shall verify and ensure that the AES Agents and the AES Assignees verify the location of all electrical and communication lines that may be situated on, within, under, and/or crossing the Easement Area and/or the Property or portions thereof affected by the System construction work and obtain the University's prior written approval, which shall not be unreasonably withheld, conditioned, or delayed, for all plans to: (a) interrupt or temporarily stop electrical or communication service and (b) install temporary or permanent lines, boosters, facilities, equipment, and/or systems to continue to furnish electrical and communication service to the Easement Area and/or the Property at the same levels as existed prior to the commencement of the System construction work.

13. Sewer and Drainage Lines. AES shall verify and ensure that the AES Agents and the AES Assignees verify the location of all sewer and drainage lines that may be situated on, within, under, and/or crossing the Easement Area and/or the Property or portions thereof affected by the System construction work and obtain the University's prior written approval, which shall not be unreasonably withheld, conditioned, or delayed, for all plans to: (a) interrupt or temporarily stop or divert sewage or drainage flow and (b) install temporary or permanent lines, pumps, facilities, equipment, and/or systems to continue to handle the sewage and/or drainage flow to, through, and across the Easement Area and/or the Property at the same capacity levels as was handled prior to the commencement of the System construction work.

Exhibit 6

General Conditions

1. AES shall notify the University in advance of planned entry date. The University shall have the right to review all System Plans.

a. AES to notify of planned entry date. AES shall provide the University with reasonable prior notice of the initial dates upon which AES, the AES Agents, and/or the AES Assignees, shall desire to enter the Easement Area and the Property for purposes of commencing System planning and design and commencing System construction.

b. University incurs no liability for System Plans. The University shall not incur any responsibility nor any liability under contract, tort or otherwise for the University's review of, comment on, consent to and/or approvals of the System Plans, the AES Contractors' schedules, the Construction Management Plan, and/or any other plans relating to the Authorized Activity and/or the System Improvements. The University's approval of any System Plans or any other plans submitted by AES shall not be deemed a representation, warranty or opinion of the University that such plans are adequate in any manner whatsoever, or free from defects, or in compliance with engineering standards, codes or legal requirements.

c. AES to submit as-built System Plans. Upon completion of the System construction work, AES will submit to the University as-built plans covering the System Improvements that are completed on, within, and/or under the Easement Area and the Property. Failure by AES to timely submit such as-built plans to the University will be considered a breach of or default under this Agreement.

2. AES obligations during System Construction. During the time that AES is constructing, installing, operating, improving, maintaining, repairing, and/or replacing the System Improvements, AES will perform and comply with the following obligations. If no deadline is set forth below or elsewhere in this Agreement, AES shall ensure prompt completion of said obligations:

a. AES responsible for all costs associated with the Authorized Activity. AES shall be responsible for providing and furnishing all the necessary funding for performing and completing the Authorized Activity (including the construction, operation and maintenance of the System Improvements). The University shall not have any obligation to provide or furnish funding for the planning, design, construction, operation, maintenance, repair, alteration, renovation, improvement, upgrade, expansion, replacement, and/or removal of the System or System Improvements or the commencement or completion of the Authorized Activity. AES shall not start any Authorized Activity without first providing written certification to the University that AES has obtained all funds necessary for the completion of the portion of the Authorized Activity (including construction, operation, and maintenance of System Improvements) on or within the Easement Area and/or the Property.

b. Keep University informed. AES shall keep the University informed and

apprised of all material Authorized Activity activities, including, without limitation, the System construction work and the operational and maintenance work activities, particularly any work activities that will or may impact or affect the Easement Area or the Property, including any improvements or operations thereon, all through the coordination process developed by AES or as otherwise required by the University.

c. Address complaints. AES shall respond to and address complaints received by the University and AES from any person or entity regarding the Authorized Activity, including System construction, within, affecting, or impacting the Easement Area and/or the Property. AES shall keep the University informed regarding their handling and the resolution of such complaints. AES shall, at no cost to the UNIVERSITY, be responsible for public outreach, awareness, and education related to the Authorized Activity, including System construction, operational, and maintenance work, and to respond to public inquiries and complaints relating to the Authorized Activity and the System construction, operational, and maintenance work.

d. Implement mitigation measures. To mitigate and address the Adverse Impacts on or to the Easement Area and the Property resulting from or attributable to the Authorized Activity (including System construction, operational, and maintenance work), AES will have, at no cost to the University, implemented such measures as may be reasonably requested by the University to mitigate and address such Adverse Impacts (or have obtained the University's consent to its plan to implement such mitigation measures), including, without limitation: (i) scheduling adjustments to prevent or minimize Authorized Activity impacts upon the Easement Area and/or the Property; (ii) dust control measures (such as erecting screens and frequent watering); (iii) sound mitigation measures (such as baffling, noise barriers, dampening of construction vehicles and equipment); (iv) access control measures (such as fencing, barriers, gated entry and exit points, and guard stations); (v) security control measures (such as security patrols, security lighting, and camera/video and motion sensor systems); and (vi) traffic control measures (such as traffic control officers, flagmen, police officers during peak traffic times, directory, warning, and caution signage/lights, and temporary traffic signals).

e. Control traffic movement. The Authorized Activity, particularly System construction work, is expected to cause increased traffic congestion for vehicular, bicycle, and pedestrian modes of travel in and around the Easement Area and the Property, and AES shall develop and maintain traffic plans, such as traffic control plans, to minimize such traffic congestion and allow free and safe flow of vehicular, bicycle and pedestrian traffic, and ready access by emergency responders, in and around the Easement Area and the Property during the Authorized Activity, particularly the System construction work. AES shall ensure that the AES Agents and the AES Assignees manage, coordinate, and direct the safe, efficient, effective, and continued movement of traffic around the work zone(s) of the Authorized Activity, particularly the System construction work.

f. Inspection of Authorized Activity. AES will permit the University, including the UH Agents, to inspect and monitor the Authorized Activity, particularly the System construction work, covered by the System Plans at any time during the Authorized Activity upon a minimum of six (6) hours prior notice.

g. No runoff into Property. AES shall not allow additional runoff from any areas into or onto any of part of the Easement Area or the Property. AES represents and warrants that the Authorized Activity, the System Improvements and the System construction, operational, and maintenance work will not increase the flow of surface water onto, under, across, or into the Easement Area and/or the Property.

h. Historic preservation. In the event any historic properties or burial sites, as defined in Section 6E-2, Hawaii Revised Statutes, are found or discovered on any portion of the Easement Area or the Property, AES shall and will cause the AES Agents, the AES Contractors, and the AES Assignees to: (1) immediately stop all work relating to any portions of the Easement Area or the Property upon which such a find or discovery is or has been made, (2) implement measures and take action to protect the find or discovery, and (3) contact the Historic Preservation Division of the State of Hawai'i Department of Land and Natural Resources (hereafter the "***Historic Preservation Division***") in compliance with Chapter 6E, Hawaii Revised Statutes (hereafter "***HRS***"). Neither AES, the AES Agents, the AES Contractors, nor the AES Assignees shall recommence the Authorized Activity, particularly the System construction work relating to the Easement Area and/or the Property upon which such find or discovery is made unless and until the Historic Preservation Division allows further Authorized Activity, particularly the System construction work to proceed in compliance with HRS Chapter 6E. AES shall and will cause the AES Agents, the AES Contractors, and the AES Assignees to, comply with HRS Chapter 6E, HRS and the National Historic Preservation Act (16 U.S.C. 440, et seq), and all other Federal and State laws pertaining to the protection of archaeological, historical, and cultural resources, including HRS Chapter 6E. AES and the University acknowledge and agree that during the conduct of the AES Work, AES may discover historic properties and/or human remains (as defined in Section 6E-2, Hawai'i Revised Statutes) on, within, or under the Easement Area. If such discovery occurs, AES and the University acknowledge and agree that AES has agreed to accept the Easement Area in its "as is" condition with no representations or warranties from the University. In no event or way whatsoever shall the University be obligated to remediate or share in the cost to protect and/or relocate any such historic properties and/or human remains, including implementing any mitigation or other protective measures required by the Historic Preservation Division, or obtain any associated governmental approvals in order to allow AES, the AES Agents, the AES Contractors, and/or the AES Assignees to enter or use or occupy the Easement Area or any portion of the Property or complete, operate, maintain, or remove the AES Work, the System Improvements, and/or the System.

3. System Improvements. AES will keep the University informed of any material changes to the System Plans and/or material modifications or additions to the System Improvements, including the impacts of the modified and/or new System Improvements upon the Easement Area, the Property, the UH Facilities, the UH Research, and/or University operations.

a. Maintenance. AES shall perform the Maintenance Work in accordance with the following:

(1) Reasonably prudent owner maintenance standard. AES shall perform the Maintenance Work to the same degree and level and take the same good care of the Exclusive Easement Area, the Utility Easement Area, and the System Improvements that would

be taken by a reasonably prudent owner who desired to keep and maintain the same so that at the expiration or sooner termination of this Agreement, the same will be in a condition substantially similar to that which existed at the commencement of this Agreement, reasonable wear and tear excepted.

(2) Perform in accordance with accepted industry standards. The Maintenance Work shall be performed by AES in accordance with accepted industry standards and then applicable University policies, practice, standards and guidelines and shall include, without limitation: (a) watering, weeding, fertilizing, mowing, reseeding, cultivating, spraying, mulching, trimming and care of shrubs, trees, vegetation, edging, invasive plant removal, and other services necessary for care of areas within the Property where landscaping or vegetation exists; (b) repair and maintenance (including repaving and reconstruction) of roads, streets, access ways, sidewalks, driveways, and parking areas; (c) replacement of dead or damaged plants or vegetation; (d) street cleaning; (e) cleaning and clearing of sidewalks, gutters, swales, ditches, and other drainage facilities and areas; and (f) removal and disposal of trash and debris. AES shall be responsible for obtaining permission from third parties as necessary to complete the Maintenance Work.

b. Damage or destruction of System Improvements. If the System Improvements are severely damaged or destroyed by fire or other causes or casualties, thereby rendering the System Improvements unsuitable, unusable, or untenantable for the purposes and uses contemplated by this Agreement as determined by AES, AES shall have as long as AES shall reasonably need to notify the University in writing how AES intends to proceed, including whether and to what extent to rebuild or restore the System Improvements (the "***Casualty Notice***"), provided that AES continues to pay the full amount of Rent to the University for any period of time during which AES is deciding whether and how to proceed with repairs, rebuilding, and/or restoration.

(1) AES fails to timely notify University. If AES fails to provide the Casualty Notice, the University will thereafter have the right to determine whether the Agreement will be terminated or continued. If AES decides to rebuild or restore at least a portion of the System Improvements so damaged, the University will, within a reasonable period of time after receiving AES's notice of their intent to rebuild/restore, approve or not approve the extent to which AES intends to rebuild/restore the System Improvements, such approval not to be unreasonably withheld. If the University does not so approve, the University may terminate this Agreement.

(2) Parties may terminate this Agreement. If AES elects not to rebuild or restore the System Improvements, AES and/or the University may be terminate this Agreement.

(3) AES to remove System Improvements. If this Agreement is terminated, AES, the AES Agents, the AES Contractors, and/or the AES Assignees shall have six (6) months thereafter to demolish all damaged System Improvements and remove such System Improvements, all debris, rubbish, and trash, and all of the Personal Property (defined below) of AES, the AES Agents, the AES Contractors, and/or the AES Assignees from the Easement Area and the Property and restore the same to a condition reasonably similar to that

which existed as of the Commencement Date herein, including restoring the ground to an even grade, reasonable wear and tear excepted.

(4) University may remove if AES does not. If AES, the AES Agents, the AES Contractors, and/or the AES Assignees fail to remove all System Improvements and all debris, rubbish, and trash, and all of their Personal Property and restore the Easement Area and other affected portions of the Property within the requisite time period, the University may, at AES's sole cost, complete such removal and restoration, including restoring the ground to even grade, in which case AES shall immediately reimburse to the University, upon written demand from the University for all reasonable costs incurred by the University in completing such removal and restoration efforts, plus ten percent (10%) for the University's administrative overhead. The University would be willing, upon demand from AES, to furnish written evidence supporting the costs incurred by the University in such removal and restoration efforts.

(5) AES restoration of System Improvements. If, after destruction of or damage to any of the System Improvements, AES decides to restore the destroyed and/or damaged System Improvements, AES shall provide the University with written notice of their intent to rebuild/restore the System Improvements and the extent to which AES intends to so rebuild/restore the System Improvements within a reasonable time after the date of casualty. AES acknowledges and agrees that before proceeding with any rebuilding or restoration efforts, AES must: (a) obtain the University's prior written approval for all System Plans relating to the rebuilding and restoration of the System Improvements, and (b) meet all obligations of AES under this Agreement, including this paragraph 3 (System Improvements) with respect to the construction and installation of the System Improvements.

(6) Partial damage. If the System Improvements are damaged by fire or other causes or casualties, but are not rendered unsuitable, unusable, or untenantable for the purposes and uses contemplated by this Agreement as determined by AES, AES shall, and will cause the AES Agents, the AES Contractors, and/or the AES Assignees to, promptly repair and restore the System Improvements so damaged. AES shall obtain the University's prior written approval, which shall not be unreasonably withheld, conditioned, or delayed, for all repair and restoration System Plans before starting such repair and restoration work, provided that the estimated cost of repairing and restoring the System Improvements is $100,000 or more. AES shall also satisfy all other applicable requirements for the construction, installation, operation, maintenance, repair, alteration, renovation, improvement, upgrade, expansion, replacement, and removal of the System Improvements as described in this Agreement, including this paragraph 3 (System Improvements).

c. Inspection. The University and the UH Agents may enter upon all portions of the Easement Area, the System Improvements, the Property, or any portion thereof for the purpose of: (1) inspecting the same and examining the condition and state of repair thereof, (2) observing AES' performance of its obligations under this Agreement (including the Maintenance Responsibility), (3) to make any repairs the University deems reasonably necessary, such as situations where AES fails to effect required repairs, (4) to serve or post or keep posted notices that are required by Applicable Laws on or within the Easement Area, the System Improvements, and/or the Property, and (5) performing or completing any act or thing that the University may be obligated or have the right to do under this Agreement or otherwise.

AES shall provide reasonable access to the University and the University Agents. The University will notify AES in writing at least forty eight (48) hours in advance of the requested entry. If AES' operations do not allow immediate University entry, AES may reschedule the University's entry for another date but such rescheduled date shall not be more than seven (7) days from the University's initial requested entry date, unless otherwise agreed to by the University. In permitting entry, AES will have an AES Agent or representative accompany the University during the University's entry and may require the University and the University Agents to attend a safety orientation (at AES' discretion) and comply with AES safety protocols. The University reserves the right, in cases of emergencies, as determined by the University, in the University's reasonable discretion, to enter the Easement Area, the System Improvements, and the Property and effect such repairs and implement such measures as the University deems necessary to address the emergency, mitigate the adverse conditions, or reduce the possibility of a larger casualty without the need to obtain a court order or other authorization, and AES hereby authorizes the University in such emergency situations, to enter the Easement Area, the System Improvements, and the Property and address such emergency, effect such repairs, and implement such measures as the University deems necessary.

d. No obligation to construct or repair. Nothing in this paragraph 3 (System Improvements) shall impose or shall be construed to impose upon the University any obligations to so construct or maintain, or to make repairs, replacements, additions, or alterations to the Easement Area, the System Improvements, and/or the Property, nor shall the University's entry upon the Easement Area, the System Improvements, and/or the Property create any liability on the part of the University for any failure to do so.

4. Indemnification by AES. AES, on behalf of itself and the AES Agents, shall indemnify, defend, hold harmless the University and the UH Agents from any claims, demands, suits, actions, causes of action, judgments, injunctions, orders, rulings, directives, penalties, assessments, liens, liabilities, losses, damages, costs, and expenses (including Attorneys' Fees and Costs (as defined herein)), by whomsoever incurred, sustained or asserted, including, without limitation, claims for property damage, personal injury, bodily injury, death, lost revenues and other economic loss, and/or environmental damage, directly or indirectly arising from or related in any way to the following:

a. Exercise of rights. Exercise of any of the rights and privileges under this Agreement by AES, the AES Agents, the AES Contractors, and/or the AES Assignees and/or entering into and/or using or occupying any portion of the Easement Area and the Property.

b. Act or omission. Any act or omission by AES, the AES Agents, the AES Contractors, and/or the AES Assignees.

c. Casualty. Any accident, fire or other casualty on or within the Easement Area and/or the Property arising from events, occurrences, or incidents at, on, within, or attributable to the acts or omissions of AES, the AES Agents, the AES Contractors, and/or the AES Assignees on or in relation to the Easement Area and/or the Property.

d. Violation. Any violation or alleged violation by AES, the AES Agents, the AES Contractors, and/or the AES Assignees of any Applicable Laws (including, without

limitation, any Environmental Laws), arising from events, occurrences, or incidents at, on, within, or attributable to the Easement Area and/or the Property and/or attributable to the acts or omissions of AES, the AES Agents, the AES Contractors, and/or the AES Assignees.

e. Hazardous Materials. Any liability, claim, cost, and/or expense connected with: (a) the release, discharge, disposal, or escape of Hazardous Materials on or from the Easement Area, the Property, the System Improvements, and/or the System caused by AES, the AES Agents, the AES Contractors, and/or the AES Assignees or otherwise attributable to AES', the AES Agents' , the AES Contractors' and/or the AES Assignees' use and occupancy of the Easement Area and the Property, (b) the presence, treatment, handling, generation, transport, accumulation, collection, or storage of Hazardous Materials within or under the Easement Area, the Property, the System Improvements, and/or the System caused by AES, the AES Agents, the AES Contractors, and/or the AES Assignees and (c) the failure of AES, the AES Agents, the AES Contractors, and/or the AES Assignees to perform any of their Hazardous Materials obligations contained in paragraph 8 (Hazardous Materials), including, without limitation, the obligations of AES, the AES Agents, the AES Contractors, and/or the AES Assignees to remediate, clean up, and remove Hazardous Materials released by AES, the AES Agents, the AES Contractors, and/or the AES Assignees from the Easement Area and the Property and/or to restore the Easement Area, the Property, the System Improvements, and/or the System.

f. Liens. Any act or neglect by AES, the AES Agents, the AES Contractors, and/or the AES Assignees whereby the Easement Area, the Property, the System Improvements, and/or the System, or any part or parts thereof, at any time during the Term hereof shall become subject to any Liens, including, without limitation, all costs and expenses arising from actions to challenge, discharge, satisfy, and/or release the Liens, such as all Attorneys' Fees and Costs (as defined herein).

g. Loss. Any loss or theft whatsoever of any property placed or stored by AES, the AES Agents, the AES Contractors, and/or the AES Assignees on or about the Easement Area and/or the Property.

h. Misrepresentation. Any material misrepresentation or inaccuracy in any representation or warranty by AES, the AES Agents, the AES Contractors, and/or the AES Assignees under this Agreement.

i. Challenge. Any challenge to the authority of AES to negotiate, enter into, and execute this Agreement or to the authority of AES, the AES Agents, the AES Contractors, and/or the AES Assignees or perform obligations under this Agreement.

j. Failure to perform. Any failure by AES, the AES Agents, the AES Contractors, and/or the AES Assignees, in whole or in part, to fully and properly perform any of the terms and conditions contained in this Agreement, including, without limitation, the breach or default by AES, the AES Agents, the AES Contractors, and/or the AES Assignees in the performance of any of said terms and conditions of this Agreement.

k. Removal. Any enforcement by the University of any provision of this paragraph 23 and any costs of duly removing AES, the AES Agents, the AES Contractors, and/or

the AES Assignees from the Easement Area and/or the Property and restoring the same as provided herein.

l. University's enforcement. Any actions by the University or others to enforce the terms and conditions of this Agreement, including the performance of any of the obligations of AES, the AES Agents, the AES Contractors, and/or the AES Assignees hereunder.

"***Attorneys' Fees and Costs***" means and includes all reasonable attorneys' fees, expert witness fees and costs, discovery and pretrial costs, costs incurred in the investigation, prosecution, defense, and/or handling of any action, costs for research relating to settlement or resolution, costs of implementing preventive measures necessary to protect and preserve the position of the University and/or the UH Agents with regard to any such claim or action, and all other reasonable fees and costs incurred or imposed upon the University or the UH Agents in connection with such claim or action.

5. Insurance. AES shall, and shall ensure that all AES Agents, AES Contractors, and AES Assignees procure and maintain, at their own cost and expense, the following insurance, issued by an insurance company authorized to do business in the State of Hawaii and reasonably satisfactory to the University:

a. Required Insurance Coverage.

(1) Commercial General Liability. Commercial general liability insurance covering claims with respect to injuries or damages to persons or property sustained as a result of the activities performed by AES, the AES Agents, the AES Contractors, and/or the AES Assignees within, on, or about the Easement Area and/or the Property, with minimum combined single limits of liability (written on an occurrence form) no less than the following:

General Liability

General Aggregate	$5,000,000.00
Products/Completed Operations Aggregate	$5,000,000.00
Personal/Advertising Injury	$5,000,000.00
Each Occurrence	$5,000,000.00

Such limits may be achieved through the use of umbrella/excess liability insurance sufficient to meet the requirements of this paragraph for the System Improvements, the System, the Easement Area, ways and means surrounding the Easement Area, and the Property. Said policy or policies shall cover the System Improvements, the System, the Easement Area, and the Property, and all of the activities and operations of AES, the AES Agents, the AES Contractors, and the AES Assignees on, about and with respect to the Easement Area and the Property.

(2) All Risk Property Insurance. Insurance against loss or damage by perils, typically covered under an "all risk" property form, covering the System Improvements,

the Utilities, and the System within, on, or adjacent to the Easement Area and/or the Property, in an amount equal to the replacement cost of the System Improvements, Utilities, and the System.

(3) Builder's Risk Insurance. Builder's all risk insurance in an amount reasonably satisfactory to the University during the course of the AES Work (as defined herein) covering, at a minimum, the replacement cost of any System Improvements, the Utilities, and the System constructed or installed by AES, the AES Agents, the AES Contractors, and/or the AES Assignees on or in portions of the Easement Area and/or the Property. Only AES and the AES Assignees and not the AES Agents or the AES Contractors shall procure and maintain the Builder's Risk Insurance.

(4) Pollution Liability. Pollution liability insurance for environmental liabilities, which would include claims for bodily injury, property damage, environmental damage, and remediation costs resulting from pollution conditions caused by AES, the AES Agents, the AES Contractors, or the AES Assignees in connection with or during the exercise of the rights granted to AES under this Agreement, with a combined single limit coverage of not less than the following:

Pollution Liability

Each Common Cause	$3,000,000.00
Aggregate	$3,000,000.00

(5) Automobile Liability. Automobile liability insurance to include coverage for any owned, non-owned, or hired automobiles with limits of: not less than the following:

Automobile Liability

Bodily Injury – Per Person	$1,000,000.00
Bodily Injury – Per Accident	$1,000,000.00
Property Damage - Each Accident	$1,000,000.00

In the event there is a change in the Applicable Laws regarding the financial responsibility and insurance requirements of automobile owners or users which modifies, amends, or repeals these requirements or otherwise makes any of these requirements obsolete, AES shall comply with such new requirement in accordance with then Applicable Laws.

(6) Workers Compensation & Employer's Liability Insurance. Workers compensation insurance as required by statute with respect to the AES Work performed by the employees of AES, on or involving the Easement Area and employer's liability insurance with limits not less than:

Employers Liability

Bodily Injury – Each Accident	$500,000.00
Disease – Policy Limit	$500,000.00
Disease – Each Employee	$500,000.00

AES shall ensure that the AES Agents, the AES Contractors, and the AES Assignees obtain workers compensation and employer's liability insurance with the limits described herein to cover the AES Work performed by their respective employees on or involving the Easement Area.

b. Common provisions. AES shall ensure that each insurance policy that AES is obligated to obtain under this Agreement shall be subject to the following:

(1) Notice of change. All insurance policies required to be obtained by AES under this Agreement shall contain a clause to the effect that should any of the insurance policies be materially changed from the coverages and/or limits required herein, or cancelled before the expiration date thereof, the insurer shall provide AES with notice in accordance with the policy provisions or sooner, if required by law and AES shall notify the University in writing of any such notices received by AES from its insurers. AES shall provide and shall ensure that the AES Agents, the AES Contractors, and the AES Assignees provide the University notice of (a) any act or omission by AES, the AES Agents, the AES Contractors, and/or the AES Assignees, respectively, that would allow the insurer to terminate or modify any of the insurance coverage within two (2) business days of such act or omission (including, but not limited to, failure to renew an insurance policy or pay a required premium therefor) and (b) notice of cancellation, limitation in scope, material change, or non-renewal by the insurer within two (2) business days of receipt.

(2) Insurance obtained by the University shall apply in excess of AES's insurance. Any insurance maintained by AES shall be primary and not require any insurance maintained by the University to contribute to or with, either pro rata or otherwise, or be applied in any way prior to, any insurance maintained by AES under this Agreement.

(3) University as additional insured. AES shall, and shall ensure that the AES Agents, the AES Contractors, and the AES Assignees name the University, the UH Agents, and those persons or entities identified in writing from time to time by the University to AES, as additional insured on the insurance policies for all insurance coverage obligated to be obtained under this Agreement, except for the Workers' compensation and employer's liability insurance obtained by AES, the AES Agents, the AES Contractors, and/or the AES Assignees.

(4) Waiver of subrogation endorsement. All insurance required under this Agreement will contain a waiver of subrogation endorsement in favor of the University.

(5) University not required to pay premiums. AES shall be solely responsible for the costs of procuring and maintaining the insurance coverage described in this Agreement and shall not charge the University or expect the University to pay any portion of the premiums or charges to obtain the insurance coverage required under this Agreement.

(6) Acceptable deductibles. The terms and amounts of any deductibles for the insurance policies required under this Agreement must be reasonable and acceptable to the University based upon the type of insurance involved and the nature of AES's, AES Agents', AES Contractors' and/or the AES Assignees' use of the Easement Area, the Property, the System Improvements, the Utilities, and the System and AES's responsibility to maintain the System Improvements, the Utilities, the System, and the Easement Area.

(7) AES to ensure compliance. AES shall ensure that the AES Agents, the AES Contractors, and the AES Assignees obtain the insurance coverages required paragraph 5a (Required Insurance Coverage) herein and that they comply with the provisions as described in paragraph 5b (Common provisions), paragraph 5c (Deposit insurance certificates), paragraph 5d (UH may cure failure to obtain/maintain insurance), paragraph 5e (Lapse in insurance constitutes a breach), paragraph 5f (Insurance shall not limit AES's liability), and paragraph 5g (UH may adjust insurance requirements) herein.

c. Deposit insurance certificates. AES shall (a) deposit with the University, on or before the date AES, the AES Agents, the AES Contractors, and/or the AES Assignees enter the Property (or the effective date of any amendment to this Agreement with respect to any additions to the Easement Area or the Property herein), certificates of insurance sufficient to satisfy the University that the insurance provisions of this Agreement have been fully complied with and (b) keep such insurance in effect and the certificates therefore on deposit with the University during the entire term of this Agreement. AES shall ensure that the AES Agents, the AES Contractors, and the AES Assignees also timely deposit with the University prior to their entry and upon each renewal or purchase of equivalent insurance coverage, the certificates of insurance confirming that they have obtained the insurance coverage required under this Agreement.

d. University may cure failure to obtain/maintain insurance. Upon failure of AES, the AES Agents, the AES Contractors, and/or the AES Assignees to provide and maintain the insurance required herein, after a ten (10) day prior written notice to comply from the University, the University may, but shall not be required to, procure such insurance at AES's sole cost and expense, and AES shall be obligated to immediately reimburse the University for the cost thereof plus ten percent (10%) for the University's administrative overhead.

e. Lapse in insurance constitute a breach. Any lapse in, or failure by AES to procure, maintain, and keep in full force and effect or cause the AES Agents, the AES Contractors, and/or the AES Assignees to procure, maintain, and keep in full force and effect such insurance coverage as is required under this Agreement, at any time during and throughout the Term of this Agreement, shall be a breach of this Agreement and the University may terminate the rights of AES, the AES Agents, the AES Contractors, and/or the AES Assignees to use, occupy, or access the Easement Area and/or the Property.

f. Insurance shall not limit AES's liability. The procuring of such required policy or policies of insurance shall not be construed to limit AES's liability hereunder or to fulfill the indemnification provisions and requirements of this Agreement. Notwithstanding said policy or policies of insurance, AES shall be responsible for complying with AES's obligations under paragraph 4 (Indemnification by AES) herein.

g. University may adjust insurance requirements. The University may, upon reasonable notice and reasonable grounds, increase or change the form, type, coverage, or coverage limits of the insurance required hereunder, in which event AES shall obtain such required insurance or cause such required insurance to be obtained. The University's requirements shall be reasonable and shall be designed to provide protection from and against the kind and extent of risks that exist at the time a change in insurance is required.

6. Coordination. AES shall coordinate its use of the Easement Area and any portion of the Property with the University so that the University may evaluate potential impacts on the University's use of the Property and the Easement Area. AES shall notify the University of AES's planned work activities and schedule, including the System construction work and the Maintenance Work. The University will notify AES, which notification shall not be unreasonably delayed, of the University's concerns or issues that need to be resolved before AES proceeds with the scheduled placement, construction, installation, operation, maintenance, repair, alteration, renovation, improvement, upgrade, expansion, and/or removal activities relating to the Authorized Activity and/or the System Improvements. AES will attempt to expeditiously resolve the University's concerns or issues.

7. AES Guarantee.

8. Hazardous Materials.

a. Prohibitions. AES shall not cause or permit and will ensure that the AES Agents, the AES Contractors, and the AES Assignees do not cause or permit the escape, disposal, or release of Hazardous Materials from or within the Easement Area and/or the Property. AES shall not and will ensure that the AES Agents, the AES Contractors, and the AES Assignees do not bring, store, or use any Hazardous Materials on or within the Easement Area or the Property without the University's prior written consent, which may be withheld at the University's sole discretion.

b. Definitions.

(1) ***"Environmental Laws"*** means all applicable laws, statutes, regulations, rules, ordinances, codes, standards, directives of every kind, guidelines, permits, licenses, authorizations, approvals, and orders of all governmental agencies, departments, commissions, boards, bureaus, or instrumentalities of the United States, states, and political subdivisions thereof (hereafter "***Governmental Authority***"), interpretations of the foregoing by any court, legislative body, agency or official, all applicable judicial, administrative, and regulatory orders, decrees, requirements, rulings, and judgments, and rules of common law which currently are in effect or which may come into effect through enactment, issuance, promulgation, adoption or otherwise, which in any way pertain to, relate to, or have any relevance to the environment, health or safety, including, without limitation:

(a) Reporting, licensing, and remediation requirements. All requirements pertaining to reporting, licensing, permitting, investigation, and remediation of emissions, discharges, releases, or threatened releases of Hazardous Materials, chemical substances, pollutants, contaminants, or hazardous or toxic substances, materials or wastes whether solid, liquid or gaseous in nature, into the air, surface water, groundwater, or land, or relating to the use, treatment, storage, disposal, transport, or handling of Hazardous Materials, chemical substances, pollutants, contaminants, or hazardous or toxic substances, materials, or wastes, whether solid, liquid, or gaseous in nature;

(b) Natural resource protection requirements. All requirements pertaining to the protection of natural resources or of the health and safety of employees or the public; and

(c) Specific statutes and rules. The Comprehensive Environmental Response, Compensation, and Liability Act of 1980, the Resource Conservation and Recovery Act, as amended by the Hazardous and Solid Waste Amendments of 1984, the Federal Insecticide, Fungicide and Rodenticide Act, the Hazardous Materials Transportation Act, the Clean Water Act, the Clean Air Act, the Toxic Substances Control Act, the Safe Drinking Water Act, and any similar federal, State of Hawai'i (including without limitation Hawai'i Revised Statutes Chapters 128D and 342B through 342P, inclusive), and county laws and ordinances, and regulations now or hereafter adopted, approved, and promulgated pursuant thereto, all as any of the foregoing may be amended from time to time, applying to the License Area, the Property, or any portion thereof.

(2) ***"Hazardous Materials"*** means any substance, element, compound, mixture or solution:

(a) Presence requires remediation. The presence of which requires investigation or remediation under any applicable Environmental Law; or

(b) Defined as a pollutant or contaminant. Which is now or at any time hereafter in effect becomes defined as a "hazardous waste," "hazardous substance," pollutant or contaminant under any federal, state, or county statute, regulation, rule, or ordinance

or amendments thereto, including without limitation, the Environmental Laws, now or hereafter adopted, approved, and promulgated pursuant thereto; and asbestos, polychlorinated biphenyls, petroleum, and petroleum byproducts, fuel oil, sludge, crude oil or residue, or trichloropropane; or

(c) Defined as toxic, explosive, or regulated. Which is toxic, explosive, corrosive, flammable, infectious, radioactive, carcinogenic, mutagenic, or otherwise hazardous and is or becomes regulated by any Governmental Authority; or

(d) Poses or threatens to pose a hazard. The presence of which on the Easement Area or the Property poses or threatens to pose a hazard to the health or safety of persons, to property, or to the environment, on or about the Easement Area or the Property.

c. Responsibility for Hazardous Materials impacts. Prior to the Effective Date of this Agreement, AES shall have completed a site visit and inspection of the portion of the Easement Area upon which AES plans to construct, install, and operate the System Improvements and the System, including the portions of the Property that AES will be entering and using in conjunction therewith at no cost to the University ("***Site Baseline Assessment***"). AES shall, however, be responsible for any Hazardous Materials conditions and environmental issues arising from its use and occupancy of the Easement Area and the Property, due to, caused by, or attributable to the acts and/or omissions of AES, the AES Agents, the AES Contractors and/or the AES Assignees. The University makes no representations or warranties as to: (1) the condition of the Easement Area and/or the Property, (2) the presence of Hazardous Materials thereon or therein, or (3) any environmental condition relating thereto.

(1) AES to notify of Hazardous Material conditions. AES shall notify and provide the University the results of such site visit, inspection, and inventory of conditions, including any reports such as the Site Baseline Assessment. If AES contends that the site visit, inspection, and inventory of conditions has identified Hazardous Materials conditions or environmental issues, AES will notify the University and attempt to negotiate a mutually acceptable resolution, but in no way whatsoever shall University be obligated to remediate Hazardous Materials in order to allow AES, the AES Agents, the AES Contractors, and/or the AES Assignees to construct, install, operate, maintain, repair, and/or remove the System Improvements (collectively the "***AES Work***"). If AES subsequently discovers any Hazardous Materials within the Easement Area or the Property, AES shall notify the University of such discovery. AES will be deemed responsible for remediating, cleaning up, and removing such subsequently discovered Hazardous Materials from the affected Easement Area and the Property and restoring the Easement Area and the Property, unless AES can prove to the University, pursuant to paragraph 8j (Burden of Proof) herein, that neither AES, the AES Agents, the AES Contractors, nor the AES Assignees are or were not responsible for the presence, discharge, and/or release of the Hazardous Materials. Any decision by the University to engage in remediation expenditures shall be at the sole discretion of the University and AES shall have no right to force the University to remediate Hazardous Materials, even if such Hazardous Materials conditions or environmental issues existed before AES, the AES Agents, the AES Contractors, or the AES Assignees entered the Easement Area or the Property. If AES proves that neither AES, the AES Agents, the AES Contractors, nor the AES Assignees are or

were not responsible for the presence, discharge, and/or release of the Hazardous Materials, AES will have the option to terminate this Agreement upon thirty (30) days prior written notice to the University should the University choose to not remediate such Hazardous Materials.

(2) AES responsible from entry date. From and after the date of AES' first entry onto the Easement Area under this Agreement, AES shall be responsible for: (a) any Hazardous Materials conditions and environmental issues and violations that are due to, caused by, or attributable to the acts and/or omissions of AES, the AES Agents, the AES Contractors, or the AES Assignees under this Agreement, including any attributable to the AES Work and (b) any fines and penalties, mitigation, restoration, and clean-up requirements, and/or the results of any other enforcement actions arising from said Hazardous Materials conditions and/or environmental issues and violations, regardless of when the enforcement action commenced or was concluded. If the University is required to remediate and cleanup any Hazardous Materials within the Easement Area or the Property as a result of the AES Work, AES shall pay for or cause to be paid all costs and expenses incurred or to be incurred by the University in remediating and cleaning up any such Hazardous Materials.

d. Removal and Remediation. If any Hazardous Materials are used, stored, treated, disposed, handled, or determined to be present on or within the Easement Area or the Property, or discharged, released, or determined to be present on or within the Easement Area or the Property due to, caused by, or attributable to the acts or omissions of AES, the AES Agents, the AES Contractors, or the AES Assignees, AES shall, at AES's sole cost and expense and at no cost to the University, clean-up, remediate, remove, and dispose of all said Hazardous Materials on or within the Easement Area and the Property. Upon termination of this Agreement, AES shall be responsible, at AES's sole cost and at no cost to the University, for restoring the Easement Area and/or Property affected by the presence, clean-up, remediation, removal, and disposal of the Hazardous Materials, to the same or better condition existing at the Effective Date of this Agreement, to the University's reasonable satisfaction. If AES fails to clean-up, remediate, remove, and/or dispose of said Hazardous Materials and/or fails to restore the affected portions of the Easement Area and the Property as required hereunder, the University may, after giving AES thirty (30) days' written notice, complete such clean-up, remediation, removal, disposal, and/or restoration at AES's sole cost and expense, which amount AES shall upon demand immediately pay to the University plus ten percent (10%) for the University administrative overhead.

e. Notice to the University. AES shall keep the University fully informed at all times regarding all matters related to any Environmental Laws affecting AES and its use of the Easement Area and the Property.

(1) AES to furnish and update Hazardous Materials listing. This duty shall include, but not be limited to, providing the University with a current and complete list and accounting (with periodic updates) of all Hazardous Materials which are present in, on, or about the Easement Area or the Property by or as a result of AES, the AES Agents, the AES Contractors and/or the AES Assignees, together with evidence that AES, the AES Agents, the AES Contractors, and the AES Agents had or have in effect all required and appropriate permits, licenses, registrations, approvals, and other consents that may be required by any Governmental Authority or under any Environmental Laws.

(2) AES to notify of investigation or enforcement action. AES shall also provide immediate written notice of any investigation, enforcement action, compliance order, or order of any type, or any other legal action, initiated, issued, or any indication of an intent to do so, communicated in any way to AES, the AES Agents, the AES Contractors, and/or the AES Assignees by any Governmental Authority that relates in any way to any Environmental Laws or any Hazardous Materials on or within the Easement Area or the Property.

(3) AES to submit written communications. This written notice to the University shall include copies of all written communications from any Governmental Authority, including copies of all correspondence, claims, complaints, warnings, reports, technical data, and any other documents received or obtained by AES, the AES Agents, the AES Contractors, and/or the AES Assignees.

(4) AES to furnish proof of Environmental Laws compliance. Upon termination of this Agreement, AES shall provide the University with written evidence reasonably satisfactory to the University that AES, the AES Agents, the AES Contractors, and the AES Assignees have fully complied with all Environmental Laws, including any orders issued by any Governmental Authority responsible for enforcement of the Environmental Laws that relate to the Easement Area or the Property, and the results of all assessments and investigations that may be reasonably ordered by the University pursuant to subparagraph 8g (Environmental Reports) herein, or by any Governmental Authority responsible for enforcement of the Environmental Laws.

f. Disposal/Removal. Except the possession and handling of Hazardous Materials for which AES is exempt and those Hazardous Materials for which AES has obtained all currently required permits to sort or use certain Hazardous Materials on the Easement Area or the Property, including written permission from the University, AES shall cause any Hazardous Materials resulting from use by AES, the AES Agents, the AES Contractors, and/or the AES Assignees to be removed and transported from the Easement Area and the Property for disposal solely by duly licensed Hazardous Materials transporters to duly licensed facilities for final disposal as required by all applicable Environmental Laws. AES shall provide the University with copies of documentary proof, including manifests, receipts, or bills of lading, which reflect said Hazardous Materials have been properly removed and disposed of in accordance with all Environmental Laws.

g. Environmental reports. AES has obtained a Phase I environmental report for the Easement Area dated March 6, 2019, prepared by Tetra Tech, Inc.. AES shall provide a copy of such report to the University upon the University's request.

h. University's right to act. In the event AES fails for any reason to comply with any of their duties under any Environmental Laws within the time set for doing so, or within a reasonable time as determined by the University after a thirty (30) day prior written notice to comply from the University, the University shall have the right, but not the obligation, in its sole discretion, to perform those duties, or cause them to be performed. AES hereby grants to the University, the UH Agents, and anyone designated by the University access to the Easement

Area and the portions of the Property upon which AES is performing the AES Work at all reasonable hours, in order to perform said acts and duties. Any cost, expense, or liability of any type that may be incurred by the University in performing said acts or duties shall be the sole responsibility of AES and AES hereby agrees to immediately pay to the University all of such costs and expenses incurred by the University (plus a ten percent (10%) markup to cover the University's administrative overhead) in performing said acts or duties. This obligation shall extend to any costs and expenses incident to enforcement of the University's right to act, including Attorneys' Fees and Costs and the costs and fees for collection of said Attorneys' Fees and Costs.

i. Release and indemnity. AES hereby agrees to release the University, the UH Agents, and their successors, and assigns from any liability of any kind, including, but not limited to, any liability for any damages, penalties, fines, judgments, or assessments that may be imposed or obtained by any person, agency, or Governmental Authority against AES, the AES Agents, the AES Contractors, and/or the AES Assignees by reason of any Hazardous Materials that may be present by or as a result of the use of the Easement Area or the Property by AES, the AES Agents, the AES Contractors, and/or the AES Assignees by whatever means on, in, or under the Easement Area or the Property, including any fines or penalties assessed against the University for non-compliance with any Environmental Laws, unless such actions which result in liability for damages, penalties, fines, judgments, or assessments imposed are caused by the University or the University's officers or employees.

(1) AES indemnity. AES shall indemnify, defend with counsel reasonably acceptable to the University, and hold harmless the University and the UH Agents from any liability that may arise in connection with, or by reason of, the presence of Hazardous Materials or any occurrence involving any Hazardous Materials that may be alleged to be connected to, or related in any way with: (1) the entry onto and use and occupancy of the Easement Area and/or the Property by AES, the AES Agents, the AES Contractors, and/or the AES Assignees, (2) any of the AES Work performed by AES, the AES Agents, the AES Contractors, and/or the AES Assignees, (3) any System Improvements or System on or within the Easement Area and the Property constructed or installed by AES, the AES Agents, the AES Contractors, and/or the AES Assignees, (4) the University making the Easement Area and/or portions of the Property available to AES, the AES Agents, the AES Contractors, and/or the AES Assignees, (5) the University granting rights to AES, the AES Agents, the AES Contractors, and/or the AES Assignees to enter and use and occupy the Easement Area or portions of the Property, and (6) any fines or penalties assessed against the University for non-compliance with any Environmental Laws arising from entry onto and use and occupancy of the Easement Area and/or the Property by AES, the AES Agents, the AES Contractors, and/or the AES Assignees, unless such actions which result in liability for damages, penalties, fines, judgments, or assessments imposed are caused by the University or the University's officers or employees.

(2) University not obligated to remediate. Notwithstanding any provision of this Agreement or any other agreement to the contrary, in no event or way whatsoever shall the University be obligated to remediate or share in the cost to remediate or deal with Hazardous Materials in order to allow AES, the AES Agents, the AES Contractors, and/or the AES Assignees to enter or use or occupy the Easement Area or any portion of the

Property or complete, operate, maintain, or remove the AES Work, the System Improvements, and/or the System.

(3) University to decide on extent of participation. Any decision by the University to participate in remediation expenditures shall be at the sole discretion of the University. AES, the AES Agents, the AES Contractors, and/or the AES Assignees shall not have the right to and may not force the University to remediate Hazardous Materials, even if such Hazardous Materials conditions or environmental issues existed before AES, the AES Agents, the AES Contractors, and/or the AES Assignees entered the Easement Area or the Property.

j. Burden of proof. AES, for itself and on behalf of the AES Agents, the AES Contractors, and the AES Assignees, accept the burden of establishing that they are not responsible for the presence of Hazardous Materials on, in, or under the Easement Area and/or the Property, including any Hazardous Materials that could be discharged or released from the Easement Area and/or the Property. If AES, the AES Agents, the AES Contractors, and/or the AES Assignees cannot establish that they are not responsible for the presence of such Hazardous Materials on, in, or under the Easement Area and/or the Property, AES, on behalf of itself and the AES Agents, the AES Contractors, and the AES Assignees shall be deemed responsible for the presence of the Hazardous Materials. AES and the University agree that upon AES' completion of the Site Baseline Assessment and the University's acceptance of the results thereof, AES' responsibilities to remediate, remove, and clean up Hazardous Materials within the Easement Area and the Property will be limited to remediating, removing, and cleaning up those portions of the Hazardous Materials that exceed the levels established in the Site Baseline Assessment.

9. Liens. AES shall not, and shall ensure that the AES Agents, the AES Contractors, and the AES Assignees shall not, commit or suffer any act or neglect whereby any portion of the Easement Area, the Property, the System Improvements, or any part or parts thereof, at any time during the Term hereof, shall become subject to any Liens.

a. AES shall remove Liens. AES shall take immediate action to discharge, eliminate, or remove the Liens, including, without limitation, bonding or posting other security until the discharge, elimination, or removal is finally determined and the Liens resolved and discharged.

b. University may act if AES fail to timely discharge. If the University reasonably determines that AES is not taking timely action or may be unsuccessful in its efforts to discharge, eliminate, or remove the Liens, the University may, after issuing a ten (10) day prior written notice to AES: (1) at AES' sole cost and expense, take such action as the University deems necessary, including, without limitation, seeking judicial or administrative action or intervention to discharge, eliminate, and/or remove the Liens and/or (2) treat AES to be in breach or default of this Agreement and terminate the rights of AES, the AES Agents, the AES Contractors, and/or the AES Assignees under this Agreement. AES shall immediately pay to the University such costs as may be incurred by the University (including a ten percent (10%) markup for the University's administrative overhead) upon demand by the University.

10. Surrender. At the expiration or sooner termination of this Agreement, AES shall and will ensure that the AES Agents, the AES Contractors, and the AES Assignees peaceably deliver unto the University any and all use or possession of the Easement Area and any portion of the Property in good condition and repair and in a condition substantially similar to that which existed as of the Commencement Date herein.

a. Remove and restore. AES shall, at its sole cost, and to the University's reasonable satisfaction, within six (6) months of the expiration or sooner termination of the Term: (a) remove any debris or trash from the Easement Area; (b) properly clean-up and restore any portions of the Easement Area or the Property that were used and/or disturbed by AES, the AES Agents, the AES Contractors, and/or the AES Assignees to a condition substantially similar to that which existed as of the Commencement Date herein, reasonable wear and tear excepted, except that such restoration obligation shall not require removal of the any System Improvements unless the University requires the removal of such System Improvements; (c) repair any damage to the Easement Area, the Property, and/or the System Improvements and/or the UH Facilities thereon, caused by AES, the AES Agents, the AES Contractors, and/or the AES Assignees; and (d) remove all tools, equipment, appliances, appurtenances, equipment, power lines, wires, transmission lines and facilities, vehicles, and personal property of any kind or description (collectively the "Personal Property") from the Easement Area. AES shall complete delivery of possession of the Easement Area and affected portions of the Property to the University within six (6) months after the expiration or sooner termination of this Agreement.

b. AES to remove System Improvements. The University may require AES to remove and ensure that the AES Agents, the AES Contractors, and the AES Assignees remove from the Easement Area and the Property the System Improvements, all at their sole cost and expense, and restore the portions of the Easement Area no longer occupied by the System Improvements and any portions of the Property affected by the use, occupancy and/or operations of AES, the AES Agents, the AES Contractors, and/or the AES Assignees to a condition substantially similar to that which existed as of the Commencement Date herein, reasonable wear and tear excepted.

AES shall, at its sole cost, complete such removal of the System Improvements in accordance with: (a) Applicable Laws, (b) the requirements in this Agreement applicable to AES' construction, installation, maintenance, repair, alteration, renovation, repair, and/or removal of the System Improvements (including requiring the AES Contractors and the AES Assignees to post or provide performance bond(s) sufficient to cover all of the demolition and removal activities, securing insurance, obtaining governmental approvals, and repairing any damage caused by such demolition and removal), (c) the requirements in the Agreement applicable to AES' restoration of the Easement Area (including removing any Hazardous Materials from the Easement Area or the Property), and (d) AES demolition and removal plans that were submitted by AES to the University prior to the start of any demolition or removal work.

c. [Reserved].

d. University may remove and restore upon AES failure to perform. If AES fails to meet its removal, restoration, and delivery of possession obligations hereunder within said six (6) month deadline, the University may complete such removal and restoration, all at AES' sole cost and expense, which costs AES shall pay immediately to the University plus a ten percent (10%) markup for the University's administrative overhead, upon written demand by the University.

e. AES to remove Personal Property. AES shall, and will ensure that the AES Agents, the AES Contractors, and the AES Assignees, at their sole cost and expense, remove any and all Personal Property placed on or within the Easement Area or the Property by AES, the AES Agents, the AES Contractors, and/or the AES Assignees and restore the Easement Area and the Property and any other affected UH Facilities to a condition satisfactory to the University within six (6) months after the expiration or sooner termination of this Agreement. If after six (6) months from the expiration, termination, and/or cancellation of this Agreement, AES has not removed any or all of the Personal Property from the Easement Area or the Property, the University may remove any and all of the Personal Property from the Easement Area and/or the Property and either: (a) treat the Personal Property as abandoned and dispose of the same without liability of any kind to AES, the AES Agents, the AES Contractors, the AES Assignees or anyone else, or (b) place the Personal Property in storage at the sole cost and expense of AES. AES shall immediately pay to the University such removal and storage costs as may be incurred by the University (including a ten percent (10%) markup for the University's administrative overhead) upon demand by the University.

11. Termination.

a. AES Default. The occurrence at any time of the following events shall constitute a "***AES Default***".

(1) Failure to perform obligations. AES' failure to timely perform or cause to be performed any obligation required to be performed by AES under this Agreement or any other agreement or commitment with the University, including, without limitation, the failure of any certification, representation and warranty set forth herein or otherwise delivered by or on behalf of AES to be true and correct at any time; provided, however, that if such failure by its nature can be cured, then AES shall have a period of sixty (60) days after receipt of written notice from the University of such failure of AES to perform its obligations and cure the AES Default.

(2) Failure to obtain sufficient funding. AES' failure to obtain or caused to be obtained sufficient funding to complete the Authorized Activity (including, without limitation, completing the System construction work, the AES Work, and the Maintenance Work), particularly any portion within or affecting the Easement Area or the Property and AES fails to submit to the University documentation showing or proving, to the University's reasonable satisfaction, that AES has obtained or has caused to be obtained a commitment (within sixty (60) days of the Effective Date) to furnish sufficient funding to complete the Authorized Activity (including, without limitation, completing the System construction work, the AES Work, and the Maintenance Work) with respect to the Easement Area or the Property.

(3) AES Bankruptcy Actions. (a) AES admits in writing its inability to pay their debts generally as they become due; (b) AES files a petition or answer seeking reorganization or arrangement under the federal bankruptcy laws or any other applicable law or statute of the United States of America or any State, district, or territory thereof; (c) AES makes an assignment for the benefit of creditors; (d) AES consents to the appointment of a receiver of the whole or any substantial part of its assets; (e) AES has a petition in bankruptcy filed against it, and such petition is not dismissed within 120 days after the filing thereof; (f) a court of competent jurisdiction enters an order, judgment, or decree appointing a receiver of the whole or any substantial part of AES's assets, and such order, judgment or decree is not vacated or set aside or stayed within sixty (60) days from the date of entry thereof; or (g) under the provisions of any other law for the relief or aid of debtors, any court of competent jurisdiction shall assume custody or control of the whole or any substantial part of the assets of AES and such custody or control is not terminated or stayed within sixty (60) days from the date of assumption of such custody or control (collectively "***AES Bankruptcy Actions***").

(4) Abandonment. When AES shall abandon, desert, or vacate the Easement Area and/or the Property, or any relevant portions thereof, or discontinues its operations on or within the Easement Area and/or the Property.

(5) Suspension. The happening of any act that results in the suspension or revocation by any Governmental Authority of the rights, powers, licenses, permits, or authorities, including any Governmental Approvals, necessary for the conduct and operation of AES' business for a period of more than sixty (60) consecutive days.

(6) Liens. Any Liens are filed against or affecting the Easement Area, the Property, and/or the System Improvements, because of any act or omission of AES and such Liens are not removed or enjoined or a bond or other security for satisfaction of such Liens is not posted within sixty (60) days.

(7) Insurance default. AES fails to obtain or keep in force or cause to be obtained or kept in force any insurance coverage identified in paragraph 5 (Insurance) herein at all times that such insurance policy or policies is/are required to be obtained and/or kept in force or caused to obtained and kept in force hereunder.

(8) AES Guarantee default. If AES or the AES Guarantor fail to timely establish the required AES Guarantee in a form and upon such terms as may be acceptable to the University and/or the AES Guarantor fails to timely pay any required amounts or timely perform any AES obligations under this Agreement.

b. Notice of default. If AES defaults on or otherwise fails to perform any of their material obligations under this Agreement, the University shall issue a written notice of default to AES in accordance with paragraph 19 (Notice) of the Agreement.

c. Time to cure defaults. Any and all defaults or failures to perform contained in such notice of default must be resolved and remedied to the University's reasonable

satisfaction expeditiously (with special efforts made by AES whenever there is any hazard to health or safety arising out of a AES Default), but not later than sixty (60) days of the date of the University's written notice to AES. In cases when, through no fault of AES, it is not possible to cure a AES Default within sixty (60) days of the University's notice of default, then AES' obligations under this paragraph 11 (Termination) shall be deemed satisfied if AES commences, within sixty (60) days of the notice of default, efforts necessary to cure the default as soon as reasonably possible and diligently continues such efforts until the default is cured or resolved to the University's reasonable satisfaction. If AES fails to cure the AES Default or either fails to perform within the required time period or fails to immediately pay to the University said costs and expenses incurred by the University (plus 10% for the University's administrative overhead) in performing said cure or remedy, the University may by written notice immediately terminate AES's rights under this Agreement which shall be effective upon AES's receipt or imputed receipt of such notice.

d. University remedies upon AES Default. On the happening of any AES Default, the University shall have all legal or equitable rights and remedies, including, without limitation, terminating this Agreement, not terminating AES' right to use and occupy the Easement Area and operate the System and reletting or regranting an easement for the use and occupancy of the Easement Area, and recovering against AES all losses, damages, costs, and expenses incurred or imposed upon the University in connection with the AES Default, including, without limitation, the cost of recovering possession of the Easement Area and the worth at the time of such termination of the excess, if any, of the amount of Rent and charges equivalent to rent reserved in this Agreement for the remainder of the stated Term less the then reasonable rental value of the Easement Area for the remainder of the stated Term, , all of which amounts shall be immediately due and payable from AES to the University. In the event the University is required to use the services of an attorney or collection agent to collect amounts due under this Agreement or to seek a remedy as a result of the AES Default, AES agrees to reimburse the University in an amount equal to the amount of Attorneys' Fees and Costs incurred by the University in pursuit of a remedy, plus an additional ten percent (10%) to cover the University's administrative overhead, whether or not the AES Default results in an action being filed. AES shall pay such amounts to the University immediately upon AES' receipt of written demand from the University.

(1) Termination of AES rights. If an AES Default has occurred and is continuing, then, unless AES shall cure the AES Default before the end of the applicable cure period (if any), the University may terminate AES' rights under this Agreement and pursue all other applicable remedies for claims arising out of the AES Default.

(2) Suspension of AES' rights to use. If an AES Default has occurred and is continuing, then, unless AES shall cure the AES Default before the end of the applicable cure period (if any), the University may suspend AES's rights under this Agreement and any other agreement relating to the Authorized Activity and pursue all other applicable remedies for claims arising out of the AES Default.

(3) Other rights and remedies. If any AES Default has occurred, whether or not the University has terminated the AES' rights under this Agreement, the University may continue to hold AES responsible for any damages arising from such AES

Default and enforce any and all obligations of AES under this Agreement, including, without limitation, obligations regarding improvements, insurance, indemnity/defense, coordination, compliance with Applicable Laws, hazardous materials, liens, surrender, default, funding limitations, litigation, assignment, sublicensing, disposition of project improvements, and representations.

(4) Right to terminate or relet/regrant. Should the University elect to reenter for an AES Default, or should the University take possession pursuant to legal proceedings or pursuant to any notice provided for by law, such as a notice to vacate, it may either terminate this Agreement or it may from time to time without terminating this Agreement, make such alterations and repairs as may be necessary in order to relet or regrant the Easement area or any part thereof for such term or terms (which may be for a term extending beyond the term of this Agreement) and at such rental or rentals and upon such other terms and conditions as the University in its sole discretion may deem advisable; upon each such reletting and/or regranting all rentals received by the University from such reletting or regranting shall be applied, first, to the payment of any indebtedness, including interest, other than Rent due hereunder from AES to the University; second, to the payment of any costs and expenses of such reletting and regranting and of such alterations and repairs; third, to the payment of Rent due and unpaid hereunder; and the residue, if any, shall be held by the University and applied in payment of future Rent or other obligations as the same may become due and payable hereunder. If such Rents received from such reletting and regranting during any month be less than that to be paid during that month by AES hereunder, AES shall pay any such deficiency to the University. Such deficiency shall be calculated and paid monthly. Termination shall be made effective by the giving of written notice to AES of the University's intention to end the Term of this Agreement, specifying a day not earlier than thirty (30) days thereafter, and upon the giving of such notice, the Term of this Agreement and all right, title and interest of AES hereunder shall expire as fully and completely on the day so specified as if that day were the date herein specifically fixed for the expiration of the Term. No reentry or taking possession of the Easement Area by the University shall be construed as an election on its part to terminate this Agreement unless a written notice of such intention be given to AES or unless the termination thereof be decreed by a court of competent jurisdiction. Notwithstanding any such reletting and regranting without termination, the University may at any time thereafter elect to terminate this Agreement for such previous AES Default.

(5) Separate suits. The University shall have the privilege of splitting its cause of action for Rent so as to permit institution of a separate suit or suits or proceedings for the Rent hereunder reserved to the University and a separate suit or suits or proceedings for any other payments or obligations required hereunder, and neither the institution of such suit or proceeding, nor the entering of judgment therein, shall bar the University from bringing a subsequent suit or proceeding for the Rent or for any other payments required hereunder.

(6) Call on AES Guarantee. Once the University satisfies the notice requirements contained in paragraph 7 (AES Guarantee) and if AES fails to correct or cure the AES Default or AES' failure to perform within the thirty (30) day period following AES' receipt of the AES Default notice, the University may seek payment from the AES Guarantor with or without first demanding payment from AES.

e. Reserved.

f. Default not necessary for termination. Notwithstanding the University's right to terminate this Agreement for an AES Default or failure to perform or failure to pay and reimburse the University for any costs and expenses incurred by the University to cure an AES Default or failure to perform, the University may terminate this Agreement in accordance with this paragraph 11 (Termination) herein.

g. University remedies cumulative. If AES defaults or otherwise fails to perform as required under this Agreement, the University shall be entitled to all remedies available under this Agreement and by law (which remedies shall be cumulative and not exclusive), including, without limitation, immediate termination of this Agreement upon AES' receipt or imputed receipt of the University's written notice to AES pursuant to subparagraph 11c (Time to cure defaults).

h. Survival of obligations. Any termination or cancellation of this Agreement, in whole or in part, shall not relieve AES of any of its obligations contained in this Agreement that are intended to survive the expiration or termination of this Agreement, including, without limitation, the following AES obligations that are intended to survive the expiration or termination of this Agreement: obligations regarding improvements, insurance, indemnity/defense, coordination, compliance with Applicable Laws, hazardous materials, liens, surrender, default, funding limitations, litigation, assignment, sublicensing, disposition of project improvements, and representations.

i. Accrued obligations. AES's obligations that AES was required to perform and/or complete prior to any termination or expiration of this Agreement, including, without limitation, the obligation to fully and properly address and mitigate all Adverse Impacts, comply with the AES Covenants and the Site Specific Conditions, and perform the Maintenance Work, shall survive the expiration or earlier termination of this Agreement.

j. Waiver of all claims for consequential damages. The University and AES each agree to waive, release, and discharge any and all claims for consequential, special, indirect, incidental, and exemplary damages (but not compensatory damages).

k. Non-Waiver by University. The waiver by the University of any breach of any term, covenant or condition herein contained shall not be deemed to be a waiver of such term, covenant or condition or any subsequent breach of the same or any other term, covenant or condition herein contained. The subsequent acceptance of Rent hereunder by the University shall not be deemed to be a waiver of any preceding breach by AES of any term, covenant or condition of this Agreement, other than the failure of AES to pay the particular Rent so accepted, regardless of the University's knowledge of such preceding breach at the time of acceptance of such Rent.

l. No accord and satisfaction. No payment by AES or receipt by the University of a lesser amount than the monthly Rent herein stipulated shall be deemed to be

other than on account of the earliest Rent then due, nor shall any endorsement or statement on any check or any letter accompanying any check or payment as Rent be deemed an accord and satisfaction, and the University may accept such check or payment without prejudice to AES' right to recover the balance of such Rent or pursue any other remedy in this Agreement.

m. Interest on past due amounts. Any amounts owing by AES to the University under the terms of this Agreement shall carry interest from the date the same become due until paid at the lower of ten percent (10%) annually or the maximum rate then allowed by law. Said interest shall be considered as a part of the Rent payable hereunder.

n. Late Charge. If AES shall fail to pay the required Rent and/or other charges within ten (10) days of the date on which such is due hereunder, then without the requirement of notice from the University, AES shall pay to the University a penalty of ten percent (10%) of any amount not paid.

o. University Default and AES remedies. The occurrence at any time of the following events shall constitute a "***University Default***".

(1) Failure to perform obligations. The University's failure to timely perform or cause to be performed any obligation required to be performed by the University under this Agreement; provided, however, that if such failure by its nature can be cured, then the University shall have a period of sixty (60) days after receipt of written notice from AES of such failure of the University to perform its obligations and cure the University Default. If it is not possible to cure a University Default within sixty (60) days of AES' notice of default, then the University's obligations under this paragraph 11 (Termination) shall be deemed satisfied if the University commences, within sixty (60) days of the notice of default, efforts necessary to cure the University Default as soon as reasonably possible and diligently continues such efforts until the University Default is cured or resolved to AES' reasonable satisfaction.

(2) AES remedies upon University Default. If a University Default has occurred and is continuing, then, unless the University shall cure the University Default before the end of the applicable cure period (if any), AES may terminate this Agreement by providing the University with thirty (30) days written notice and may exercise any of AES' rights provided at law or in equity.

12. No Unreasonable Interference. The University agrees not to unreasonably interfere with AES' operations and activities in, on, or connected with the Easement Area and/or the Property to the extent permitted by this Agreement. AES agrees that in AES' use of the Easement Area or the Property, AES agrees not to unreasonably interfere with the facilities, operations, and activities of the University or other users of the Easement Area and/or the Property.

13. University Limitations.

a. University not authorized to indemnify. AES acknowledges and agrees that the University, as an agency of the State of Hawai‘i, is not authorized to indemnify AES, the

AES Agents, the AES Contractors, and the AES Assignees in any way, including against any claims for bodily injury, wrongful death and/or property damage by any person or entity. Notwithstanding anything to the contrary contained in this Agreement, the University shall have no contractual duty to indemnify, defend, or hold harmless AES, the AES Agents, the AES Contractors, the AES Assignees, and/or any other person or entity under any circumstances arising out of or related to this Agreement or any entry onto or use and occupancy of the Easement Area and/or the Property. In each instance in this Agreement where the University is or may be obligated to indemnify, defend, or hold harmless AES, the AES Agents, the AES Contractors, the AES Assignees, and/or any other person or entity, such obligations shall be deemed null and void and such contrary indemnity, defense, and hold harmless obligations and provisions shall be deemed to be superseded by this provision, and of no force or effect.

b. University not responsible for others. Notwithstanding anything to the contrary contained in this Agreement, AES acknowledges that the University can only be held responsible for the actions of the University's officers and employees, and AES shall not hold the University responsible for any actions or omissions of any other person or entity, including any person or entity who (except for the University's officers and employees) could be deemed to be UH Agents. In each instance in this Agreement where the University is obligated to assume responsibility for the actions or omissions of any person or entity other than the University's officers or employees, such obligations shall be deemed null and void and such contrary University responsibility obligations or provisions shall be deemed to be superseded by this provision, and of no force or effect. AES acknowledges that this provision, in itself, shall not constitute or be interpreted to be any type of indemnification, defense, or hold harmless obligation of the University.

c. Subject to funding. To the extent that the University is: (1) obligated to perform under this Agreement, (2) obligated to make any payments under this Agreement, or (3) deemed liable under this Agreement, the University's liability and obligation and ability to perform under this Agreement, particularly to pay any amount of monies, is limited to that which is permitted by law and is subject to the precondition that funds are properly appropriated, allotted, and otherwise properly made available for the purpose of such performance or to cover such liability.

(1) Minimum Conditions. At a minimum, the following conditions must be satisfied in order for funding to be made properly available: (a) the Hawaii State Legislature shall have appropriated sufficient funding to satisfy such obligations or liabilities; (b) the Governor of the State of Hawaii shall have authorized the use of such funds for satisfying such obligations or liabilities; and (c) the satisfaction of conditions, if any, imposed by the Hawaii State Legislature and/or the Governor on the use of such funds.

(2) University to Seek Funding. The University shall use reasonable good faith efforts to have funds properly appropriated, allotted, or made available for such purposes (including, without limitation, obtaining legislative and Governor's authorizations for use of such funds) and to satisfy any such conditions in a timely manner.

(3) Qualifies All University's Obligations. Notwithstanding anything

to the contrary contained in this Agreement, this provision shall apply to and qualify each and every University obligation to perform under this Agreement.

d. Subject to University Limitations. Subparagraphs 13a *(University not Authorized to Indemnify)*, 13b *(University not Responsible for Others)* and 13c *(Subject to Funding)* are referred to collectively herein as the "***University Limitations***." Notwithstanding and superseding anything to the contrary contained in this Agreement (and any exhibits or appendices attached hereto), AES acknowledges and agrees that any and all obligations, duties, responsibilities, and liabilities of the University under this Agreement and the University's liability for and/or ability to perform such obligations, duties, and responsibilities hereunder (including any that are intended to survive and/or survive the expiration or termination of this Agreement) are expressly subject to and limited by the University Limitations.

14. Reserved.

15. Interpretation of Agreement.

a. Headings. The headings and captions used herein are for convenience of reference only and are not to be used to construe, interpret, define, or limit the paragraphs to which they may pertain.

b. Not against drafter. This Agreement has been negotiated at arm's length and shall be interpreted to achieve the intents and purposes of the Parties, without any presumption against the Party responsible for drafting any part of this Agreement. The language hereof, and in all parts of this Agreement shall, in all cases, be construed simply according to its fair meaning, and not strictly for or against any Party hereto.

c. Fair meaning. Provisions in this Agreement relating to number of days shall be calendar days. Use of the word "including" shall mean "including, without limitation." References to statutes, sections, ordinances, or regulations are to be construed as including all statutory, ordinance, or regulatory provisions consolidating, amending, replacing, succeeding or supplementing the statute, section, ordinance or regulation.

d. Gender and number. Whenever the singular number is used in this Agreement and when required by the context, the same includes the plural, the plural includes the singular, and the masculine gender includes the feminine and neuter genders, and the word "person" shall include corporation, partnership, firm, limited liability company, trust, and association. The use of any pronoun herein shall include any and all pronouns.

16. [Reserved].

17. Binding Effect. The term "University" wherever used herein shall include the UNIVERSITY OF HAWAI'I and its successors and assigns, the term "AES" wherever used herein shall include AES WEST OAHU SOLAR, LLC, a Delaware limited liability company, and its successors and permitted assigns, and this instrument shall be binding upon and shall inure to the benefit of the Parties hereto and their legal representatives, successors, and assigns.

18. No Partnership. It is expressly understood and agreed by and between the University and AES that the University shall in no way be nor for any purpose become or be construed to become a partner of AES in the conduct of AES' business, or otherwise, or a joint venturer or a member of a joint enterprise with AES or to have a principal/agent or employer/employee relationship, and the University does not assume responsibility for AES' conduct or performance under this Agreement. The University and AES acknowledge and agree that there are no third-party beneficiaries to this Agreement.

19. Severability. In case any one or more of the provisions contained in this Agreement shall for any reason be held to be invalid, illegal, or unenforceable in any respect, such invalidity, illegality, or unenforceability shall not affect any other provision hereof, and this Agreement shall be construed as if such invalid, illegal, or unenforceable provision had never been contained herein.

20. Amendment. This Agreement shall not be amended except in writing signed by the Parties.

21. Governing Law. This Agreement shall be governed by, enforced, construed, and interpreted in accordance with the laws of the State of Hawaii and the Circuit Court of the First Circuit in Honolulu, Hawaii will have the exclusive jurisdiction over any actions initiated to interpret or enforce the terms of this Agreement.

22. Waiver. Any waiver of the terms, conditions, or provisions of this Agreement or a Party's rights or remedies under this Agreement must be in writing to be effective. Failure, neglect, or delay by a Party to enforce the terms, conditions, or provisions of this Agreement or such Party's rights or remedies at any time, will not be construed as a waiver of such Party's rights under this Agreement and will not in any way affect the validity of the whole or any part of this Agreement or prejudice such Party's right to take any subsequent action. No exercise or enforcement by any Party of that Party's rights or remedies under this Agreement will preclude the enforcement by such Party of any of its other rights or remedies that are available under this Agreement or by law.

23. Entire Agreement. Except for the execution of the documents expressly contemplated under this Agreement, this Agreement constitutes the entire agreement between the Parties hereto with respect to the subject matter hereof, and supersedes all other prior or concurrent oral or written letters, agreements, and understandings.

24. No Third Party Rights. The Parties to this Agreement agree that this Agreement shall not be deemed to run to the benefit of any third party, including, without limitation, any assignee or transferee (such as the University's Assignee), unless and until, in accordance with this Agreement, the University makes an assignment or transfer of interest in writing to such third party, including any said assignee or transferee (such as the University's Assignee).

25. Disputes. If any disputes arise between the University and AES concerning any aspect of this Agreement, AES and the University will use their best efforts to address and

resolve such disputes and the Parties agree to negotiate face-to-face within thirty (30) days of receipt of a letter describing the nature of the dispute and referencing this paragraph of this Agreement. The meeting will be held on the island of Oahu, Hawaii at the place of business of the Party receiving the letter unless the Parties mutually agree to meet at another place. In the event the matter is not resolved by negotiation within thirty (30) days of this initial negotiation meeting, the Parties shall engage a mediator and attempt to mediate the dispute. The Parties agree to try in good faith to settle the dispute by mediation under the mediation rules of a mutually acceptable alternative dispute resolution firm, before resorting to litigation. If the dispute is not resolved by mediation within sixty (60) days of the initial mediation meeting or such further time as the Parties may agree to, or if a Party does not cooperate with mediation, any Party may commence a legal action in the state circuit court in the City and County of Honolulu. The Parties will equally share the cost of the mediator services and the mediation sessions but each Party will bear the cost and expense of making its presentation to the mediator.

26. AES Representations. In addition to any other representations and warranties contained in this Agreement, AES represents and warrants to the University as of the Effective Date of this Agreement that:

a. Duly organized. AES is duly organized, validly existing, and in good standing in the jurisdiction of its organization, and is validly registered to conduct business in the State of Hawai‘i;

b. Full right and authority. AES has the full right and authority and has taken all requisite corporate or other action to enter into, execute, deliver, and perform its obligations under this Agreement;

c. Has obtained all requisite approvals. AES has obtained all Government Approvals and all approvals and consents from their respective entities, members, managers, and their directors, shareholders, partners, owners, and/or lenders that are necessary to fully authorize and empower AES to validly enter into this Agreement;

d. Agreement is a binding obligation. This Agreement constitutes a legal, valid, and binding obligation enforceable against AES in accordance with its terms, except as may be limited by applicable bankruptcy, insolvency, reorganization, moratorium, and other similar laws now or hereafter in effect relating to creditors' rights generally;

e. No litigation or investigation. There is no litigation, action, proceeding or investigation pending or, to the best of AES' knowledge, threatened before any court or other Governmental Authority by, against, affecting, or involving AES or any of AES' business or assets that would affect AES's ability to carry out its obligations under this Agreement; and

f. No other breach. Neither the execution and delivery of this Agreement by AES nor AES' compliance with any of the terms and conditions of this Agreement results in a condition or event that would constitute (or that upon notice or lapse of time or both would constitute) an event of default, including an AES Default, under any material contractual obligation of AES in any other agreement to which AES is a party.

g. Same entity signing Agreement and RDG PPA. The legal entity signing this Agreement shall be the same entity that is bound to and obligated to perform obligations under the RDG PPA.

27. Covenant Against Discrimination. The use and enjoyment of the Easement Area and the Property shall not be in support of any policy which discriminates against anyone based upon race, creed, sex, color, national origin, religion, marital status, familial status, ancestry, physical handicap, disability, age, or HIV (human immunodeficiency virus) infection.

28. Force Majeure.

a. University's obligations. The University shall not be liable for any failure, delay, or interruption in performing its obligations hereunder due to causes or conditions beyond its control, including (but without limitation thereto) the Force Majeure Events (as defined and described below), whether affecting AES, the AES Agents, the AES Contractors, and/or the AES Assignees. The University shall not be obligated to supply any service or services, if and to the extent, and during any period, that the supplying of any such service or services, or the use of any component necessary therefor, shall be prohibited by any Applicable Laws or order or direction of a Government Authority, provided, however, that even if such prohibition does not expressly apply to the University, the University may choose to comply with such prohibition, in whole or in part, and in so choosing, the University shall not be obligated to supply any such service or services.

b. AES's obligations. AES shall not be liable for any failure, delay, or interruption in performing its obligations hereunder due to causes or conditions beyond its control, including (but without limitation thereto) the Force Majeure Events (as defined and described below). AES shall be obligated to immediately notify the University in writing regarding AES' inability to perform any of AES' obligations under this Agreement due to any Force Majeure Events but in no event later than two (2) weeks following the occurrence of one of the Force Majeure Events. AES's failure to so timely notify the University will preclude AES from claiming the benefits of the Force Majeure Events under this Agreement. Notwithstanding the Force Majeure Events, AES shall be obligated to recommence performance of any of its obligations delayed by the Force Majeure Events as soon as reasonably practicable. AES' failure to timely recommence such performance may be deemed by the University to be a breach or default by AES under this Agreement.

c. Obligations remain payable. No abatement, diminution, or reduction of the fees, charges, or other obligations payable by AES shall be claimed by or allowed to AES for any inconvenience, interruption, cessation, or loss of business or other loss caused, directly or indirectly, by any of the following force majeure events ("***Force Majeure Events***"):

(1) Laws. Present or future laws, statutes, rules, requirements, orders, directives, rulings, ordinances, or regulations of any Government Authority that are enacted, adopted, or implemented subsequent to the date of this Agreement or other acts of superior Government Authority.

(2) War and terrorism. War, war-like conditions, hostilities, acts of terrorism, acts of the public enemy, sabotage, rebellion, riots, looting, military mobilization, and blockades.

(3) Transportation delays. Embargoes or other transportation delays or any act or thing resulting therefrom.

(4) Rationing. Priorities, rationing, or curtailments.

(5) Labor related issues. Strikes, boycotts, picketing, slowdowns, work stoppages, or other labor disputes or troubles.

(6) Shortages. Shortage of labor or materials, or inability to secure fuel, materials, supplies, or power due to shortages thereof.

(7) Acts of God. Acts of God, severe weather conditions, rainstorms, floods, earth movements, tsunamis, volcanic activity, high winds, hurricanes, typhoons, tornadoes, or fires.

(8) Health related emergencies. Epidemics, quarantines, or other national or regional health related emergencies.

(9) Other causes. Any other causes or casualties beyond the control of the University and/or the City, as applicable.

d. Non-economic relief. Upon the occurrence of any of the Force Majeure Events, as determined by the University, in the University's sole discretion, the University may, but is not obligated to, grant non-economic relief to AES, the amount, extent, and duration of which shall be determined by the University, in the University's sole discretion.

Capitalized terms used in this Exhibit 6 and not otherwise defined herein shall have the meanings assigned to such terms in the Grant of System Easement Agreement to which this Exhibit 6 is attached.

[End of Exhibit 6].

Exhibit 7

[Insert form of Guaranty]

Exhibit 8

[Insert form of Memorandum of Grant of Easement]

AMENDMENT NO. 1 TO
OPTION AGREEMENT TO GRANT SYSTEM EASEMENT
BETWEEN
UNIVERSITY OF HAWAI'I
AND
AES WEST OAHU SOLAR LLC

This Amendment No. 1 (the "***1st Amendment***"), is made and entered on May 12, 2020 ("***Execution Date***"), but shall be effective as of May 12, 2020 (the "***Effective Date***"), by and between the **UNIVERSITY OF HAWAI'I**, the state university and a body corporate of the State of Hawai'i, whose business address is Bachman Hall, 2444 Dole Street, Honolulu, HI 96822 ("***UH***"), and **AES West Oahu Solar, LLC**, a Delaware limited liability company, whose business address is c/o AES Distributed Energy, Inc., 282 Century Place, Suite 2000, Louisville, Colorado 80027 ("***AES***") (UH and AES, each a "***Party***", and collectively, the "***Parties***").

WITNESSETH THAT:

WHEREAS, UH and AES entered into that certain Option Agreement to Grant System Easement dated August 30, 2019 (the "***Agreement***); and

WHEREAS, all terms with initial capital letters that are defined terms in the Agreement shall have the same definitions and meanings when used in this 1st Amendment; and

WHEREAS, under the Agreement, UH granted AES the right to conduct due diligence and investigative studies with respect to a portion of the Property owned by UH comprising the Premises; and

WHEREAS, under the Agreement, AES must satisfy certain preconditions before UH is obligated to grant AES the System Easement, the form of which is attached as an exhibit (Exhibit D) to the Agreement; and

WHEREAS, the Premises is described in the Agreement as being eighty (80) acres and the Easement Area is described in the System Easement (Exhibit D) as consisting of eighty (80) acres; and

WHEREAS, as part of its due diligence efforts to construct the System within the Premises and the Easement Area, AES has prepared an environmental assessment ("***EA***"), which notes that the project area being covered under the EA is about 97 acres; and

WHEREAS, AES plans to decide at some point prior to exercising AES' option to have UH grant the System Easement to AES regarding the size of the Easement Area, with the parties agreeing that said Easement Area will be up to ninety-seven (97) acres; and

WHEREAS, AES agrees that until AES makes its final election as to the size of the Easement Area, AES shall pay, as and when applicable, the rental amounts due for use of the Premises starting in the third year of the Term under the Agreement shall be proportionately adjusted depending on the number of acres constituting the Premises at the beginning of such third year; and

WHEREAS, the parties agree to amend the Agreement to implement these understandings, upon the terms and conditions described herein,

NOW, THEREFORE, in consideration of the premises and the covenants contained herein, the parties hereto mutually agree as follows:

1. Increase area of Premises/Exclusive Area and Easement Area. All references to and the definitions of the "Premises" and the "Exclusive Area," respectively, under the Agreement shall be increased from eighty (80) acres to up to ninety-seven (97) acres. All references to and the definition of "Exclusive Easement Area" under the System Easement attached as Exhibit D to the Agreement shall be increased from eighty (80) acres to up to ninety-seven (97) acres. All references to the "Easement Area" under the System Easement shall include the "Exclusive Easement Area" which is being increased from eighty (80) acres to up to ninety-seven (97) acres.

    a. 3rd recital in the Agreement. The reference to "eighty (80) acres" in the third recital of the Agreement is hereby amended to read "up to ninety-seven (97) acres."

    b. Section II.1.a (Exclusive Easement). The phrase "approximately sixty (60) to eighty (80) acres" in section II.1.a (Exclusive Easement) of the Agreement is replaced with "up to ninety-seven (97) acres."

    c. Section III. 2.a (Easement Area). The phrase "approximately sixty (60) to eighty (80) acres" in section III. 2.a (Easement Area) of the Agreement is replaced with "up to ninety-seven (97) acres."

    d. Exhibit A (Use Area). The map attached as Exhibit A (Use Area) will be amended to reflect that the Use Area will consist of up to 97 acres.

    e. 3rd recital in the System Easement. The phrase "approximately eighty (80) acres" in the third recital in the System Easement, which is Exhibit D (System Easement) attached to the Agreement, is hereby amended to read "up to ninety-seven (97) acres."

2. Rent. The rental amounts payable by AES to UH during the Term of the Agreement and the Term of the System Easement are clarified as follows:

a. Use Time under the Agreement. The last sentence in paragraph I.4 (Use Time) is hereby deleted and amended to read as follows:

"If the Term is extended for one (1) additional year for a total Term of three (3) years, AES shall pay to UH [redacted] per month for the use of the Premises (consisting of ninety-seven (97) acres) during the extended period. As the System design is refined based on the results of technical studies, community input, and the EA process, it is possible that the area of the Premises and the Exclusive Area under this Agreement, and the area of the Exclusive Easement under the System Easement (attached as Exhibit D to this Agreement) could be decreased and adjusted to less than ninety-seven (97) acres, in which case the amount AES shall pay to UH will be adjusted proportionally."

b. Rent under the System Easement. The third and fourth sentences in paragraph 9 (Rent) are hereby deleted and amended to read as follows:

"From the Effective Date until the Commercial Operation Date, the Rent payable by AES to the University shall be [redacted] for the Exclusive Area (the "***Construction Period Rent***"). If the Exclusive Area as of the Effective Date hereof is ninety-seven (97) acres, the total Construction Period Rent shall be [redacted] per year. For the first year from and after the Commercial Operation Date, the Rent payable by AES to the University shall be [redacted] for the Exclusive Area delivered to the AES on the Effective Date hereof (the "***Easement Period Rent***"). If the Exclusive Area delivered to AES as of the Effective Date hereof consists of ninety-seven (97) acres, the total Easement Period Rent shall be [redacted] per year."

4. No other changes. Except as amended by the 1st Amendment herein, the remaining terms of this Agreement shall remain unchanged, unaffected and in full force and effect.

[Remainder of page intentionally left blank]
[Signature page to follow]

IN WITNESS WHEREOF, UH and AES have caused this 1st Amendment to be executed on the Execution Date, but effective as of the Effective Date.

AES:

AES West Oahu Solar, LLC,
a Delaware limited liability company

By: AES DE DEVCO NC, LLC
Its Member

By: _____
Woody Rubin
Its President

UNIVERSITY OF HAWAI'I, the state university and a body corporate of the State of Hawai'i

By: _____
David Lassner
Its President

Approved as to Form:

Office of University
General Counsel

_____
Bruce Y. Matsui
Associate General Counsel

By: _____
Jan S. Gouveia
Its Vice President for Administration

IN WITNESS WHEREOF, UH and AES have caused this 1st Amendment to be executed on the Execution Date, but effective as of the Effective Date.

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Its President

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By: _____
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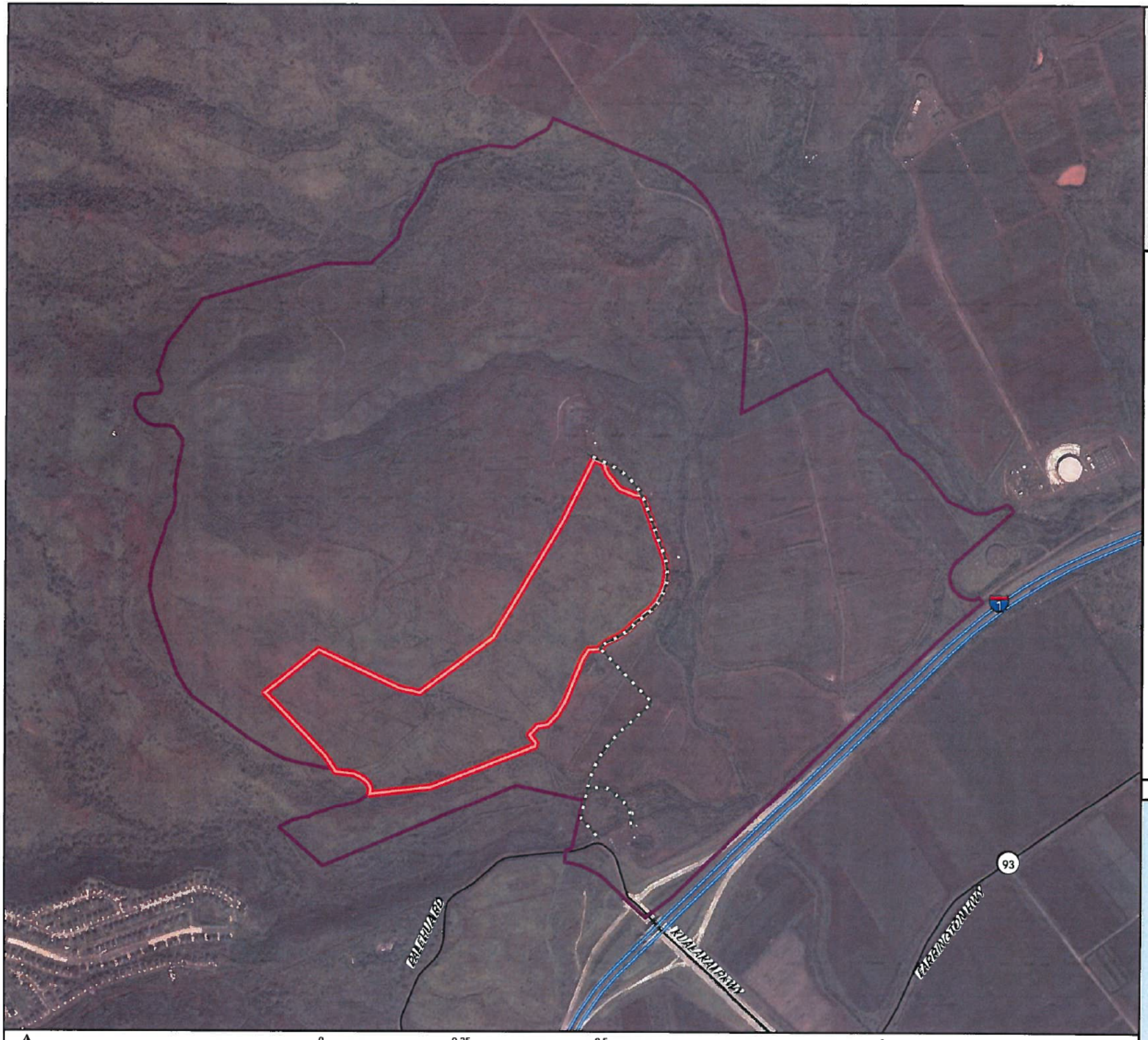
Its President

Approved as to Form:

Office of University
General Counsel

By: _____
Jan S. Gouveia
Its Vice President for Administration

_____
Bruce Y. Matsui
Associate General Counsel



West Oahu Solar Plus Storage Project

AES Distributed Energy

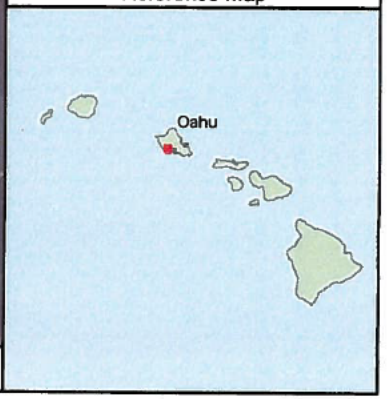
Project Area

HONOLULU COUNTY, HI

- Project Area
- Property Boundary
- Existing Access Road
- Interstate Highway
- Roadway

EXHIBIT A

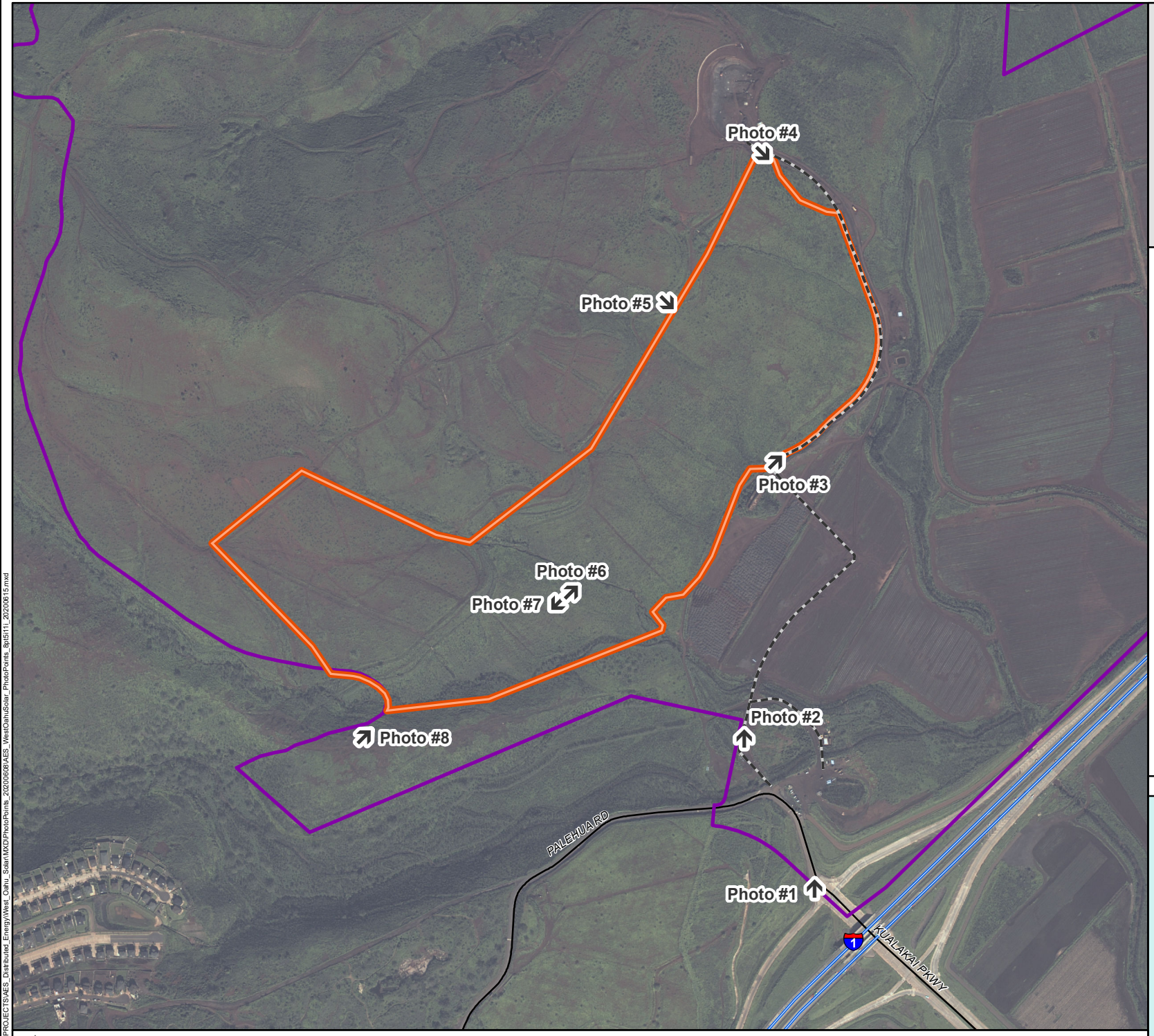
Reference Map



Attachment C
Final Environmental Assessment and Finding of No Significant Impact

Final Environmental Assessment and Finding of No Significant are available online at:
http://oeqc2.doh.hawaii.gov/Doc_Library/2020-07-08-OA-FEA-West-Oahu-Solar-Plus-Storage.pdf)

Attachment D
Representative Photographs of Project Area



West Oahu Solar Plus Storage Project

AES Distributed Energy

Key Map of Representative Photograph Locations

HONOLULU COUNTY, HI

- Project Area
- Property Boundary
- Existing Access Road
- Interstate Highway
- Photo Points

TETRA TECH

Reference Map

1:9,000 WGS 1984 UTM Zone 4N

0 0.125 0.25 0.5 Miles

NOT FOR CONSTRUCTION

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Photograph 1. Looking north along Pālehua Road toward guard shack

Photograph 2. Looking north along existing access road toward mill building and pump station

Photograph 3. Looking northeast along existing access road from mill building

Photograph 4. Looking southeast along existing access road from water tank

Photograph 5. Looking southeast over Project area, with mill building in background

Photograph 6. Looking northeast over Project area, with mill building in background

Photograph 7. Looking southwest from Project area toward Makakilo neighborhood

Photograph 8. Looking northeast toward Project area

Attachment E
Biological Resource Survey and Supplemental Pueo Survey Reports

West O'ahu Solar Plus Storage Project
Biological Resources Survey Report

Prepared for:

AES Distributed Energy
May 2019

TETRA TECH

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1 Introduction

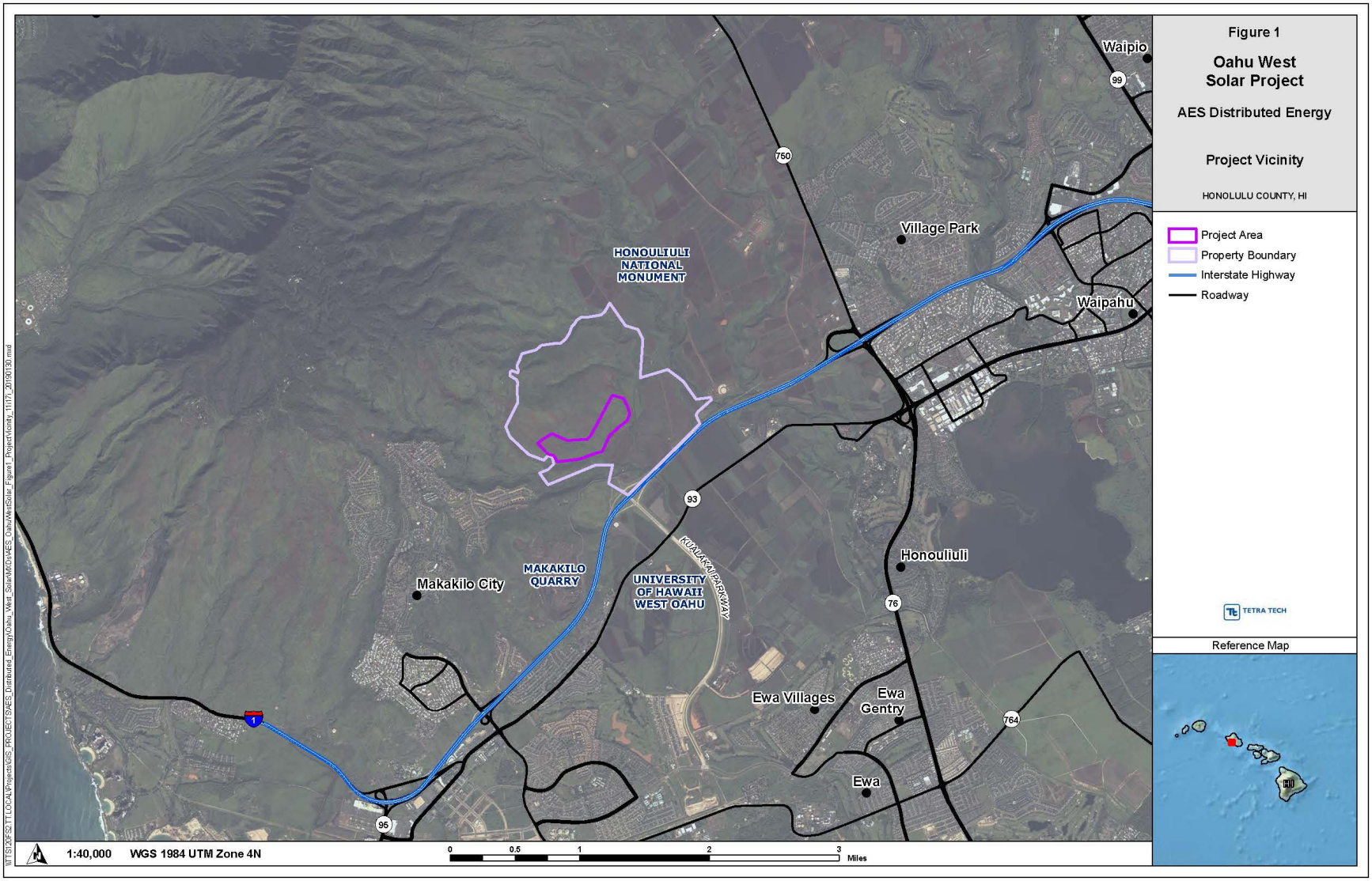
AES Distributed Energy (AES) is proposing the West O'ahu Solar Plus Storage Project (Project) near Kapolei on the island of O'ahu. The Project will involve construction and operation of a solar photovoltaic and battery energy storage system on land owned by University of Hawai'i (UH). The major components of the Project will be an approximately 12.5-megawatt (MW) ground-mounted solar photovoltaic system coupled with a 50 MW-hour battery energy storage system, and related interconnection and ancillary facilities. Interconnection of the Project with the Hawaiian Electric Company (HECO) electrical grid will be via an existing 46-kilovolt transmission line that traverses the Project Area. A Project substation and interconnection equipment will be located immediately proximate to the existing transmission line, with a short connection installed to the transmission line. The Project will be accessed via the existing gated entry off Palehua Road and Kualakai Parkway, and will utilize a network of existing and new on-site access roads. Temporary construction staging and laydown will occur within the Project Area.

Tetra Tech, Inc. (Tetra Tech) was contracted by AES to conduct a general biological survey for the Project. The purpose of the survey was to characterize the habitat and determine whether state or federally listed threatened, endangered, or otherwise rare plants or animals have the potential to occur within the Project Area, and whether they could be impacted by construction or operation of the Project. In addition, the survey evaluated the potential occurrence of streams, wetlands, and other features that may be considered Waters of the U.S. (WoUS), and therefore subject to agency jurisdiction under the Clean Water Act. This report summarizes the results of the biological survey conducted within the Project Area by Tetra Tech on January 31, 2019 and February 5, 2019.

2 Description of Project Area

As shown in Figure 1, the Project Area is located on the southwest side of O'ahu, approximately 3 miles northeast of Kapolei. It encompasses approximately 80 acres in an area commonly referred to as the UH West O'ahu Mauka property and is within tax map key 9-2-002:007. The Project Area and vicinity was previously cultivated as part of the extensive sugar cane and pineapple plantation that extended across O'ahu's 'Ewa Plain. Since closure of the plantation in the 1990s, this area has not been recently cultivated and is now undeveloped, vacant land, with domestic cattle grazing occurring within portions of the Project Area. A minimal amount of infrastructure associated with the former plantation remains in the area, including a pump station, an associated wooden structure, and components of the irrigation system. A tributary to Kalo'i Gulch runs through the central portion of the Project Area. Elevation in the Project Area ranges from approximately 300 to 600 feet above sea level.

Figure 1. Project Area and Vicinity



3 Methods

Prior to the field survey, Tetra Tech conducted a review of relevant publicly available literature and data with respect to biological resources in and near the Project Area. This review included environmental assessments and environmental impact statements, National Wetlands Inventory (NWI) data, the U.S. Geological Survey National Hydrography Dataset (NHD), scientific journals and reports, and available, unpublished data that are relevant to the natural history and ecology of the area. In addition, Tetra Tech reviewed available geospatial data, aerial photographs, and topographic maps of the area to identify occurrences of state or federally listed species, or habitats that could support these species. Details of the field survey conducted by Tetra Tech on January 31, 2019 and February 5, 2019 are provided below.

3.1 Plants

A pedestrian survey was conducted to record common plant species and dominant vegetation types, as well as rare or listed plant species within the Project Area. Areas more likely to support native plants (e.g., rocky outcrops and shady areas) were more intensively examined. Plant identifications were made in the field; plants that could not be positively identified were photo documented for comparison with the recent taxonomic literature.

Plants recorded during this survey are indicative of the season and environmental conditions at the time of the survey. Since plants are dynamic and influenced by seasonal and temporal changes, there may be additional species that occur on site, but which were not present during this survey.

The taxonomy and nomenclature of the flowering plants are in accordance with Wagner et al. (1999, Wagner et al. 2012) and Wagner and Herbst (2003) for native and naturalized flowering plants, and Staples and Herbst (2005) for ornamental plants. In Section 4 and Appendix B, common/Hawaiian names are provided first, followed by scientific names in parentheses. If no common or Hawaiian name is known, only the scientific name is provided.

3.2 Wildlife

Wildlife surveys consisted of observations of birds, mammals, and large insects and other invertebrates. All species detected by sight and sound were recorded, and any wildlife sign (e.g., scat, tracks, feeding) noted. Specific survey methods of each wildlife group are provided below.

3.2.1 Birds

Tetra Tech recorded all birds seen or heard within the Project Area. Habitats or plants that could support listed birds were also identified, if present (e.g., water features as potential habitat for listed Hawaiian waterbirds).

A survey specifically to detect the pueo or Hawaiian short-eared owl (*Asio flammeus sandwichensis*) was conducted in the morning on February 5, 2019. Pueo are not federally listed but are listed as endangered by the State of Hawai'i for the Island of O'ahu. The survey followed the Pueo Project Survey

Protocol (Price and Cotín 2018), and was conducted from civil twilight to 60 minutes after sunrise on February 5, 2019. A single survey location was chosen to provide the best vantage point of the Project Area, which was scanned with binoculars and the naked eye.

Scientific nomenclature for birds follows the American Ornithologists' Union *Check-list of North American Birds 7th Edition* (American Ornithologists' Union 1998) and the 42nd through the 46th supplements to *Check-list of North American Birds* (American Ornithologists' Union 2000, Banks et al. 2002, Banks et al. 2003, Banks et al. 2004, Banks et al. 2005).

3.2.2 Mammals

The mammal survey was limited to visual and auditory detection, coupled with visual observation of scat, tracks, and other animal sign. Scientific names for mammals follow Tomich (1986).

Specific surveys for the endangered Hawaiian hoary bat or ʻōpeʻapeʻa (*Lasiurus cinereus semotus*), through the use of acoustic bat detectors or night vision goggles, were not conducted. The U.S. Fish and Wildlife Service (USFWS) recognizes woody vegetation greater than 15 feet tall as potential bat roosting habitat (USFWS 2019). For this reason, Tetra Tech noted the presence/absence of trees or shrubs greater than 15 feet tall within the Project Area.

3.2.3 Insects and Other Invertebrates

Large insects and other invertebrates were noted while conducting the pedestrian surveys. Scientific nomenclature follows Nishida (2002) for insects.

3.3 Waters of the U.S.

Prior to the survey, data from the NWI, NHD, and the State of Hawaiʻi Department of Aquatic Resources (DAR) dataset were reviewed to identify streams, wetlands, and other potential jurisdictional features in the Project area. These features may be potential WoUS, regulated under Sections 404 and 401 of the Clean Water Act. During the survey, streams and ditches identified by these datasets were visited to evaluate the presence of an ordinary high water mark (OHWM) and assess whether the features are potentially jurisdictional. This survey did not constitute a formal delineation of WoUS but was intended to determine whether a formal delineation is warranted.

4 Results and Discussion

In general, the biological resources in the Project Area have been modified by previous agricultural use and the introduction of invasive species, which has resulted in a reduction of the number and abundance of native species and the habitats suitable for native species. No federal or state-listed species were recorded during the survey. Although not observed, several listed animal species, including the Hawaiian hoary bat and pueo, may occasionally occur in or transverse the area. These species are

discussed in further detail below. No critical habitat has been designated by USFWS within or adjacent to the Project Area.

Conditions during the survey were relatively dry, particularly for the wet season. The National Weather Service rainfall gages closest to the Project Area (Kunia and Honouliulli) documented below average rainfall for January 2019 and the months preceding the survey (National Weather Service 2019). Representative photographs from the survey are presented in Appendix A.

4.1 Plants

In all, 28 plant species were observed during the survey (Appendix B). Of these, only three are native to the Hawaiian Islands and include: hoary abutilon (*Abutilon incanum*), 'ilima (*Sida fallax*), and 'uhaloa (*Waltheria indica*). These three native plants are indigenous, that is found in the Hawaiian Islands and elsewhere. Two additional native plant species—wiliwili (*Erythrina sandwicensis*) and 'a'ali'i (*Dodonaea viscosa*)—were observed immediately outside the Project Area. No federal or state-listed threatened, endangered, proposed listed, or candidate plant species were observed in the Project Area during the survey. None of the native plants observed are considered rare throughout the Hawaiian Islands (Wagner et al. 1999).

The area is dominated by Koa Haole Scrub. This vegetation type is characterized by open to dense stands of non-native koa haole trees (*Leucaena leucocephala*), ranging from 4 to 8 feet in height. Guinea grass (*Urochloa maxima*) is the most abundant plant in the understory, although buffelgrass (*Cenchrus ciliaris*) is also occasionally present. Kiawe trees (*Prosopis pallida*) are sparsely scattered throughout the area. Other common species widely occurring in the Project Area include klu (*Acacia farnesiana*), 'ilima, 'uhaloa, and *Sida ciliaris*.

4.2 Wildlife

4.2.1 Birds

A total of 21 bird species were recorded during the survey (Table 1). All of these species are non-native to the Hawaiian Islands and are commonly found in rural or agricultural areas. Zebra dove (*Geopelia striata*) and common myna (*Acridotheres tristis*) were the most common bird species recorded during the survey. Several of the bird species seen or heard are protected under the Migratory Bird Treaty Act (Table 1).

Table 1. Birds Recorded in the Project Area during the Survey

Common Name	Scientific Name	Status	MBTA
Barn owl	*Tyto alba*	NN	X
Black francolin	*Francolinus francolinus*	NN	
Cattle egret	*Bubulcus ibis*	NN	X
Chestnut munia	*Lonchura atricapilla*	NN	

Common Name	Scientific Name	Status	MBTA
Common myna	*Acridotheres tristis*	NN	
Common waxbill	*Estrilda astrild*	NN	
Gray francolin	*Francolinus pondicerianus*	NN	
House finch	*Haemorhous mexicanus*	NN	X
Japanese White-eye	*Zosterops japonicus*	NN	
Java sparrow	*Padda oryzivora*	NN	
Northern cardinal	*Cardinalis cardinalis*	NN	X
Northern mockingbird	*Mimus polyglottos*	NN	X
Nutmeg mannikin	*Lonchura punctulata*	NN	
Red avadavat	*Amandava amandava*	NN	
Red-crested Cardinal	*Paroaria coronata*	NN	
Red-vented Bulbul	*Pycnonotus cafer*	NN	
Rock pigeon	*Columba livia*	NN	
Sky lark	*Alauda arvensis*	NN	X
Spotted dove	*Streptopelia chinensis*	NN	
White-rumped Shama	*Copsychus malabaricus*	NN	
Zebra dove	*Geopelia striata*	NN	

Status: E = Endemic, End = Endangered, I = Indigenous, M = Migrant, NN = non-native established species.
MBTA = Migratory Bird Treaty Act.

No state or federally listed bird species were recorded during the survey, but several such species have the potential be present in or transverse the Project Area, as discussed below.

- **Pueo:** The state-listed pueo was not seen nor heard during the survey; however, pueo have been reported to use the surrounding areas and have been observed in similar vegetation types (Price and Cotín 2018, Pueo Project 2019). Pueo could also potentially forage or nest in and around the Project Area, given the habitat present.
- **Seabirds:** The endangered Hawaiian petrel (*Pterodroma sandwichensis*) and threatened Newell's shearwater (*Puffinus newelli*) (collectively referred to as seabirds) have not been documented in the Project Area, and suitable nesting habitat does not occur in the area. However, suitable nesting habitat may exist in upper elevations of the Wai'anae Mountains, suggesting the potential for these birds to fly over the area at night while transiting between nest sites and the ocean. These listed seabirds may be attracted to construction lights at night. Disorientation and fallout as a result of light attraction could occur for individuals attracted to nighttime construction lighting and unshielded nighttime facility lighting. Juvenile birds are particularly vulnerable to light attraction, and grounded birds are vulnerable to mammalian predators or vehicle strikes.

- **Waterbirds:** Listed waterbird species include Hawaiian stilt or ae'o (*Himantopus mexicanus knudseni*), Hawaiian coot or 'alea kea (*Fulica alai*), Hawaiian common gallinule, 'alea 'ula (*Gallinula galeata sandvicensis*), and Hawaiian duck or koloa (*Anas wyvilliana*). No listed waterbirds or their habitat were observed in the Project Area. At solar facilities in the continental U.S., water dependent birds (e.g., grebes, loons, rails, coots, shorebirds, and waterfowl) have been documented to collide with photovoltaic arrays. It has been hypothesized that water-dependent birds perceive the panel arrays to be bodies of water and collide with the panels while attempting a water landing (Kagan et al. 2014, WEST 2014, Walston et al. 2016). This hypothesis is termed the "lake effect." Much more research is needed to investigate whether water-dependent birds are actually attracted to solar arrays, and how proximity to water sources relates to avian mortality at the facilities. There has been no evidence from operating solar facilities in Hawai'i to suggest the lake effect occurs in Hawai'i. It is possible the lake effect would not occur in Hawai'i, where water is generally not limited in the surrounding environment.

4.2.2 Mammals

Two non-native terrestrial mammalian species - cattle (*Bos taurus*) and small Indian mongooses (*Herpestes auropunctatus*) - were seen in the area during the survey. Although not observed, other introduced mammals, such as dogs (*Canis familiaris*), cats (*Felis catus*), house mice (*Mus musculus*), and rats (*Rattus* spp.) are likely to occur within the Project Area.

The endangered Hawaiian hoary bat is also likely to forage in the Project Area. This species will forage in open and semi-cluttered landscapes in a wide range of habitats and vegetation types (Bonaccorso et al. 2015). Although the majority of the woody vegetation within the Project Area is under 15 feet (primarily shorter koa haole trees), some kiawe trees greater than 15 feet tall are scattered throughout the Project Area. According to USFWS and the State of Hawai'i Department of Land and Natural Resources Division of Forestry and Wildlife (DOFAW), these trees have the potential to function as bat roost trees (USFWS 2019; ESRC 2015).

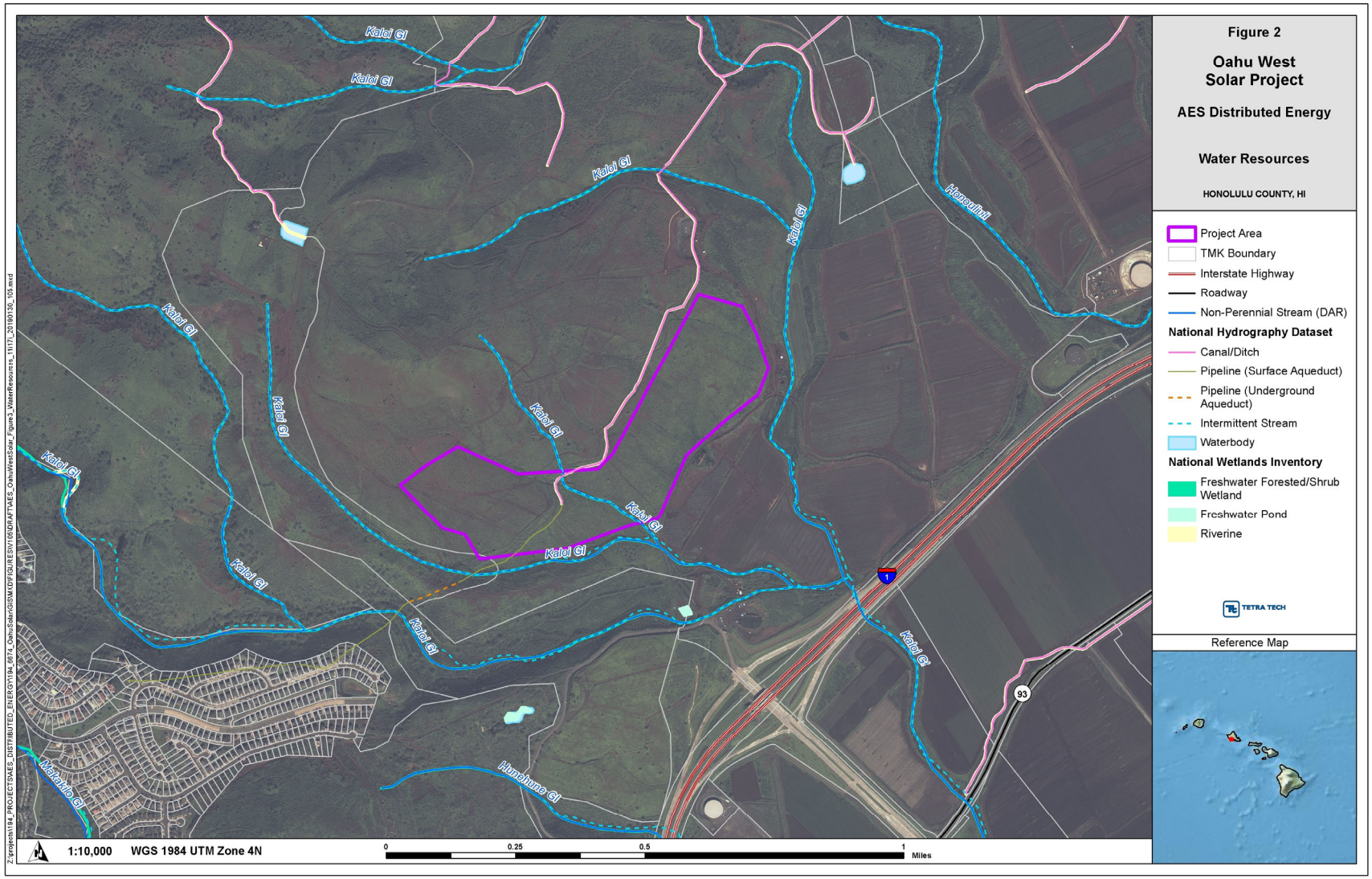
4.2.3 Insects and Other Invertebrates

Large insects observed during the survey include: yellow garden spider (*Argiope aurantia*), globe skimmer (*Pantala flavescens*), fork-tailed bush katydid (*Scudderia furcata*), praying mantis (*Mantis religiosa*), large orange sulfur (*Phoebis agarithe*), gulf fritillary (*Agraulis vanillae*), and Carolina locust (*Dissosteira carolina*). Of these species, only the globe skimmer is native to the Hawaiian Islands.

4.3 Waters of the U.S.

Figure 2 depicts water resources identified by the NWI, NHD, and Hawai'i DAR data in relation to the Project Area. The Project is located in the Kalo'i Gulch watershed. The Kalo'i Gulch stream system consists of numerous tributaries that originate in the Wai'anae Mountain Range near Palikea Ridge and

Figure 2. Water Resources in the Project Area and Vicinity



enjoin just mauka of the H-1 Freeway (Parham et al. 2008). One intermittent tributary of Kalo'i Gulch occurs within the Project Area. Various indicators of OHWM were observed at this tributary during the survey. Additional tributaries skirt the Project Area to the west and east.

South of the Project Area, the Kalo'i Gulch passes through the UH West O'ahu campus, various residential developments, and a series of golf courses. Kalo'i Gulch does not currently have a defined ocean outlet; however, a storm drainage improvement plan for the Kalo'i Gulch watershed has been proposed for the lowermost reaches, which would create a permanent open channel at the Oneula Beach Park (R.M. Towill Corporation 2005, WRRC 2019).

In addition to Kalo'i Gulch, NHD identifies a canal/ditch and pipeline crossing through the Project Area that intersects with Kalo'i Gulch. The canal/ditch is identified as riverine by NWI data (Figure 2). This feature is part of the former Waiāhole Ditch System. The potential jurisdictional status of the ditch and pipeline will need to be further evaluated based on connection to other jurisdictional waters, flow regime, and the recently implemented federal Clean Water Rule.

5 Conclusions and Recommendations

As described in Section 4, no federal or state-listed threatened, endangered, proposed listed, or candidate species for listing were observed during the biological survey. The species observed in the Project Area are primarily non-native and not considered unique. Although not observed, the following listed wildlife have the potential to occur in or transit through the Project Area: pueo, Hawaiian petrel, Newell's shearwater, and Hawaiian hoary bat. Recommended measures to avoid and minimize potential impacts to listed species that may occur in the Project area are included below.

5.1 Plants

Overall, the vegetation in the Project Area is disturbed from previous and current land use activities. Only three native plant species were observed within the Project Area, all of which commonly occur throughout Hawai'i; no federal or state-listed threatened, endangered, proposed listed, or candidate plant species were observed. No specific impact avoidance or minimization measures are warranted for plants; however, Tetra Tech encourages the use of native species as part of any landscaping or revegetation activities.

5.2 Wildlife

5.2.1 Pueo

Although not observed in the Project Area during the biological survey, pueo have been reported to use the surrounding areas (Price and Cotín 2018, Pueo Project 2019) and it is possible that pueo may fly through or nest within the Project Area. Should this species occur within the Project Area, it could be impacted by construction activities. Tetra Tech recommends the following avoidance measures, which are consistent with the protocols established by UH for their West O'ahu property:

- At least two (preferably three) additional pueo surveys should be conducted in the Project Area to increase detectability; two survey points for each survey would ensure the entire Project Area is visible. Because most pueo detections have occurred in the evenings (Price and Cotín 2018), twilight pueo surveys are preferred over morning surveys. Additional pueo surveys should follow the Pueo Project Survey Protocol (Price and Cotín 2018).
- Conduct pre-construction pueo nest surveys to confirm no pueo are nesting in the area prior to any vegetation clearing or ground-disturbing activities.
- All regular, on-site staff should be trained to identify pueo and implement the appropriate steps to take if pueo are present in the Project Area.
- If a ground nest or an owl nesting on the ground is observed, an approximately 50-foot buffer should be established and marked in the field.
- A designated UH representative should be contacted immediately, and the UH representative should notify USFWS and DOFAW.

5.2.2 Seabirds

The Project Area does not provide suitable nesting or foraging habitat for listed Hawaiian seabirds. However, individuals may fly over the area at night, and may be attracted to construction lights at night. Tetra Tech recommends the following measures to avoid and minimize potential impacts to listed seabirds:

- Construction activity should be restricted to daylight hours as much as possible during the seabird peak fallout period (September 15–December 15) to avoid the use of nighttime lighting that could attract seabirds.
- Should nighttime construction be required, construction lighting should be shielded, directed downward, and fitted with non-white lights if construction safety is not compromised, to minimize the attractiveness of construction lights to seabirds.
- If nighttime construction occurs during the seabird peak fallout period, a biological monitor should be present in the construction area between approximately 0.5 hours before sunset to 0.5 hours after sunrise to watch for the presence of seabirds. Should a seabird be observed, and appears affected by the lighting, the monitor should notify the construction manager to reduce or turn off construction lighting until the individual(s) move out of the area.
- Operational on-site lighting should consist of fixtures that will be shielded or directed downward to prevent upward radiation, triggered by a motion detector, and fitted with non-white light bulbs to the extent possible.

5.2.3 Hawaiian Hoary Bat

It is possible that Hawaiian hoary bats could forage or possibly roost within the Project Area. Direct impacts to bats could occur if a juvenile bat that is too small to fly, but too large to be carried by a parent, is present in a tree that is cut down or disturbed. The USFWS provides the following avoidance and minimization measures for the Hawaiian hoary bat (USFWS 2019):

- No woody vegetation (trees or shrubs) taller than 15 feet should be disturbed, removed, or trimmed between June 1 and September 15, which is when juvenile bats that are not yet capable of flying may be roosting in the trees and have the potential to be impacted.
- Barbed wire should not be used for any fences that are erected as part of the Project to prevent entanglement.

5.2 Waters of the U.S.

Tetra Tech recommends a complete WoUS determination and delineation be completed to identify the boundaries of potentially jurisdictional waters, so that the Project can be sited to avoid impacts to the extent possible. Kaloʻi Gulch may be jurisdictional based on evidence of OHWM and bed and bank. The features related to the Waiāhole Ditch System may also be jurisdictional. If the features identified in Figure 2 are considered jurisdictional by the U.S. Army Corps of Engineers (USACE) and the Project intends to place dredged or fill material within these features, a Clean Water Act 404 permit may be required from USACE, Honolulu District. The determination will need to be verified by USACE, Honolulu District.

In general, if USACE requires a permit (e.g., Nationwide Permit) under Section 404, the applicant will likely also need a Section 401 Water Quality Certification from the Hawaiʻi Department of Health Clean Water Branch. In addition, depending on the activities proposed, a Stream Channel Alteration Permit may be required from the Commission on Water Resource Management, pursuant to the State Water Code.

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APPENDIX A

REPRESENTATIVE PHOTOGRAPHS OF THE WEST O'AHU SOLAR PROJECT AREA

Photo 1. Overview of the site showing dry conditions during the survey. 1/31/2019.

Photo 2. Typical Koa Haole Scrub vegetation dominated by koa haole trees and Guinea grass. 1/31/2019.

Photo 3. Native *Abutilon incanum* in the foreground. 1/31/2019.

Photo 4. Waiahole Ditch pipe and former concrete ditch crossing over a gulch in the northern section of the Project Area. 1/31/2019.

Photo 5. Eroded right bank and bed of Kalio Gulch within the Project Area. 1/31/2019.

APPENDIX B

LIST OF PLANT SPECIES OBSERVED DURING SURVEYS

The table below provides a list of plant species observed in the Project Area by Tetra Tech on January 31 and February 5, 2019. The plant names are arranged alphabetically by family and then by species into two groups: monocots and dicots. The taxonomy and nomenclature of the flowering plants are in accordance with Wagner et al. (1999), Wagner and Herbst (2003), and Staples and Herbst (2005). Recent name changes are those recorded in Wagner et al. (2012).

Status:

- E = endemic = native only to the Hawaiian Islands
- I = indigenous = native to the Hawaiian Islands and elsewhere
- P = Polynesian = introduced by Polynesians
- X = introduced/ non-native = all those plants brought to the Hawaiian Islands by humans, intentionally or accidentally, after Western contact (Cook's arrival in the islands in 1778)

List of Plant Species Observed During Surveys for the West O'ahu Solar Project

Scientific Name and Authorship	Hawaiian/Common Name	Status
MONOCOTS		
Poaceae		
Cenchrus ciliaris L.	buffelgrass	X
Melinis repens (Willd.) Zizka	Natal redtop, Natal grass	X
Urochloa maxima (Jacq.) R.D.Webster	Guinea grass	X
DICOTS		
Apocynaceae		
Stapelia gigantea (N.E. Brown)	zulu giant	X
Asteraceae		
Pluchea carolinensis (Jacq.) G.Don	sourbush, marsh fleabane	X
Chenopodiaceae		
Salsola tragus L.	tumbleweed	X
Convolvulaceae		
Ipomoea obscura (L.) Ker Gawl.	morning glory	X
Euphorbiaceae		
Ricinus communis L.	castor bean	X
Fabaceae		
Acacia confusa Merr.	Formosa koa	X
Acacia farnesiana (L.) Wild.	klu	X
Crotalaria pallida Aiton	smooth rattlepod, pikakani	X
Indigofera spicata Forssk.	creeping indigo	X

List of Plant Species Observed During Surveys for the West O'ahu Solar Project

Scientific Name and Authorship	Hawaiian/Common Name	Status
Chamaecrista nictitans (L.) Moench	partridge pea	X
Leucaena leucocephala (Lam.) de Wit	koa haole	X
Macroptilium atropurpureum (DC.) Urb.	–	X
Mimosa pudica var. *unijuga* (Duchass. & Walp.) Griseb.	sensitive plant, sleeping grass, pua hilahila	X
Pithecellobium dulce (Roxb.) Benth.	Manila tamarind, opiuma	X
Prosopis pallida Kunth	kiawe	X
Lamiaceae		
Hyptis pectinata (L.) Poit.	comb hyptis	X
Leonotis nepetifolia (L.) R.Br.	lion's ear	X
Malvaceae		
Abutilon grandifolium (Willd.) Sweet	hairy abutilon	X
Abutilon incanum (Link.) Sweet	hoary abutilon	I
Sida ciliaris L.	–	X
Sida fallax L.	'ilima	I
Sida sp.	–	X
Polygonaceae		
Antigonon leptopus Hook. & Arn.	Mexican creeper	X
Sterculiaceae		
Waltheria indica L.	'uhaloa	I?
Verbenaceae		
Stachytarpheta jamaicensis (L.) Vahl	Jamaica vervain, oī	X

Pueo Surveys for the West O'ahu Solar Plus Storage Project

To:	AES Distributed Energy
From:	Tetra Tech, Inc.
Date:	January 2020
Subject:	West O'ahu Solar Plus Storage Project Pueo Surveys

Introduction

AES Distributed Energy, Inc. (AES) is proposing the West O'ahu Solar Plus Storage Project (Project), a 12.5-megawatt ground-mounted solar photovoltaic (PV) and battery energy storage system (BESS) facility located approximately 3 miles northeast of Kapolei on the island of O'ahu. The Project area encompasses approximately 95.5 acres in an area commonly referred to as the University of Hawai'i (UH) West O'ahu Mauka Lands property and is within tax map key 9-2-002:007.

As part of the due diligence efforts for the Project, Tetra Tech conducted general biological surveys within the Project area in January and February 2019. The results of the surveys indicate that the Project area has been heavily modified over time by agricultural practices and the introduction of invasive species. The vegetation in the Project area is primarily Koa Haole Scrub. This vegetation type is characterized by open to dense stands of non-native koa haole trees (*Leucaena leucocephala*), ranging from 4 to 8 feet in height, with guinea grass (*Urochloa maxima*) as the most abundant plant in the understory.

As part of the general biological surveys, Tetra Tech conducted a survey specifically to detect the pueo or Hawaiian short-eared owl (*Asio flammeus sandwichensis*) in the morning on February 5, 2019. The Hawaiian short-eared owl or pueo is listed as endangered by the State of Hawai'i only on the island of O'ahu; it is not a federally listed species. Although not detected within the Project area during the biological surveys, this species been previously reported from the surrounding areas; the nearest known observation to the Project area is near the southern edge of the UH West Oahu campus (Price and Cotín, 2018, Pueo Project, 2019). Based on the habitat that is present, Tetra Tech's biologists determined it was possible that pueo may fly through or nest within the Project Area. Because pueo is listed by the State and has the potential to be impacted by construction activities, Tetra Tech recommended at least two (preferably three) additional pueo surveys be conducted in the Project area according to the Pueo Project survey protocol (Price and Cotín 2018). This technical memorandum documents the methodology and results of the additional pueo survey efforts in the Project area.

Methodology

Tetra Tech conducted pueo surveys on the evenings of September 26, November 14, and December 19, 2019, following the protocol outlined for the Pueo Project (Price and Cotín 2018). Because most pueo detections have occurred in the evenings (M. Price/ UH Mānoa, pers. comm., September 2019; Cotin et.

al. 2018), twilight pueo surveys were conducted. Surveys began 60 – 75 minutes before sunset and finished at civil twilight. Two survey points were established in the Project area to ensure that the entire Project area was visible (see Attachments 1 and 2). A biologist was present at each survey point for the duration of each of the three surveys to increase detectability. The ground and sky within the viewshed of each survey point were scanned with binoculars and the naked eye throughout the survey period.

The following general information was collected during each survey: date, observer, GPS coordinates, start time, and end time. Environmental information was recorded, including: cloud cover, wind speed, temperature, precipitation, extent of surveyed area (maximum length of viewshed surveyed in cardinal directions), and habitat classification. For any pueo observations, the following information would be collected: detection start time, detection end time, detection type, owl behavior classification, owl vocalization description, distance from observer, direction from observer, habitat where owl observed, and courtship behavior description. All surveys were conducted in good weather with light winds, few clouds, and no precipitation.

Results and Recommendations

No pueo were documented during the three surveys within the Project area (see Attachment 3). Although pueo were not observed or heard during the surveys, this species has been reported to use the surrounding areas (Price and Cotín 2018, Pueo Project 2019). Given the habitat present, pueo could potentially forage or nest in and around the Project area. However, based on consultation with DOFAW biologists and Pueo Project researchers regarding the survey results and previous pueo detections in the vicinity, it is understood that pueo are not likely to use the Project area on a regular basis as they were not detected during any of the pueo-specific surveys (A. Siddiqui/ DOFAW, pers. comm., October 2019).

Based on the survey results, Tetra Tech recommends the following avoidance and minimization measures, which are consistent with the protocols established by UH for their West Oʻahu property as well as input from DOFAW:

- A wildlife education and observation program should be implemented for all construction and regular on-site staff. Staff should be trained to identify pueo (and other listed species) and to take appropriate steps if a pueo is detected in the Project area.
- Prior to clearing vegetation within the Project area, pre-construction pueo surveys should be conducted by a qualified biologist (following the Pueo Project survey protocol) to confirm no pueo are nesting in the area. Nests are constructed by females and are comprised of simple scrapes in the ground lined with grasses and feather down (Holt 1993).
- If a ground nest or an owl nesting on the ground is observed at any time (prior to construction, during construction, or during operation), an approximately 50-foot buffer should be established and marked in the field. In accordance with existing protocol for UH West Oʻahu, a designated UH West Oʻahu representative should be contacted immediately, and that representative should provide notification to DOFAW. No vegetation clearing should occur until pueo nesting ceases.
- If a live pueo is observed on-site by Project staff all activities within 50 feet of the bird should cease, and the bird should not be approached.

Literature Cited

Cotín, J., K.E. Davis, A. Siddiqi, and M. Price. 2018. The Pueo Project Annual Report 2018. Breeding phenology and daily activity of the Hawaiian Short-eared Owl (*Asio flammeus sandwichensis*) on O'ahu.

Holt, D.W. and S.M. Leasure. 1993. Short-eared owl (*Asio flammeus*). In The Birds of North America, No. 62 (Poole A, Gill F, editors). Philadelphia, (PA): The Academy of Natural Sciences; and Washington DC: The American Ornithologists' Union.

Price, M. and J. Cotín. 2018. The Pueo Project. Final Report. April 2017-March 2018. Population size, distribution and habitat use of the Hawaiian Short-eared Owl (*Asio flammeus sandwichensis*) on O'ahu.

Pueo Project. 2019. Pueo Distribution and Sightings Map. https://www.pueoproject.com/distribution-map

Attachment 1. Location of Pueo Survey Points within Project Area

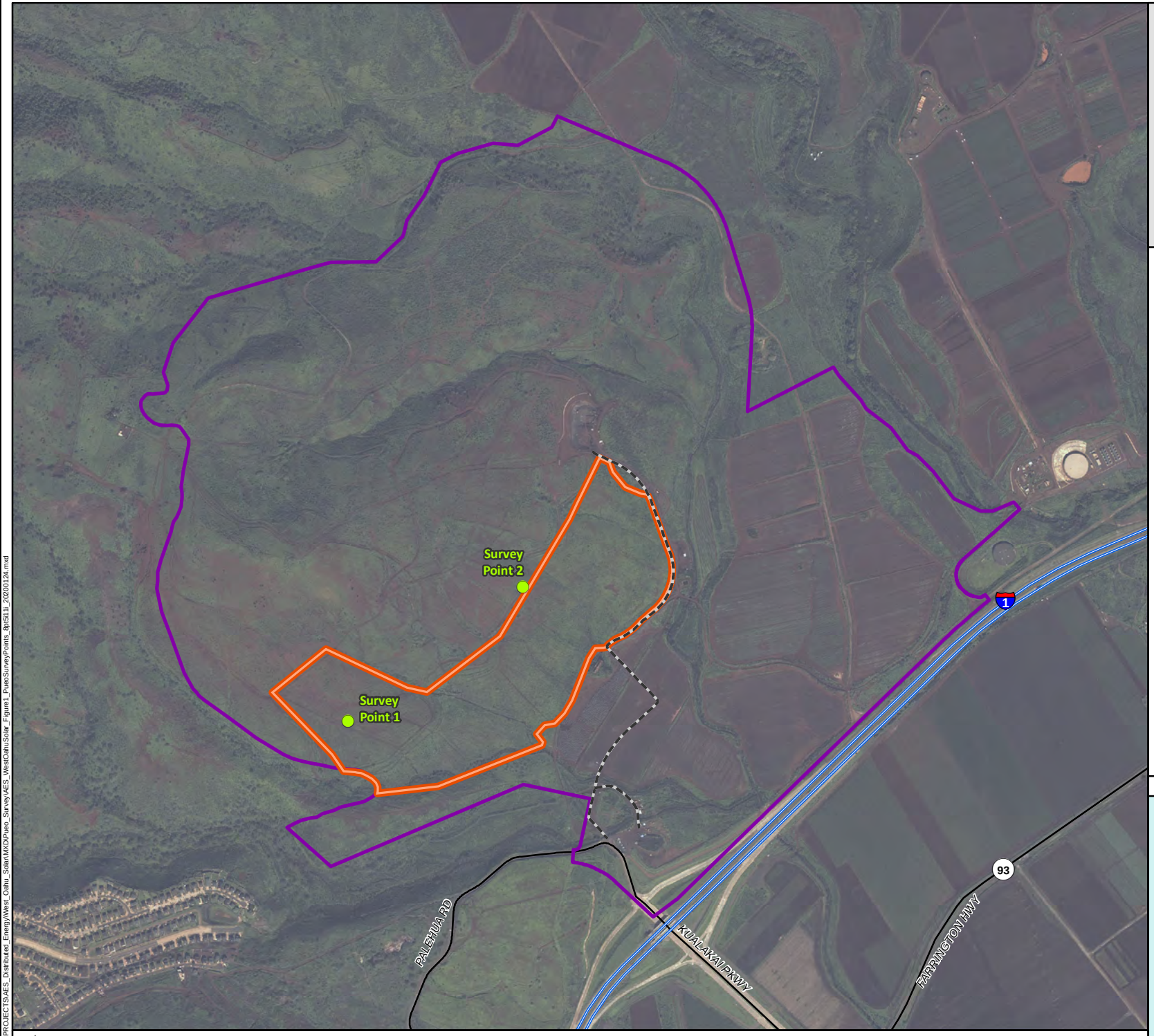


Figure 1

West Oahu Solar Plus Storage Project

AES Distributed Energy

Pueo Survey Points

HONOLULU COUNTY, HI

- Project Area
- Property Boundary
- Existing Access Road
- Interstate Highway
- Roadway
- Survey Point

TETRA TECH

Reference Map

1:15,000 WGS 1984 UTM Zone 4N

0 0.25 0.5 1 Miles

NOT FOR CONSTRUCTION

P:\GIS_PROJECTS\AES_Distributed_Energy\West_Oahu_Solar\MXD\Pueo_Survey\AES_WestOahuSolar_Figure1_PueoSurveyPoints_8in511i_20200124.mxd

Attachment 2. Photographs from the Pueo Survey Points

Photo 1. View from pueo survey point 1 looking to the southeast over the Project area. Notice the steam plant in the middle left of the photo for reference between photos of survey points 1 and 2.

Photo 2. View from pueo survey point 2 looking to the southeast over the Project area.

Attachment 3. Pueo Survey Datasheets

Pueo Project Survey Datasheet 2017

Site: UH West Side GPS point: 286 (Western Corner) GPS coordinates: (D.dddddd, -D.dddddd) 576517 2363571

Date: 9/26/19 Visit # (1, 2 or 3): 1 Survey Start Time: 5:35 Survey Stop Time: 6:50 Observers: JD

Temperature: 80 Cloud cover (Clear, PC, MC, Cloudy): PC Rain: None Wind (0-7): 0-1

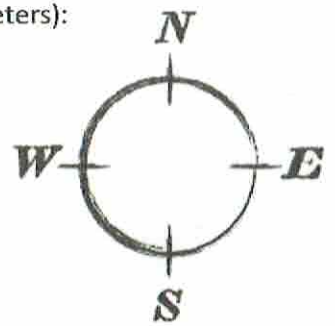
Detection start time	Detection end time	Number	Initial distance	Initial direction	Sounds	Behavior	Habitat
—	—	—	—	—	—	—	—
No	detections						

% Habitat w/in 400 m or surveyed area (must be 100%):

Developed	Wetland	Agricultural Crops	Agricultural Dirt	Grasslshort Grazed	Grasslshort Golf	Grasslshort Mowed
Grassland Fallow	Grasslands Tall >75cm	Shrublands	Non Native Forest	Native Forest	Other	Total
100%						

Surveyed area (max visible meters):

N: 400 S: 800
NE: 1600+ SW: 800
E: 1000+ W: 1000+
SE: 1000+ NW 400



Observations: Lots of cattle and cyclists onsite

Pueo Project Survey Datasheet 2017

Site: UH West Solar GPS point: survey point GPS coordinates: (D.dddddd, -D.dddddd) 0597019, 2363956 ±4m

Date: 9-26-19 Visit # (1, 2 or 3): ___ Survey Start Time: 5:15 pm Survey Stop Time: 6:50pm Observers: Philip Taylor

Temperature: 82°F Cloud cover (Clear, PC, MC, Cloudy): PC Rain: 0 Wind (0-7): 1

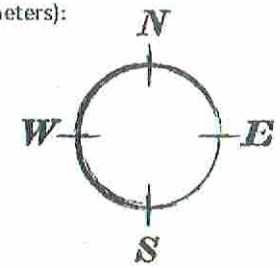
Detection start time	Detection end time	Number	Initial distance	Initial direction	Sounds	Behavior	Habitat

% Habitat w/in 400 m or surveyed area (must be 100%):

Developed	Wetland	Agricultural Crops	Agricultural Dirt	Grassl/short Grazed	Grassl/short Golf	Grassl/short Mowed
Grassland Fallow	**Grasslands Tall >75cm**	**Shrublands**	**Non Native Forest**	**Native Forest**	**Other**	**Total**
100%						

Surveyed area (max visible meters):

N: 250 S: 1000
NE: 600 SW: 500
E: 1000 W: 150
SE: 1000 NW 200



Observations: other species observed: Cattle egret, zebra dove, red-vented bulbul, red avadavat

Limited visibility after 6:40pm.

Pueo Project Survey Datasheet 2017

Western Point

~~596557 2363566 (299) Meta~~ ?

Site: UH West Solar GPS point: (286) GPS coordinates: (D.dddddd, -D.dddddd) 596517 2363571 (256)

Date: 11/14/17 Visit # (1, 2 or 3): 2 Survey Start Time: 4:30 pm Survey Stop Time: 6:17 Observers: JD

Temperature: 78 Cloud cover (Clear, PC, MC, Cloudy): PC Rain: None Wind (0-7): 2 From South

Detection start time	Detection end time	Number	Initial distance	Initial direction	Sounds	Behavior	Habitat
—	—	—	—	—	—	—	—

% Habitat w/in 400 m or surveyed area (must be 100%):

Developed	Wetland	Agricultural Crops	Agricultural Dirt	Grasslshort Grazed	Grasslshort Golf	Grasslshort Mowed
Grassland Fallow	Grasslands Tall >75cm	Shrublands	Non Native Forest	Native Forest	Other	Total
100%						

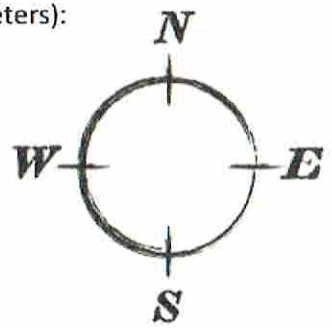
Surveyed area (max visible meters):

N: 400 S: 800

NE: 1000+ SW: 800

E: 1000+ W: 1000+

SE: 1000+ NW 400



Observations: Good conditions, no detections

Pueo Project Survey Datasheet 2017

Site: UH West GPS point: _____ GPS coordinates: (D.dddddd, -D.dddddd) 0597016, 2363956 ±3M

Date: 11-14-19 Visit # (1, 2 or 3): 2 Survey Start Time: 4:45p Survey Stop Time: 6:20p Observers: Philip Taylor

Temperature: 75°F Cloud cover (Clear, PC, MC, Cloudy): PC Rain: 0 Wind (0-7): 3

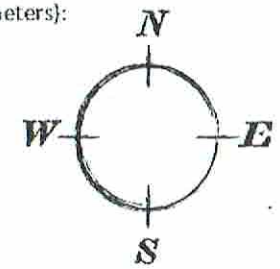
Detection start time	Detection end time	Number	Initial distance	Initial direction	Sounds	Behavior	Habitat

% Habitat w/in 400 m or surveyed area (must be 100%):

Developed	Wetland	Agricultural Crops	Agricultural Dirt	Grasslshort Grazed	Grasslshort Golf	Grasslshort Mowed
Grassland Fallow	Grasslands Tall >75cm	Shrublands	Non Native Forest	Native Forest	Other	Total

Surveyed area (max visible meters):

N: 300 S: 500+
NE: 500+ SW: 100
E: 500+ W: 200
SE: 500+ NW 250



Observations: No pueo observed. Barn owl heard inside structure at bottom of survey area.

Pueo Project Survey Datasheet 2017

Site: VH West Solar GPS point: (Western Corner 282) GPS coordinates: (D.dddddd, -D.dddddd) 596517 2363571

Date: 12/19/19 Visit # (1, 2 or 3): 3 Survey Start Time: 4:35 PM Survey Stop Time: 6:21 PM Observers: JD

Temperature: 80 Cloud cover (Clear, PC, MC, Cloudy): PC Rain: None Wind (0-7): 2-3

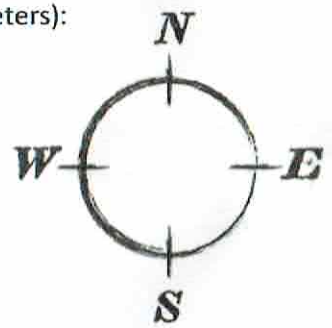
Detection start time	Detection end time	Number	Initial distance	Initial direction	Sounds	Behavior	Habitat
—	—	—	—	—	—	—	—

% Habitat w/in 400 m or surveyed area (must be 100%):

Developed	Wetland	Agricultural Crops	Agricultural Dirt	Grasslshort Grazed	Grasslshort Golf	Grasslshort Mowed
Grassland Fallow	Grasslands Tall >75cm	Shrublands	Non Native Forest	Native Forest	Other	Total

Surveyed area (max visible meters):

N: 400 S: 500+
NE: 500+ SW: 500+
E: 500+ W: 500+
SE: 500+ NW 400



Observations: A little breezy but overall good survey conditions

Pueo Project Survey Datasheet 2017

Site : UH West GPS point: East GPS coordinates: (D.dddddd, -D.dddddd) 0597019, 2363956 ± 4m

Date: 12/19/19 Visit # (1, 2 or 3): 3 Survey Start Time: 4:30p Survey Stop Time: 6:20p Observers: Phil Taylor

Temperature: 78°F Cloud cover (Clear, PC, MC, Cloudy): _____ Rain: 0 Wind (0-7): 4

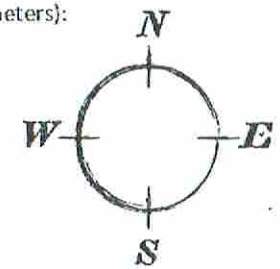
Detection start time	Detection end time	Number	Initial distance	Initial direction	Sounds	Behavior	Habitat

% Habitat w/in 400 m or surveyed area (must be 100%):

Developed	Wetland	Agricultural Crops	Agricultural Dirt	Grasslshort Grazed	Grasslshort Golf	Grasslshort Mowed
Grassland Fallow	**Grasslands Tall >75cm**	**Shrublands**	**Non Native Forest**	**Native Forest**	**Other**	**Total**
100%						

Surveyed area (max visible meters):

N: 200 S: 500
NE: 500+ SW: 100
E: 500+ W: 100
SE: 500+ NW 100



Observations: No pueo observed.

Attachment F
Archaeological Inventory Survey Report

Draft
Archaeological Inventory Survey Report for the AES West Oʻahu Solar Project, Honouliuli Ahupuaʻa, ʻEwa District, Oʻahu TMK: [1] 9-2-002:007 (por.)

Prepared for
Tetra Tech, Inc.
on behalf of
AES Distributed Energy

Prepared by
Alison Welser, M.A.,
Scott Belluomini, B.A.,
Tyler Turran, B.A.,
David W. Shideler, M.A.,
and
Hallett H. Hammatt, Ph.D.

Cultural Surveys Hawaiʻi, Inc.
Kailua, Hawaiʻi
(Job Code: HONOULIULI 171)

February 2020

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Management Summary

Reference	Archaeological Inventory Survey Report for the AES West O‘ahu Solar Project, Honouliuli Ahupua‘a, ‘Ewa District, O‘ahu, TMK: [1] 9-2-002:007 (por.) (Welser et al. 2020)
Date	February 2020
Project Number(s)	Cultural Surveys Hawai‘i, Inc. (CSH) Job Code: HONOULIULI 171
Investigation Permit Number	CSH completed the archaeological inventory survey (AIS) fieldwork under archaeological fieldwork permit number 19-07, issued by the Hawai‘i State Historic Preservation Division (SHPD) per Hawai‘i Administrative Rules (HAR) §13-13-282.
Agencies	SHPD; Department of Planning and Permitting (DPP); Land Use Commission (LUC)
Land Jurisdiction	State of Hawai‘i
Project Proponent	AES Distributed Energy
Project Funding	AES Distributed Energy
Project Location	The project area is on undeveloped lands located in the southeastern foothills of the Wai‘anae Range, northeast of Pu‘u Makakilo and the Makakilo subdivision and about 600 m northwest of the intersection of the H-1 freeway and the Kualaka‘i Parkway. The project area is depicted on a portion of the Ewa and Schofield Barracks 2013 U.S. Geological Survey (USGS) 7.5-minute topographic quadrangle.
Project Description	The proposed AES West O‘ahu Solar project consists of construction and operation of an approximately 12.5 MW ground-mounted solar photovoltaic system, coupled with a 50 MWh battery energy storage system and related interconnection and ancillary facilities. Specifically, it includes the following major components: (1) solar photovoltaic system, (2) battery energy storage system, (3) substation and interconnection equipment, (4) a network of electrical wiring and collector lines, and (5) access roads and fencing. In addition to these facilities, the Project area would be made available for compatible agricultural activities. The solar photovoltaic system would consist of a series of solar modules mounted on a fixed-tilt racking system. The racking system would hold the modules at a fixed angle of 15 degrees facing toward the south and would be supported by steel posts, spaced approximately every 19 feet (5.8m) (varies). The posts would be installed using a hydraulic pile driver and/or augur for pre-drilling, with approximate depths of 6 feet (1.8m) (depending on soil conditions). In the event it is determined that the desired depth cannot be achieved, foundations would be pre-drilled and supported with concrete. Once mounted on the racking system, the highest point of the modules is expected to extend

	approximately 8.5 feet (2.6m) above the ground surface, with an average of approximately 3 feet (0.9m) of ground clearance below the modules. Electrical equipment (including inverters and transformers) and the battery units (housed in containers) would be installed on concrete equipment pads distributed throughout the Project area. A total of five concrete pads would be installed; each approximately 2,800 square feet (260.1 m^2) in area. The Project would also include a substation and associated electrical equipment to facilitate interconnection with the Hawaiian Electric grid. These facilities would be constructed immediately adjacent to the existing Hawaiian Electric ‘Ewa Nui #42 46kV sub-transmission line and would occupy a total of approximately 7,800 square feet (724.6m^2). A short overhead electrical connection (approximately 300 feet or 91.4m in length), supported by approximately three 60-foot or 18.3m tall wood poles, would also be installed. Electrical wiring and collector lines connecting the solar modules with the equipment pads and the substation would be installed underground; approximately 14,000 linear feet (4.267 km) of trenching would be required, with widths ranging between 5-10 feet (1.5m to 3.0m) and depths up to 4 feet (1.2m). Perimeter fencing and new access roads would also be installed within the Project area. Equipment to support compatible agricultural activities would include four beekeeping stations (each approximately 40 square feet or 3.7m^2) and two cattle pens (each with a small concrete slab for a water trough). In addition to construction of the facilities described above, grading would also occur in localized areas as needed to smooth the ground surface and for other civil engineering purposes (e.g., stormwater retention and management).
Project Acreage	The project area is approximately 101.62 acres (41.12 hectares).
Historic Preservation Regulatory Context	This AIS investigation fulfills the requirements of HAR §13-276. The AIS was conducted to identify, document, and assess the significance of historic properties within the project area, assess the potential for the project to adversely affect significant historic properties, and to provide agreed upon mitigation commitments to address any adverse impacts. This document is intended to support the proposed project’s historic preservation review under Hawai‘i Revised Statutes (HRS) §6E-42 and HAR §13-284, as well as the project’s environmental review under HRS §343. It is also intended to support any project-related historic preservation consultation with stakeholders such as state and county agencies and interested Native Hawaiian Organizations (NHOs) and community groups. The AIS investigation was designed in consultation with the SHPD. An *Archaeological Inventory Survey of the University of Hawai‘i West O‘ahu Campus, District of ‘Ewa, Island of O‘ahu, Hawai‘i (TMKs: 9-2-02:01, 03, and 05)* (Dega et al. 1998) that included the entirety of the

	present project area was previously accepted by SHPD on 3 February 1999 (LOG NO. 22959, DOC. NO. 9901EJ28; Appendix A). Due to the passage of time and given that the present project is different than that addressed by the 1998 report, it was agreed in consultation with Dr. Susan Lebo on 12 February 2019 that it would be appropriate to move forward with an AIS specific to this project.
Fieldwork Effort	CSH archaeologists Scott Belluomini, B.A., Alison Welser, M.A., Tyler Turran, B.A., Chris Konen, B.A., and David W. Shideler, M.A., conducted fieldwork between 4 and 6 February 2019 under the general supervision of Hallett H. Hammatt, Ph.D., Principal Investigator. This work required approximately 11 person-days to complete. Following the initial pedestrian inspection, the project area boundaries were altered slightly, extending to the north and the west, as well as south to encompass the existing access roads to be used for the project. Additional pedestrian inspection was conducted for these areas on 12 December 2019.
Historic Properties Identified and Historic Property Significance	The AIS further documented two previously identified historic properties within the project area: State Inventory of Historic Places (SIHP) # 50-80-08-5593 consists of an historic irrigation system and plantation infrastructure, including a mill building and pump station (“Pump Station 12”), bridges, troughs, transport ditches, culvert, pipes, culvert and sluice gate, and various other features related to water retention and movement. SIHP # 50-80-08-5593 was previously assessed by Dega et al. (1998) as significant under Hawai‘i State historic property significance Criteria a (be associated with events that have made an important contribution to the broad patterns of our history) and d (has yielded, or may be likely to yield, information important for research on prehistory or history). The current study assesses SIHP # 50-80-08-5593 as significant under only HAR §13-284-6 Criterion d. This historic property has yielded information on land utilization and agricultural history of the ‘Ewa Plain. However, it is not associated with specific impactful events in the area, unlike the Waiahole Ditch, which immeasurably altered the entirety of the landscape. The historic property retains integrity of location, design, materials, and workmanship. SIHP # 50-80-09-2268 consists of the Waiahole Ditch System, previously assessed by various studies. The historic property is assessed as significant pursuant to HAR §13-284-6 under Criteria a (be associated with events that have made an important contribution to the broad patterns of our history), c (embody the distinctive characteristics of a type, period, or method of construction, represent the work of a master, or possess high artistic value), and d (has yielded, or is likely to yield, information important for research on prehistory or history). The

	historic property has yielded information on agricultural history of the area and contributed greatly to the development and evolution of the ‘Ewa Plain throughout its history. The historic property retains integrity of location, design, materials, and workmanship. However, within the project area, the historic property only retains sufficient integrity of location, which is also diminished in portions of the project area due to erosion and neglect. While there are some portions that retain some integrity of design, materials, and workmanship within the project area, this integrity is diminished. The overall ditch is significant, however, the remnant portion of SIHP # 50-80-09-2268 within the project area does not retain sufficient integrity to be considered significant.
Effect Recommendations	The portion of SIHP # 50-80-09-2268 within the project area does not retain sufficient integrity to be considered significant, and therefore no further work is recommended for the historic property. Sufficient information regarding the location, extent, function, and age of the portion of SIHP # 50-80-08-5593 within the project area have been generated by the current archaeological inventory survey investigation to mitigate any adverse effect caused by the proposed project. Pursuant to HAR §13-284-7, the project-specific effect determination is “no historic properties affected.”
Mitigation Recommendations	The proposed project will have no effect on significant historic properties within the project area, therefore no mitigation is required.

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Section 1 Introduction

1.1 Project Background

At the request of Tetra Tech, Inc., and on behalf of AES Distributed Energy, Cultural Surveys Hawai‘i, Inc. (CSH) has prepared this archaeological inventory survey report (AISR) for the AES West O‘ahu Solar project, Honouliuli Ahupua‘a, ‘Ewa District, O‘ahu, TMK: [1] 9-2-002:007 (por). The project area is 101.62 acres (41.12 hectares) of undeveloped lands in the southeastern foothills of the Wai‘anae Range, northeast of Pu‘u Makakilo and the Makakilo subdivision, and 600 m northwest of the intersection of the H-1 Freeway and the Kualaka‘i Parkway. The project area is depicted on a portion of the 2013 Ewa and Schofield Barracks U.S. Geological Survey (USGS) 7.5-minute topographic quadrangle (Figure 1), a tax map plat (Figure 2), and a 2018 aerial photograph (Figure 3).

1.2 Proposed Project Description

The proposed AES West O‘ahu Solar project consists of construction and operation of an approximately 12.5 MW ground-mounted solar photovoltaic system, coupled with a 50 MWh battery energy storage system and related interconnection and ancillary facilities (see Overall Site Plan, Figure 4). Specifically, it includes the following major components: (1) solar photovoltaic system, (2) battery energy storage system, (3) substation and interconnection equipment, (4) a network of electrical wiring and collector lines, and (5) access roads and fencing. In addition to these facilities, the Project area would be made available for compatible agricultural activities.

The solar photovoltaic system would consist of a series of solar modules mounted on a fixed-tilt racking system. The racking system would hold the modules at a fixed angle of 15 degrees facing toward the south and would be supported by steel posts, spaced approximately every 19 feet (5.8m) (varies). The posts would be installed using a hydraulic pile driver and/or augur for pre-drilling, with approximate depths of 6 feet (1.8m) (depending on soil conditions). In the event it is determined that the desired depth cannot be achieved, foundations would be pre-drilled and supported with concrete. Once mounted on the racking system, the highest point of the modules is expected to extend approximately 8.5 feet (2.6m) above the ground surface, with an average of approximately 3 feet (0.9m) of ground clearance below the modules. Electrical equipment (including inverters and transformers) and the battery units (housed in containers) would be installed on concrete equipment pads distributed throughout the Project area. A total of five concrete pads would be installed; each approximately 2,800 square feet (260.1 m^2) in area. The Project would also include a substation and associated electrical equipment to facilitate interconnection with the Hawaiian Electric grid. These facilities would be constructed immediately adjacent to the existing Hawaiian Electric ‘Ewa Nui #42 46kV sub-transmission line and would occupy a total of approximately 7,800 square feet (724.6m^2). A short overhead electrical connection (approximately 300 feet or 91.4m in length), supported by approximately three 60-foot or 18.3m tall wood poles, would also be installed. Electrical wiring and collector lines connecting the solar modules with the equipment pads and the substation would be installed underground; approximately 14,000 linear feet (4.267 km) of trenching would be required, with widths ranging between 5-10 feet (1.5m to 3.0m) and depths up to 4 feet (1.2m). Perimeter fencing and new access roads would also be installed within the Project area. Equipment to support compatible agricultural

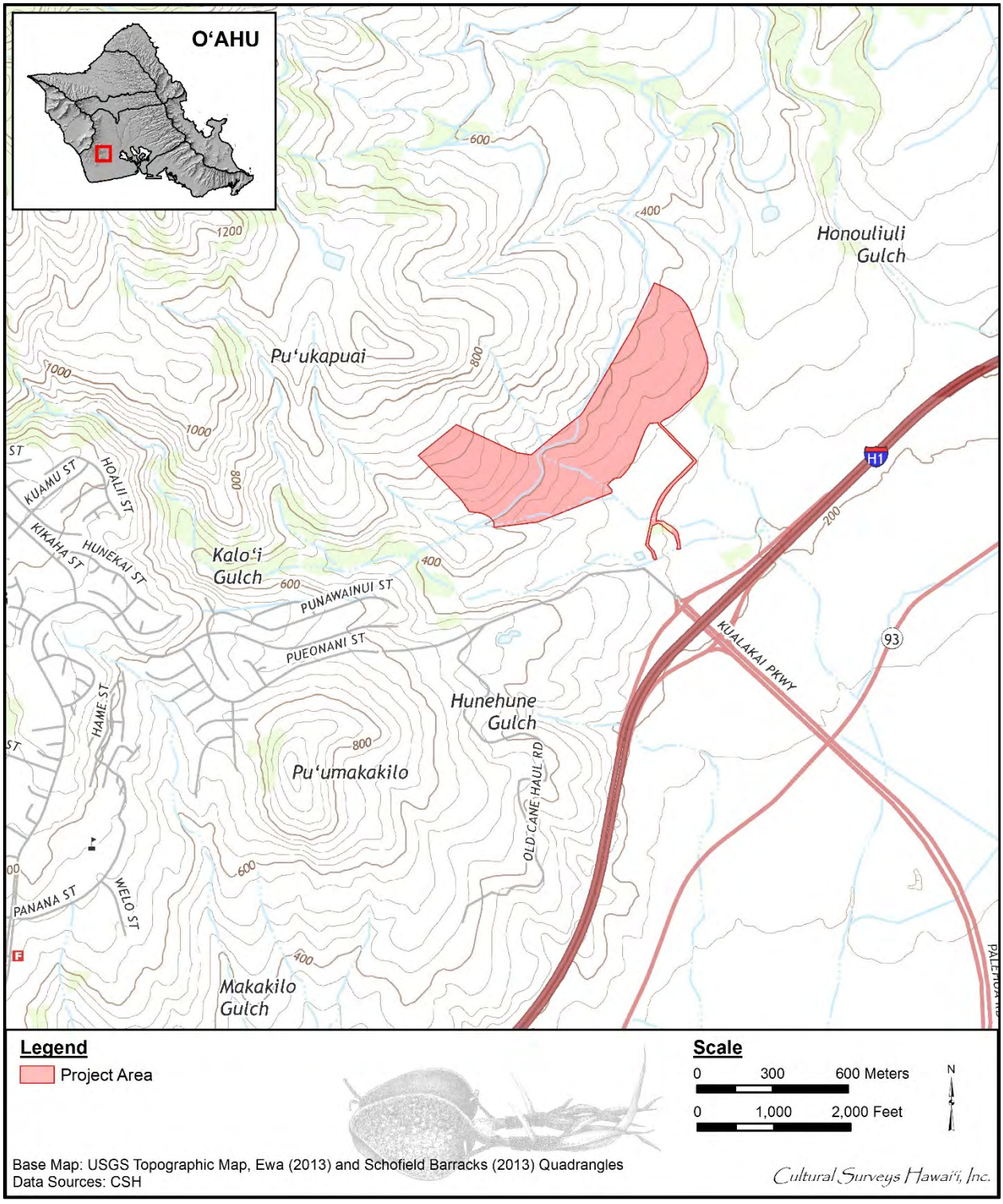


Figure 1. Portion of the 2013 Ewa and Schofield Barracks USGS 7.5-minute topographic quadrangles showing the location of the project area

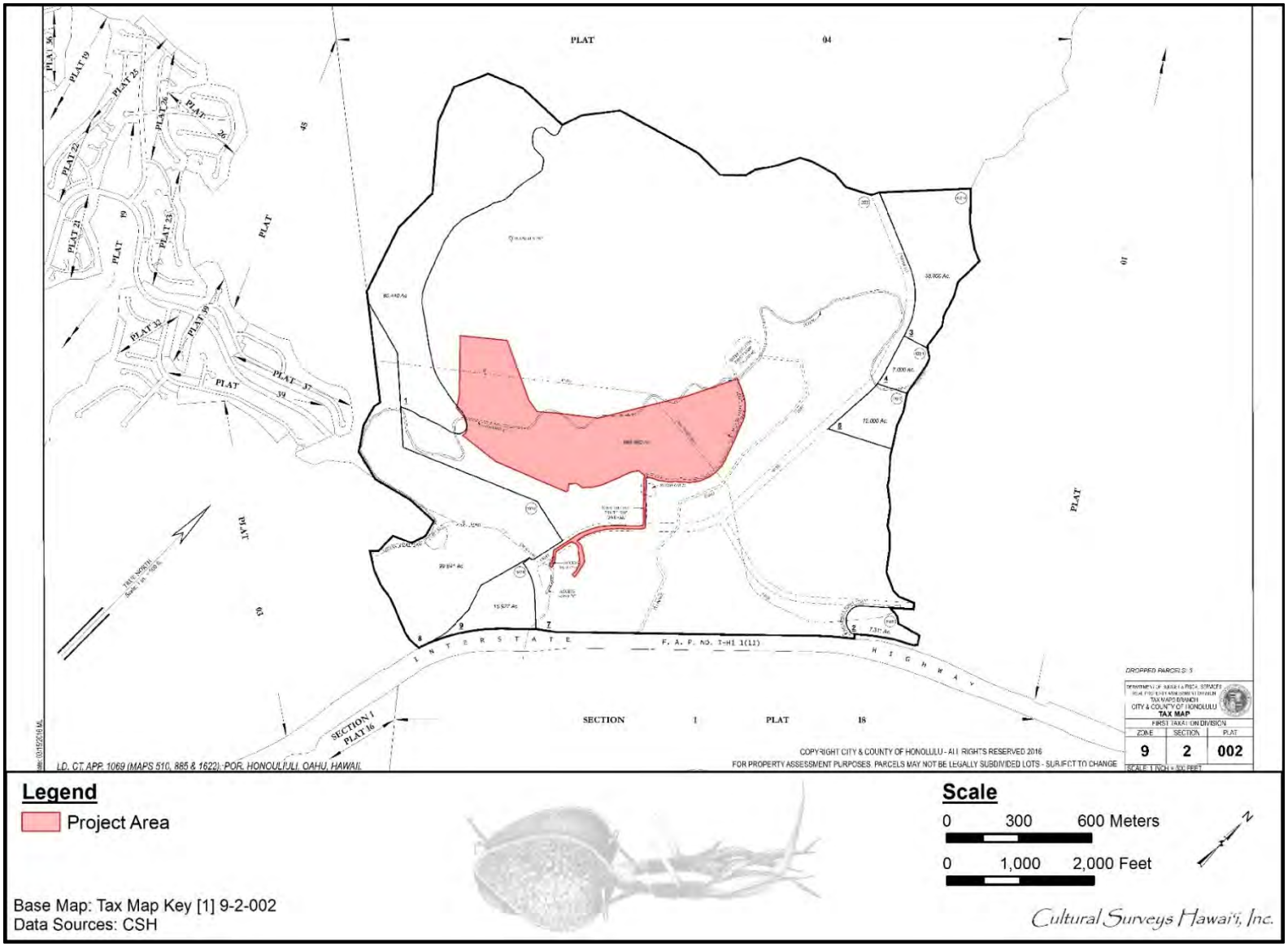


Figure 2. Tax Map Key (TMK) [1] 9-2-002 showing the location of the project area (Hawai‘i TMK Service 2014)

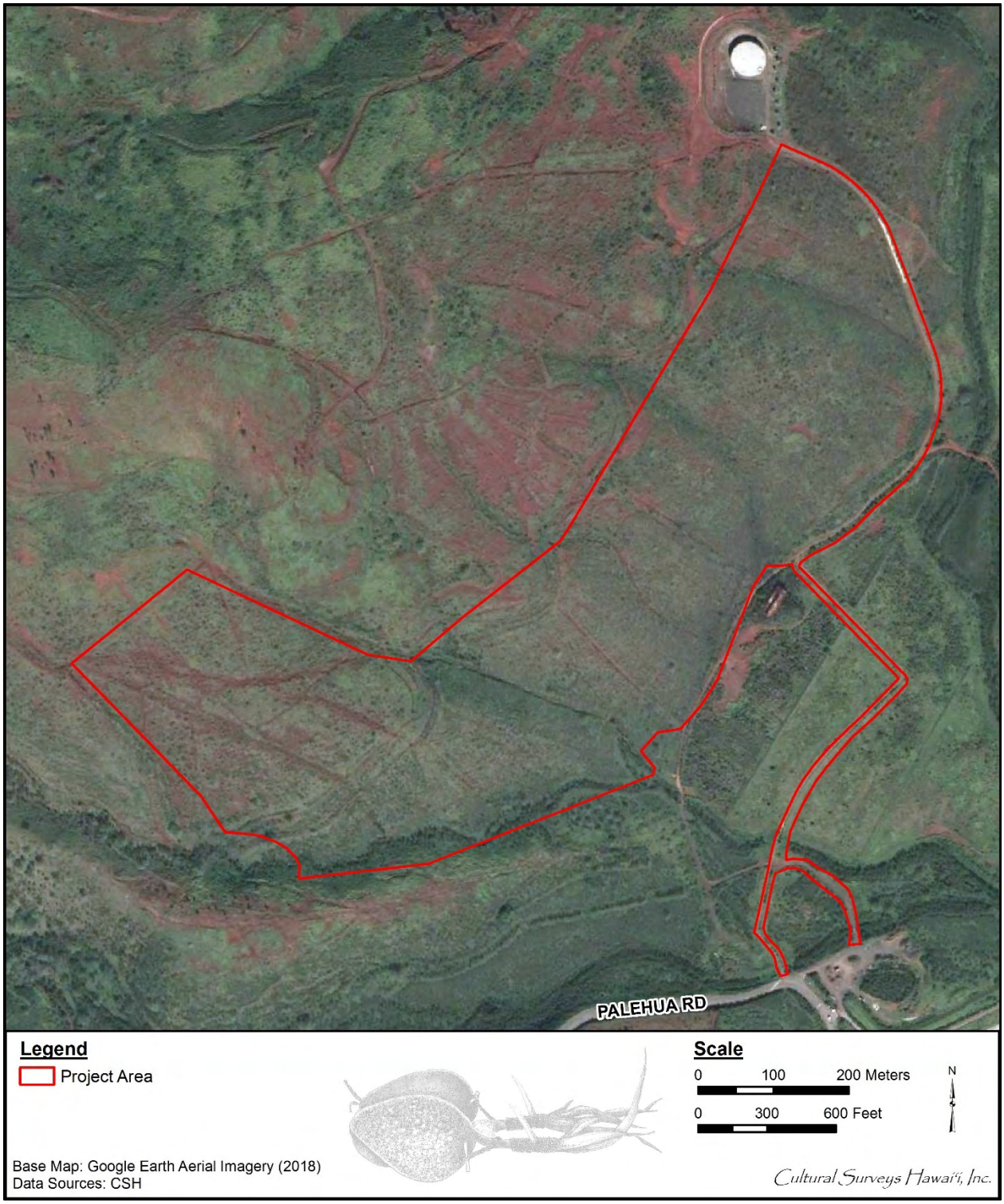


Figure 3. Aerial photograph of the project area (Google Earth 2018)

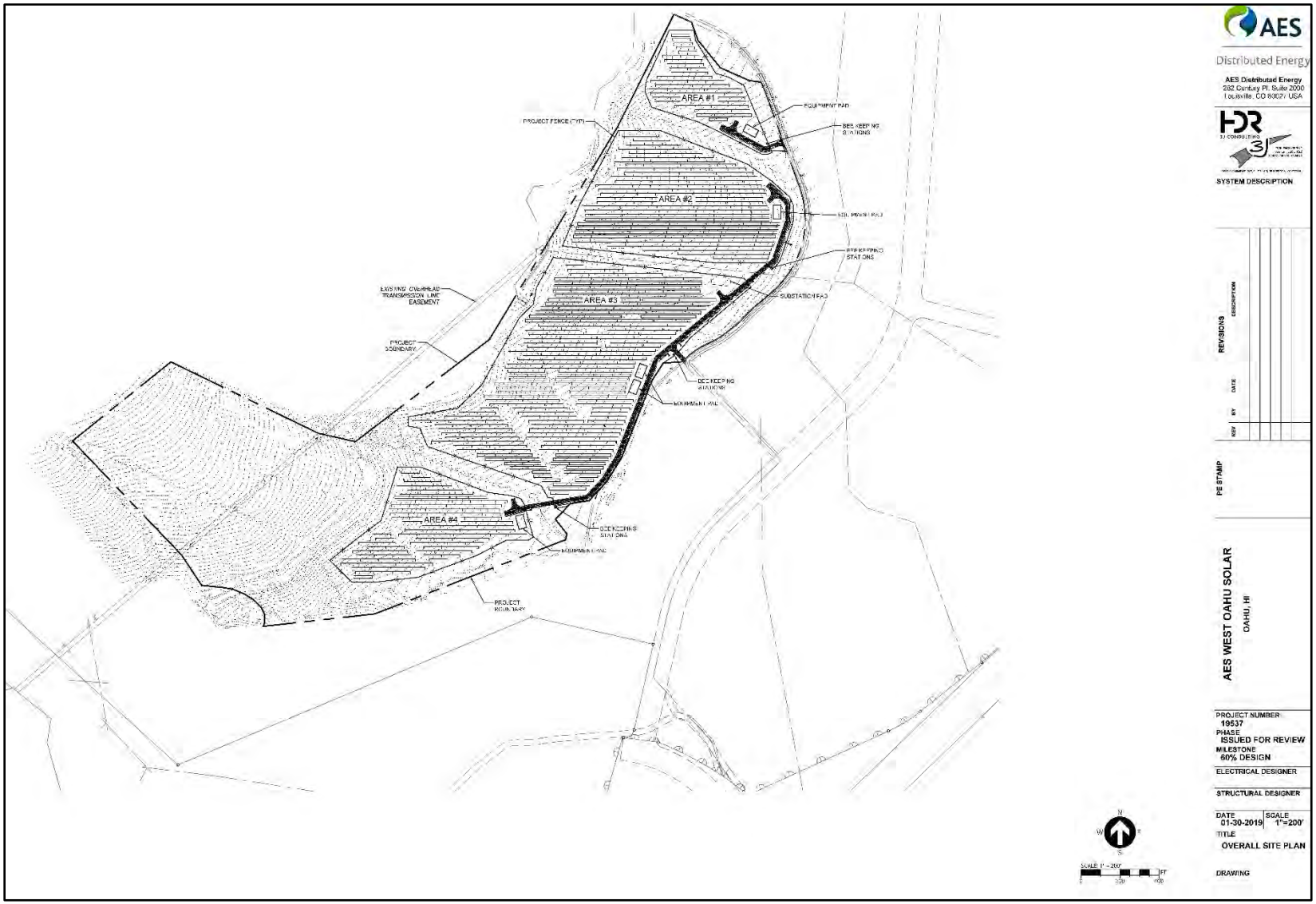


Figure 4 AES West Oahu Overall Site Plan (supplied by client, dated 1/30/2019)

activities would include four beekeeping stations (each approximately 40 square feet or 3.7m^2) and two cattle pens (each with a small concrete slab for a water trough). In addition to construction of the facilities described above, grading would also occur in localized areas as needed to smooth the ground surface and for other civil engineering purposes (e.g., stormwater retention and management).

1.1 Historic Preservation Regulatory Context and Document Purpose

The entire AES West O‘ahu Solar project area was previously addressed within an *Archaeological Inventory Survey of the University of Hawai‘i West O‘ahu Campus, District of ‘Ewa, Island of O‘ahu, Hawai‘i (TMK 9-2-02:01, 9-2-02:03, 9-2-02:05)* (Dega et al. 1998), which was accepted by the State Historic Preservation Division (SHPD) on 3 February 1999 (LOG NO. 22959, DOC. NO. 9901EJ28; Appendix A). Due to the passage of time and given that the present project is different than that addressed by the 1998 report, it was agreed in consultation with Dr. Susan Lebo on 12 February 2019 that it would be appropriate to move forward with an AIS specific to this project.

This AIS investigation fulfills the requirements of Hawai‘i Administrative Rules (HAR) §13-13-276. The AIS was conducted to identify, document, and assess the significance of historic properties within the project area, assess the potential for the project to adversely affect significant historic properties, and to provide agreed upon mitigation commitments to address any adverse impacts. This document is intended to support the proposed project’s historic preservation review under Hawai‘i Revised Statutes (HRS) §6E-42 and HAR §13-284, as well as the project’s environmental review under HRS §343. It is also intended to support any project-related historic preservation consultation with stakeholders such as state and county agencies and interested Native Hawaiian Organizations (NHOs) and community groups. The AIS investigation was designed in consultation with the SHPD.

1.2 Environmental Setting

1.2.1 Natural Environment

The project area is in the southeast Wai‘anae Range at an elevation of approximately 280 to 640 feet (ft) above mean sea level. The Wai‘anae Range comprises the eroded remnant of a great shield volcano, dating back in origin to approximately 2.2 to 3.8 million years ago, now in the form of a long narrow ridge shaped by erosion (Macdonald et al. 1983:420, 303). Pu‘u Kapua‘i is 0.5 km to the northwest and Pu‘u Makakilo is 1.2 km to the southwest. These are understood as “very late cones [of the Wai‘anae volcano] […] composed of a varied mixture of cinder, spatter and lava flows” (Macdonald et al. 1983:429).

Topography of the area is moderately sloping. In terms of hydrology, the area is drained by two deeply dissected gulches, Kalo‘i Gulch 300 m to the southwest and Honouliuli Gulch 700 m to the northeast. These gulches at a comparable elevation are believed to rarely run with water. Historic maps indicate a spring located approximately 2.2 km to the north. Such infrequent springs may have been key to the early human activity on the southeast Wai‘anae slope. The project area is relatively dry with a mean annual rainfall at the neighboring Station Field 105 of 703 mm or 27.7 inches (Giambelluca et al. 2013). This rainfall would be marginal for non-irrigated agriculture. Average annual temperatures range from 38° to 75° Fahrenheit (Giambelluca et al. 2014).

According to the U.S. Department of Agriculture (USDA) Soil Survey Geographic (SSURGO) database (2001) and soil survey data gathered by Foote et al. (1972), the project area's soils consist of Kawaihapai clay loam (KIB), 2 to 6% slopes (KIaB), Mahana silt clay loam, 6 to 12% slopes, eroded (McC2), Mahana silt clay loam, 12 to 20% slopes, eroded (McD2), Mahana silt clay loam, 20 to 35% slopes, eroded (McE2), Molokai silty clay loam, 7 to 15% slopes (MUC) and Molokai silty clay loam, 15 to 25% slopes (MUD) soils (Figure 5).

Kawaihapai series soils are described as follows:

> This series consists of well-drained soils in drainageways and on alluvial fans on the coastal plains on the islands of Oahu and Molokai. These soils formed in alluvium derived from basic igneous rock in humid uplands. They are nearly level to moderately sloping. Elevations range from nearly sea level to 300 feet. The annual rainfall amounts to 30 to 50 inches. […] These soils are used for sugarcane, truck crops, and pasture. The natural vegetation consists of kiawe, koa haole, lantana, and bermudagrass. [Foote et al. 1972:63–64]

Further, Kawaihapai clay loam, 2 to 6% slopes soils (KIB), are described as having slow runoff and a slight erosion hazard (Foote et al. 1972).

Kawaihapai stony clay loam, 2 to 6% slopes (KIaB) is described as similar to Kawaihapai clay loam, but with "enough stones to hinder, but not prevent cultivation. Runoff is slow, and the erosion hazard is slight" (Foote et al. 1972:64).

Mahana series soils are described as follows:

> This series consists of well-drained soils on uplands on the islands of Kauai and Oahu. These soils developed in volcanic ash. They are gently sloping to very steep. Elevations range from 1,000 to 3,000 feet. The annual rainfall amounts to 30 to 45 inches. […] These soils are used for pasture, woodland, wildlife habitat, irrigated sugarcane, and water supply. The natural vegetation consists of puakeawe, aalii, ricegrass, molassesgrass, silver oak, yellow foxtail, lantana, joee, Japanese tea, passion flower, and associated plants. [Foote et al. 1972:85]

Mahana silt clay loam, 6 to 12% slopes, eroded (McC2) soils are described as follows:

> This soil occurs on ridgetops and moderately sloping uplands […] Permeability is moderately rapid. Runoff is slow, and the erosion hazard is slight. […] In places roots penetrate to a depth of 5 feet or more. […] This soil is used for pasture, woodland, wildlife habitat, pineapple, and sugarcane. [Foote et al. 1972:85–86]

Mahana silt clay loam, 12 to 20% slopes, eroded (McD2) soils, are described as having medium runoff and a moderate erosion hazard, used for pasture, woodland, wildlife habitat, and sugarcane (Foote et al. 1972).

Mahana silty clay loam, 20 to 35% slopes, eroded (McE2) soils are further described as follows:

> Most of the surface layer has been removed by erosion. Runoff is very rapid, and the erosion hazard is very severe. Included in mapping were areas where all of the surface layer and part of the subsoil have been removed by erosion. Also included were small, stony areas and reddish-colored upland soils that are underlain by a

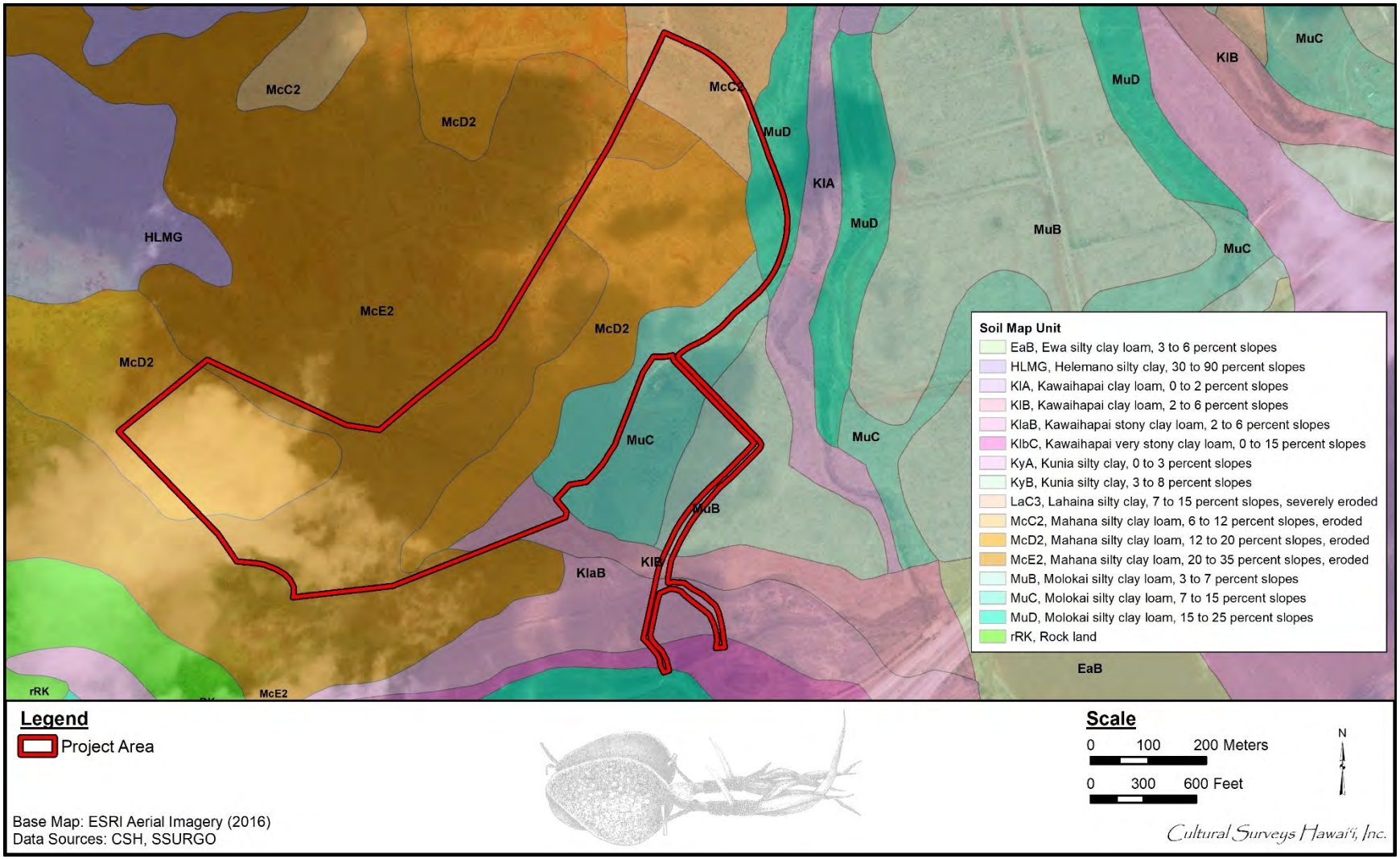


Figure 5. ESRI Aerial Imagery (2016) with overlay of *Soil Survey of the State of Hawaii* (Foote et al. 1972; USDA SSURGO 2001), indicating soil types within and surrounding the project area

> panlike layer at a depth of 15 to 50 inches. This soil is used for pasture, pineapple, and irrigated sugarcane. [Foote et al. 1972:86]

Molokai series soils are described as follows:

> This series consists of well-drained soils on uplands on the islands of Maui, Lanai, Molokai, and Oahu. These soils formed in material weathered from basic igneous rock. They are nearly level to moderately steep. Elevations range mainly from nearly sea level to 1,000 feet but are as much as 1,500 feet on Lanai. The annual rainfall amounts to 20 to 25 inches, most of which occurs between November and April […] These soils are used for sugarcane, pineapple, pasture, wildlife habitat, and homesites. The natural vegetation consists of kiawe, ilima, uhaloa, feather fingergrass, and buffelgrass. [Foote et al. 1972:96]

Molokai silty clay loam, 3 to 7% slopes (MuB) are further described as having slight to moderate erosion hazard with slow to medium runoff.

Molokai silty clay loam, 7 to 15% slopes (MUC) soils, are described as occurring on knoll slope breaks, with medium runoff and a moderate erosion hazard (Foote et al. 1972). This material is used for sugarcane, pineapple, pasture, wildlife habitat, and home sites (Foote et al. 1972).

Molokai silty clay loam, 15 to 25% slopes (MUD) soils are further described as follows:

> This soil occurs on Oahu. In most places the slope does not exceed 20 percent. Runoff is medium, and the erosion hazard is severe. Workability is slightly difficult because of the slope. Included in mapping were small areas where boulder cores are exposed. This soil is used for sugarcane and pineapple. [Foote et al. 1972:97]

Today the project area is largely covered with *haole koa* (*Leucaena leucocephala*) and exotic grasses. *Wiliwili* (*Erythrina sandwicensis*), sweet acacia or klu (*Acacia farnesiana*), and *kiawe* (*Prosopis pallida*) were also observed within the project area.

1.2.2 Built Environment

The project area was utilized for commercial sugarcane from the early twentieth century into the late 1970s. Some of the sugarcane plantation infrastructure in the vicinity was relatively elaborate, with the Waiahole Ditch transporting irrigation water from windward O‘ahu into the foothills of the southern Wai‘anae Range. The sugarcane fields have remained fallow for decades. Some plantation infrastructure is still present in the form of cane haul roads and remnant irrigation features (see Figure 3). The project area is otherwise undeveloped. The H-1 Freeway is approximately 800 m south of the project area.

Section 2 Methods

2.1 Field Methods

Fieldwork was completed under archaeological fieldwork permit number 19-07, issued by the SHPD pursuant to HAR §13-282. CSH archaeologists Scott Belluomini, B.A., Chris Konen, B.A., Tyler Turran, B.A., and Alison Welser, M.A., conducted fieldwork between 4 and 6 February 2019 under the direction of project manager David W. Shideler, M.A., and general supervision of Hallett H. Hammatt, Ph.D., Principal Investigator. Following the initial pedestrian inspection, the project area boundaries were extended slightly to the north and the west, as well as south to encompass the existing access roads to be used for the project. Additional pedestrian inspection was conducted for these areas on 12 December 2019. This work required approximately 12 person-days to complete.

2.1.1 Pedestrian Survey

Archaeologists undertook a 100%-coverage pedestrian inspection of the project area for the purpose of historic property identification and documentation. The pedestrian survey was accomplished through systematic sweeps of four CSH archaeologists spaced approximately 10 to 15 m apart based on ground visibility. Archaeologists walked transects beginning at the north end of the project area down to the southern border, oriented southwest (Figure 6). Additionally, archaeologists walked the length of the Waiahole Ditch within the project area. Archaeologists recorded the general characteristics of the project area, including vegetation, and took general photographs of the project area. Only minimal vegetation clearance was attempted for the purpose of feature documentation and photography.

When potential historic properties were identified, archaeologists documented their locations. This included GPS data collection of the historic property and associated features. All surface features visible within the project area were photographed with a scale and generally described, which often included descriptions of dimensions, shape, materials, method of construction, integrity, general condition, and evidence of age and function of the feature. Plan maps were completed for features, as well as profiles and cross-sections when appropriate. Additionally, archaeologists documented areas of the historic properties outside the project area boundaries and photographed and noted construction methods and components of the ditch for an overall description of the historic property. Note that historic property extents were defined by a 1-m radius surrounding the documented portions of all identified features.

2.1.2 GPS Data Collection

The locations of all documented components of historic properties were recorded using a Trimble Pro XH mapping grade GPS unit with real-time differential correction. This unit provides sub-meter horizontal accuracy in the field. GPS field data was post-processed, yielding horizontal accuracy between 0.5 and 0.1 m. GPS location information was converted into GIS shape files using Trimble’s Pathfinder Office software, version 5.85, and graphically displayed using ESRI’s ArcGIS 10.6.1. CSH utilizes the NAD 83 HARN datum and UTM Zone 4N coordinate system.

In addition to feature locations, archaeologists recorded data points, which were also recorded on illustrated plan maps. For feature complexes, GPS points were taken at several data points, which were recorded on plan maps to assist in the accurate mapping of the horizontal extent of the

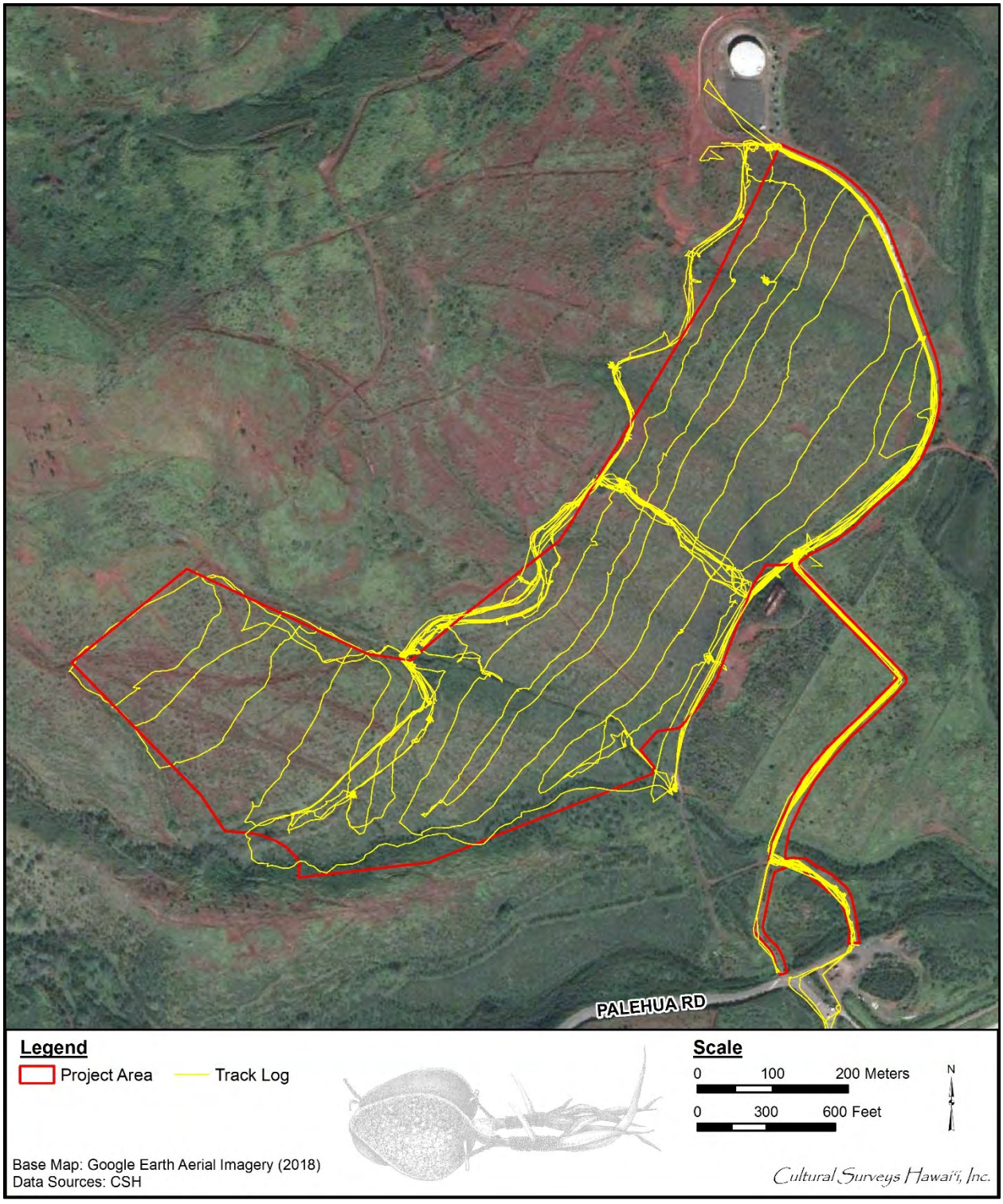


Figure 6. Aerial photograph showing the project area with overlay of two of four archaeologists' GPS track logs (Google Earth 2018)

historic property. The data points were used to geo-reference the historic properties' location using scaled illustrated maps and field notes.

2.2 **Research Methods**

Background research included a review of previous archaeological studies on file at the SHPD; review of documents at Hamilton Library of the University of Hawai‘i, the Hawai‘i State Archives, the Mission Houses Museum Library, the Hawai‘i Public Library, and the Bishop Museum Archives; study of historic photographs at the Hawai‘i State Archives and the Bishop Museum Archives; and study of historic maps at the Survey Office of the Department of Land and Natural Resources. Historic maps and photographs from the CSH library were also consulted. In addition, Māhele records were examined from the Waihona ‘Aina database (Waihona ‘Aina 2020). This research provided the environmental, cultural, historic, and archaeological background for the project area. The sources studied were used to formulate a predictive model regarding the expected types and locations of historic properties in the project area.

2.3 **Disposition of Materials**

No materials were collected during AIS fieldwork. All data generated during the course of the AIS are stored at the CSH office in Waimānalo, O‘ahu.

Section 3 Background Research

3.1 Traditional and Historical Background

The *ahupua‘a* (traditional land division) of Honouliuli is the largest, in total land area, *ahupua‘a* on the island of O‘ahu. It stretches across 16,446.4 hectares (40,640 acres) from the summit of the Wai‘anae Range in the northwest, to the west shore of Pearl Harbor in the east. It is separated from the Pearl Harbor entrance channel and the ocean by Pu‘uloa Ahupua‘a on its southeast side.

Honouliuli Ahupua‘a, as a traditional land unit, had tremendous and varied resources available for exploitation by early Hawaiians. Within Honouliuli Ahupua‘a, not only is there a long coastline fronting the normally calm waters of leeward O‘ahu, but there are also 4 miles of waterfront along the west side of the West Loch of Pearl Harbor. The “karstic desert” and marginal characterization of the limestone plain, which is the most readily visible terrain, does not do justice to the *ahupua‘a* as a whole. Although the *ahupua‘a* was rich in resources in many locations, the upper-middle portion of the Honouliuli Ahupua‘a, where the project area is located, has little recorded traditional use.

Traditional sources, the earliest maps, and early archaeological studies do not display much land use in this portion of Honouliuli Ahupua‘a. Kalo‘i Gulch, which courses just south of the project area, and Pu‘u Kapua‘i just to the northwest are the only Hawaiian-named land forms in the vicinity of the project area that have been documented (Figure 7). Pukui et al. (1974:77) translate the name “Ka-lo‘i” to mean “the taro patch” and Sterling and Summers (1978:35) relate a number of vignettes regarding the “Waihuna” or “Punahuna” hidden spring associated with Kalo‘i Gulch. Ida E.K. von Holt (in Sterling and Summers 1978:35) relates in the account of “two old Hawaiians” that the hidden spring “had been one of the principal sources of water for all that country, which was quite heavily populated before the smallpox epidemic of 1840.” “Pu‘u Kapua‘i” is translated as “footprint hill” (Pukui et al. 1974:199) but the association with that name is unclear.

The political and cultural center of the *ahupua‘a* is understood to have been the relatively dense settlement and rich lands for irrigated taro cultivation at the *‘ili* (land division smaller than an *ahupua‘a*) of Honouliuli, located where Honouliuli Stream empties into the north portion of West Loch (east of the current project area). The name of the *ahupua‘a*, translated as “dark bay” (Pukui et al. 1974:51), may refer to the nature of the waters of West Loch at the mouth of Honouliuli Stream. Early accounts and maps indicate a large settlement at the *‘ili* of Honouliuli. It is possible the political power of this village was so great it was able to extend its jurisdiction well to the northwest, into an area which might have been anticipated to fall under the dominion of the Wai‘anae ruling chiefs.

3.1.1 Mythological and Traditional Accounts

The traditions of Honouliuli Ahupua‘a have been compiled and summarized in studies by Sterling and Summers (1978), Hammatt and Folk (1981), Kelly (1991), Charvet-Pond and Davis (1992), and Maly and Rosendahl (1993). Some of the themes of these traditions include connections with Kahiki (the traditional homeland of Hawaiians, probably in reference to central Polynesia) and the special character and relationship of the places known as Pu‘u ‘o Kapolei and Kualaka‘i.

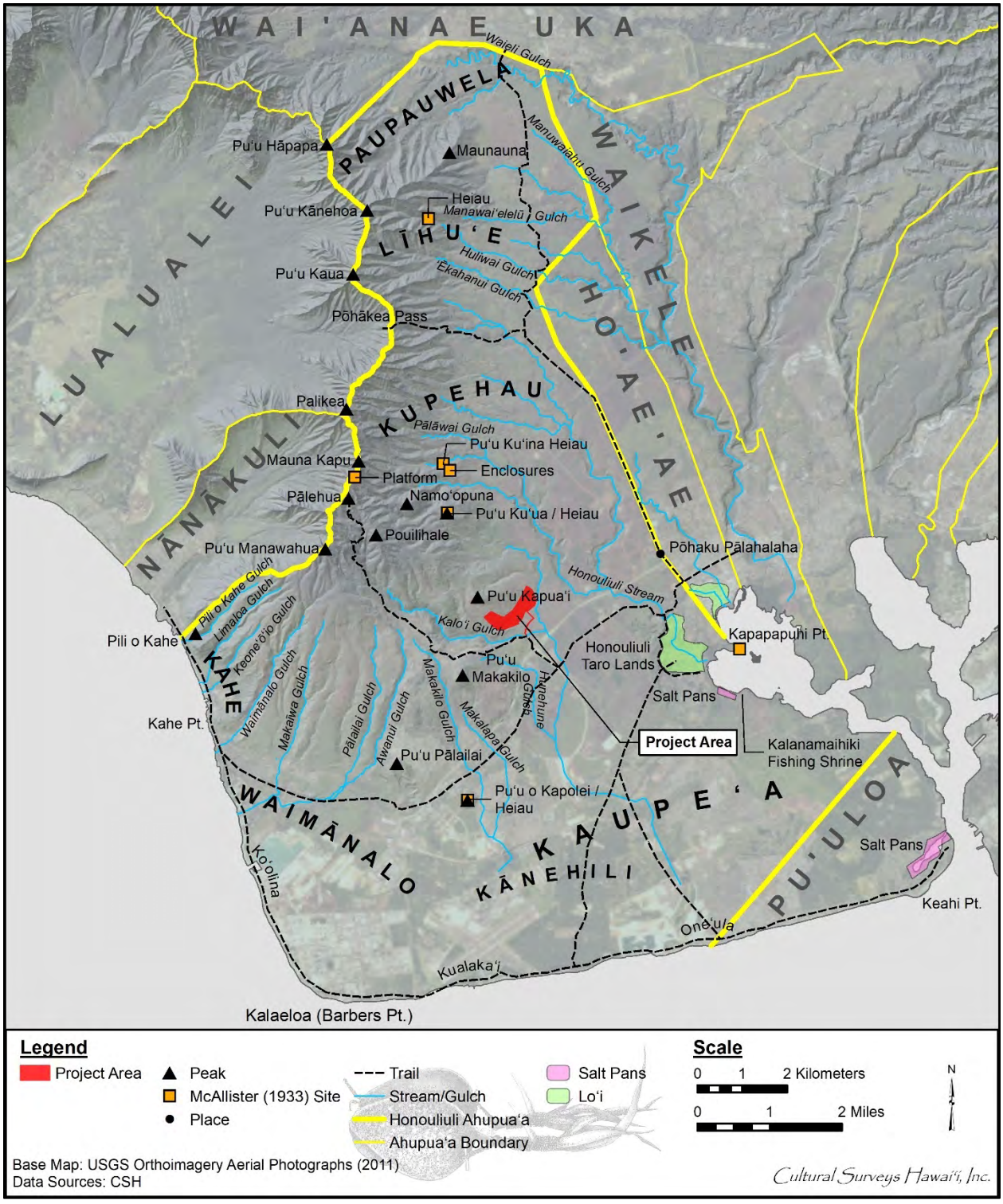


Figure 7. Portion of a USGS Orthoimagery aerial photograph (2011) showing place names, trails and streams of Honouliuli Ahupua‘a with the location of the project area

Connections with Kahiki are found in numerous place names, traditional events, and in the beings associated with Honouliuli. There are several versions of Kaha‘i leaving from Kalaeloa for a trip to Kahiki to bring breadfruit back to ‘Ewa (Kamakau 1991:110). There are several stories that associate places in the region with Kamapua‘a and the Hina family, as well as with Pele’s sisters, all of whom have strong connections with Kahiki (Kamakau 1961:111; Pukui et al. 1974:200).

Pu‘u ‘o Kapolei (approximately 4 km southwest of the project area) was one of the more sacred places in Honouliuli (cf. Sterling and Summers 1978:33). Pu‘u ‘o Kapolei is connected with Kahiki, as the hill is noted as the home of Kamapua‘a’s grandmother, Kamaunuaniho, the Kahiki ancestor to the people of O‘ahu (Fornander 1916:5:318; Kahiolo 1978:81, 107). By name, Kapolei is associated with the goddess Kapo, another connection with the Pele and Kamapua‘a stories (Kamakau 1976:14).

McAllister (1933:108) records that a *heiau* (pre-Christian place of worship) was once located on Pu‘u ‘o Kapolei, but was destroyed before his survey of 1930. The *heiau* may have been associated with the sun, as the hill was used as a point of solar reference or as a place where such observations were made (Fornander 1916:3:292). Pu‘u ‘o Kapolei might have been understood as the gate of the setting sun. It is notable that the rising sun at the eastern gate of Kumukahi in Puna is associated with the Hawaiian goddess Kapo (Emerson 1978:41). There is little specific information for Pu‘u ‘o Kapolei, but the place name itself (“hill of beloved Kapo”) is hard to ignore. It is mentioned in some cosmologies that Kū was the god of the rising sun, and Hina should be associated with the setting sun (Hina is the mother of Kamapua‘a). Fornander (1916:3:292) states, Pu‘u ‘o Kapolei may have been a jumping off place (also connected with the setting sun) and associated with the dead who roamed the adjacent Plain of Kaupe‘a.

Pu‘u ‘o Kapolei was the primary landmark for travelers between Pearl Harbor and the west O‘ahu coast, with a main trail running inland of it (‘Ī‘ī 1959:27, 29). Pu‘u ‘o Kapolei was probably the most common name used as a reference for the area of the ‘Ewa Plain in traditional Hawai‘i (Fornander 1916:2:318; Nakuina 1992:54; E.M. Nakuina 1904 in Sterling and Summers 1978:34).

3.1.2 Early Historic Period

Early historical accounts indicate the *ahupua‘a* of Honouliuli was once widely inhabited by pre-Contact Hawaiian populations, including the Hawaiian *ali‘i* (chiefly class). This substantial population can largely be attributed to the plentiful marine and estuarine resources available at the coast, along which several sites interpreted as permanent habitations were located. Other attractive subsistence-related features of the *ahupua‘a* included irrigated lowlands suitable for wet land taro cultivation (Hammatt and Shideler 1990), as well as the lower forest area of the mountain slopes for the procurement of forest goods.

Exploitation of the forest resources along the slopes of the Wai‘anae Range—as suggested by E.S. and E.G. Handy—probably acted as a viable subsistence alternative during times of famine:

> The length or depth of the valleys and the gradual slope of the ridges made the inhabited lowlands much more distant from the *wao*, or upland jungle, than was the case on the windward coast. Yet the *wao* here was more extensive, giving greater opportunity to forage for wild foods during famine time. [Handy and Handy 1972:469–470]

These upper valley slopes may have also been a significant resource for opportunistic quarrying of basalt for the manufacturing of stone tools. This is evidenced in part by the existence of a probable quarrying site (State Inventory of Historic Places [SIHP] # 50-80-12-4322) in Makaīwa Gulch at 152 m (500 ft) above mean sea level, west of the current project area (Hammatt et al. 1991).

The Hawaiian *ali‘i* were also attracted to the region. One historical account of particular interest refers to an *ali‘i* residing in Ko Olina, southwest of the current project area:

> Ko Olina is in Waimanalo near the boundary of Ewa and Waianae. This was a vacationing place for chief Kakuhihewa and the priest Napuaikamao was the caretaker of the place. Remember reader, this Ko Olina is not situated in the Waimanalo on the Koolau side of the island but the Waimanalo in Ewa. It is a lovely and delightful place and the chief, Kakuhihewa loved this home of his. [Sterling and Summers 1978:41]

John Papa ‘Ī‘ī describes a network of Leeward O‘ahu trails (Figure 8 through Figure 10) which in later historic times encircled and crossed the Wai‘anae Range. These trails allowed passage from West Loch to the Honouliuli lowlands, past Pu‘u ‘o Kapolei and Waimānalo Gulch to the Wai‘anae coast and onward circumscribing the shoreline of O‘ahu (‘Ī‘ī 1959:96–98). The main trail along the south shore of O‘ahu would have been approximately 1.5 km to the southeast. A main trail extending up the central valley of O‘ahu would have been approximately 3 km to the east. The 1825 Malden map (see Figure 9) shows a trail extending from the main trail along the south shore of O‘ahu into the uplands in the Pālehua area, passing just a couple hundred meters to the southwest of the project area. The 1873 Alexander map (see Figure 10), one of the earliest detailed maps of the vicinity, shows no development near the project area.

Other early historical accounts of the general region typically refer to the more populated areas of the ‘Ewa district, where missions and schools were established, and subsistence resources were perceived to be greater. However, the presence of archaeological sites along the coral plains and coast of southwest Honouliuli Ahupua‘a indicate prehistoric and early historic populations also adapted to less inviting areas, despite the environmental hardships.

Subsequent to Western Contact in the area, the landscape of the ‘Ewa Plain and Wai‘anae slopes was adversely affected by the removal of the sandalwood and other trees, and the introduction of domesticated animals and new vegetation. Goats, sheep, and cattle were brought to the Hawaiian Islands by Vancouver in the early 1790s and allowed to graze freely about the land for some time after. L.A. Henke reports the existence of a longhorn cattle ranch in Wai‘anae by at least 1840 (Frierson 1972:10). During this time, perhaps as early as 1790, exotic vegetation species were introduced to the area. These typically included vegetation best suited to a terrain disturbed by the logging of sandalwood forest and eroded by animal grazing. The following dates for the introduction of exotic vegetation are given by R. Smith and outlined by Frierson (1972:10–11):

1. ‘early,’ c. 1790: for the establishment of Prickly pear cactus, (*Opuntia tuna), Haole koa, (Leucaena leucocephala)* and Guava (*Psidium guajava)*
2. 1835-1840: Burmuda [*sic*] grass (*Cynodon dactylon)* and Wire grass (*Eleusine indica)*
3. 1858: Lantana (*Lantana camara)*

The *kiawe* tree (*Prosopis pallida*) was also introduced during this period, either in 1828 or 1837 (Frierson 1972:11).

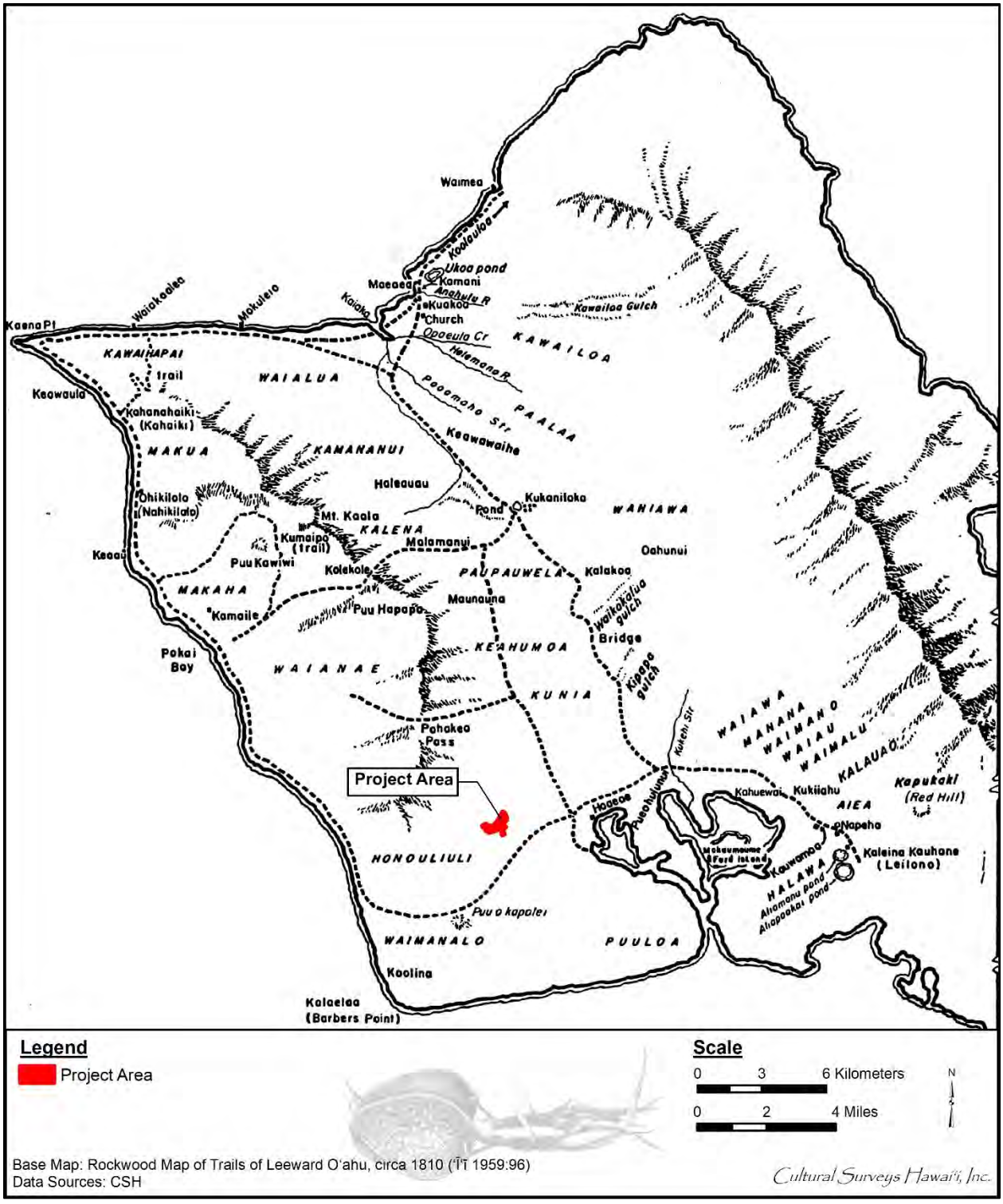


Figure 8. Portion of the 1810 Rockwood map of trails of Leeward O‘ahu with overlay of project area (Ī‘ī 1959:96)

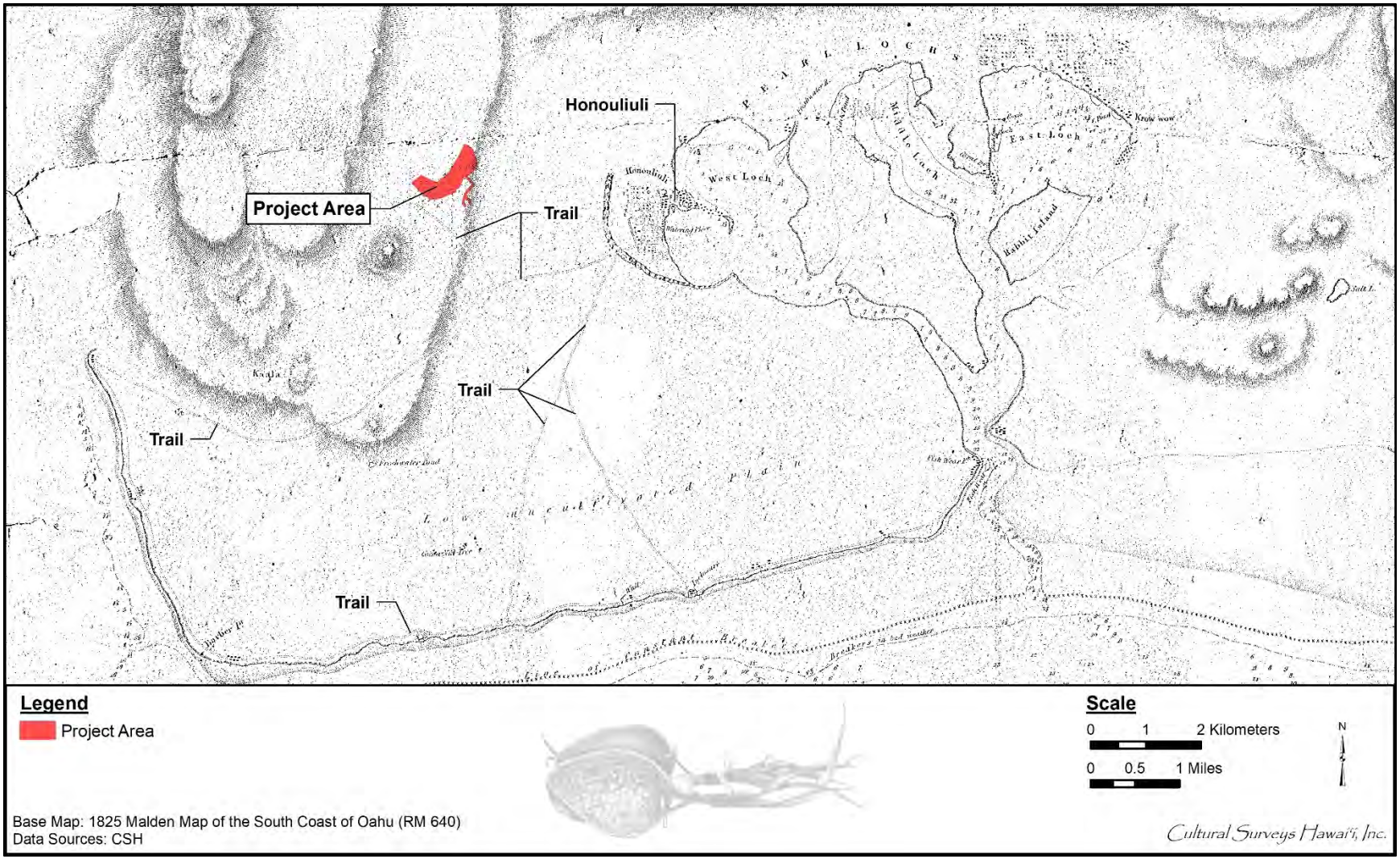


Figure 9. Portion of 1825 Malden map of the South Coast of Oahu (RM 640) showing the location of the project area

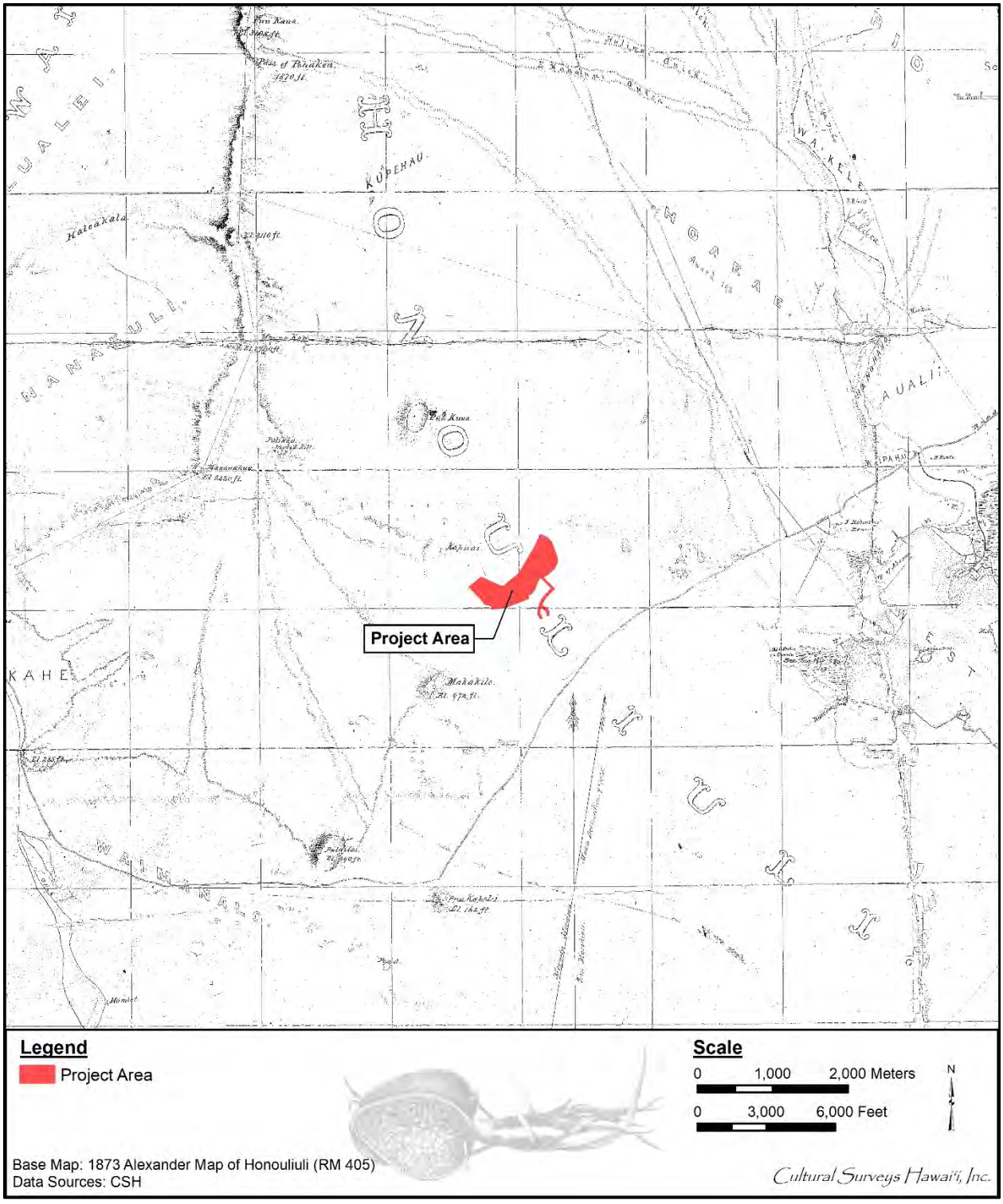


Figure 10. Portion of 1873 Alexander map of Honouliuli (RM 405) showing trail network in vicinity of project area

3.1.3 The Māhele and the Kuleana Act

During the Māhele of 1848, 99 individual land claims in the *ahupua‘a* of Honouliuli were registered and awarded by King Kamehameha III. No *kuleana* land claims were made for land within the current project area or vicinity. The vast majority of the Land Commission Awards (LCA) were located in Honouliuli near the taro lands of the *‘ili* of Pu‘uloa and the Pu‘uloa Salt Works. The largest award (Royal Patent 6071, LCA 11216, *‘Āpana* [parcel] 8) in Honouliuli Ahupua‘a was granted to Miriam Ke‘ahi-Kuni Kekau‘onohi on January 1848 (Native Register 1848). Kekau‘onohi acquired a deed to all unclaimed land within the *ahupua‘a*, including 43,250 acres encompassing the present project area.

Samuel Kamakau relates the following about Kekau‘onohi as a child:

> Kamehameha’s granddaughter, Ke-ahi-Kuni Kekau-onohi […] was also a tabu chiefess in whose presence the other chiefesses had to prostrate and uncover themselves, and Kamehameha would lie face upward while she sat on his chest. [Kamakau 1961:208–209]

Kekau‘onohi was one of Liholiho’s (Kamehameha II’s) wives, and after his death, she lived with her half-brother, Luanu‘u Kahala‘i‘a, who was governor of Kaua‘i (Kamakau 1961:20). Subsequently, Kekau‘onohi ran away with Queen Ka‘ahumanu’s stepson, Keli‘i-ahonui, and then became the wife of Chief Levi Ha‘alelea. Upon her death on 2 June 1851, all her property passed to her husband and his heirs. When Levi Ha‘alelea died, the property went to his surviving wife, who in turn leased it to James Dowsett and John Meek in 1871 for stock running and grazing.

3.1.4 Mid- to Late 1800s

In 1877, James Campbell purchased most of Honouliuli Ahupua‘a for a total of $95,000. He then drove off 32,347 head of cattle belonging to Dowsett, Meek, and James Robinson and constructed a fence around the outer boundary of his property (Bordner and Silva 1983:C-12). In 1879, Campbell brought in a well-driller from California to search the ‘Ewa Plain for water and successfully “tapped artesian water which, from internal pressure, forced its way to the surface without being pumped” (Hitch 1992:79). Following this discovery, plantation developers and ranchers drilled numerous wells in search of the valuable resource. By 1881, the Campbell property of Honouliuli prospered as a cattle ranch with “abundant pasturage of various kinds” (Briggs in Haun and Kelly 1984:45). Within ten years of the first drilled well in ‘Ewa, the addition of a series of artesian wells throughout the island supplied most of Honolulu’s water needs (Armstrong and Bier 1983).

In 1889, Campbell leased his property to Benjamin Dillingham, who subsequently formed the Oahu Railway & Land Company (OR&L) in 1890. To attract business to his new railroad system, Dillingham subleased all land below 200 ft elevation to William Castle who in turn sublet the area to the Ewa Plantation Company for sugarcane cultivation (Frierson 1972:15). Dillingham’s Honouliuli lands above 200 ft elevation that were suitable for sugarcane cultivation were sublet to the Oahu Sugar Company.

Ewa Plantation Company was incorporated in 1890 and operated into modern times. The plantation grew quickly with the abundant artesian water. As a means to generate soil deposition on the coral plain and increase arable land in the lowlands, the Ewa Plantation Company installed

ditches running from the lower slopes of the mountain range to the lowlands, then plowed the slopes vertically just before the rainy season to induce erosion (Frierson 1972:17).

The Oahu Sugar Company was incorporated in 1897 and included lands in the foothills above the ‘Ewa Plain and Pearl Harbor. Prior to commercial sugar cultivation, the lands occupied by the Oahu Sugar Company were described as being “of near desert proportion until water was supplied from drilled artesian wells and the Waiahole Water project” (Condé and Best 1973:313). The Oahu Sugar Company took control of the Ewa Plantation lands in 1970 and continued operations into the 1990s.

Dillingham’s *mauka* (inland, toward the mountains) lands in western Honouliuli that were unsuitable for commercial sugar production remained pasture for grazing livestock. From 1890 to 1892, the Ranch Department of the OR&L Company desperately sought water for their herds of cattle, tapping plantation flumes and searching for alternative sources of water. Ida von Holt shared the following account of her husband Harry’s (Superintendent of the OR&L Ranch Department) search for water in the foothills of the Wai‘anae Range:

> One of those places is on the old trail to Pālehua, and had evidently been a place of which the Hawaiians had known, for its name is Kalo‘i (the taro patch), and even in dry weather water would be standing in the holes made by the cattle, as they tried to get a drop or two. [von Holt 1985:136]

It is believed that the spring depicted in this account may have been identified during an inventory survey for the adjacent Pālehua East B project (Tulchin and Hammatt 2005). The spring was located along the upper slopes of the southern face of Kalo‘i Gulch. A second account is given of the discovery of spring water in an area over the ridge on the north side of Kalo‘i Gulch:

> Shouting to the men to come over with their picks and shovels, he [Harry von Holt] soon got them busy clearing away lots of small stones and earth. Almost at once they could see that there were evidences of a paved well, and at about three feet down they came upon a huge flat rock, as large around as two men could span with their arms. Digging the rock loose and lifting it to one side, what was their astonishment to find a clear bubbling spring! [von Holt 1985:138]

Following the discovery, two old Hawaiians began to ask Von Holt about the spring:

> Finally he [Harry von Holt] got them to explain that the spring, called ‘Waihuna’ (Hidden Spring) had been one of the principal sources of water for all that country, which was quite heavily populated before the smallpox epidemic of 1840 […] A powerful Kahuna living at the spring had hidden it before he died of the smallpox, and had put a curse on the one who disturbed the stone, that he or she would surely die before a year was out. [von Holt 1985:138–140]

3.1.5 1900s

In 1913, the Waiahole Water Company, a subsidiary of the Oahu Sugar Company, began a project to transport irrigation water from the well-watered windward side of O‘ahu, through the Ko‘olau Range, to the fields and mill of the Oahu Sugar Company in ‘Ewa. The water system, named the Waiahole Ditch System, was declared “an engineering feat of epic proportion for those times” (Condé and Best 1973:37). The original system, when completed, collected water from

stream intakes and water tunnels from Kahana Valley in the north to Waiāhole Valley in the south. The main tunnel extended through Waiāhole Valley to Waiawa, and water was then transported by ditch westward to Honouliuli, covering approximately 22 miles (Condé and Best 1973:37). The ditch system was completed in 1916 and, with some modifications, much of the ditch is in use today. This active portion of the ditch extends from the windward side of the island into Honouliuli. Remnant, inactive portions of the system extend southwest onto the ‘Ewa Plain. The remnant portion of the Waiahole Ditch crosses through the southwestern portion of the present project area.

Much of the *mauka* lands in western Honouliuli, including ridges and deep gulches, were unsuitable for commercial sugar cultivation and remained pasture land for grazing livestock. The Donn 1906 map suggests the present project area was at the edge of sugarcane cultivation at that time (Figure 11). By 1920, however, much of the lands of Honouliuli were used for commercial sugarcane cultivation (Frierson 1972:18).

A 1919 map (Figure 12) shows ditches, reservoirs, roads, and railroad lines downslope of the project area. This map shows an unimproved road alignment just south of the project area, understood as the Pālehua Road, approximating a traditional Hawaiian footpath into the uplands. However, a 1922 map (Figure 13 and Figure 14 showing annotations), shows the called out Pālehua trail as jogging into the southwest portion of the project area. This 1922 map shows pineapple fields in at least 13 locations among the foothills of the southeast Wai‘anae Range. The nearest of these pineapple fields wrapped around Pu‘u Kapua‘i some 500 m to the northwest. At least six (typically quite small) plantation camps were scattered along the bottom of these foothills with the nearest being about 500 m to the north of the project area. The Kupihau Ranch Station is shown about 2.6 km to the north. The water troughs and tanks shown upslope of the ranch station attest to the cattle operations in the vicinity at that time.

By 1925, most of the project area is depicted as within Oahu Sugar Company plantation Field 30 (Figure 15). The extreme upslope end of the project area still appears to be outside the area of sugarcane cultivation, in keeping with the depiction on the 1906 Donn map (compare with Figure 11).

In the late 1920s, the main residential communities were at the northeast edge of the ‘Ewa Plain and the largest community was still located at Honouliuli Village. ‘Ewa was primarily a plantation town, focused around the sugar mill, with a public school as well as a Japanese school. Additional settlement, in Waipahu, centered around the Waipahu sugar mill operated by the Oahu Sugar Company. However, small plantation camps were scattered within the extensive sugarcane fields (as indicated in Figure 14).

By 1936, however, “Pump Camp 5” had been established on either side of a pipeline that bisected the present project area, as seen on a 1936 U.S. Army War Department map (Figure 16). The 1936 map indicates approximately seven houses on the northeast side of the pipeline and 17 houses on the southwest side of the pipeline within the present project area at that time. The central pipeline extended downslope from the Waiahole Ditch to a large pump house structure that still exits just southeast (outside) of the project area. The alignment of the Waiahole Ditch crossing the western portion of the project area, and a roughly parallel road just upslope, are clearly depicted. It appears a spur plantation railroad serviced Pump Camp 5 connecting to the northeast and continuing a short distance to the southeast.

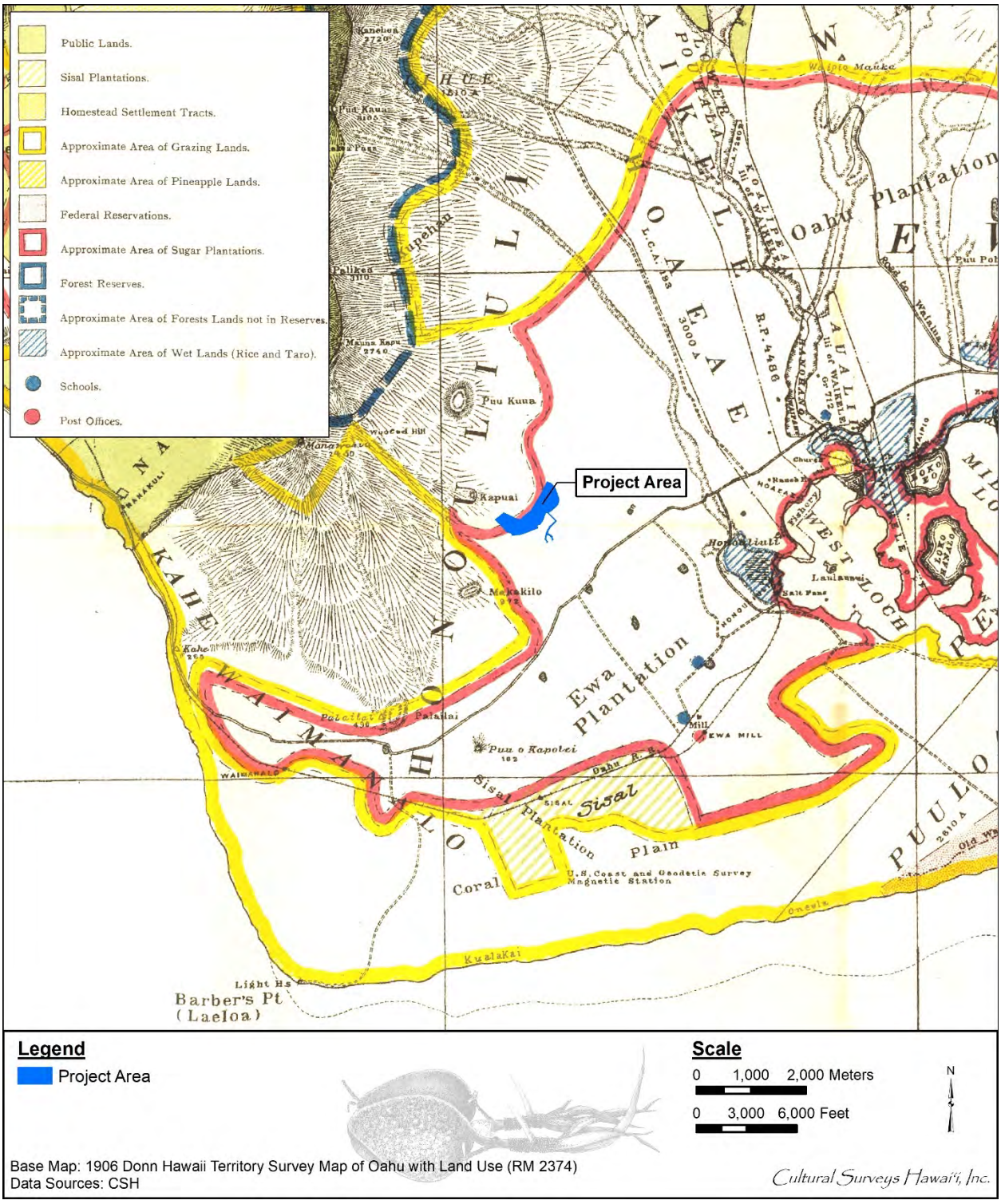


Figure 11. Portion of the 1906 Donn Hawaii Territory Survey map of Oahu with land use (RM 2374) showing breakdown of land use in southwest O‘ahu

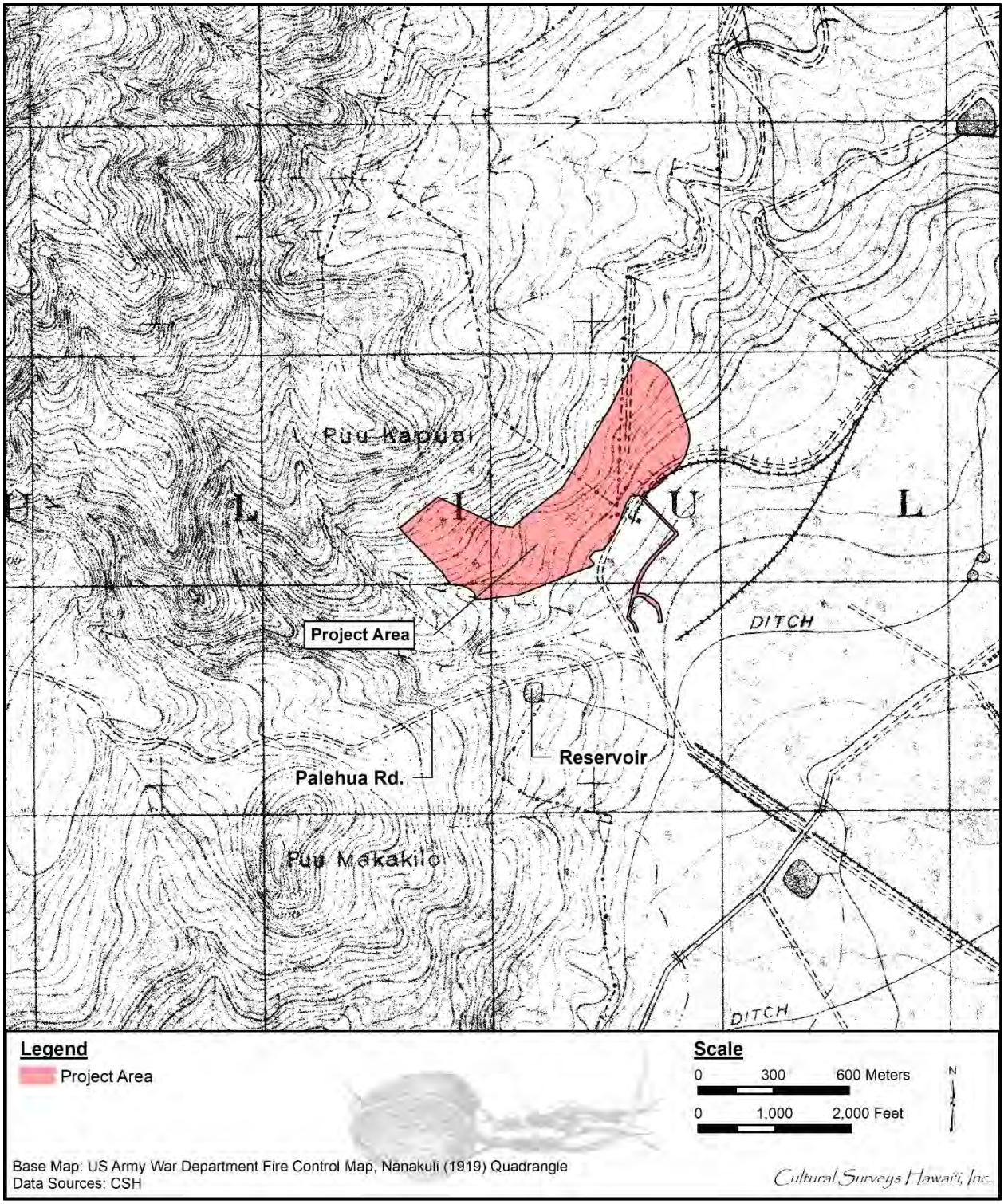


Figure 12. Portion of 1919 U.S. Army War Department fire control map, Nanakuli quadrangle showing the project area

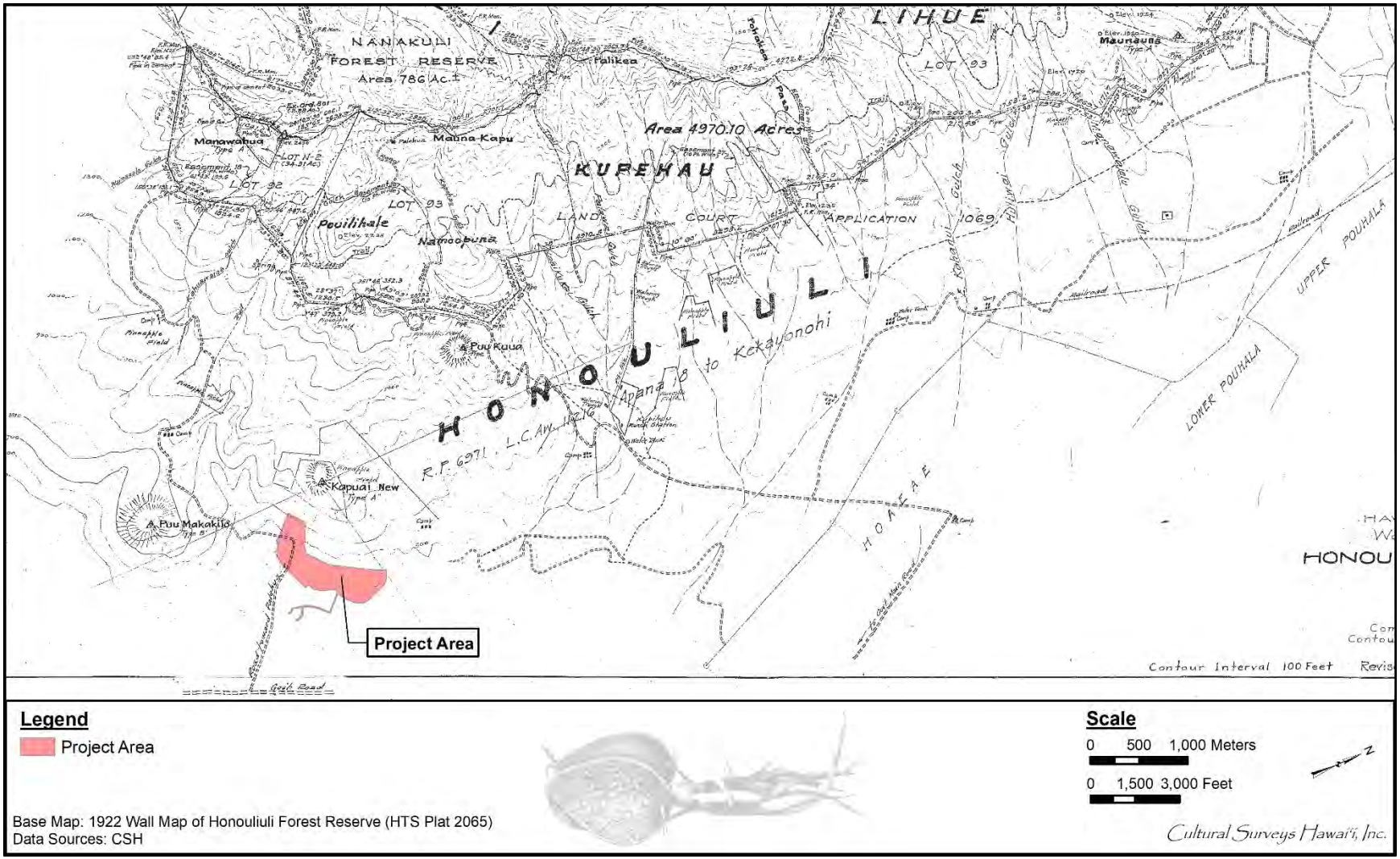


Figure 13. Portion of 1922 Wall map of Honouliuli Forest Reserve (HTS Plat 2065) showing the location of the project area

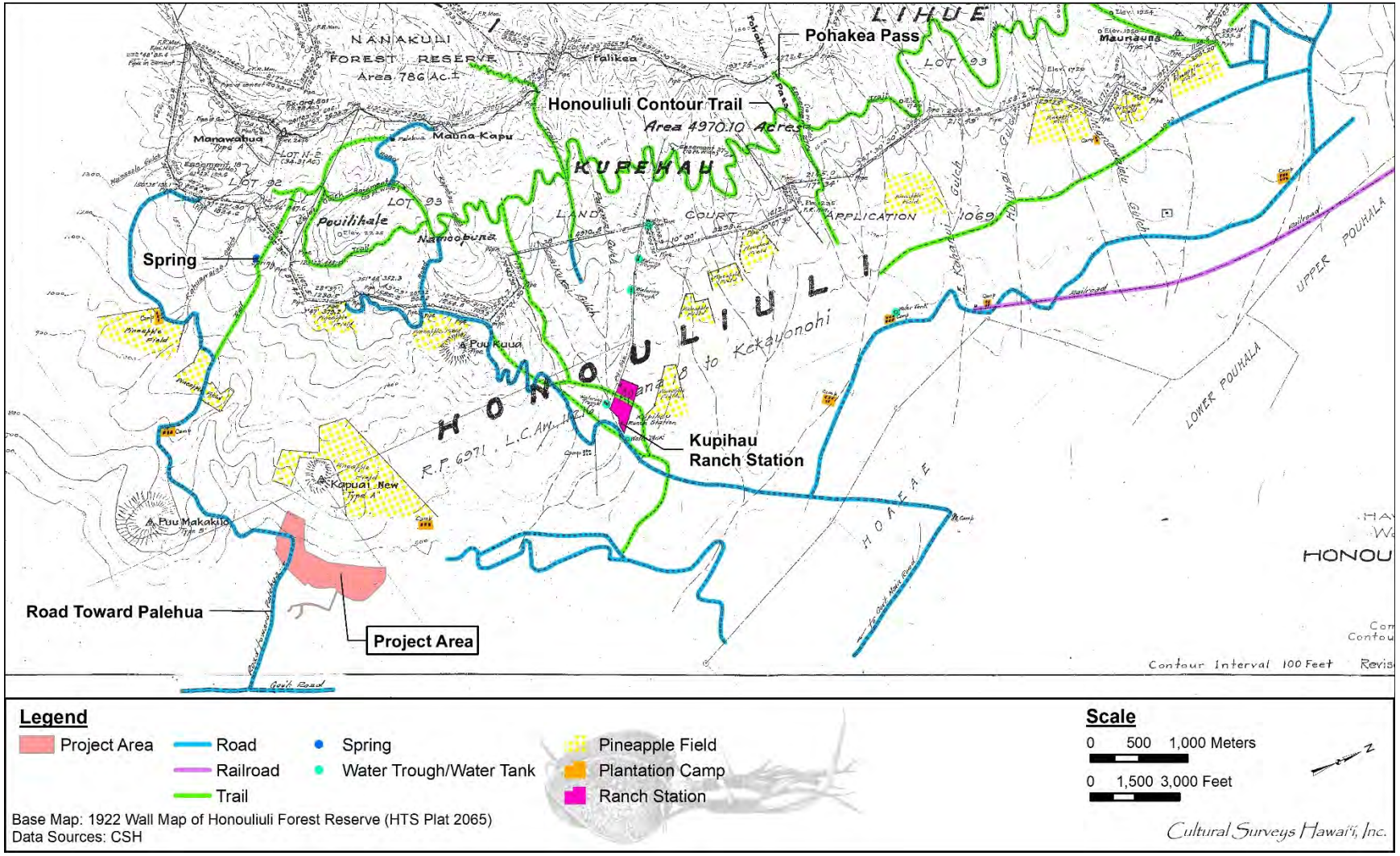


Figure 14. 1922 Wall map of Honouliuli Forest Reserve (HTS Plat 2065) showing the location of the project area with annotations

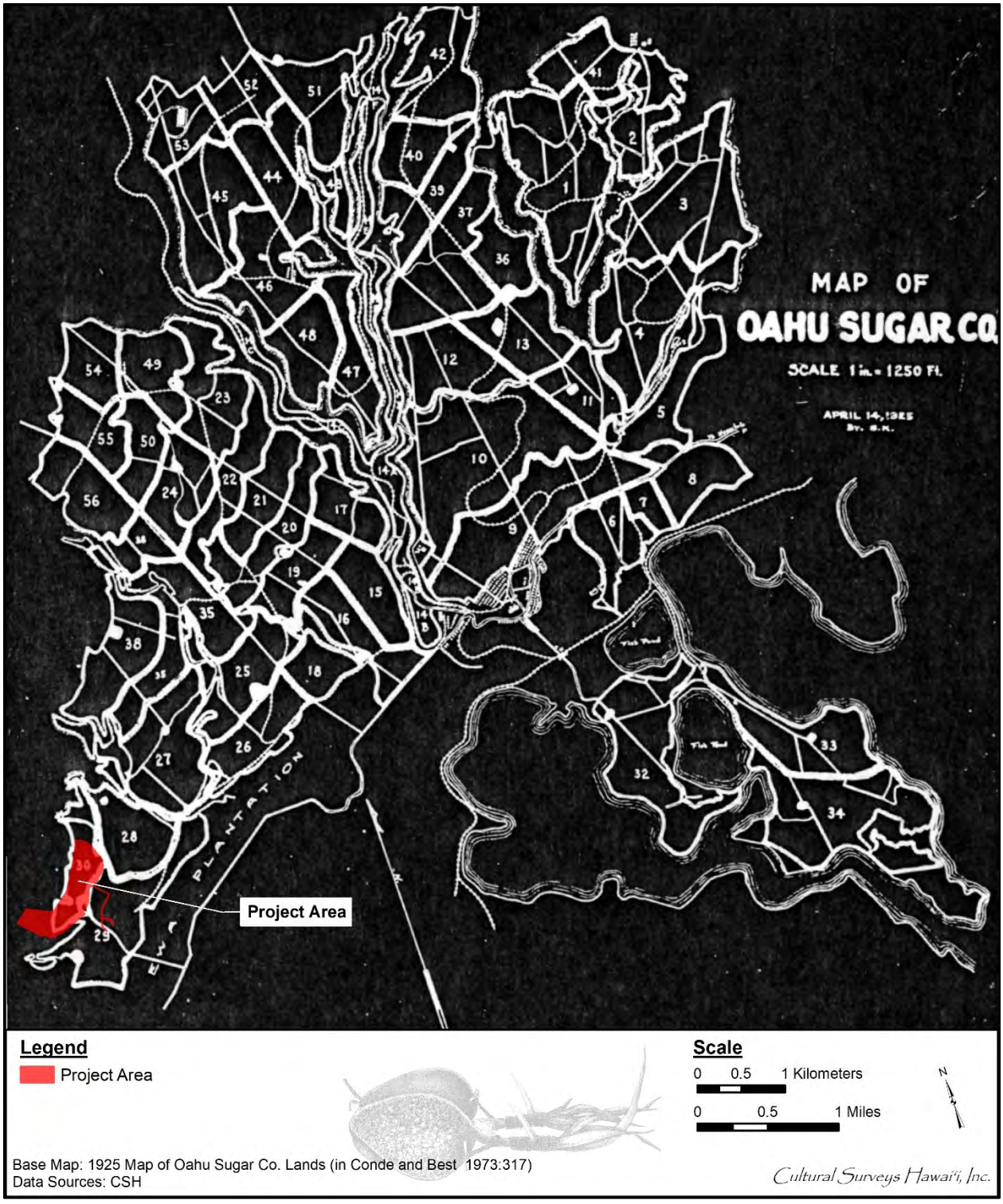


Figure 15. 1925 Oahu Sugar Company plantation map showing project area (red) as largely within former Field 30 (Condé and Best 1973:317)

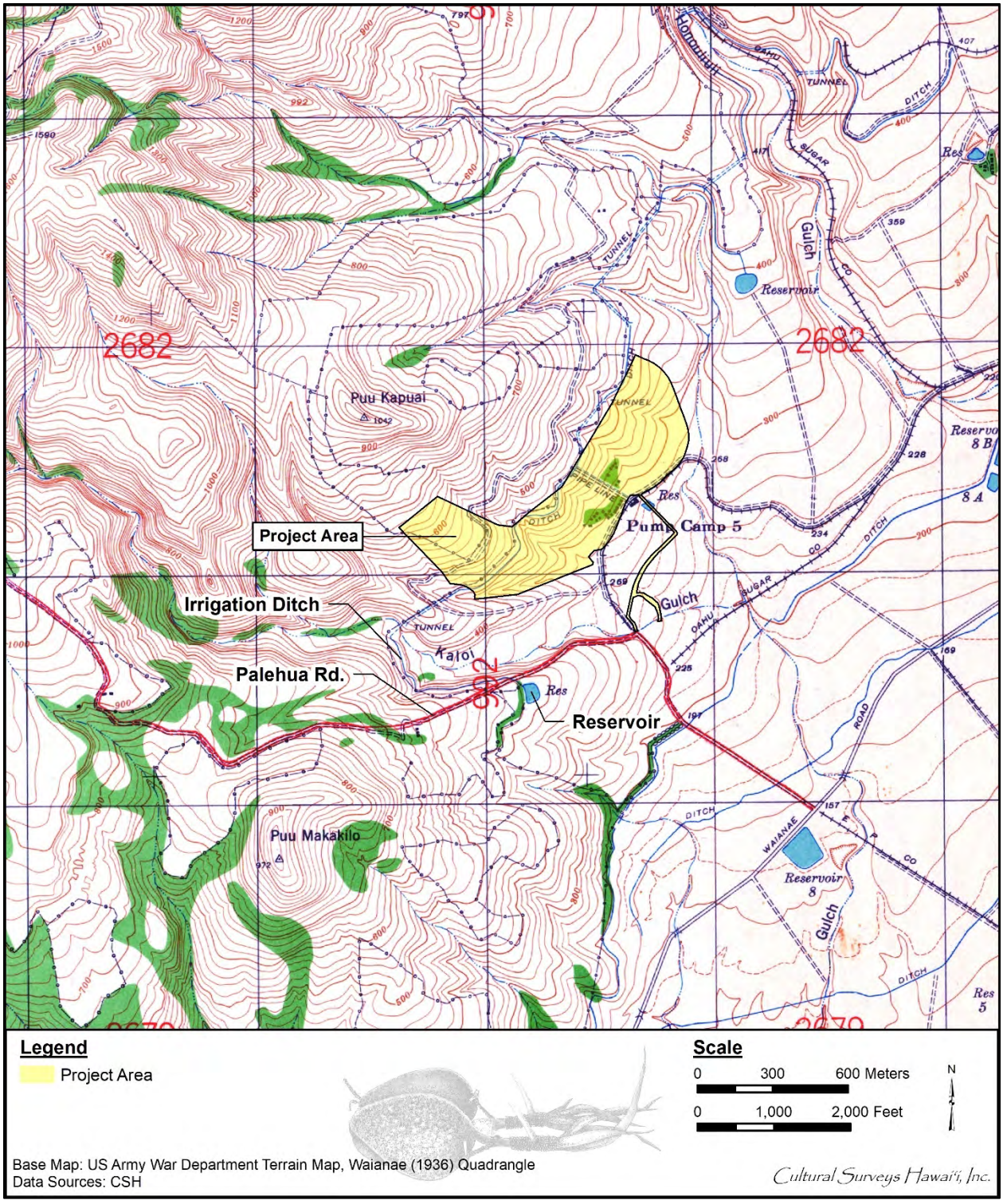


Figure 16. Portion of the 1936 U.S. Army War Department terrain map, Waianae quadrangle showing the location of the project area

A 1943 U.S. Army War Department map (Figure 17) shows much the same scene, though the unimproved road crossing the western portion of the project area now wraps around Pu‘u Kapua‘i. Additional new, unimproved roads suggest the expansion of sugarcane fields. The extensive system of fences depicted upslope indicates cattle ranching was still a significant enterprise.

Historic maps of the Makakilo area indicate a lack of any other significant development in the area into the 1940s. Major land use changes came to western Honouliuli when the U.S. Military began development in the area. Military installations were constructed near the coast as well as in the foothills and upland areas. Barbers Point Military Reservation (a.k.a. Battery Barbers Point from 1937–1944), located at Barbers Point Beach, was used beginning in 1921 as a training area for firing 155 mm guns (Payette 2003). Also in the vicinity were Camp Malakole Military Reservation (a.k.a. Honouliuli Military Reservation), used from 1939, and Gilbert Military Reservation, used from 1922–1944. Barbers Point Naval Air Station (NAS), in operation from 1942 into the 1990s, was the largest and most significant base built in the area. It housed numerous naval and defense organizations, including maritime surveillance and anti-submarine warfare aircraft squadrons, a U.S. Coast Guard Air Station, and components of the U.S. Pacific Fleet.

Fort Barrette (a.k.a. Kapolei Military Reservation and Battery Hatch), located atop Pu‘u ‘o Kapolei to the southwest, was used from 1931 to 1948 for housing four 3-inch anti-aircraft batteries (Payette 2003). In the 1950s, the site was used as a Nike missile base. Palailai Military Reservation, located atop Pu‘u Pāla‘ila‘i in Makakilo to the west, was in service from 1921, housing Battery Palailai and Fire Control Station B (Payette 2003). Fire Control Station A was located atop Pu‘u Makakilo approximately 1.4 km to the southwest of the project area. From 1942 to 1945 the Pu‘u Makakilo Training Area, including lands in and around Pu‘u Makakilo, was used for military training during World War II (Environment Hawai‘i 1992).

The 1951 aerial photograph (Figure 18) clearly shows the two neighboring housing areas of Pump Camp 5 within the central portion of the project area (just northwest and southwest of the pump house building or pumping station which remains just outside the project area). While the majority of the project area was under sugarcane cultivation, it appears the southwest portion, west or upslope of the Waiahole Ditch, was not under cultivation at that time, used instead as grazing lands. The west portion of the project area appears to have been previously cultivated but appears fallow. Extensive areas north of Pu‘u Kapua‘i appear to be under pineapple cultivation.

The 1953 USGS map (Figure 19) shows much the same landscape as the 1943 map (see Figure 17) except the railroads have now all disappeared—quickly replaced by trucking after World War II. A naval reservation is shown on the southeast base of Pu‘u Makakilo. An access road developed to service the present quarry is now depicted running up the mouth of Kalo‘i Gulch, parallel to and just north of the Kalo‘i Stream channel. The initial date of construction of an industrial quarry within Kalo‘i Gulch—depicted to the south (outside) of the current project area—is uncertain, though historic maps indicate a construction window between 1943 and 1952. In 2004, CSH conducted an archaeological inventory survey whereby the quarry was documented and designated an historic property, SIHP # 50-80-12-6680.

The 1968/1969 USGS map (Figure 20) no longer shows Pump Camp 5, which had been prominent at least as early as 1936 (see Figure 16) and lasted until at least 1953 (see Figure 19). The “Pumping Station” immediately southeast of the project area is still labeled and in general the plantation infrastructure (other than the train lines) appears active. The road up Kalo‘i Gulch,

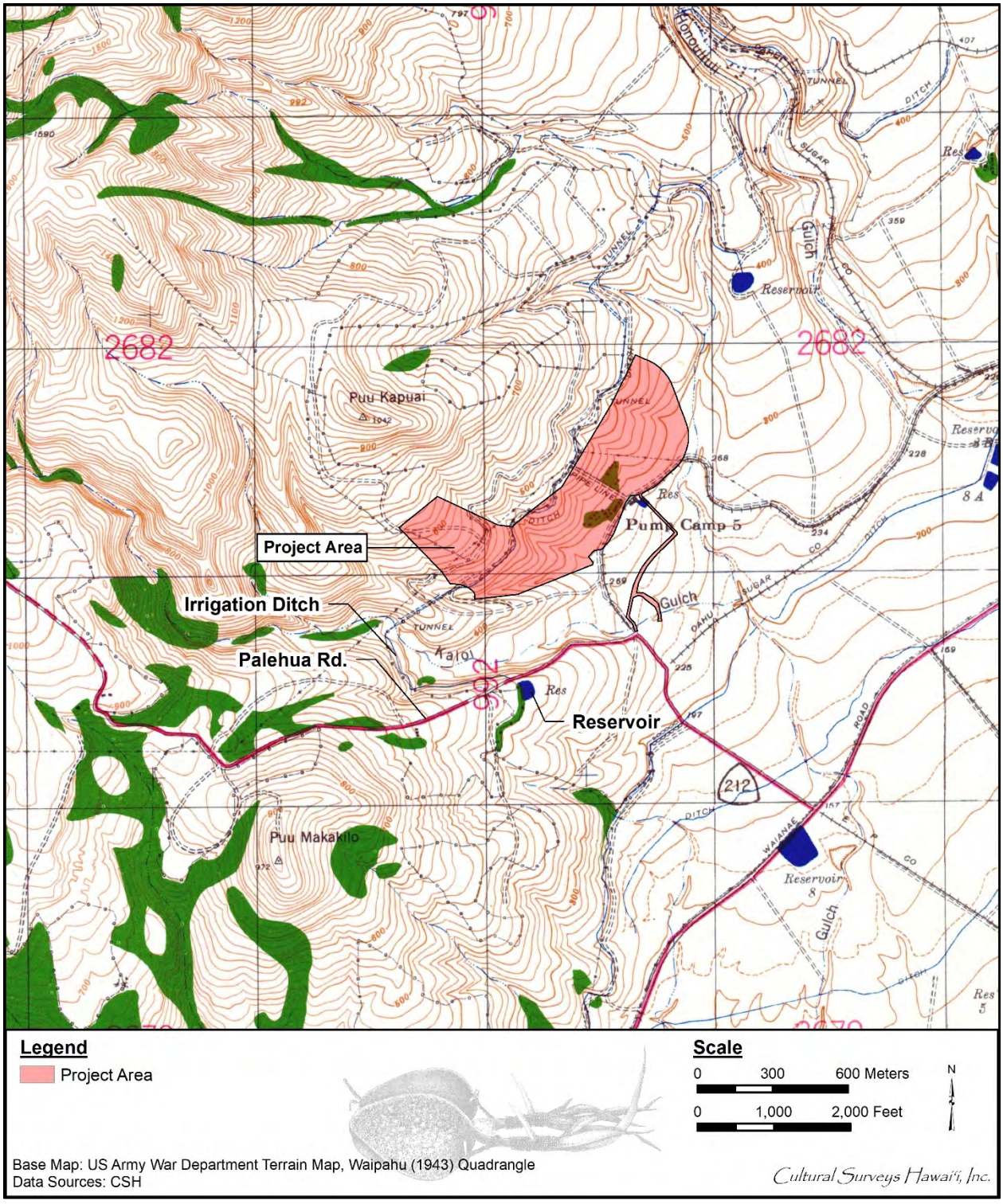


Figure 17. Portion of the 1943 U.S. Army War Department terrain map, Waipahu quadrangle showing the project area

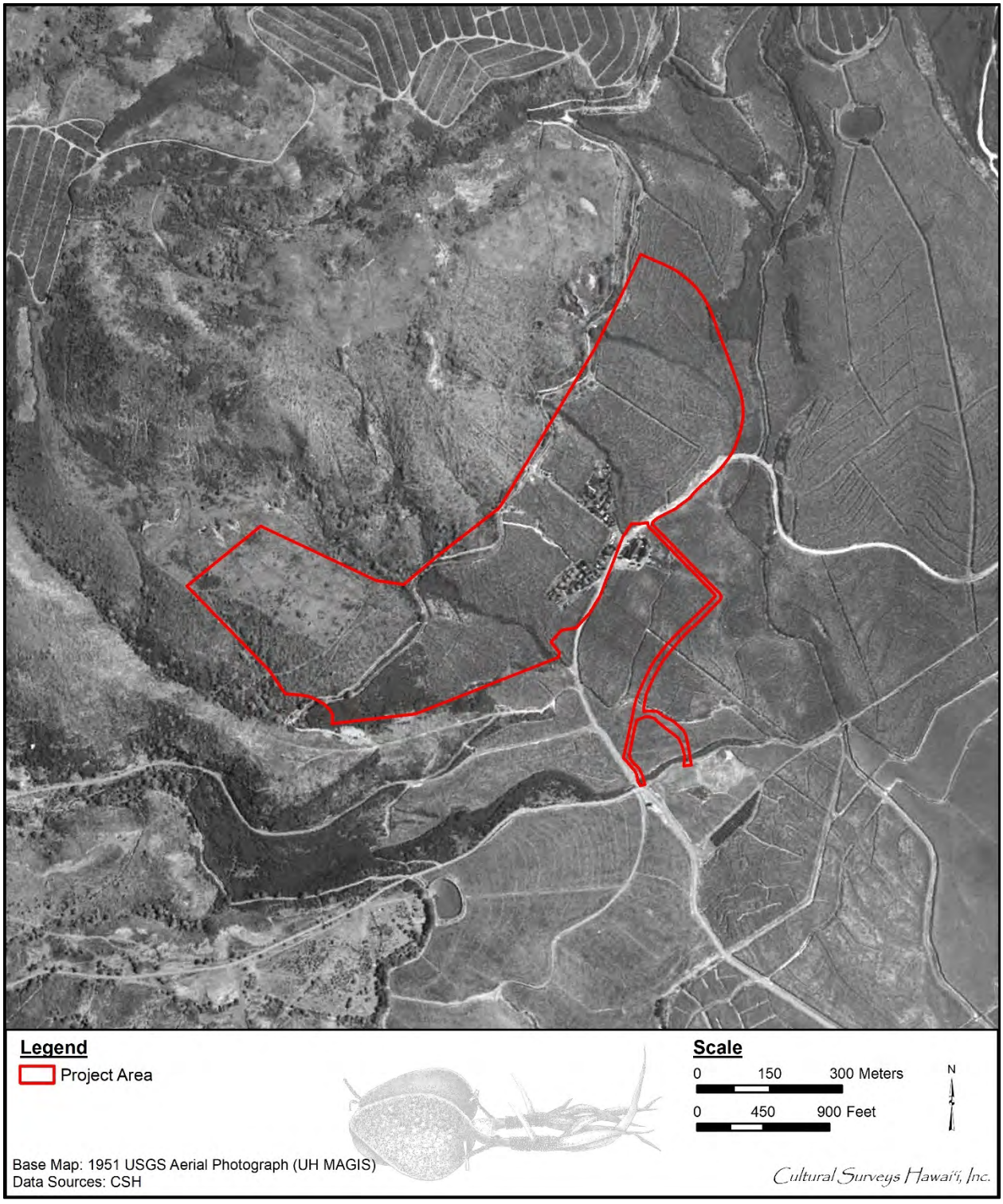


Figure 18. 1951 USGS aerial photograph (UH MAGIS) showing the project area

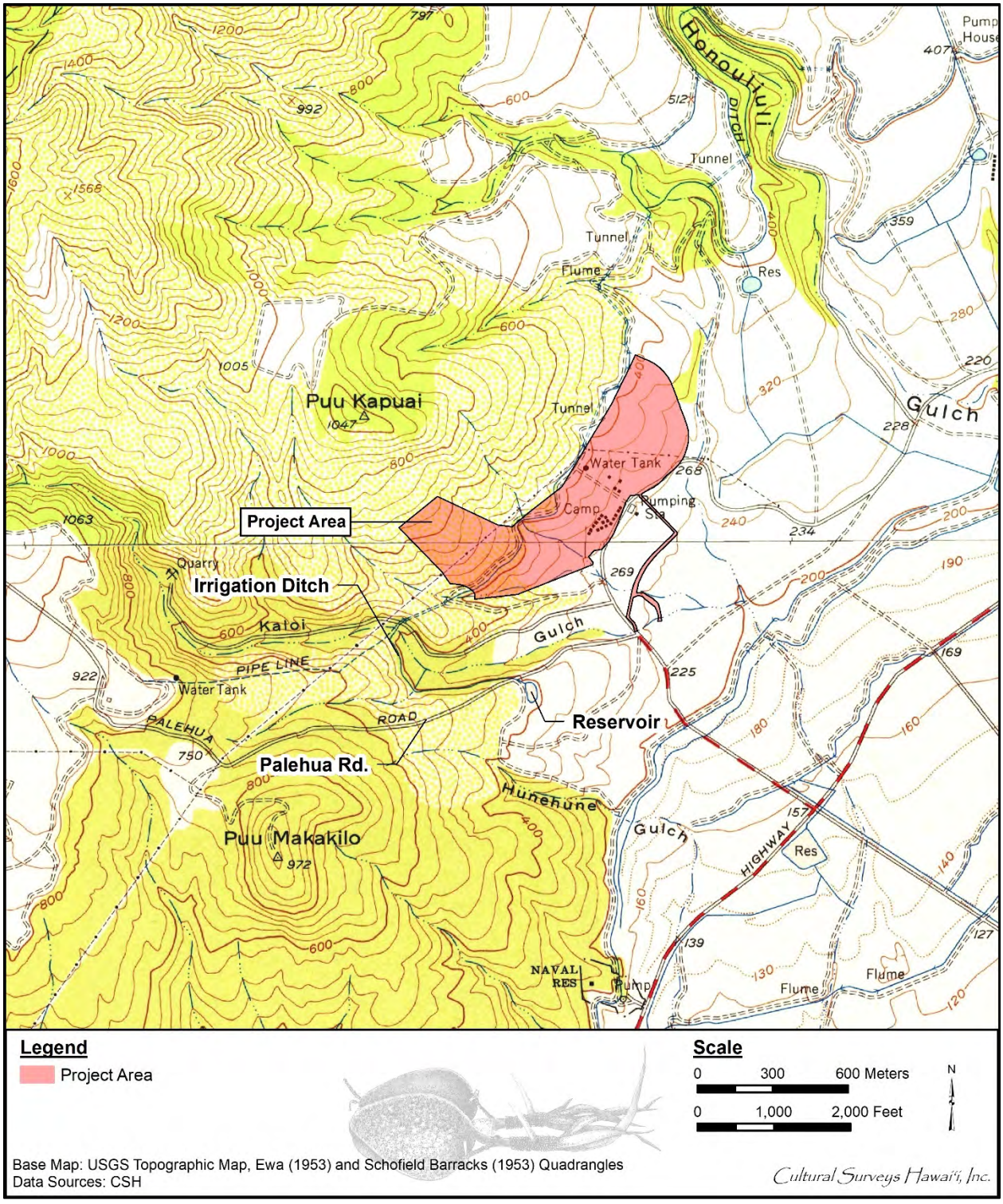


Figure 19. Portion of the 1953 Ewa and Schofield Barracks USGS topographic quadrangles showing the project area

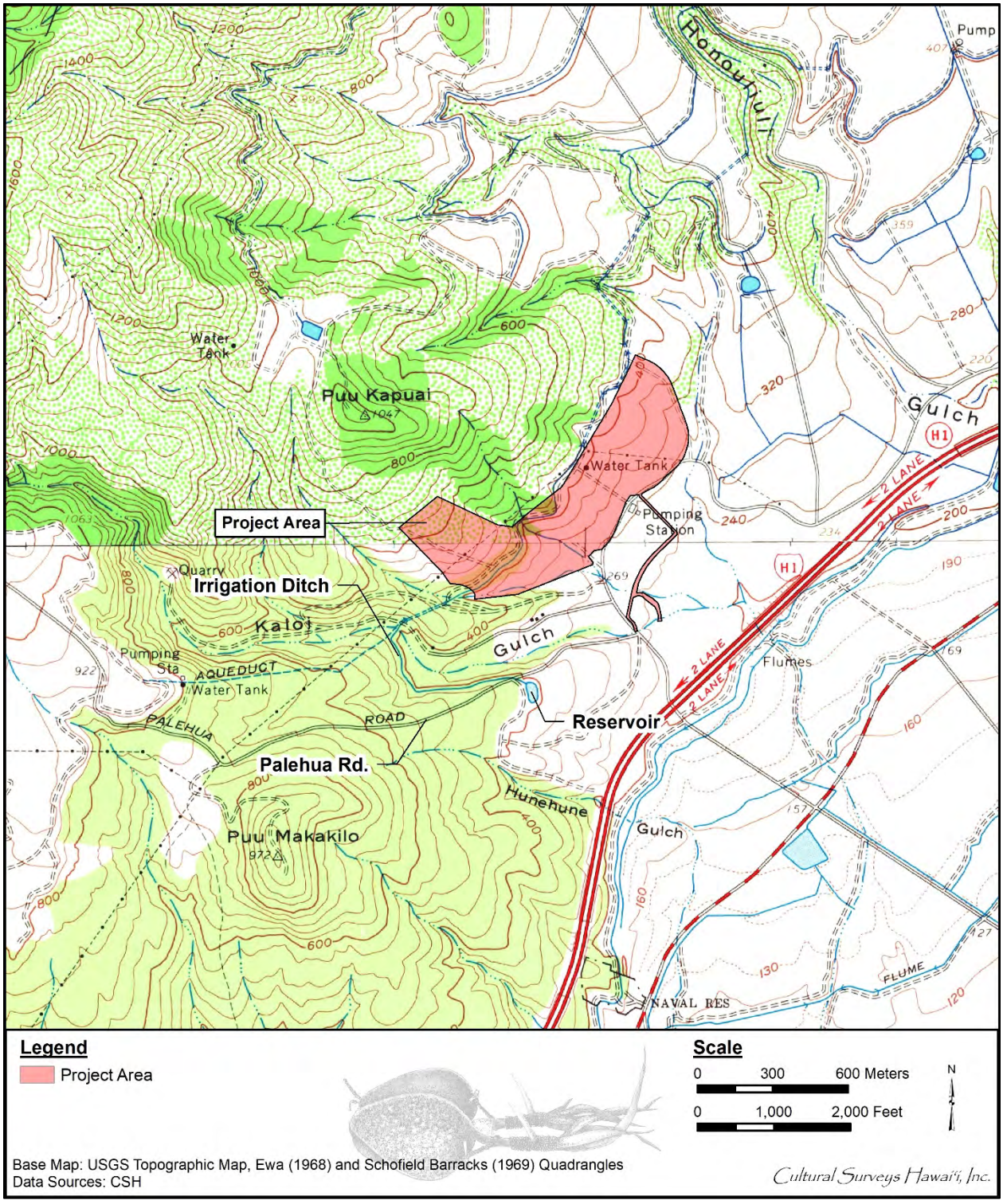


Figure 20. Portion of the 1968 Ewa and 1969 Schofield Barracks USGS topographic quadrangles showing the project area

depicted as improved in 1953, is now shown as unimproved, suggesting abandonment of some quarrying operations.

3.1.6 Contemporary Land Use

Modern maps of the Makakilo area indicate vast changes to the project area and surrounding lands, including the retreat of the sugarcane fields, the construction of the H-1 Freeway, and the partial construction of the Pu‘u Makakilo Golf Course and Grace Pacific Makakilo Quarry.

A 1968 USGS aerial photograph (Figure 21) shows virtually the entire project area still utilized for sugarcane, though there is no trace of the former Pump Camp 5 residential areas that appear to be entirely covered with cane. Many of these plantation homes are understood to have been slightly raised on “tofu-block” foundations that allowed for relatively complete demolition, leaving only the remnants of privies and trash pits. The 1968 photograph also shows new fields to the northwest (see Figure 21).

In 1969 and 1970, Pacific Concrete and Rock Company, Ltd. began subsurface drilling on the southward facing slopes of Pu‘u Makakilo for a new quarry location. The company’s previous quarry in Pu‘u Pāla‘ila‘i that had been in operation for the past 22 years was nearly exhausted. The newly proposed Makakilo Quarry would “encompass 72 acres of actual total quarry area and 188 acres of green belt buffer. Of the 72 acres of actual quarry area, only a maximum of 18 acres will be under active quarrying at any given time” (Cerny 1972:1).

A 1977 USGS aerial photograph (Figure 22) appears to display decreased sugarcane cultivation in the Wai‘anae foothills. It is not clear if the project area is in active cultivation or not. Clearly by 1993 (Figure 23) sugarcane cultivation within the project area is finished, although it remains active immediately southeast of the project area.

Sometime in the early 1990s, a group of Japanese investors poured $70 million into the development of the Pu‘u Makakilo Golf Course. The golf course’s exact date of construction is unclear; however, the proposed area was surveyed by Sinoto in 1988 (Sinoto 1988). The golf course was situated on the slopes of Pu‘u Makakilo just north of the rock quarry. During a burst bubble in the Japanese investment market the project foundered, and the course and buildings were purchased by Grace Pacific in 1994 (*Honolulu Advertiser*, May 2004:31). Construction of the golf course resulted in grading and terracing of a large area southwest of the present project area for fairway construction.

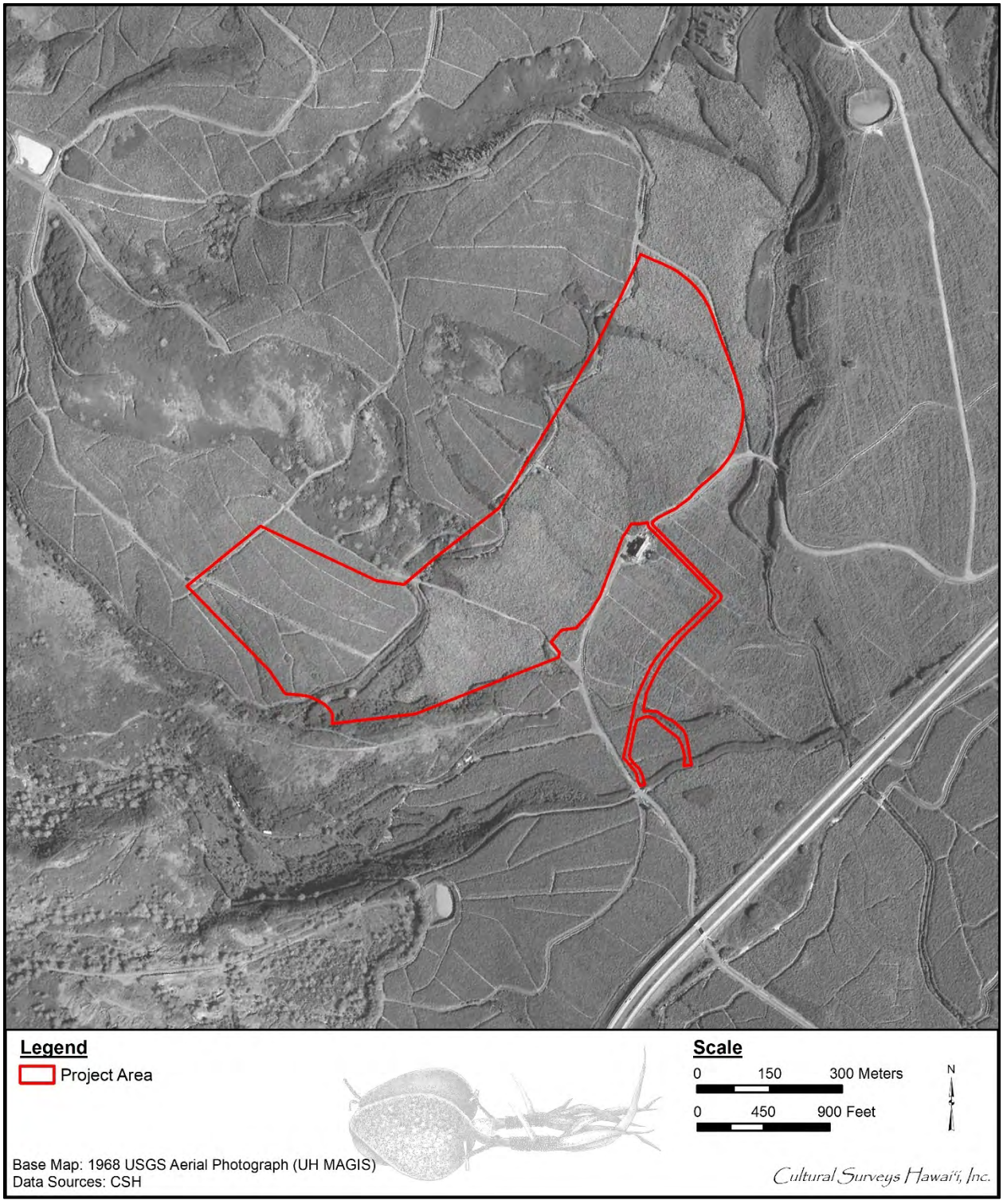


Figure 21. 1968 USGS aerial photograph (UH MAGIS) showing the project area

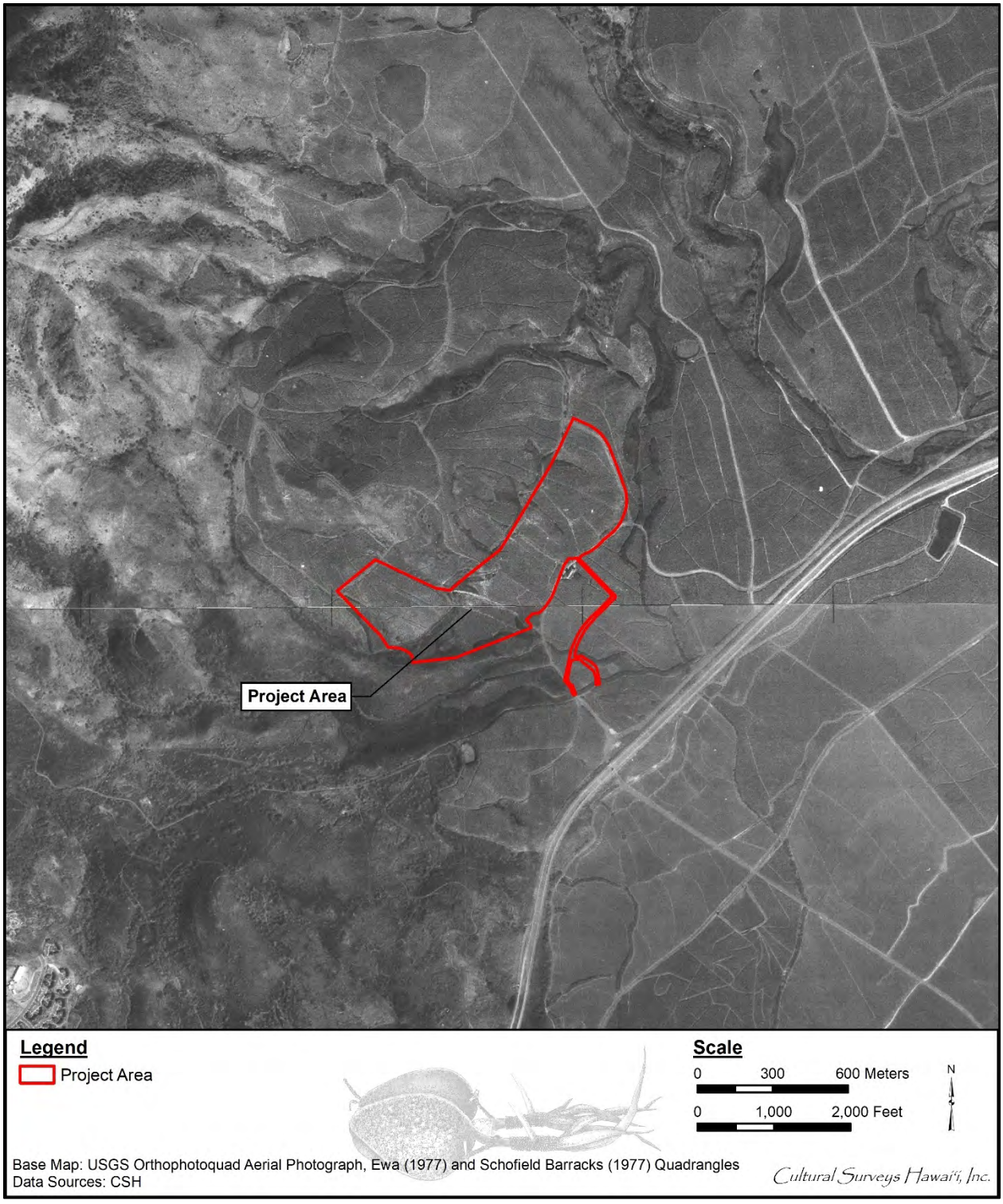


Figure 22. 1977 USGS Orthophotoquad aerial photograph, Ewa and Schofield Barracks quadrangles showing the project area

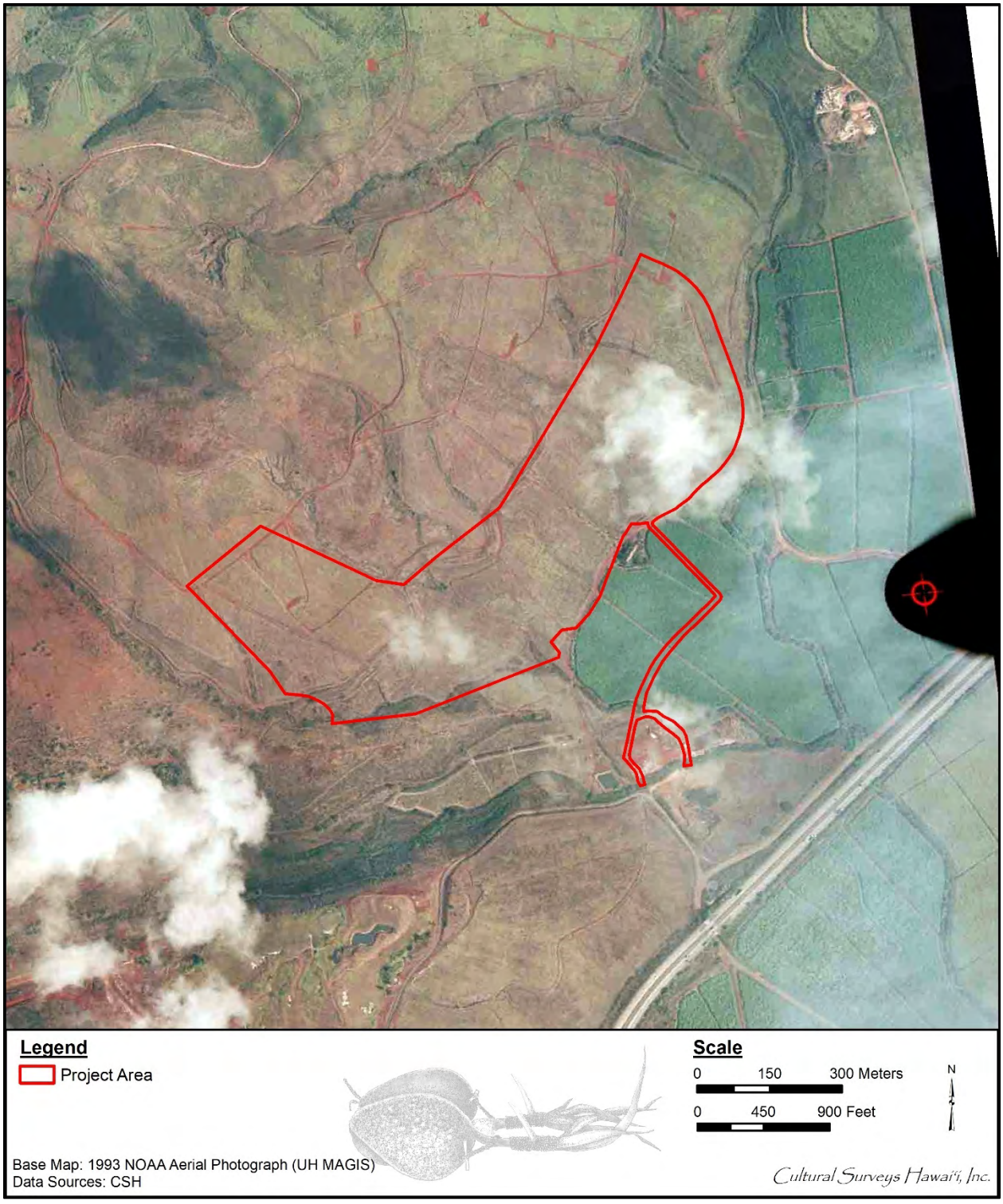


Figure 23. 1993 NOAA aerial photograph (UH MAGIS) showing the project area

3.2 **Previous Archaeological Research**

Previous archaeological studies in the vicinity (within approximately 1.5 km) of the current project area are shown in Figure 24 and Table 1, and a summary of these studies follows. Figure 25 and Table 2 show the locations of historic properties in the vicinity of the project area. There are no sites documented by McAllister (1933) in his early archaeological reconnaissance study of O‘ahu in the vicinity of the project area.

3.2.1 Bordner 1977

In 1977, the Archaeological Research Center Hawaii, Inc. (Bordner 1977) conducted an archaeological reconnaissance survey of a then proposed Kalo‘i Gulch landfill location, approximately 500 m west of the present project area. The study concluded the lower section of the gulch had been extensively modified through quarrying operations and cattle ranching. Foundations of both crushing and loading facilities were noted. In the upper reaches of the property, three walls of possible pre-Contact origin were documented between 1,250 and 1,300 ft elevation and designated as SIHP #s 50-80-12-2600, -2601 and -2602. These three historic properties were in the extreme, upslope end of the large property more than 1.5 km from the present project area. SIHP # 50-80-12-2600 was a low (only 0.61 m, or 2 ft high) wall of poorly stacked *pāhoehoe*, approximately 7.62 m (25 ft) long set on top of a small knoll jutting out from the slope. SIHP # 50-80-12-2601 is described as a wall built on the stream terrace cut following the course of the stream and constructed of stacked *pāhoehoe* with a total length of 67.70 m (222.1 ft), an average height of 0.91 m (3.0 ft) and incorporating in situ boulders into the wall. The wall appeared to have been constructed so as to protect a stream terrace from erosion. It also retained a terrace measuring approximately 12 m (39.4 ft) by 31 m (101.7 ft). SIHP # 50-80-12-2602 was a free-standing 18.2 m (59.7 ft) wall of stacked *pāhoehoe* that had the appearance of being a boundary wall. The historic properties were regarded as of “a marginal status” and no further archaeological work was recommended for the area covered by the reconnaissance survey.

3.2.2 Sinoto 1988

In 1988, the Bishop Museum Applied Research Group conducted a surface survey for a then proposed Makakilo Golf Course just southwest of the current project area (Sinoto 1988). The study concluded the majority of the project area had been damaged by severe erosion. No surface historic properties were documented and subsurface testing was deemed unnecessary. Just west (outside) of the golf course property, one deteriorated wall segment was documented on the northeast slope of Pu‘u Makakilo. The wall, designated SIHP # 50-80-12-1975, may have served as an “historic erosional control feature” (Sinoto 1988:1). Due to the deteriorated condition of the wall remnant, no further work was recommended.

3.2.3 Spear 1996

Scientific Consultant Services, Inc. conducted an archaeological reconnaissance survey of a large area extending from south of the H-1 freeway to the north side of Renton Road (Spear 1996). No historic properties were identified.

3.2.4 Dega et al. 1998

In 1998, Scientific Consultant Services, Inc. (SCS) conducted an archaeological inventory survey for the University of Hawai‘i, West O‘ahu Campus project area (Dega et al. 1998). The

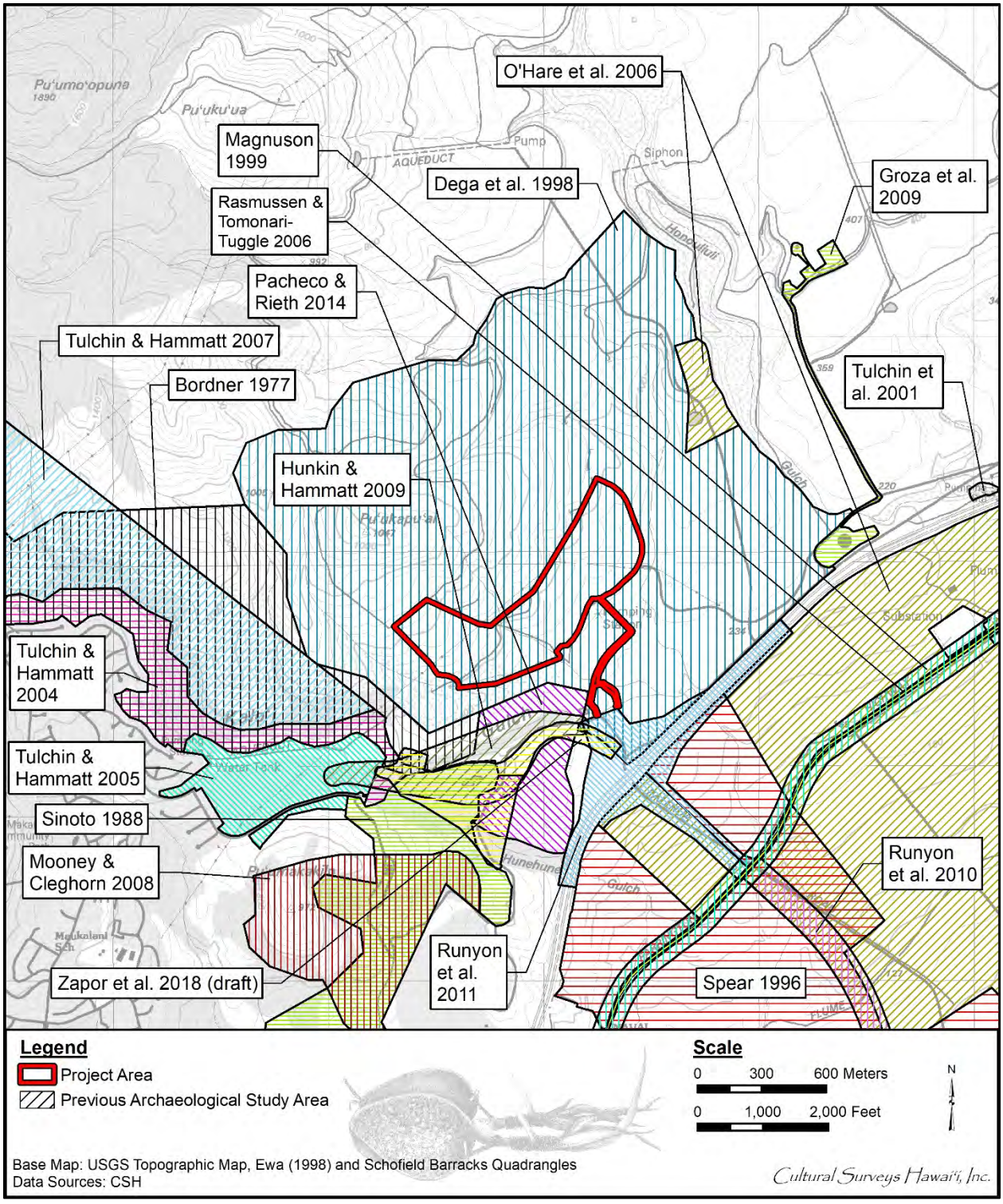


Figure 24. Portion of the 1998 Ewa and Schofield Barracks USGS topographic quadrangles showing the locations of previous archaeological studies in the vicinity (within approximately 1.5 km) of the project area

Table 1. Previous archaeological studies within the vicinity (within approximately 1.5 km) of the project area

Reference	Type of Study	Location	Results
Bordner 1977	Archaeological reconnaissance survey	Proposed Kalo‘i Gulch landfill location	Three walls designated as SIHP #s 50-80-12-2600, -2601 and -2602 in extreme west, upslope end of property, more than 1.5 km from present project area (hence not depicted in Figure 25)
Sinoto 1988	Archaeological reconnaissance survey	Makakilo Golf Course	Documented a low stacked boulder wall outside the property: SIHP # 50-80-09-1975
Spear 1996	Archaeological reconnaissance survey	East Kapolei, TMK: [1] 9-1-016:017	No historic properties identified
Dega et al. 1998	Archaeological inventory survey	UH West O‘ahu, TMK: [1] 9-2-002:001	Documented two historic property complexes: historic irrigation and plantation infrastructure system (SIHP # 50-80-08-5593) and Waiahole Ditch System (SIHP # 50-80-09-2268)
Magnuson 1999	Archaeological reconnaissance survey	‘Ewa Plain	Identified six concrete bridges, a railroad track, and a set of unidentified concrete features; no SIHP #s assigned
Tulchin et al. 2001	Archaeological inventory survey	Proposed ‘Ewa Shaft Renovation project, Honouliuli Gulch, adjacent to west-bound lanes of H-1, TMK: [1] 9-2-001	Identified one historic property: SIHP # 50-80-08-6370, stone wall alignment; also documented large pumping station and shaft building
Tulchin and Hammatt 2004	Archaeological inventory survey	86-acre proposed Pālehua Community Association, TMKs: [1] 9-2-003:078 por. and 079	Four historic properties identified: a complex of concrete and iron structures associated with industrial rock quarry operations (SIHP # 50-80-12-6680); three boulder mounds believed related to land clearing or ditch construction by Oahu Sugar Co. (SIHP # 50-80-12-6681); a small terrace believed to function as historic water diversion feature (SIHP # 50-80-12-6682); and a remnant portion of Waiahole Ditch (SIHP # 50-80-09-2268)

Reference	Type of Study	Location	Results
Tulchin and Hammatt 2005	Archaeological inventory survey	71-acre proposed Pālehua East B project, Makakilo, TMKs: [1] 9-2-003:076 and 078	Three historic properties identified: pre-Contact agricultural alignment and mound (SIHP # 50-80-12-6666), plantation-era stacked basalt boulder walls and a ditch (SIHP # 50-80-12-6667), and single alignment of upright basalt boulders and small, low terrace (SIHP # 50-80-12-6668)
O’Hare et al. 2006	Archaeological inventory survey	Ho‘opili East Kapolei	Documented six previously identified historic properties: plantation infrastructure (SIHP # 50-80-12-4344); railroad berm (SIHP # 50-80-12-4345); northern pumping station (SIHP # 50-80-12-4346); central pumping station (SIHP # 50-80-12-4347); southern pumping station (SIHP # 50-80-12-4348); and documented four newly identified features of SIHP # 50-80-12-4344: a linear wall, stone-faced berm, concrete ditch, and concrete catchment
Rasmussen and Tomonari-Tuggle 2006	Archaeological monitoring	Waiau Fuel Pipeline corridor	No historic properties identified
Tulchin and Hammatt 2007	Archaeological literature review and field inspection	Approx. 790-acre parcel, TMK: [1] 9-2-003:002 por. and 005 por.	Documented features interpreted as related to pre-Contact indigenous Hawaiian habitation (SIHP #s 50-80-08-2316 and 50-80-12-2602); historic ranching and related features (SIHP # 50-80-12-2601); and historic quarrying and related features (SIHP # 50-80-12-6680) and various pre- and post-Contact features (designated with temporary #s CSH1–CSH22)
Mooney and Cleghorn 2008	Archaeological reconnaissance survey	TMK: [1] 9-2-003:018	No historic properties identified
Groza et al. 2009	Archaeological inventory survey	TMKs: [1] 9-2-001:001 por., 004, 005, 006, 007 por.; 9-2-002:002	No historic properties identified

Reference	Type of Study	Location	Results
Hunkin and Hammatt 2009	Archaeological inventory survey	TMKs: [1] 9-2-002:006; 9-2-003:079	Documented two newly identified historic properties: irrigation ditches (SIHP #s 50-80-12-6950 and -6951); and one previously identified historic property, Waiahole Ditch (SIHP # 50-80-09-2268)
Runyon et al. 2010	Archaeological monitoring	TMKs: [1] 9-2-002:006; 9-2-003:079	No historic properties identified
Runyon et al. 2011	Archaeological monitoring	TMKs: [1] 9-1-018:001, 003, 004, 005; 9-2-002:001, 006	Documented two historic properties: a water diversion and a trash deposit (SIHP #s 50-80-12-4664 and -7128)
Pacheco and Rieth 2014	Archaeological inventory survey	East Kapolei Solar Farm, TMK: [1] 9-2-002:006 por.	Documented SIHP # 50-80-12-7433, an unpaved early twentieth century agricultural (ranching and/or sugarcane cultivation) road, understood as created between 1918 and 1928
Zapor et al. 2018	Archaeological inventory survey	Makakilo Dr extension project, TMKs: [1] 9-2-002:007, 009, 009; 9-2-003:074, 092; 9-2-039:110, 114; and 9-2-045:001	Documented two historic properties: SIHP # 50-80-09-2268, remnant portion of Waiahole Ditch, and SIHP # 50-80-12-6951, irrigation ditches; identified one new feature of Waiahole Ditch, an earthen mound and stacked stone wall, interpreted as likely remnants of a reservoir (Feature D)

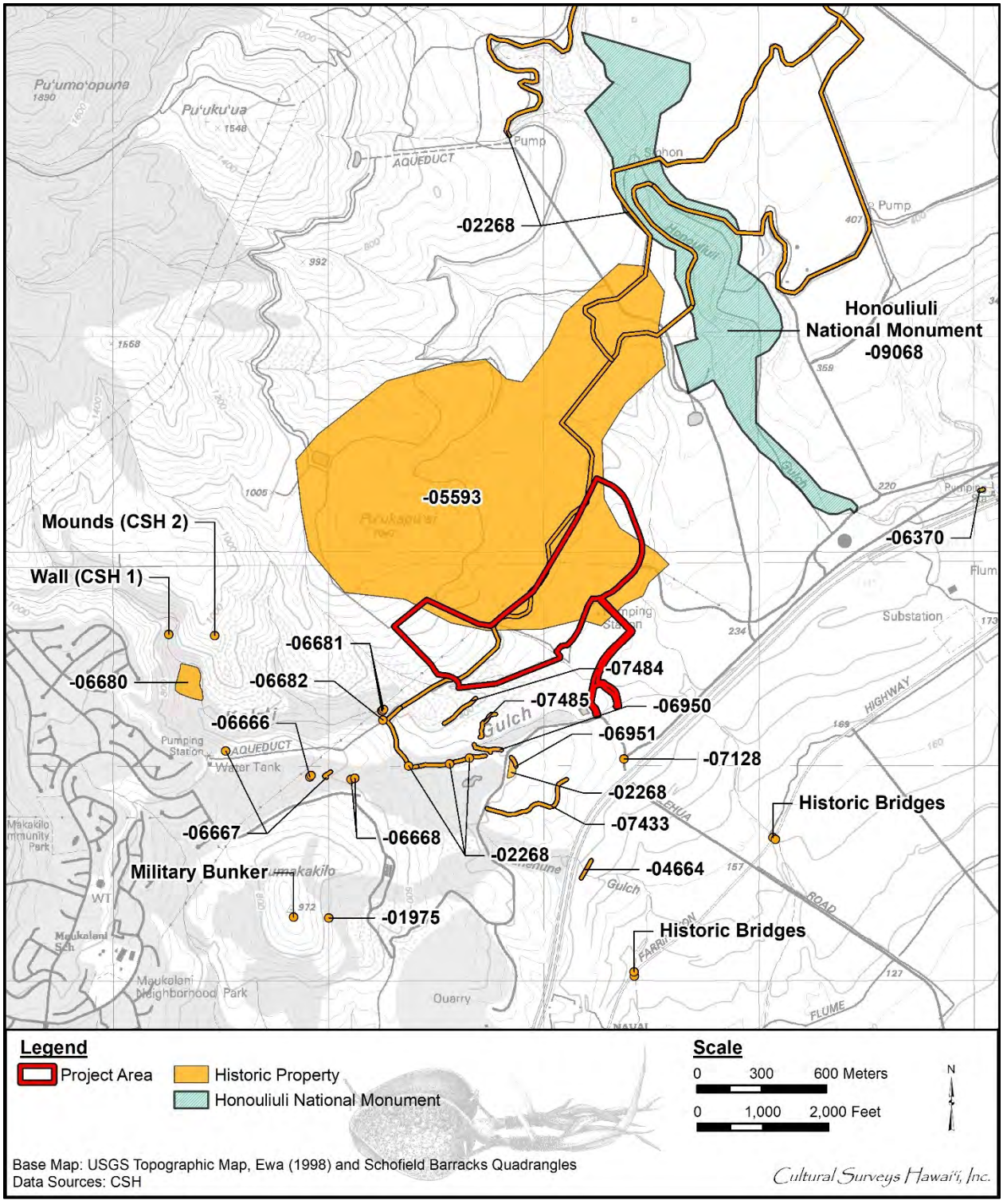


Figure 25. Portion of the 1998 Ewa and Schofield Barracks USGS topographic quadrangles showing the locations of previously identified historic properties in the immediate vicinity of the project area (note the SIHP # -5593 property boundary is defined as the Dega et al. 1998 project area and not the true extent or location of its features)

Table 2. Previously identified historic properties in the vicinity of the project area

SIHP #	Description	Reference
50-80-12-1975	Low-stacked boulder wall segment	Sinoto 1988
50-80-09-2268	Waiahole Ditch System	Goodman and Nees 1991; Hammatt et al. 1996; Dega et al. 1998; Tulchin and Hammatt 2005; Hunkin and Hammatt 2009; Zapor et al. 2018; Shideler and Hammatt 2018
50-80-12-4664	Historic water diversion structure	Nakamura et al. 1993; Runyon et al. 2011
50-80-08-5593	Plantation-era “flumes, aqueducts, ditches, pumps, and other irrigation features”	Dega et al. 1998
50-80-08-6370	Stone wall alignment, likely associated with cattle ranching or pumping station	Tulchin et al. 2001
50-80-12-6666	Alignment and mound	Tulchin and Hammatt 2005
50-80-12-6667	Two walls	Tulchin and Hammatt 2005
50-80-12-6668	Alignment and terrace	Tulchin and Hammatt 2005
50-80-12-6680	Complex of concrete and iron structures associated with industrial rock quarry operations	Tulchin and Hammatt 2005
50-80-12-6681	Three boulder mounds believed related to land clearing or ditch construction by Oahu Sugar Company	Tulchin and Hammatt 2005
50-80-12-6682	Terrace believed to function as an historic water diversion feature	Tulchin and Hammatt 2005
50-80-12-6950	Portion of a plantation-era irrigation ditch	Hunkin and Hammatt 2009
50-80-12-6951	Portion of a plantation-era irrigation ditch	Hunkin and Hammatt 2009
50-80-12-7128	Burned trash fill layer	Runyon et al. 2011

SIHP #	Description	Reference
50-80-12-7433	Unpaved early twentieth century agricultural (ranching and/or sugarcane cultivation) road, understood as created between 1918 and 1928	Pacheco and Rieth 2014
50-80-12-7484	Post-Contact irrigation ditch portion	Pacheco and Rieth 2014
50-80-12-7485	Post-Contact irrigation ditch portion	Pacheco and Rieth 2014
50-80-08-9068	Honouliuli National Monument (Internment Camp)	National Register
Historic Bridges	No SIHP #s assigned, no further documentation or mitigation recommended	Magnuson 1999
Military Bunker	WWII-era bunker	Mooney and Cleghorn 2008
CSH 1	Post-Contact wall related to historic ranching	Tulchin and Hammatt 2007
CSH 2 (Mounds)	Two basalt mounds interpreted as possible trail markers	Tulchin and Hammatt 2007

survey encompassed the entirety of the current project area. Several plantation-era “flumes, aqueducts, ditches, pumps, and other irrigation features occurring within the heavily modified landscape” were noted (Dega et al. 1998:i). The features represented an extensive complex of sugarcane irrigation features used from the 1920s through more recent times. The irrigation complex was designated SIHP # 50-80-08-5593. A portion of the Waiahole Ditch System (SIHP # 50-80-09-2268) (previously recorded by Goodman and Nees 1991) was also documented crossing through the northwest section of the subject parcel and continuing southwest through the lower agricultural fields. No artifacts were recovered from the project area. No further work was recommended for SIHP # 50-80-08-5593.

An overlay of the present project area on the Dega et al. (1998) plan map (Figure 26) indicates it lies entirely within the south/central portion of the 1998 AIS project. While the Dega et al. (1998) plan map should probably be understood as a sketch, it does indicate certain remnants of plantation infrastructure (designated as SIHP # 50-80-08-5593) were present in the property in 1998. Dega et al. (1998) defined the entire project area as the boundaries of SIHP # 50-80-08-5593. However, the identified features represent a substantially smaller area than the overall boundary.

3.2.5 Magnuson 1999

In 1999, an archaeological reconnaissance survey was completed by International Archaeological Research Institute, Inc. (IARII) for a Farrington Highway Expansion project extending along 5.3 km (3.3 miles) of Farrington Highway between Golf Course Road and Fort Weaver Road with a roughly 61-m (200-ft) wide corridor on each side (Magnuson 1999). The project identified six concrete bridges, one railroad track, and “a set of unidentified concrete features” (Magnuson 1999:17). The study concluded the following:

> The sites observed in the Farrington Highway Expansion project are neither exemplary sites of their kind nor unique. Therefore these sites have been adequately recorded during the investigations and no further work is necessary should preservation not be possible. [Magnuson 1999:25]

3.2.6 Tulchin et al. 2001

CSH archaeologists completed an archaeological inventory survey in support of a proposed ‘Ewa Shaft Renovation project. The ‘Ewa Shaft project is within Honouliuli Gulch, adjacent to the west-bound lanes of the H-1 Interstate Highway, approximately 1.7 km east of the present project area. That property included a pumping station enclosure and the surrounding area of approximately 1 acre. The survey documented one historic property, a stone wall alignment designated SIHP # 50-80-08-6370. Subsurface testing was conducted adjacent to the wall. The study interpreted the wall alignment as associated with cattle ranching or the pumping station. The study also documented a portion of the large pumping station and shaft building on the property.

3.2.7 Tulchin and Hammatt 2004

In 2004, CSH conducted an archaeological inventory survey to the west of the current project area for the Pālehua Community Association (PCA) in Makakilo (Tulchin and Hammatt 2004). Three overhang shelters were observed and tested, however, no cultural material was identified during excavation. The study documented several historic properties, including a complex of

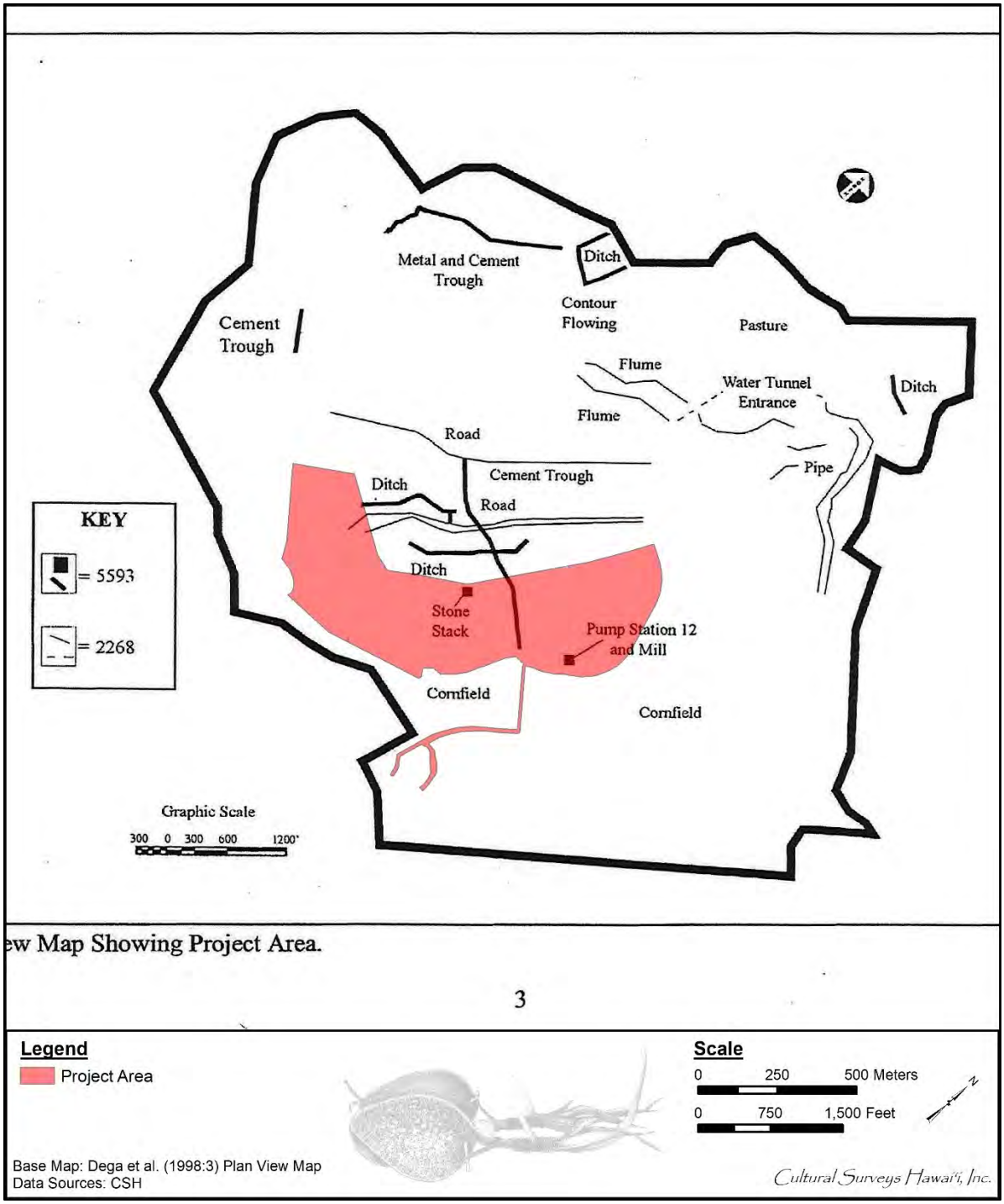


Figure 26. Plan map of the AIS for the University of Hawai‘i, West O‘ahu Campus project area showing historic properties (as of 1998) with an overlay of the current project area (adapted from Dega et al. 1998:3). This overlay suggests “Pump Station 12 and Mill” and a ditch were documented as within the present project area and another ditch and road and “Stone stack” were adjacent to the north side of the present project area (note this is a sketch and locations are approximate)

concrete and iron structures associated with industrial rock quarry operations (SIHP # 50-80-12-6680); three boulder mounds believed to be related to land clearing or ditch construction by the Oahu Sugar Company (SIHP # 50-80-12-6681); a small terrace believed to function as an historic water diversion feature (SIHP # 50-80-12-6682); and a remnant portion of the Waiahole Ditch (SIHP # 50-80-09-2268).

3.2.8 Tulchin and Hammatt 2005

In 2005, CSH conducted an archaeological inventory survey west of the current project area for the proposed Pālehua East B project in Makakilo (Tulchin and Hammatt 2005). The study identified three historic properties, including an alignment and a mound (SIHP #s 50-80-12-6666A and B), two walls (SIHP #s 50-80-12-6667A and B), and an alignment and terrace (SIHP #s 50-80-12-6668A and B). SIHP # 50-80-12-6667 is thought to contain remnants of plantation infrastructure. The historic properties were documented in an unnamed gully south of Kalo‘i Gulch.

3.2.9 O’Hare et al. 2006

In 2006, CSH conducted an archaeological inventory survey of approximately 1,600 acres for the East Kapolei project (subsequently known as the Ho‘opili project) to the southeast of the present project area (O’Hare et al. 2006). The Ho‘opili project was bounded on the east by Fort Weaver Road, *makai* (seaward) by Mango Tree Road, and *mauka* by the H-1 Freeway.

Several historic properties documented by the O’Hare et al. (2006) study were previously identified during an archaeological survey in 1990 (Hammatt and Shideler 1990). These previously identified historic properties included SIHP # 50-80-12-4344, plantation infrastructure; SIHP # 50-80-12-4345, railroad berm; SIHP # 50-80-12-4346, northern pumping station; SIHP # 50-80-12-4347, central pumping station; and SIHP # 50-80-12-4348, southern pumping station.

The survey identified four additional features of SIHP # 50-80-14-4344. These additional features include Feature D, a linear wall along the east bank of Honouliuli Stream; Feature E, a linear wall along the west bank of Honouliuli Stream; Feature F, a stone-faced berm constructed perpendicular to the orientation of the stream; and Feature G, a concrete ditch and concrete masonry catchment basement on the west bank of Honouliuli Gulch. None of the historic properties identified in the O’Hare et al. study (2006) were near the present project area.

3.2.10 Rasmussen and Tomonari-Tuggle 2006

In 2006, IARII conducted archaeological monitoring along the Waiau Fuel Pipeline corridor, extending from the Hawaiian Electric Company’s Barbers Point Tank Farm to the Waiau Generating Station (Rasmussen and Tomonari-Tuggle 2006). The Waiau Fuel Pipeline corridor follows Farrington Highway to Kunia Road, angles *makai* near Kunia Road, then continues east along the OR&L right-of-way near the Pearl Harbor coast. It appears no archaeological monitoring was conducted west of Waipi‘o Peninsula, as the corridor to the west was determined to not be archaeologically sensitive. No historic properties were identified during archaeological monitoring.

3.2.11 Tulchin and Hammatt 2007

In 2007, CSH completed an archaeological literature review and field inspection of an approximately 790-acre parcel at Pālehua, Makakilo (Tulchin and Hammatt 2007). The inspection

covered portions of Makaīwa Gulch, Awanui Gulch, and Kalo‘i Gulch. Overall, 26 historic properties were identified during the field inspection. The study included further documentation of four previously identified historic properties: SIHP # 50-80-08-2316, a *ku‘ula* stone; SIHP # 50-80-12-2601, a pre-Contact wall utilized as a water control feature; SIHP # 50-80-12-2602, a pre-Contact wall possibly utilized for agriculture; and SIHP # 50-80-12-6680, a complex of concrete and iron structures associated with industrial rock quarry operations.

Newly identified historic features (designated with temporary CSH site #s) included CSH 1, wall; CSH 2, mounds; CSH 3, large enclosure; CSH 4, platform; CSH 5, mounds; CSH 6, adze; CSH 7, platform; CSH 8, terraces; CSH 9, enclosure and two small caves; CSH 10, enclosure; CSH 11, mound; CSH 12, platform; CSH 13, enclosure; CSH 14 terrace; CSH 15, wall remnant, hearth, and military “foxhole”; CSH 16, terrace and *hau* thicket; CSH 17, level soil along ridge; CSH 18, enclosure; CSH 19, trail; CSH 20 water tunnel; CSH 21, large boulder with petroglyphs; and CSH 22, enclosure with stone uprights. These potential historic properties were not assigned SIHP #s.

Other than the previously reported SIHP # -6680 complex of structures associated with industrial rock quarry operations, none of the identified historic properties were in the vicinity of the present project area.

3.2.12 Mooney and Cleghorn 2008

In 2008, Pacific Legacy, Inc. conducted an AIS (recorded as an archaeological assessment due to lack of finds) for the proposed Makakilo Quarry expansion (Mooney and Cleghorn 2008). No historic properties were identified; however, the remnants of a modern, abandoned golf course were noted.

3.2.13 Groza et al. 2009

In 2009, CSH conducted an AIS (recorded as an archaeological assessment) for the Ho‘opili project 440-Ft Elevation Reservoir and Water Line project (Groza et al. 2009). No historic properties were identified.

3.2.14 Hunkin and Hammatt 2009

In 2009, CSH completed an archaeological inventory survey for an approximately 62-acre Makakilo Drive extension project (Hunkin and Hammatt 2009). The project documented two newly identified historic properties (SIHP #s 50-80-12-6950 and -6951). Both historic properties are portions of plantation irrigation ditches. The ditches functioned to transport water for irrigation of the sugarcane fields.

In addition to the newly identified historic properties, the project documented a portion of the previously identified SIHP # 50-80-09-2268 alignment. A meeting was held on site within the project area with CSH staff, SHPD staff, and Mr. Shad Kane on 10 February 2009 to discuss the alignment. Mr. Kane led the group along the graded alignment of SIHP # 50-80-09-2268, within the property, indicating the ditch had been constructed over the alignment of an ancient Hawaiian trail. SHPD staff observed the plantation irrigation ditch and associated infrastructure and concurred the alignment was a portion of the Waiahole Ditch System. SHPD staff also concluded the ditch was most likely constructed over the alignment of a pre-Contact Hawaiian trail. SHPD staff expressed a concern that documentation make it clear the pre-Contact Hawaiian trail function

was the dominant function of this designated site in the vicinity (which was then developed as the Waiahole Ditch in the early twentieth century). This discussion of a Hawaiian trail function was understood to apply only to that portion of the Waiahole Ditch System at Kalo‘i Gulch.

Two new features (SIHP # 50-80-09-2268 Features B and C) associated with the main ditch were also documented. These features are drainage-related, with the function of preventing storm water and sediment from entering the main Waiahole Ditch.

3.2.15 Runyon et al. 2010

In 2010, CSH conducted archaeological monitoring for Phase 1B of the North-South Road project (Runyon et al. 2010). No historic properties were identified.

3.2.16 Runyon et al. 2011

In 2011, CSH completed archaeological monitoring for phase 1C of the North-South Road project (Runyon et al. 2011). Two historic properties were identified. A previously identified historic water diversion structure (SIHP # 50-80-12-4664), originally documented by Nakamura et al. (1993), was observed on the southwest edge of Ramp C. A newly identified burnt trash fill layer (SIHP # 50-80-12-7128) was documented directly under Pālehua Road on the west edge of Ramp A.

3.2.17 Pacheco and Rieth 2014

In 2014, IARII conducted an archaeological inventory survey (Pacheco and Rieth 2014) for an East Kapolei Solar Farm project (on approximately 19 acres of TMK: [1] 9-2-002:006).The study documented one historic property: SIHP # 50-80-12-7433, an unpaved early twentieth century road related to ranching and/or sugarcane cultivation in the area, understood as created between 1918 and 1928.

3.2.18 Zapor et al. 2018

CSH conducted a supplemental archaeological inventory survey for the Makakilo Drive Extension project (Zapor et al. 2018). The survey identified two historic properties: remnant portions of the Waiahole Ditch (SIHP # 50-80-09-2268) and irrigation ditches (SIHP # 50-80-12-6951). The project documented an additional feature of the Waiahole Ditch, an earthen mound and stacked stone wall, interpreted as likely remnants of a reservoir (Feature D). SIHP # 50-80-12-6951 was observed as an irrigation ditch and associated retaining wall, pipe, valve, and sluice gate remnants.

3.3 Background Summary and Predictive Model

Background research of Honouliuli Ahupua‘a indicated pre-Contact settlement was centered around the rich cultivated lands of Honouliuli ‘Ili for extensive wetland taro cultivation and abundant coastal resources. The extensive limestone plain also included recurrent use habitations for fishermen and gatherers, and sometimes gardeners. The upland dry forest areas were used for hunting and gathering of forest resources, but likely not for widespread permanent settlement. In the intermediate area between the limestone plain and the upland forests, in the vicinity of the current study area, indigenous Hawaiian activities would have been limited to dryland agriculture within gulches or near springs, and *mauka* to *makai* trails and associated temporary shelters.

Within the “Makaīwa Hills” area, which is southwest of the project area, pre-Contact habitation sites were found clustered in higher elevations above 1,000 ft, and in lower elevations below 500 ft (Hammatt et al. 1991). The higher elevations, where the current study is located, do not contain forest subsistence resources.

In Von Holt’s (1985) accounts of discovering spring water southwest of the study area, it is noted that Kalo‘i had “been a place of which the Hawaiians had known” and the area “had been quite heavily populated before the smallpox epidemic of 1840” (von Holt 1985:138–140). However, there was no mention of observations of any physical evidence of Hawaiian settlement, other than the paved well (Hidden Spring). It is quite possible ranching or agricultural activities destroyed any remnants of Hawaiian occupation prior to the late 1800s.

By 1920, the lands of Honouliuli were used primarily for commercial sugarcane cultivation and ranching (Frierson 1972). Much of the *mauka* lands in western Honouliuli, including ridges and deep gulches, were unsuitable for commercial sugar cultivation and remained pasture land for grazing livestock. Historic maps indicate a lack of any significant development within the study area into the 1940s. Modest constructions in the area included Pālehua Road, allowing access to the uplands of western Honouliuli, as well as plantation infrastructure within and to the south of the study area.

Previous archaeological research in the vicinity of the project area has identified pre-Contact sites including habitation structures (temporary and permanent) and agricultural features (terrace and mounds). Of particular interest are three pre-Contact historic properties located within the *mauka* reaches of Kalo‘i Gulch. All three were determined to be related to erosion control and water management and suggest that in the past water was available, at least on a seasonal basis, in the Kalo‘i Gulch area. Historic properties identified in the vicinity of the study area include plantation-era infrastructure (ditches, flumes, clearing mounds, etc.) related to the Ewa Plantation Company and Oahu Sugar Company.

Based on background research, archaeologists expected to document historic features related to sugarcane cultivation and ranching, including walls, fences, maintained springs, and water tunnels as well as irrigation infrastructure including ditches and flumes related to the Ewa Plantation Company, Oahu Sugar Company, and the Waiahole Ditch System.

Section 4 Results of Fieldwork

The project area consists of a largely undeveloped property with rolling hills and several gulch areas. In general, the sloping lands within the project area are dry, fallow lands that appear to have undergone significant erosion of topsoil. Much of the nearly 101.62-acre project area is covered in thick vegetation including California grass (*Brachiaria mutica*), *koa haole (Leucaena leucocephala*), w*iliwili* (*Erythrina sandwicensis*), sweet acacia or *klu* (*Acacia farnesiana*), and *kiawe* (*Prosopis pallida*) (Figure 27 through Figure 29). The hillside within the project area also exhibited land modification in the form of graded access roads, bulldozed clearings, a portion of the Waiahole Ditch System, and remnants of the abandoned historic irrigation system and plantation infrastructure. Modern barbed wire fences were also observed surrounding the southern border of the project area, indicative of the continued use of portions of the project area for grazing livestock. Cow paths were identified meandering throughout the project area. Various fence posts were observed in the southwest project area, determined not to be associated with those fence lines noted on historic maps of the area based on their location and alignment (Figure 30).

The 1936 U.S. Army War map (see Figure 16) shows a camp (“Pump Camp 5”) located in the central portion of the project area. The camp is last depicted on the 1953 USGS map (see Figure 19). On the 1968 USGS map (see Figure 20) the camp is no longer depicted. An effort was made to identify any remnants of the former camp during fieldwork, but no remnants were identified during the pedestrian inspection.

The pedestrian survey identified two historic properties within the project area: SIHP # 50-80-08-5593, identified as remnant structures associated with water allocation related to plantation activities, and SIHP # 50-80-09-2268, identified as a portion of the Waiahole Ditch System, which extends along the northern boundary of the project area, crossing into the southwest project area and exiting at the southern boundary. Both of these historic properties were previously identified in the immediate area by Dega et al. (1998). The current project documented two features of SIHP # 50-80-08-5593 (Features 1 through 2E), which include retention basins, drain pipes, culvert, sluice gates, and various other components related to water control and retention. Most features of SIHP # 50-80-08-5593 were identified extending northwest to southeast down a slope in the north portion of the project area, designated as a complex related to water control. The complex is related to—and in line with—the pump station and mill building at the base of the hill, just outside the southern boundary of the project area. The complex consists of various water retention components, runoff features, a remnant water tower, pipes, and concrete features likely housing additional pipes. The uppermost components in this complex of features were constructed around a portion of the Waiahole Ditch, and would have utilized water from the ditch, channeling it down the slope to the pump station and mill, where it would have been pumped out to irrigate the surrounding sugarcane fields. One additional feature was identified in the north/central project area.

A remnant portion of the Waiahole Ditch (SIHP # 50-80-09-2268) extends along the northern boundary of the project area. Toward the western portion of the project area, the Waiahole Ditch crosses through the project area and extends to the southwest. The ditch extends underground through much of the project area. Observed portions of the ditch displayed culverts, bridges, tunnels, and flumes. Composition of the ditch varied from entirely earthen portions to concrete

Figure 27. Overview of southwest portion of project area, view to southwest

Figure 28. Overview of southwest portion of project area, view to west

Figure 29. Overview of northern portion of project area, view to northeast

Figure 30. Representative photo of fence posts noted in southwest portion of project area, view to southeast

and basalt lined portions. A former road that is likely an access road for the Waiahole Ditch was noted within the northern and northeastern boundaries of the project area. Portions of the Waiahole Ditch outside the project area were photographed and briefly described, included in the description of the Waiahole Ditch in Section 5 below. The project also documented seven new features of SIHP # 50-80-09-2268 (Features E through K), including sluice gate features, a drainage flume, culverts, and bridges. The portion of the Waiahole Ditch within the project area extends along the northern boundary and northeast-southwest through the southwest project area. Along this trajectory, one of the features was documented near the southern boundary of the project area (Feature E), two toward the central project area (Features F and G), three near the northern boundary of the project area (Features H, I, and J), and one in the northeast project area (Feature K). For detailed descriptions of all features of the two historic properties identified within the project area, refer to Section 5.

Within the project area, the former roads first recorded on the 1936 U.S. Army War Department map are currently in remnant condition. Temporary water diversion remnants related to the roads, identified as portable concrete flumes, were recorded in two locations along the edge of the former roads, in the west portion of the project area. The first documented portable flume spans approximately 10.6 m long and is oriented northeast-southwest (Figure 31). The second documented portable flume spans approximately 10.5 m in length and is oriented east to west (Figure 32). These remnant sections initially consisted of connected concrete troughs used to divert water from one place to another. As these components were temporary fixtures in remnant condition, they do not retain association with any potential historic properties and are not considered features.

Following the initial pedestrian inspection, the project area boundaries were altered slightly, extending to the north and the west, as well as south to encompass the existing access roads to be used for the project. Additional pedestrian inspection was conducted for these areas. The access roads that may be impacted consist of either paved or gravel roads. It is clear that modifications and upgrades have been made to the various access roads over the years. A portion of the northeast-southwest oriented access road is lined with a concrete curb (Figure 33). Some areas of the access road appear to consist of only dirt, though it may be this is actually material deposited on the road due to rain and erosion, and there may still be paved road underneath (Figure 34). This road reaches a junction, and in one direction the pavement continues, while the other direction is gravel (Figure 35). Access manholes for water lines were noted along the paved access road (Figure 36). A modern concrete culvert was noted at the base of the gravel access road (southernmost tip of the project area, west branch), allowing water flow under the road (Figure 37).

An additional, more intact concrete flume was identified *mauka* (northwest) of SIHP # -2268 Feature H, of similar composition to those noted in the western project area. Oriented east/west, this flume extends for 21 m in length, with each segment measuring 75 cm long, 45 cm wide, and 30 cm tall (Figure 38). Each concrete segment has a square hole near the base on each side, with a metal L-shaped insert, likely used for controlling water flow out of the flume (Figure 39). Again, this flume appears to have been used for water diversion related to the access roads.

Archaeologists walked a gulch now situated within the project area from the northern boundary down to the access road (Figure 40). Metal debris from an unknown source was noted within the gulch toward the north edge of the project area (see Figure 40); no historic properties were identified.

Figure 31. Remnant water diversion flume in southern project area, view to northwest

Figure 32. Remnant water diversion flume in southern project area, view to north

Figure 33. Access road encompassed within the project area, paved and lined with concrete curb, view to southwest

Figure 34. Overview of dirt (or dirt-covered) access road, view to northeast

Figure 35. Overview of access road junction, view to south

Figure 36. Access road overview showing water manhole, view to northeast

Figure 37. Overview of modern concrete culvert at the base of the access road (junction with Palehua Road), view to northeast

Figure 38. Overview of concrete flume in central northern project area, view to southeast

Figure 39. Plan view of concrete flume in central northern project area

Figure 40. Overviews of the gulch inside the project area, view to southwest (left), view to northeast with observed metal debris (right)

Section 5 Historic Property Descriptions

Two historic properties were identified within and immediately adjacent to the current project area during this AIS (Figure 41). SIHP # 50-80-08-5593 consists of remnants of an historic irrigation system and plantation infrastructure (Figure 42), and SIHP # 50-80-09-2268 designates (a portion of) the Waiahole Ditch System (see Figure 80). These historic properties within the project area are described below.

5.1 SIHP # 50-80-08-5593

FORMAL TYPE:	Historic Irrigation System and Plantation Infrastructure
FUNCTION:	Agriculture/water control
NUMBER OF FEATURES:	15 total; two newly identified (designated here as Feature 1 and Feature 2 (2A through 2E)
AGE:	1920s and continuing through the early 1990s
SIZE:	625 sq m (designated features only)
LOCATION AND DISTRIBUTION:	Concentrated in northern portion of project area extending in a line northwest-southeast, plus one feature on the southern boundary and one in the northeast project area
TMK:	[1] 9-2-002
LAND JURISDICTION:	State of Hawai‘i
PREVIOUS DOCUMENTATION:	Dega et al. 1998

SIHP # 50-80-08-5593 consists of an historic irrigation system and components of plantation infrastructure. Most of SIHP # 50-80-08-5593 was documented extending northwest to southeast, beginning outside the north boundary of the project area through the central portion. One isolated feature was documented within the northeast project area. The boundaries of SIHP # 50-80-08-5593 extend well beyond the current project area, as features of the historic property were documented northeast of the current project area by Dega et al. (1998). Table 3 lists all features considered components of this historic property both by Dega et al. 1998 and the present study.

5.1.1 Description of SIHP # -5593 by Dega et al. 1998

A 1998 archaeological inventory survey for the (then proposed) University of Hawai‘i West O‘ahu Campus (Dega et al. 1998) addressed a 991-acre area that encompassed the entire present project area. Dega et al. (1998) documented components of a newly identified historic property, designated SIHP # 50-80-08-5593.

The study mentions the mill building and pump station (“Pump Station 12”), “adjacent to the lower agricultural fields” (see Figure 42 through Figure 44). The current study noted the mill building and pump house are presently enclosed by chain-link fencing. The authors of the 1998 study also mention other features including flumes, dikes, dams, and pumps, but do not include documentation of such features. The provided site location map from the 1998 study (Figure 43)

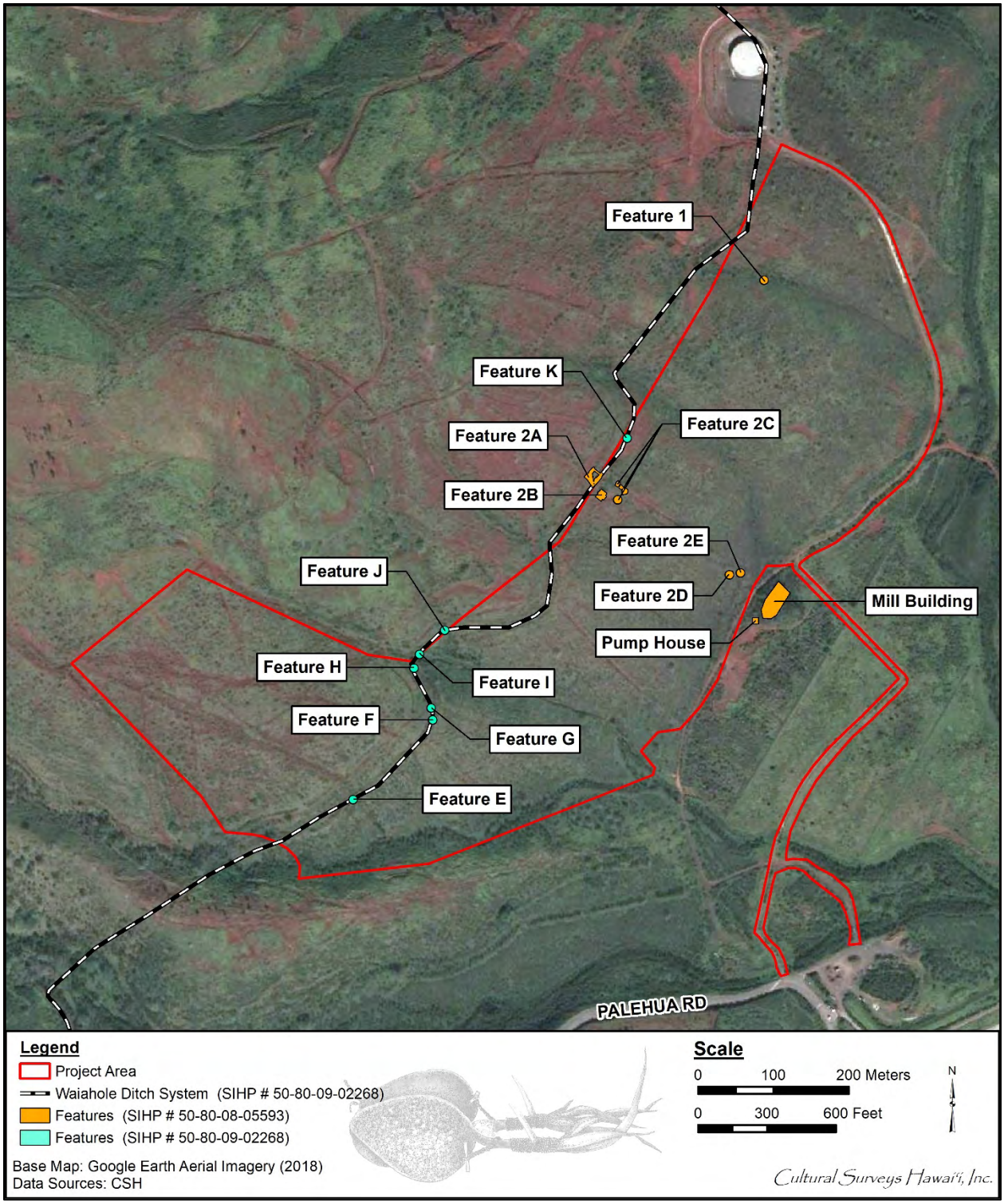


Figure 41. Aerial photograph showing the historic properties identified during the AIS: SIHP # 50-80-08-2268 Feature E through Feature K (shown in green) and SIHP # 50-80-08-5593 Feature 1 and Features 2A through 2E (shown in orange) (Google Earth 2018)

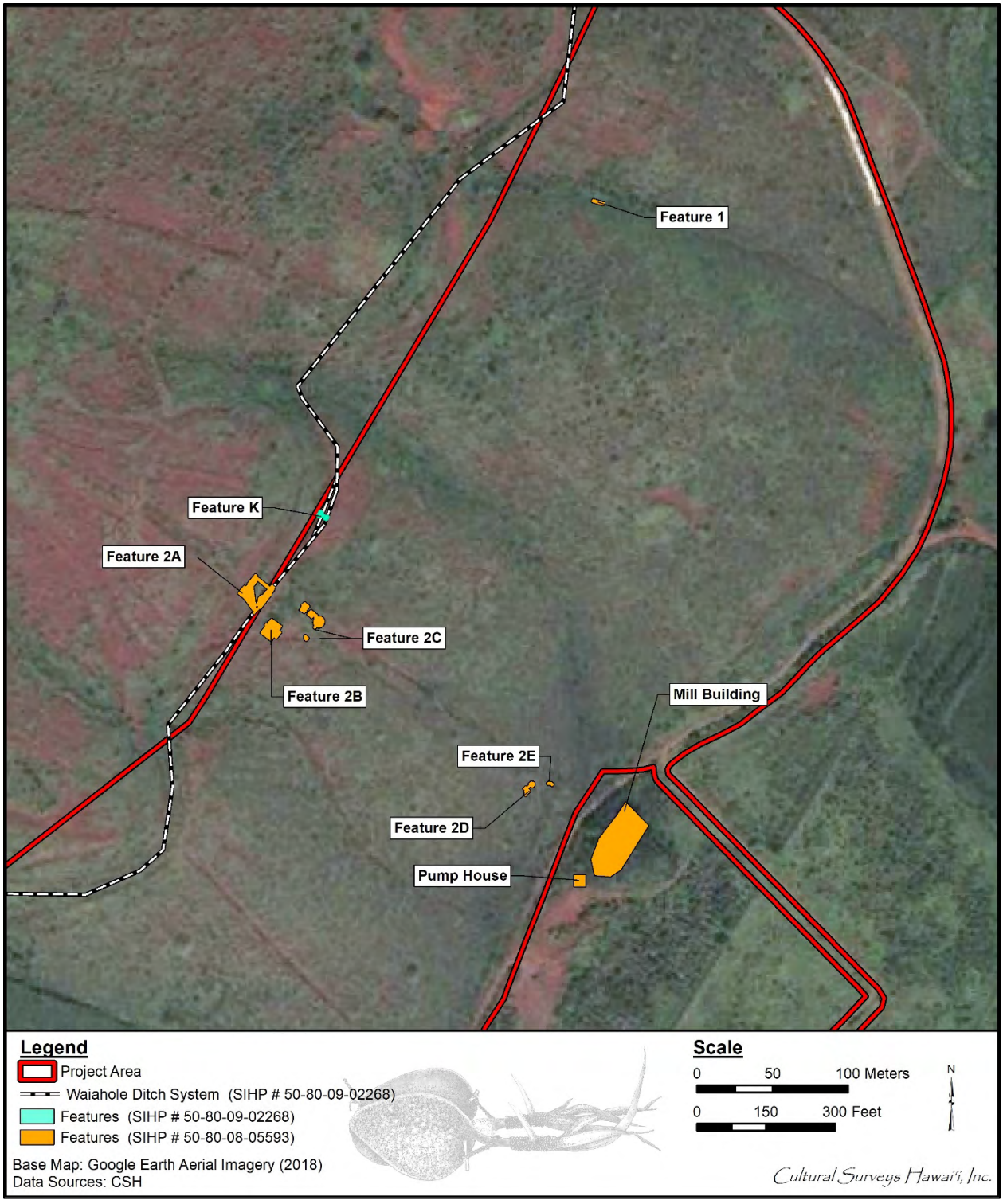


Figure 42. Aerial photograph (Google Earth 2018) depicting the distribution of features of SIHP # 50-80-08-5593 (Feature 1 and Features 2A through 2E) within the project area

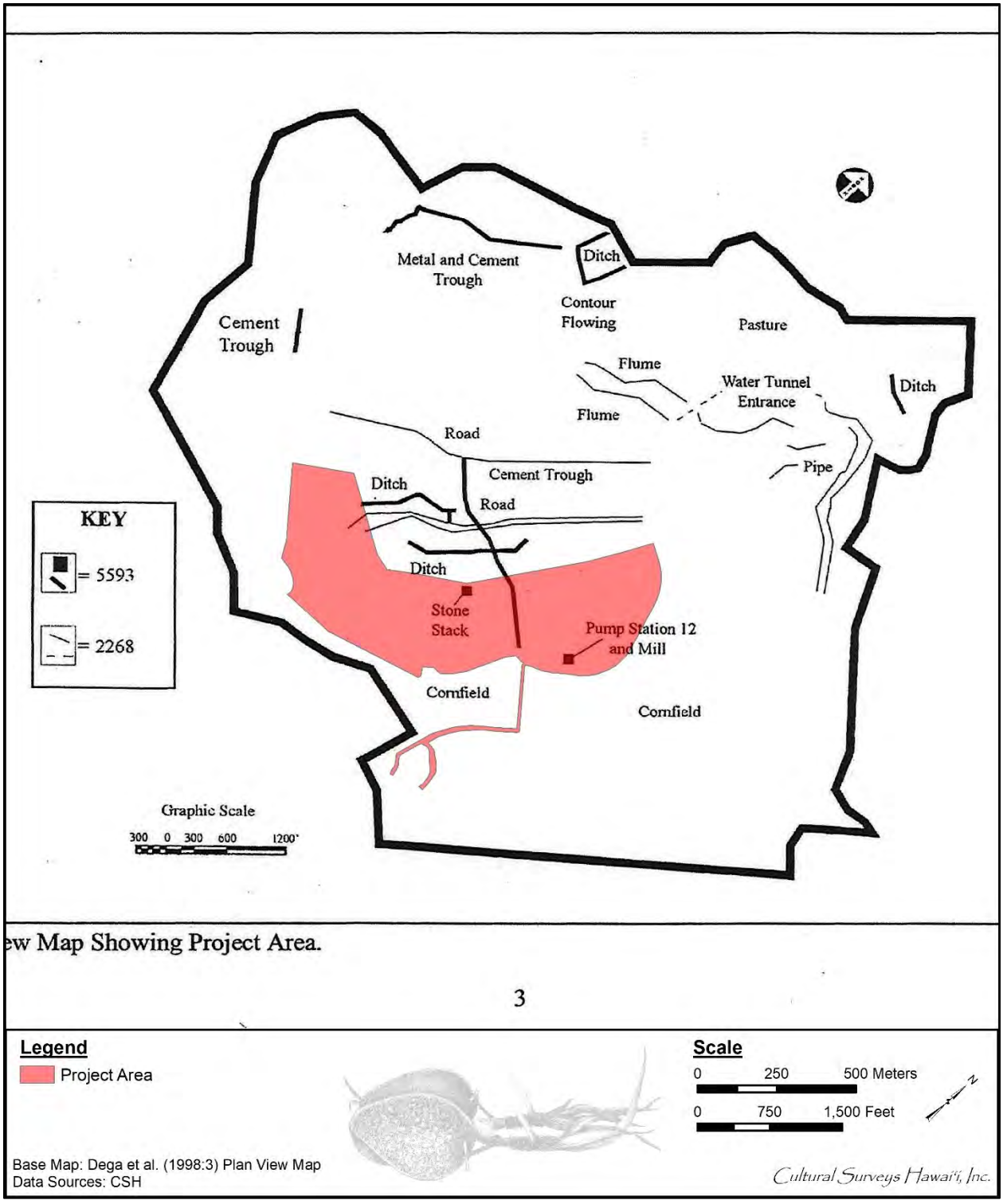


Figure 43. Figure from Dega et al. (1998) showing identified features of two historic properties (Dega et al. 1998:3), with overlay of current project area

Table 3. SIHP # 50-80-08-5593 (Dega et al. 1998 did not designate feature numbers)

Feature #	Brief Description	Reference
—	Mill building containing pumping machinery	Dega et al. 1998
—	Pump House 12	Dega et al. 1998
—	Water pump feature (concrete, wood, and pumping mechanism)	Dega et al. 1998
—	Irrigation system bridge (basalt and mortar, inscribed date of 1928)	Dega et al. 1998
—	Stone stack (not described, plotted on figure)	Dega et al. 1998
—	Two concrete and metal troughs	
—	Four earth-lined water transport ditches	Dega et al. 1998
—	Two concrete troughs, 45 cm wide and 45 cm high	Dega et al. 1998
1	Concrete and metal drain pipes	Current study
2A–2E	Complex including formal portion of the Waiahole Ditch, water catchment/retention features, flumes, and associated pumping mechanisms	Current study

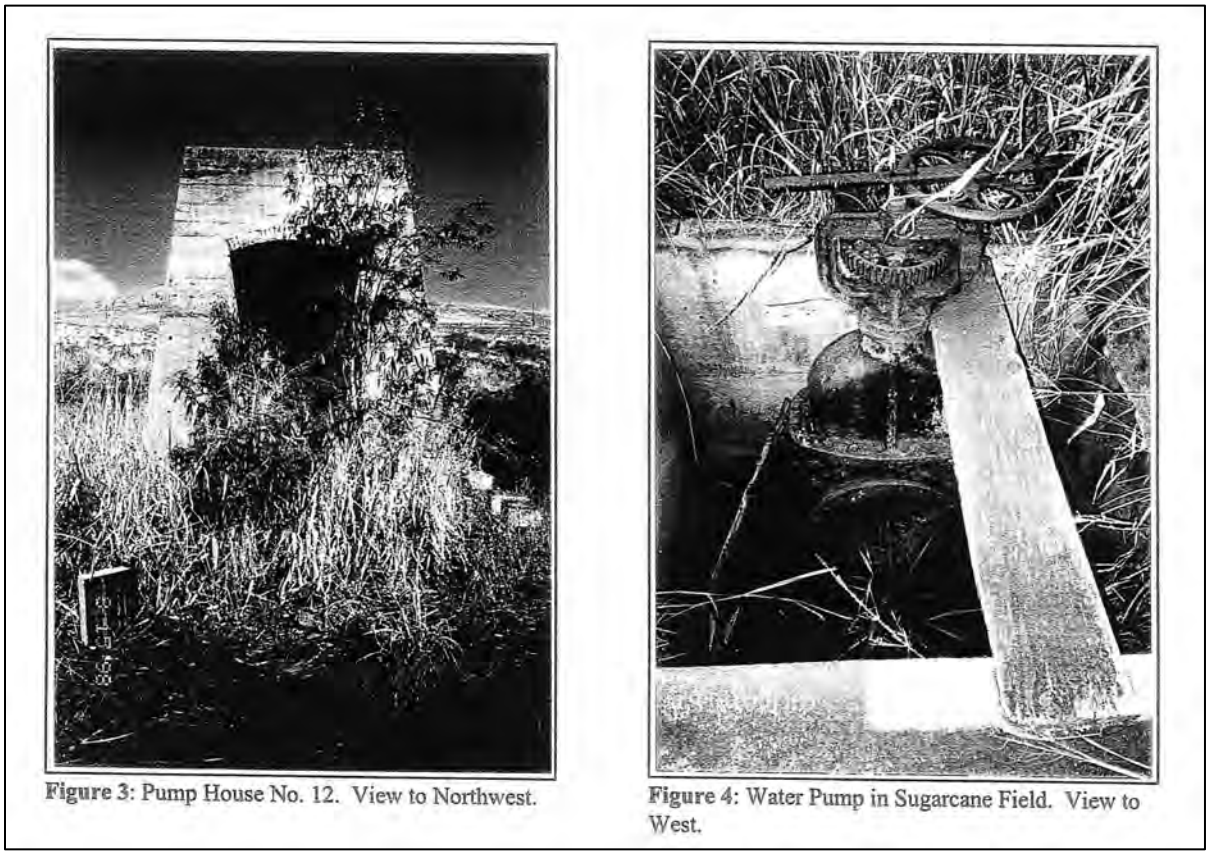


Figure 3: Pump House No. 12. View to Northwest.

Figure 4: Water Pump in Sugarcane Field. View to West.

Figure 44. Features of SIHP # 50-80-08-5593 documented by Dega et al. (1998:15)

calls out a “Stone Stack,” two “Flumes,” a “Water Tunnel Entrance,” and a “Pipe” (or pipes) that appear to have no textual discussion. The study includes a photo that depicts what appears to be a rather elaborate “Irrigation system bridge” dated 1928—understood as relating to at least one of the “Flume” annotations on the plan map (Figure 45) and as outside the present project area.

According to the authors, the study documented various distinct features: two metal and concrete troughs, four small earth-lined water transport ditches, and two concrete ditches or troughs. No feature numbers were designated in the Dega et al. (1998) study. The 1998 study describes the documented components of the historic property as follows:

> Also found on the subject parcel are the remnants of a system which appears to have been designed to gather and transport water for local use. This sites [*sic*] includes a network of small concrete troughs c. 45 cm wide and 45 cm high. These were observed along the summit ridgeline to the northeast of Pu‘u Kapua‘i, from where it entered a ditch system on the lower slopes. Remnant sections of these troughs were also found on the western and southern slopes of Pu‘u Kapua‘i and within the 38 acre parcel which forms the northeastern corner of the project area. Smaller earthen ditches are found throughout the project area, particularly on the east-facing slope at the northern area of the project. Connections of this system with the Waiahole Ditch system were not observed. Water collected and transported through this system was probably used for local ranch operations, extensive sugarcane cultivation, and small-scale agriculture. Because of the leeward location of this parcel, water would flow into this system almost exclusively during Kona or southerly storms. Thus, a total of eight features comprise Site 5593: metal and cement troughs (2), small earth-lined water transport ditches (4), solely cement constructed ditches or troughs (2) and an area containing large clearing mounds adjacent to the lower agricultural fields (1) [The plan view map in their report is referenced].
>
> Of additional interest is a large wooden building (part of Site 5593), presumably constructed in the late 1920’s and utilized through the 1950’s, that occurred on the southern flank of Pu‘u Kapua‘i’s base. This structure and associated pumping system, designated as Pump 12 by Wilcox (1996:106), contained steam engine driven pumps. The preponderance of coal within the building and mechanisms observed through the structure allow for the inference that this indeed was a steam-driven pumping station. These steam pumps were likely needed for transport of water to fields as gravity alone was not enough to propel the water into lower ‘Ewa Plain sugarcane fields. Steam-driven pumps allowed cultivators to propel water into these lower reaches. [Dega et al. 1998:19]

5.1.2 Description of SIHP # -5593 within and adjacent to the Current Project Area

Features documented during the current AIS consist of concrete and metal drain pipes (Feature 1) and a complex of water control features (Features 2A through 2E) associated with the previously documented pump house and mill building (Figure 46 and Figure 47) just southeast (outside) of the present project area. It is likely that subsurface remnants, such as pipes, are present between Feature 2A and the mill building.

Figure 5: Pumping Machinery at Mill Adjacent to Pump House No. 12. View to North.

Figure 6: Irrigation System Bridge. Note Date of 1928 in Center of Bridge. View to Southeast.

Figure 45. Features of SIHP # 50-80-08-5593 documented by Dega et al. (1998:16)

Figure 46. Mill building immediately southeast of the project area boundary (downslope of Feature 2A complex), view to east

Figure 47. Pump House No. 12, southeast of the project area (mill building to the left), view to southeast

SIHP # 50-80-08-5593 Feature 1 consists of plantation-era drain pipes located within a ditch in the northeast portion of the project area (see Figure 42 for location). It is possible this feature was identified during the Dega et al. (1998) study, however, this could not be definitively discerned based on that documentation. The upper/west end of this feature consists of a single observable concrete pipe approximately 35 cm in diameter (the second pipe is likely obscured by collapsed earth) with overlying concrete rubble and stacked basalt, three stones wide and two to three courses high (Figure 48). This upper portion measures 82 cm tall and 90 cm wide. The east/lower end of Feature 1 consists of two steel pipes (Figure 49 and Figure 50), each approximately 35 cm in diameter, and the exposed portions approximately 40 cm tall. The function of this feature is related to agriculture and water control. Feature 1 is in fair condition, as much of the area is overgrown and heavily eroded.

SIHP # 50-80-08-5593 Feature 2 is a complex encompassing six structures (Features 2A through 2F) associated with the mill building and Pump House 12 (see Figure 42 for location, and Figure 51 through Figure 62). The Feature 2 complex begins at the northern boundary of the project area and extends southeast through the central portion of the project area down the natural slope. The complex is made up of six structures designed to move water from the Waiahole Ditch down the hillside to the pump house and mill building. According to Dega et al. (1998), steam engine pumps would disperse the water to sugarcane fields, likely those situated both above and below the pump house and mill. The entire complex measures approximately 240 m in length.

SIHP # 50-80-08-5593 Feature 2A, the uppermost portion of the complex, consists of various water catchment features attached to a portion of the Waiahole Ditch, related to the mill and pump house at the base of the slope (see Figure 51, Figure 52, and Figure 62). This portion is oriented northeast-southwest, and constructed of basalt, concrete, and metal pipes. The Feature 2A complex is situated on the northwest boundary of the project area. Portions of this upper complex contain modern rubbish (modern bottles and cans), as well as a cow skeleton, likely a livestock animal that fell, died, and decayed in place. The northeast portion of this section of the Waiahole Ditch consists of a concrete-lined ditch 140 cm wide and 163 cm deep. As it extends toward the Feature 2A complex, there is an overlying addition of mortared basalt three courses high, a portion of which bears the date inscription “MAR 1939” (Figure 53). The ditch then feeds into a large catchment basin measuring a maximum of 4.0 m long and 3.2 m wide, with a maximum depth of 180 cm. The basin is flanked by notches in the concrete on both sides, for former sluice gates which are no longer intact. The basin would have fed into the two drain pipes at the base of the southeast wall of the structure (Figure 54). These pipes extend down the slope to the pump house and mill. Portions of these pipes are exposed on the slope’s surface, and much of the pipes are likely intact underground.

An additional water retention component is positioned directly northwest of this basin. This portion consists of a rectangular mortared basalt catchment area measuring 5.1 m long by 3.8 m wide (Figure 55), feeding into an oval catchment area measuring 6.3 m long and 2.6 m wide (Figure 56), with notches for a sluice gate feature in between (gate not intact). It is possible these catchment areas are gravel traps, which would have served to trap silt and clay (Reeves 1954). This function is suggested based on the complex shape of the structure, which is somewhat similar to a gravel trap from the Iao-Maniania Ditch pictured in a publication on plantation ditches (Figure 57; Wilcox 1996). Three flumes feed from the upper catchment areas into the Waiahole Ditch (Figure 58 and Figure 59). The flumes are oriented north-south and northwest-southeast. The eastern flume

Figure 48. Upper portion of SIHP # 50-80-08-5593 Feature 1 showing concrete pipes, view to east (collapse to the southwest, at right, may have covered the second pipe)

Figure 49. Lower portion of SIHP # 50-80-08-5593 Feature 1 showing metal pipes, view to northwest

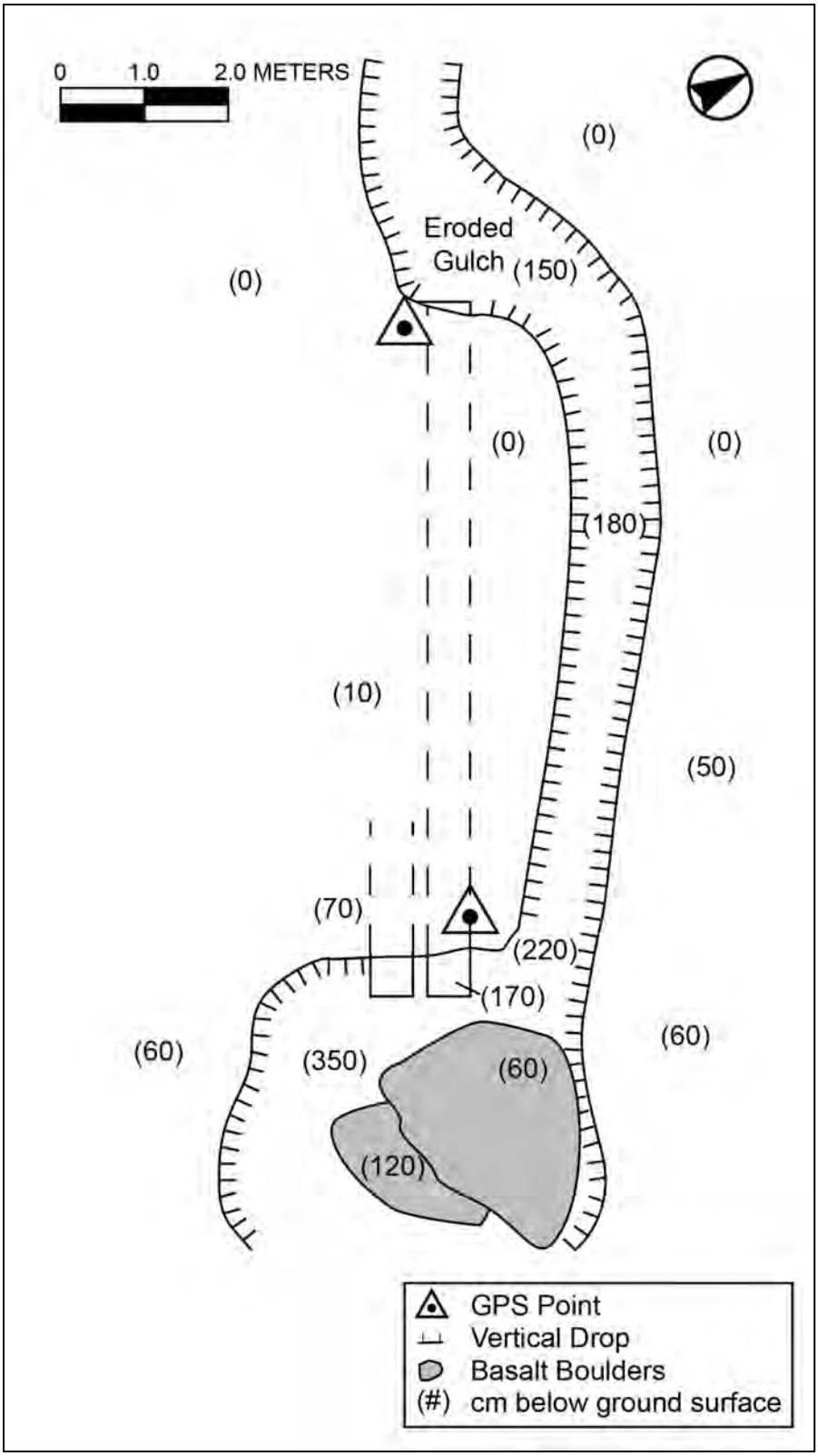


Figure 50. SIHP # 50-80-08-5593 Feature 1 plan map

Figure 51. Overview of SIHP # 50-80-09-2268 Waiahole Ditch portion, and SIHP # 50-80-08-5593 Feature 2A complex, with the pump house and mill building at the base of the slope, view to southeast

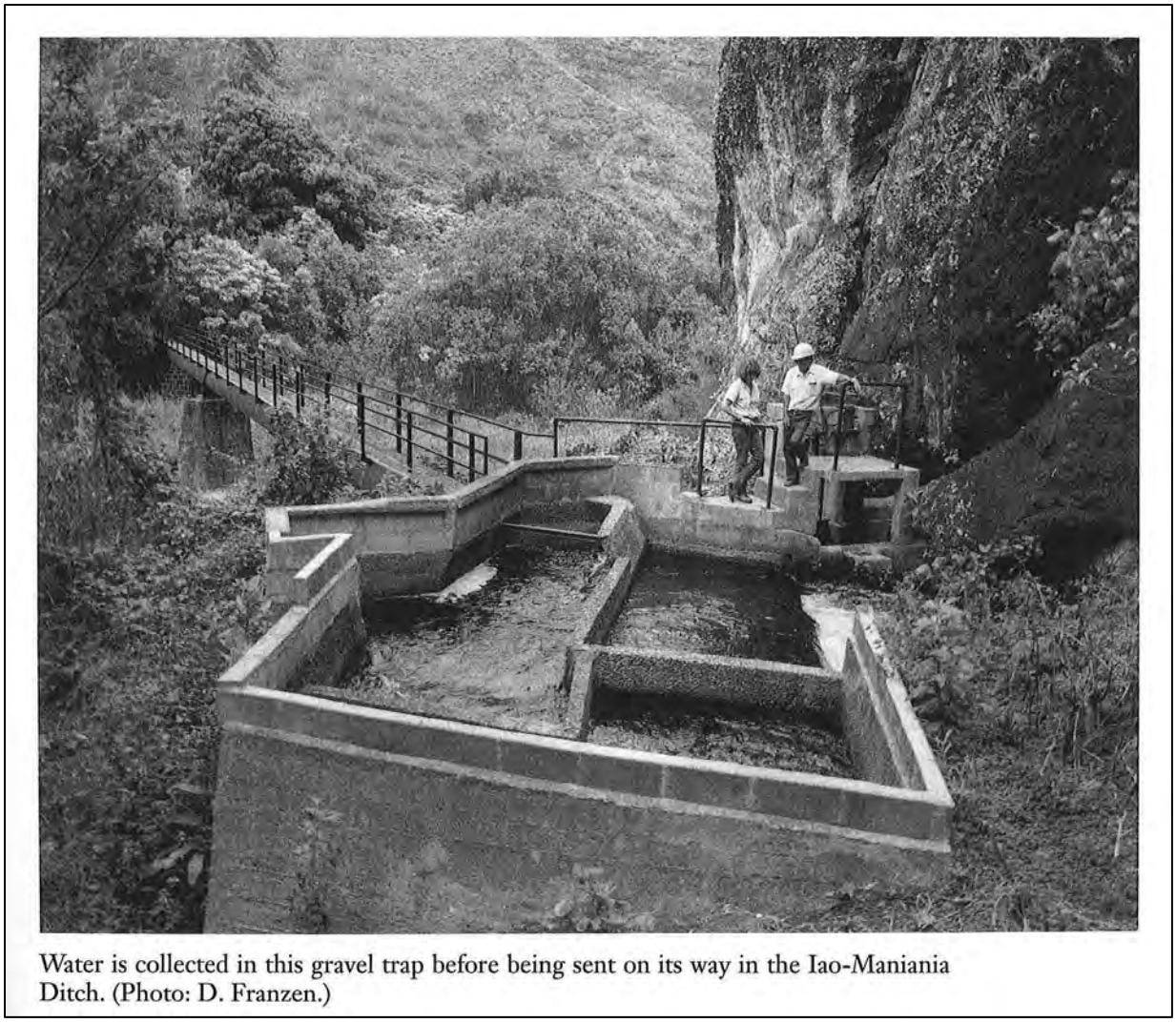
Figure 52. Overview of SIHP # 50-80-09-2268 Waiahole Ditch portion, and SIHP # 50-80-08-5593 Feature 2A complex, view to north

Figure 53. Plan view showing inscription in SIHP # 50-80-08-5593 Feature 2A complex

Figure 54. Overview of SIHP # 50-80-08-5593 Feature 2A and SIHP # 50-80-09-2268 Waiahole Ditch portion, with catchment basin (foreground) and drain pipes, view to east

Figure 55. Upper water retention area of SIHP # 50-80-08-5593 Feature 2A complex, view to west

Figure 56. Upper water retention areas (eastern portion) of SIHP # 50-80-08-5593 Feature 2A complex, view to northeast



Water is collected in this gravel trap before being sent on its way in the Iao-Maniania Ditch. (Photo: D. Franzen.)

Figure 57. Figure showing an example of a gravel trap on the Iao-Maniania ditch system on Maui (from Wilcox 1996:125)

Figure 58. Center flume of SIHP # 50-80-08-5593 Feature 2A complex extending from upper catchment area into SIHP # 50-80-09-2268 Waiahole Ditch, view to west

Figure 59. Overview of SIHP # 50-80-08-5593 Feature 2A complex with eastern flume (right), extending into SIHP # 50-80-09-2268 Waiahole Ditch, view to northwest

Figure 60. Water retention component of SIHP # 50-80-09-5593 Feature 2A complex, view to west

Figure 61. Plan view of SIHP # 50-80-09-5593 Feature 2A complex, water retention component, view to northwest

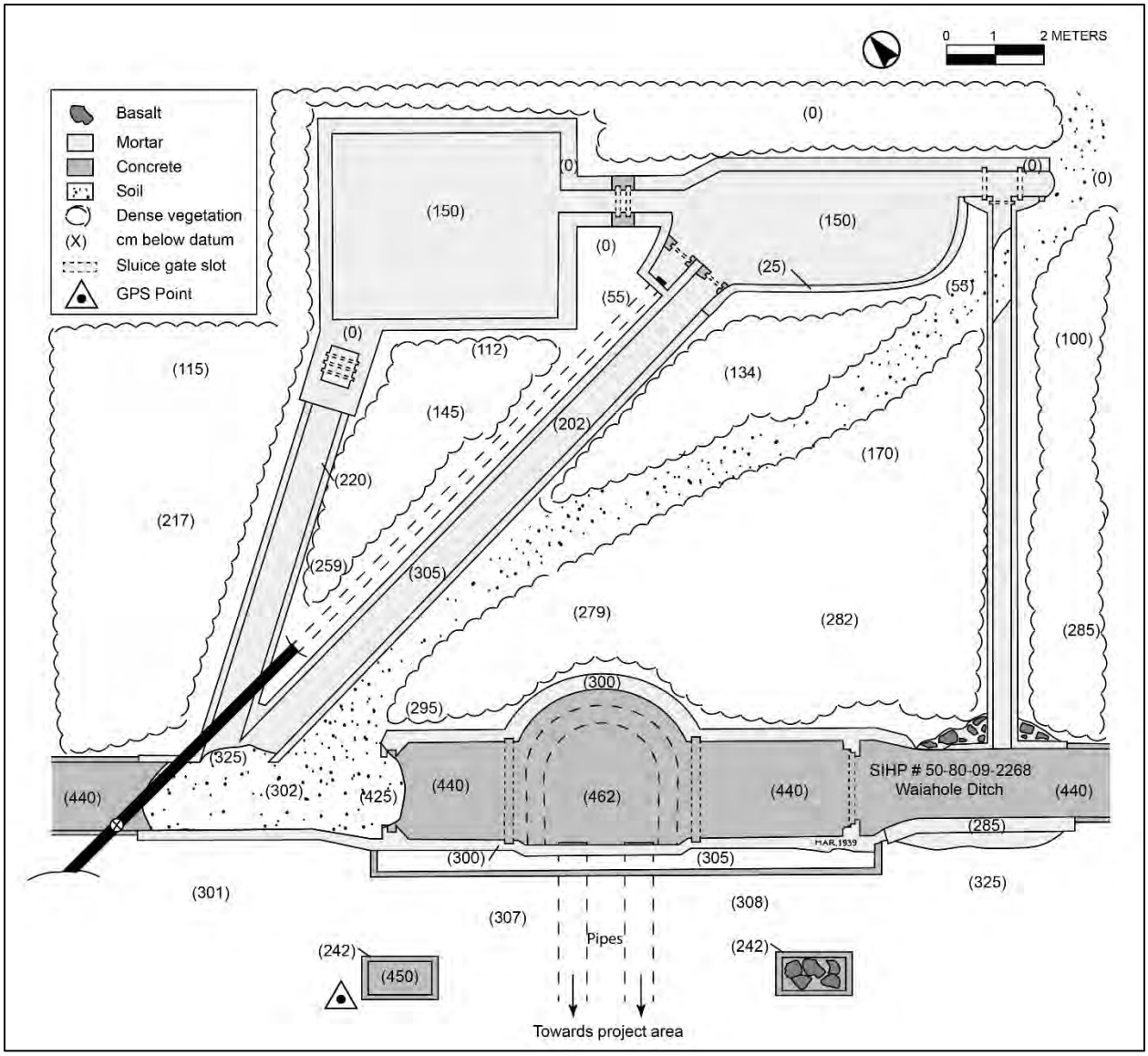


Figure 62. Plan map of SIHP # 50-80-08-5593 Feature 2A water diversion complex (just northwest of project area)

measures 11.0 m long and 0.6 m wide, the center flume measures 12.8 m long and 0.6 m wide, and the western flume measures 7.1 m long and 0.6 m wide.

The final components of the Feature 2A complex are two small rectangular water retention features, each measuring 152 cm long, 90 cm wide, and 118 cm deep, with 16-cm thick walls (see Figure 60). The south wall of the southwest retention feature contains a slit in the concrete that has a wood insert with an attached steel measuring rod (see Figure 61). The wood and steel components no longer exist in the northeast retention feature, but the slit in the concrete remains on the south wall of this component.

Descending the hillside from Feature 2A are various structures related to moving water down to the mill and pump house, including water retention areas, and concrete pads and boxes that housed pumps and pipes.

SIHP # 50-80-08-5593 Feature 2B is a rectangular water retention structure into which water from the upper Feature 2A complex/Waiahole Ditch would have been channeled (Figure 63 through Figure 66). Feature 2B measures approximately 15.2 m long, 10.6 m wide, extends 1.38 m above surface, and is a maximum depth of 3 m deep from top to bottom (see Figure 63 and Figure 64). The main structure, constructed entirely of concrete, consists of a large rectangular structure divided into two open rectangles by a concrete wall extending through the middle. The walls of the structure measure 25 cm wide, and the three northwest-southeast oriented walls have notches cut out of the surface that are 18 cm deep and range from 30 cm to 150 cm long. Two metal pipes extend out of the earth into the northeast half of the structure, at one time transporting water from the upper portion of the complex into this retention feature. Attached to the larger structure is a small rectangular portion, measuring 4.25 m long and 2.05 m wide, and containing a metal rung ladder descending into the structure and several metal pipes, which presumably continued transporting the water down the hillside (see Figure 65).

SIHP # 50-80-08-5593 Feature 2C consists of water tank remnants and related components (Figure 67 through Figure 71). The water tank was constructed of a concrete foundation with a wooden structure held together with steel cables. The wooden structure is no longer in place, leaving behind the 11 steel cables, concrete foundation, and several metal pipes (see Figure 67). The connected circular cable remnants measure a maximum 6.2 m in diameter, and the entirety of the remnants cover an area measuring 7.8 m long and 7.4 m wide. Two concrete squares measuring 80 cm by 80 cm and containing valves were documented immediately southwest of the water tower remnants (see Figure 68). A smaller related structure is 2.6 m northwest of the water tower remnants, which consists of a rectangular concrete structure measuring 3.0 m long and 2.8 m wide (see Figure 69). The northeast half of the structure is a solid concrete slab, and the southwest half of the structure is an open concrete rectangle containing metal pipes. The solid slab likely contains additional pipes related to the water control complex. Another 2.8 m northwest is an additional structure of concrete slabs and pipes, measuring 5.2 m long and 3.8 m wide. Additionally, approximately 7.4 m southwest of the water tower remnants is a damaged concrete component (see Figure 70). This concrete feature consists of three concrete walls—15 cm thick and a maximum 80 cm tall—that have broken and collapsed into a triangle shape. One metal pipe remains inside the collapsed walls. The tank is not noted on the 1943 Army War Department terrain map but appears on the 1953 Ewa and Schofield Barracks topographic quadrangles as a

Figure 63. Overview of SIHP # 50-80-08-5593 Feature 2B, showing dividing wall between two large water storage components, view to northeast

Figure 64. Overview of SIHP # 50-80-08-5593 Feature 2B, showing two large water storage compartments (background) and smaller compartment containing pipes and valves (foreground), view to northwest

Figure 65. Overview of SIHP # 50-80-08-5593 Feature 2B, smaller southeast portion, view to northeast

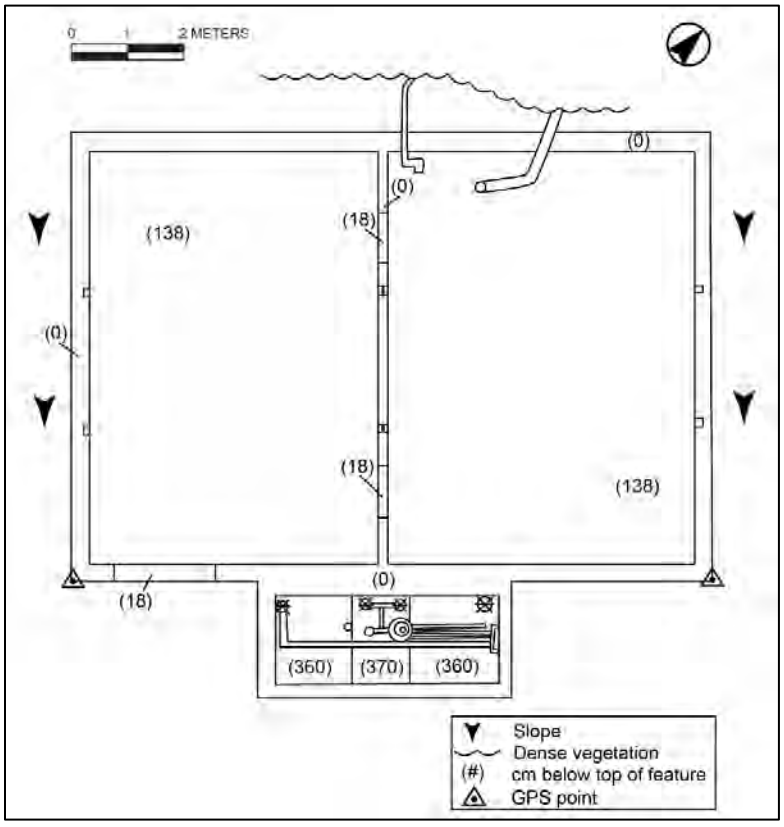


Figure 66. SIHP 3 50-80-08-5593 Feature 2B plan map

Figure 67. SIHP # 50-80-08-5593 Feature 2C, water tank and associated components, view to northeast

Figure 68. Concrete valve components of SIHP # 50-80-08-5593 Feature 2C, view to west

Figure 69. Overview of concrete foundation and pipes component of SIHP # 50-80-08-5593 Feature 2C, view to southeast

Figure 70. Collapsed walls with pipe, component of SIHP # 50-80-08-5593 Feature 2C, view to southeast

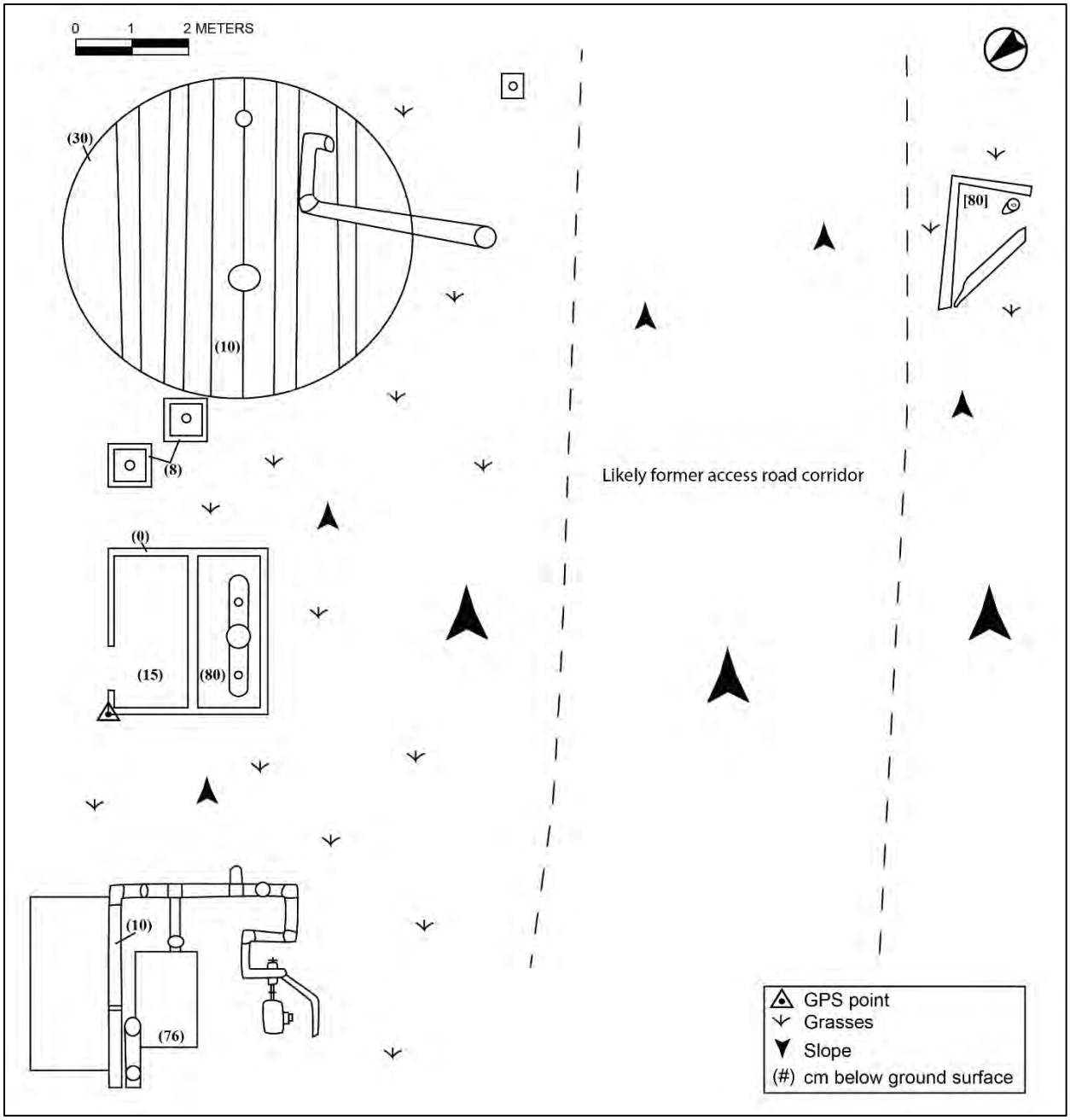


Figure 71. Plan map of SIHP # 50-80-08-5593 Feature 2C, water tank remnants and associated components

marked circular feature labeled “Water Tank” in the same location as the documented Feature 2C (see Figure 17 and Figure 19). Structures are visible in this general area as late as 1968, including an apparent circular structure, which is likely the water tank (see Figure 21; UH MAGIS 1968).

SIHP # 50-80-08-5593 Feature 2D, a rectangular-shaped likely water retention feature, is situated near the base of the slope toward the pump house and mill building (Figure 72 through Figure 76). This is constructed of concrete, metal, and wood. The feature has three components: two rectangular shafts and one concrete culvert. The first portion measures 2.4 m long and 2.0 m wide, consisting of a rectangular shaft extending to a maximum depth of 215 cm with an attached small square shaft extending to a maximum depth of 205 cm (see Figure 72). A metal pipe oriented north-south extends from inside the rectangular shaft out above ground for 3.6 m before extending downward into the shaft of the second rectangular component. The second rectangular shaft measures 2.1 m long and 1.2 m wide, extending to a maximum depth of 215 cm (see Figure 73). This second retention shaft includes notches for an intact wooden sluice gate on the east edge, which leads out into a sloped, mortared basalt channel, possibly for overflow runoff (see Figure 74 and Figure 75). The mortared basalt portion measures 3.6 m long by 1.4 m wide and is two courses high (exposed portion is 50 cm tall on average). This feature may be connected to Feature 2E, described below, as a pipe in the squared shaft on the northeast end appears to extend in the direction of Feature 2E (see Figure 75). Apparent infrastructure is observed in the vicinity of this feature in a 1951 aerial photograph (see Figure 18; UH MAGIS 1951).

SIHP # 50-80-08-5593 Feature 2E consists of a remnant concrete culvert (see Figure 76 through Figure 78). Feature 2E is in poor condition and measures 2.4 m long and 0.75 m wide. Feature 2E is in the lower portion of the project area and appears to have been used to help channel water overflow runoff. A pipe was observed in a shaft of Feature 2D extending in the direction of 2E, suggesting water overflow was channeled from the retention feature out of Feature 2E.

5.1.3 Significance

SIHP # 50-80-08-5593, historic irrigation system and plantation infrastructure, was previously assessed by Dega et al. (1998) as significant under Hawai‘i State historic property significance Criteria a (be associated with events that have made an important contribution to the broad patterns of our history) and d (has yielded, or may be likely to yield, information important for research on prehistory or history). The current study assesses SIHP # 50-80-08-5593 as significant only under Criterion d. This historic property has yielded information on land utilization and agricultural history of the ‘Ewa Plain. However, it is suggested that SIHP # 50-80-08-5593 did not make an important contribution to the broad patterns of our history, unlike the Waiahole Ditch, which immeasurably altered the entirety of the landscape. The historic property possesses integrity of location, design, materials, and workmanship.

Figure 72. Overview of SIHP # 50-80-08-5593 Feature 2D, northeast valve box, view to east

Figure 73. Overview of SIHP # 50-80-08-5593 Feature 2D, southwest valve box, view to southwest

Figure 74. SIHP # 50-80-08-5593 Feature 2D sluice gate and possible water overflow channel, view to northeast

Figure 75. Feature 2D plan view of southern retention area with sluice gate and possible overflow channel, view to southwest

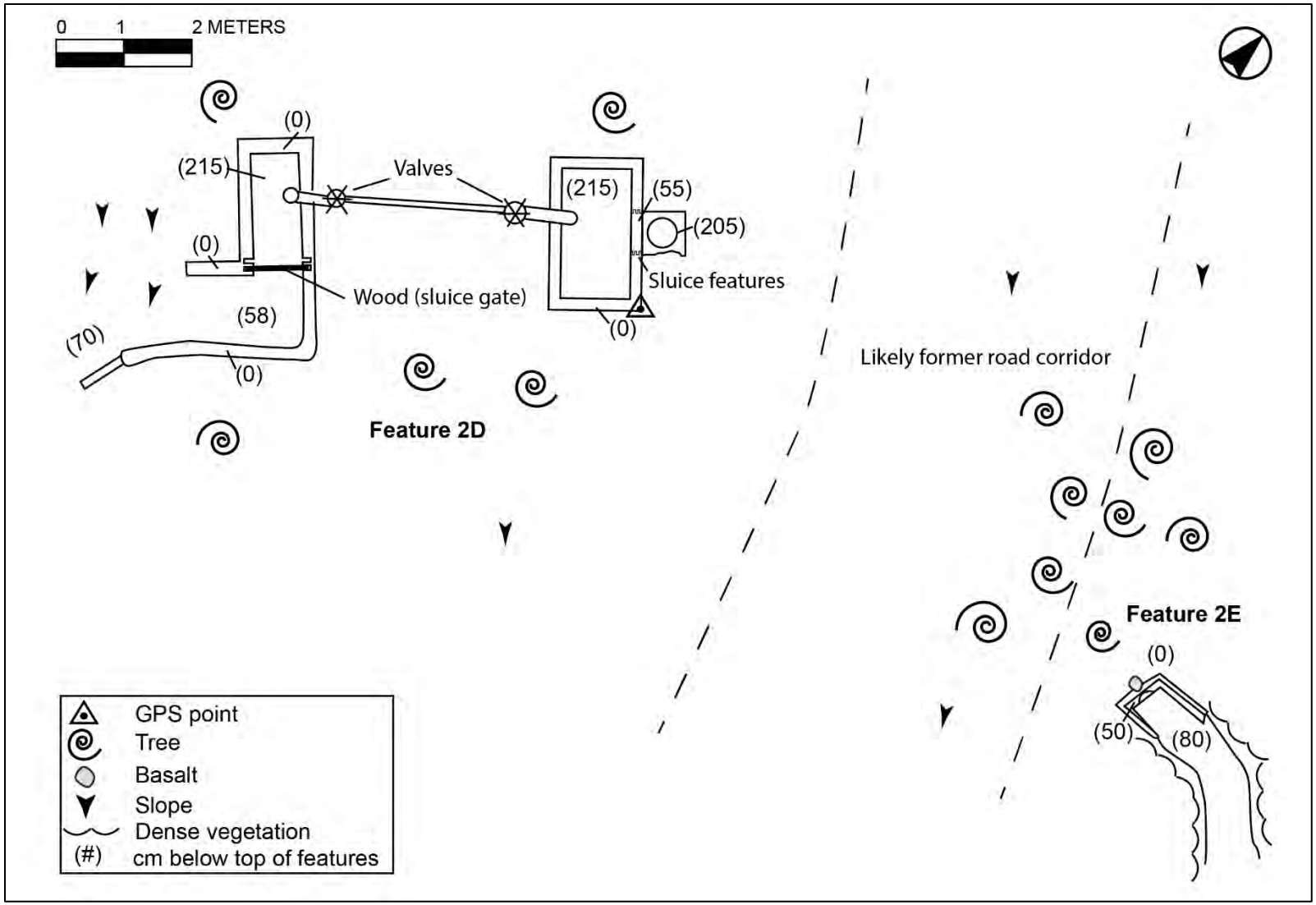


Figure 76. SIHP # 50-80-08-5593 Feature 2D, northeast and southeast valve boxes (top left), and Feature 2E runoff channel (bottom right) plan map

Figure 77. SIHP # 50-80-08-5593 Feature 2E, culvert remnants, view to northwest

Figure 78. SIHP # 50-80-08-5593 Feature 2E, close-up of culvert remnants, view to west

5.2 SIHP # 50-80-09-2268 Waiahole Ditch System/ post-Contact Irrigation Ditch

NAME:	Waiahole Ditch System
FORMAL TYPE:	Post-Contact irrigation ditch
FUNCTION:	Agricultural (plantation irrigation)
NUMBER OF FEATURES:	11; 7 newly identified (and designated as Feature E through Feature K)
AGE:	Post-Contact, irrigation ditch from 1916
SIZE:	22 miles total; approximately 380 linear m within project area
LOCATION AND DISTRIBUTION:	Extends from the windward side of the Ko‘olau Range on to the ‘Ewa Plain; within the current project area extends through the western portion
TMK:	[1] 9-2-001, 9-2-002, 9-2-003, 9-4-003, 9-4-006, 9-6-005
LAND JURISDICTION:	State of Hawai‘i
PREVIOUS DOCUMENTATION:	Hammatt and Borthwick 1988; Goodman and Nees 1991; Hammatt et al. 1996; Dega et al. 1998; Tulchin and Hammatt 2004; Hunkin and Hammatt 2009; Tulchin et al. 2009; Groza et al. 2014; Zapor et al. 2018

SIHP # 50-80-09-2268 consists of the entire Waiahole Ditch System, a post-Contact irrigation ditch dating from 1916. The historic property spans approximately 22 miles (Figure 79) transporting water from the windward side of the Ko‘olau Range through the Ko‘olau Range by a system of tunnels, across central O‘ahu and on to the ‘Ewa Plain (Condé and Best 1973). Approximately 380 linear m of the Waiahole Ditch was identified in the northern and western portions of the project area. The ditch extends along the northern boundary, crossing the central project area as it extends southwest down the natural sloping landscape, exiting the southern boundary and continuing to extend southwest away from the project area (Figure 80).

5.2.1 Overview

Currently, a portion of the Waiahole Ditch remains active (see Figure 79). This active portion begins on the windward side of the island and terminates at Reservoir 155 in Honouliuli. Various features associated with the active portions of the Waiahole Ditch have been identified, including the reservoirs, flumes, sluices, and siphons (Goodman and Nees 1991; Groza et al. 2014; Hammatt and Borthwick 1988; Hammatt et al. 1996; Tulchin et al. 2009). Descriptions of the in-use stretch of the Waiahole Ditch range from a concrete-lined ditch to only a metal siphon structure crossing over gulches.

Remnant, inactive portions of the Waiahole Ditch extend beyond the reservoir. This includes a portion of the main ditch extending west of the reservoir and a portion that originates at the ditch and extends southwest from the reservoir. Several archaeological studies documented this southwest extending inactive portion of the Waiahole Ditch, including the current project (Dega et al. 1998; Hunkin and Hammatt 2009; Tulchin and Hammatt 2004; Zapor et al. 2018).

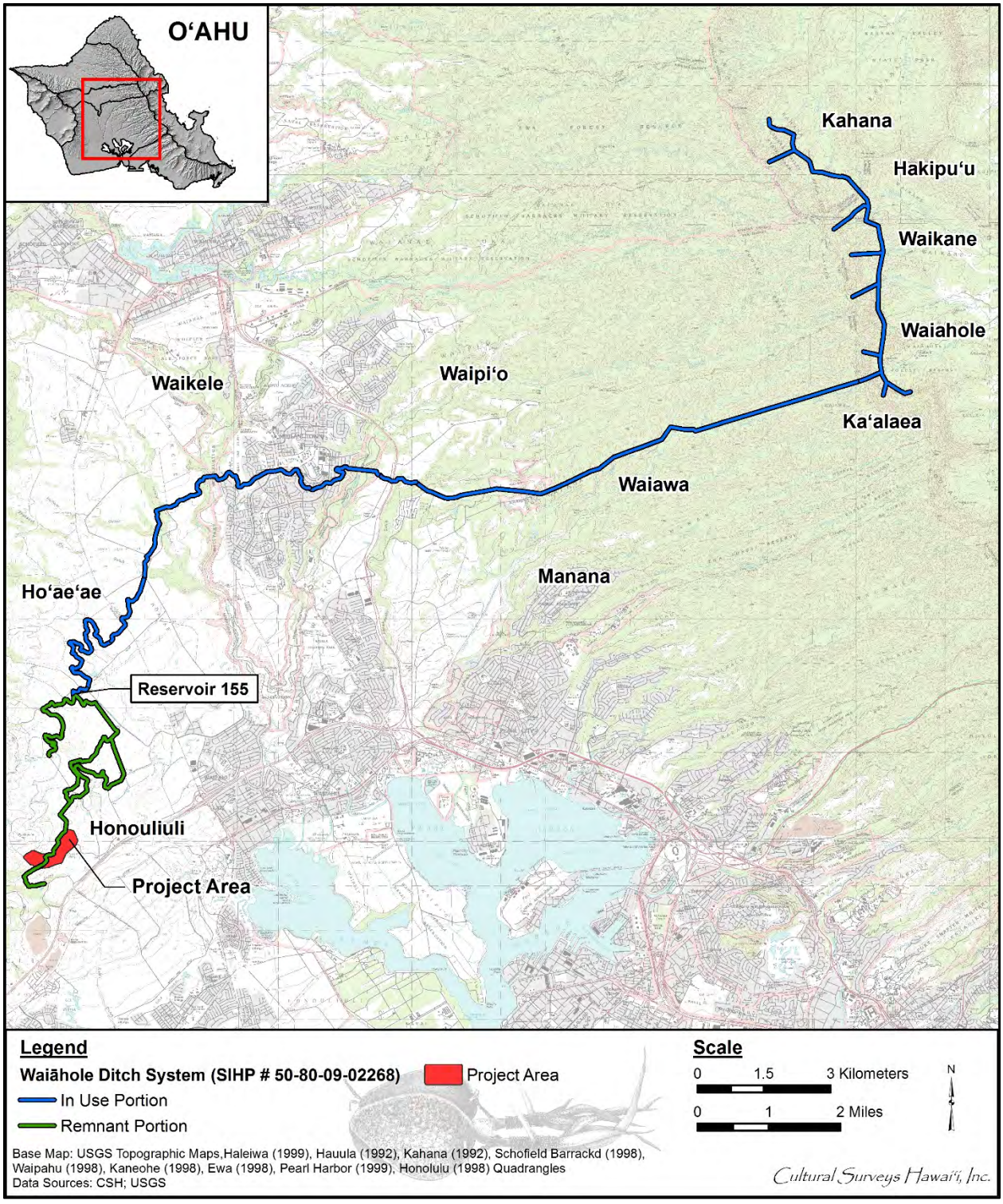


Figure 79. Route of the Waiahole Ditch System in relation to the present project area, showing in-use and remnant portions, depicted on a 1992–1999 USGS topographic quadrangle map

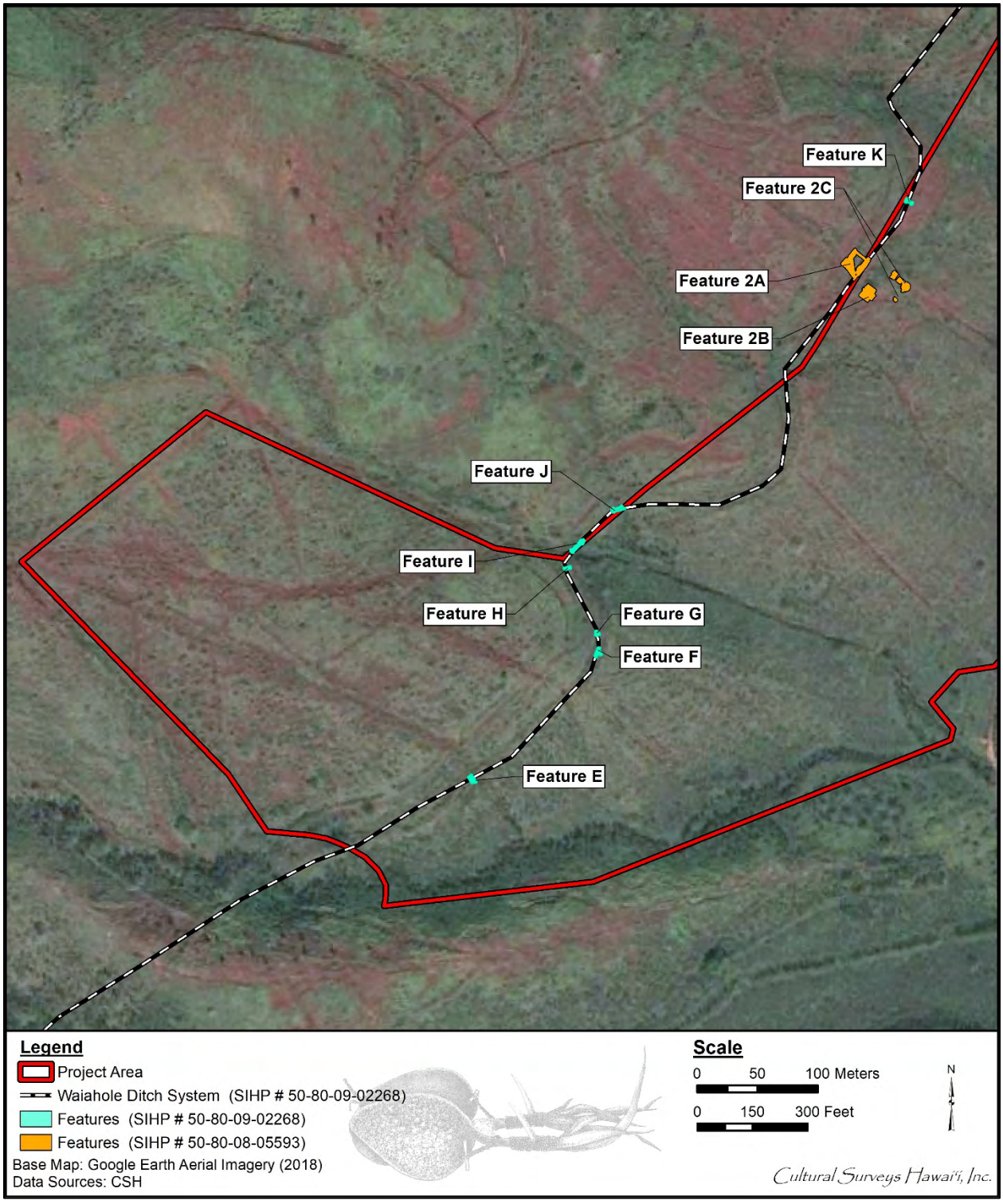


Figure 80. Aerial photograph depicting the distribution of portions of SIHP # 50-80-09-2268 Feature E through Feature K, as well as features of SIHP # 50-80-08-5593, identified within the current project area (Google Earth 2018)

Documented features related to the inactive ditch include flumes, tunnels, walls, drainage channels, sluice gates, culverts, bridges, and one earthen mound, as discussed below. Portions of the remnant portion likely no longer exist or may have been buried. The historic property description presented here focuses on the remnant portion of the Waiahole Ditch, as that is the portion documented within the current project area and immediate vicinity.

Dega et al. (1998) documented remnant portions of the Waiahole Ditch, described as follows:

> The ditch was encountered on the western slope of the westernmost gulch which trends north-south through the eastern portion of the property. The major flume crosses the bottom of the gulch through a concrete flume and enters a c. 1000 m long tunnel. A branch within this tunnel is also connected to the Waiahole Ditch System via a more northerly route. This ditch exits the tunnel, crosses the bottom of another smaller gulch through a shorter concrete flume and then enters another tunnel. The ditch follows along the 400 to 440 foot contours in this manner along the eastern and southern slopes of Pu‘u Kapua‘i and exits the property to the west near Kaloi Gulch. There are, altogether, seven tunnels of various lengths along the ditch within the project area.
>
> The flume itself is 60 cm deep and about 1 m across […] The sides of the ditches have been shored with stone masonry. The tunnels are 90 cm wide and about 140 cm high. Cement was used to support the sides and roofs of the tunnels only near the entrances. At greater depth within the tunnels cement was used only to shore up the walls. The tunnel roofs in these areas consist of bare rock.
>
> Along the south-facing slope of Pu‘u Kapua‘i there are segments of the ditch which are lined with concrete and smaller segments lined with corrosive metal. Differing channels appear to divert some of the water to the sugarcane fields which occur at and near the base of the slope. There is also a small, rectangular, concrete basin in this area measuring about 12 by 10 m and 2 m deep which perhaps served to store small quantities of water for later diversion downslope. [Dega et al. 1998:17–18]

Figure 81 shows the section of the flume feature documented by Dega et al. (1998).

5.2.2 Previously Identified Features of the Remnant Portion of SIHP # -2268 outside the Current Project Area

Tulchin and Hammatt (2004) described additional remnant portions of the ditch (outside the present project area), describing the components as follows:

> The improved ditch appeared to be constructed in a U-shaped configuration, with a flat bottom and nearly vertical sidewalls. However, heavy sedimentation within the interior of the ditch did not allow for direct observation of the base of the ditch. The main constructed portion of the ditch measured 90 cm [centimeter] wide and 1 m [meter] in height. The sidewalls were of cut basalt stone and mortar construction [present Figure 82]. In areas where the ditch was cut deeply into the slope, loosely stacked basalt boulder and cobble retaining walls were constructed along the top edges of the ditch as necessary. The stones composing the retaining wall appeared to be flaked, likely during the fashioning of cut basalt blocks. [Tulchin and Hammatt 2004:52]

Figure 7: Site 2268, a Section of Water Flume. View to Northeast.

Figure 81. Portion of SIHP # 50-80-09-2268 documented by Dega et al. (1998:18)

Figure 82. SIHP # 50-80-09-2268 showing the dressed basalt boulder and mortar Waiahole Ditch (top), and stacked basalt boulder and cobble retaining wall (below) (Tulchin and Hammatt 2004:53)

SIHP # 50-80-09-2268 Feature A, a flume bridge documented by Tulchin and Hammatt (2004), is described as follows:

> Near the easternmost point of the project area, the ditch crosses an unnamed drainage gully which empties into Kalo‘i Gulch. In order to cross the gully, foundations were constructed at each edge of the gully to support a metal flume section spanning the approximately 4.8 m gap. At the time of the inventory survey, the metal flume was not intact, though remnants were observed in the brush in the immediate vicinity of the structure. Each foundation consisted of a central portion constructed of cut basalt boulders and mortar, measuring 2.8 m wide and a maximum height of 1.8 m [Figure 84 and Figure 83]. In addition to the central stone and mortar constructed portion, additional stacked basalt boulder and cobble retaining walls were constructed along the edges of the gully both up and down slope of the main ditch foundation. The retaining walls extended approximately 7.2 m upslope and 3.4 m down slope of the main ditch foundation. The stones were stacked a maximum of 7-8 courses high, with a maximum height of 2.2 m. The retaining walls were generally constructed of loosely stacked stones, though mortar was observed at the interface between the retaining wall and the ditch foundation, as well as at the down slope terminus of the retaining wall. Wooden fence posts with attached barbed wire were observed to run along the top of the retaining walls and over the ditch foundations. [Tulchin and Hammatt 2004:52]

SIHP # 50-80-09-2268 Feature B identified by Hunkin and Hammatt (2009) is described as follows:

> Feature B is an improved drainage channel and short flume section. Feature B is located in the central portion of the project area, where the Waiāhole Ditch crosses a small drainage channel along the Kalo‘i Gulch slope. The drainage channel appears to have been improved by excavation of loose soil and stones to improve water flow. Feature B consists of a metal half-pipe flume section constructed over the Waiāhole Ditch [Figure 87 and Figure 88]. The metal flume is constructed of three (3) riveted sections of U-shaped sheets of iron. The flume is oriented perpendicular to the ditch, with the upslope end of the flume located in the center of the drainage channel. The flume is supported on the upslope end by a stone and mortar foundation and retaining walls that direct the water flow from the drainage channel into the flume [Figure 85]. The central portion of the flume is supported by wooden support beams and crossed with wooden cross beams. The down slope portion of the flume rests on the soil berm down slope of the ditch, with a stacked-stone retaining wall constructed along the berm in the vicinity of the flume. Down slope of the end of the metal flume section are remnants of a wooden flume that likely connected to the end of the metal flume [Figure 86]. Feature B functions as a drainage improvement associated with the Waiāhole Ditch. The flume collects storm water from an improved drainage channel and transports the water over the ditch and down the gulch slope, thereby reducing damage to and sedimentation of the ditch during periods of heavy rainfall. [Hunkin and Hammatt 2009:47]

Figure 83. Showing the eastern (top, view to east) and western (bottom, view to south) ends of the southern portion of SIHP # 50-80-09-2268 Feature A: flume bridge (Tulchin and Hammatt 2004:55)

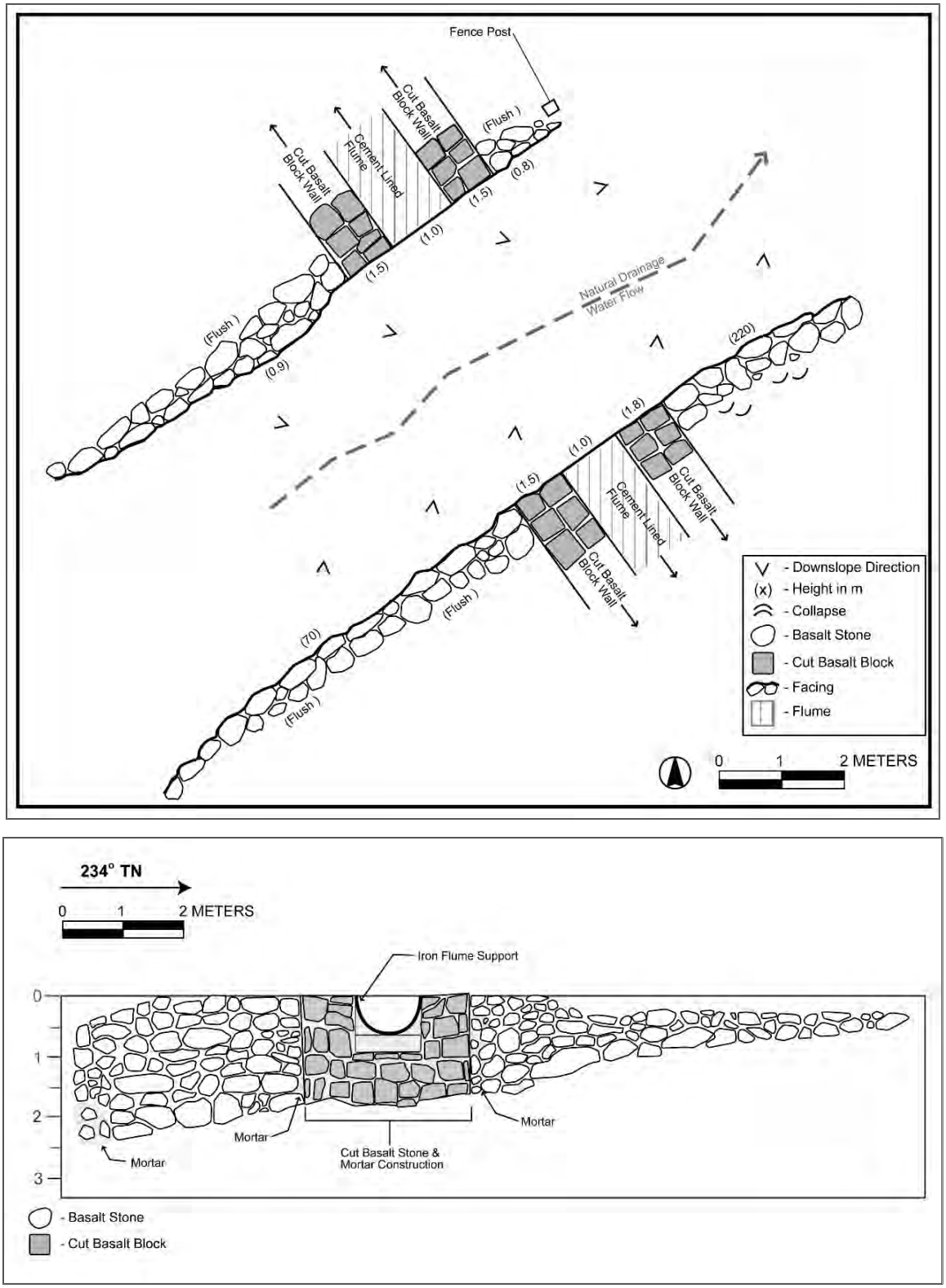


Figure 84. Plan view diagram (top) and profile (bottom) of SIHP # 50-80-09-2268 Feature A: flume bridge (Tulchin and Hammatt 2004:54)

Figure 85. SIHP # 50-80-09-2268 Feature B, showing stone and mortar flume support foundation, view to north (Hunkin and Hammatt 2009:50)

Figure 86. SIHP # 50-80-09-2268 Feature B flume, showing wooden flume extension (Hunkin and Hammatt 2009:50), view to southeast

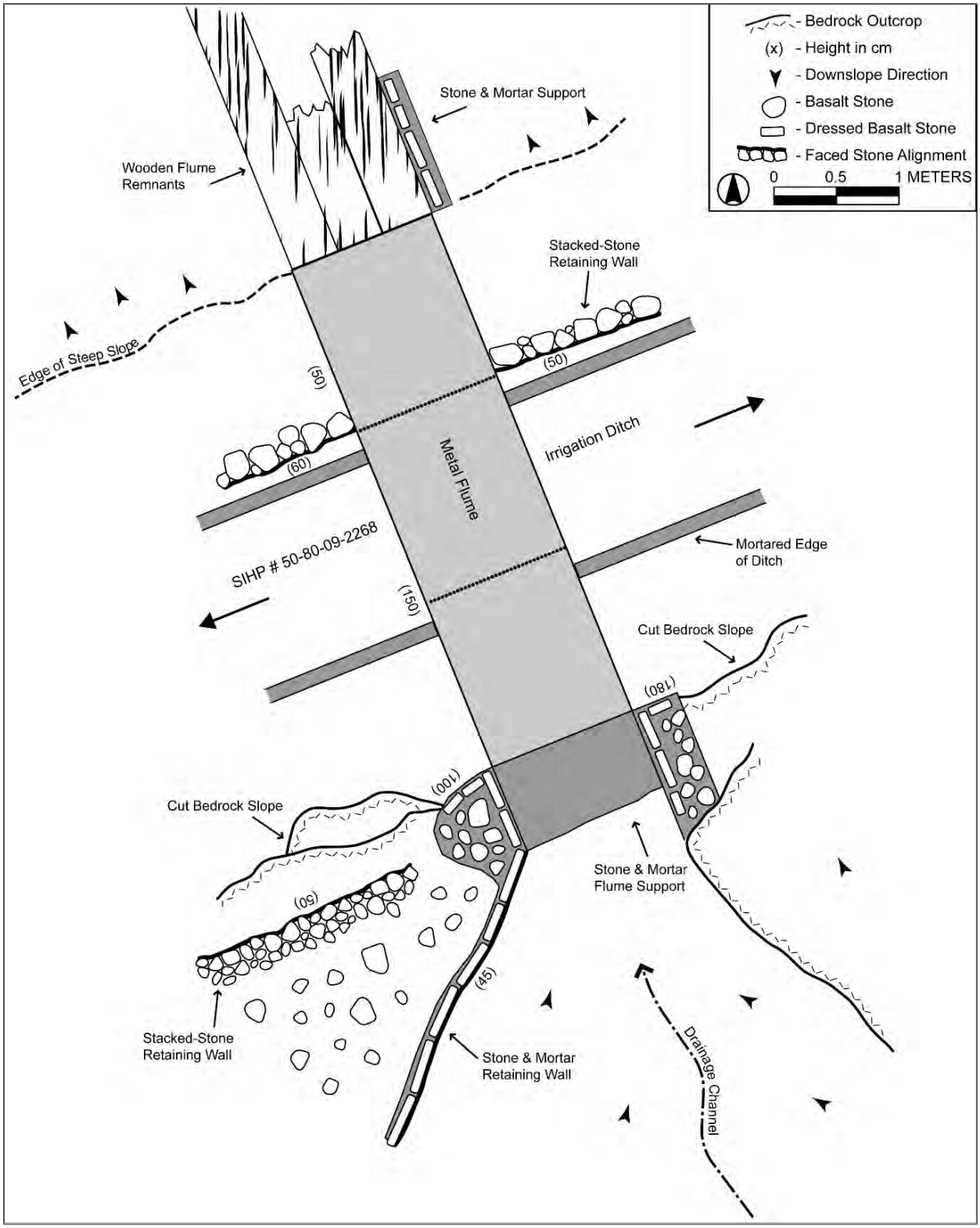


Figure 87. Plan view of SIHP # 50-80-09-2268 Feature B (Hunkin and Hammatt 2009:48)

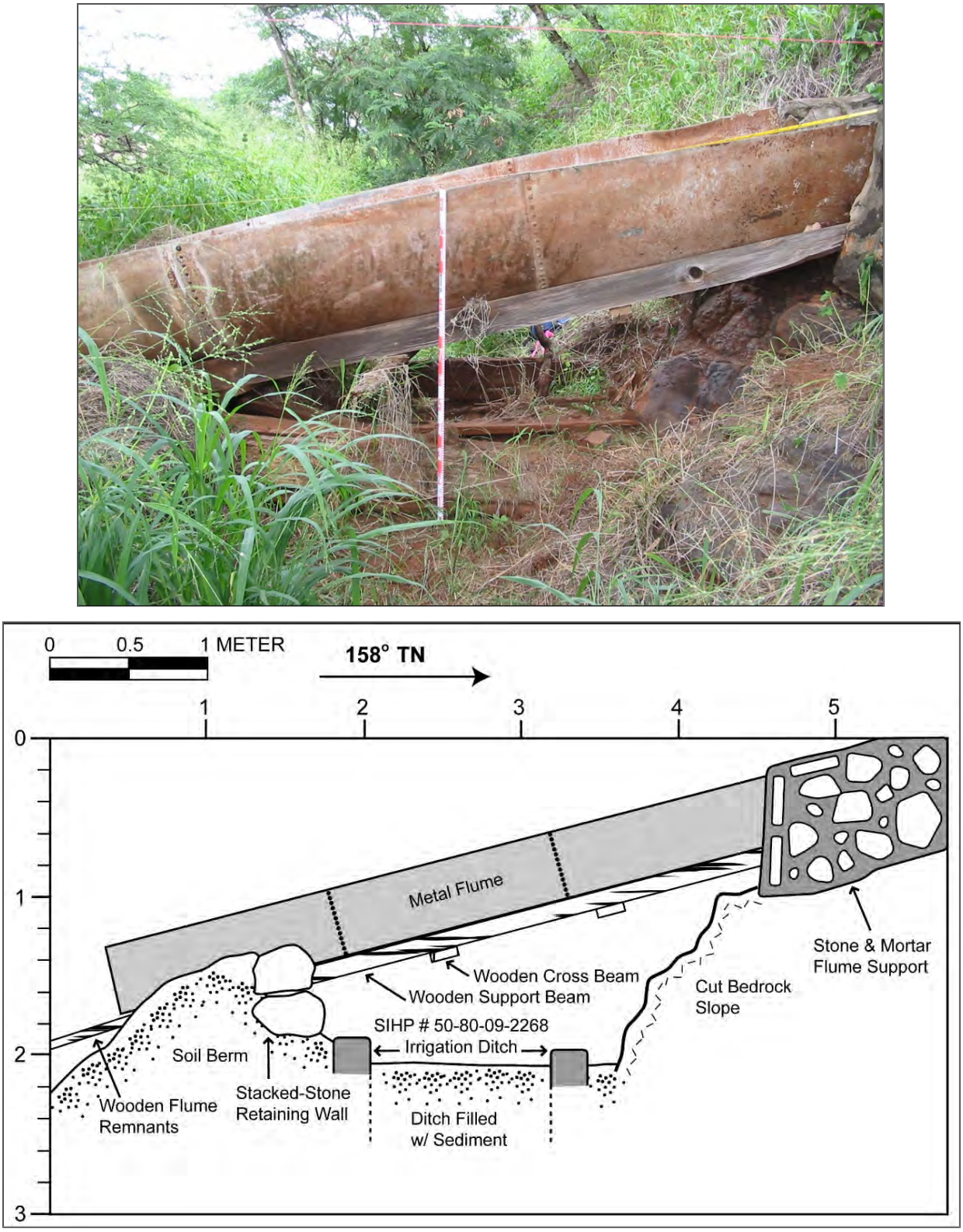


Figure 88. Photograph (top, view to east) and cross-section map (bottom) of SIHP # 50-80-09-2268 Feature B flume (Hunkin and Hammatt 2009:49)

SIHP # 50-80-09-2268 Feature C, also identified by Hunkin and Hammatt (2009), is described as follows:

> Feature C is an improved drainage channel and short flume section, similar to Feature B. Feature C is located where the Waiahole Ditch crosses a small drainage channel, approximately 100 m east of Feature B. The drainage channel appears to have been improved by excavation of loose soil and stones to improve water flow. Feature C consists of a wooden U-shaped flume section constructed over the Waiahole Ditch (Figure 91 through Figure 90). The flume is oriented perpendicular to the ditch, with the upslope end of the flume located in the center of the drainage channel. The flume is supported on the upslope end by a stone and mortar foundation and retaining walls that direct the water flow from the drainage channel into the flume. The downslope portion of the flume rests on the soil berm downslope of the ditch. Feature C functions as a drainage improvement associated with the Waiahole Ditch. The flume collects storm water from an improved drainage channel and transports the water over the ditch and down the gulch slope, thereby reducing damage to and sedimentation of the ditch during periods of heavy rainfall. Due to its wooden construction, much of the Feature C flume has deteriorated. [Hunkin and Hammatt 2009:47]

As noted in Zapor et al. (2018), based upon consultation with SHPD staff and Mr. Shad Kane, the alignment of SIHP # 50-80-09-2268 along the southern slope of Kalo‘i Gulch is suggested to be a traditional Hawaiian trail alignment facilitating pedestrian travel from the uplands of Pālehua down to the coast.

SIHP # 50-80-09-2268 Feature D was identified by Zapor et al. (2018) and described as follows:

> The newly identified Feature D is a large earthen mound and stacked stone wall [Figure 92 and Figure 93] located in the northeastern portion of the project area running adjacent to SIHP # 50-80-12-6951 and is likely the remnants of the reservoir that can be seen on historic maps at the terminus of the Waiahole Ditch System...Sometime after 1977, the reservoir was filled in with sediment resulting in the current state of Feature D. [draft Zapor et al. 2018:76]

5.2.3 Features of the Remnant Portion of SIHP # -2268 within the Current Project Area

Components related to the Waiahole Ditch were documented within the project area and are discussed below. The Waiahole Ditch and all associated components are related to former water control needs for agriculture in the area.

Several variations of the Waiahole Ditch were observed during the current study. Just outside the northern boundary of the project area, the ditch consists of a more formal construction, with mortared basalt sides and tunnels (Figure 94 through Figure 96). Concrete-lined portions were also observed just north of the project area boundary, as were several tunnel entrances and sluice gate features (Figure 97 and Figure 98). Much of the length of the Waiahole Ditch runs underground in concrete-lined tunnels. In the central portion of the project area, the ditch was observed as an informal earthen ditch, largely overgrown (Figure 99). In the southwest portion of the project area, dry-stacked basalt sides were observed (Figure 100 and Figure 101). As discussed above,

Figure 89. SIHP # 50-80-09-2268 Feature C, view to south (Hunkin and Hammatt 2009:52)

Figure 90. SIHP # 50-80-09-2268 Feature C, showing partially intact wooden flume section, view to south (Hunkin and Hammatt 2009:52)

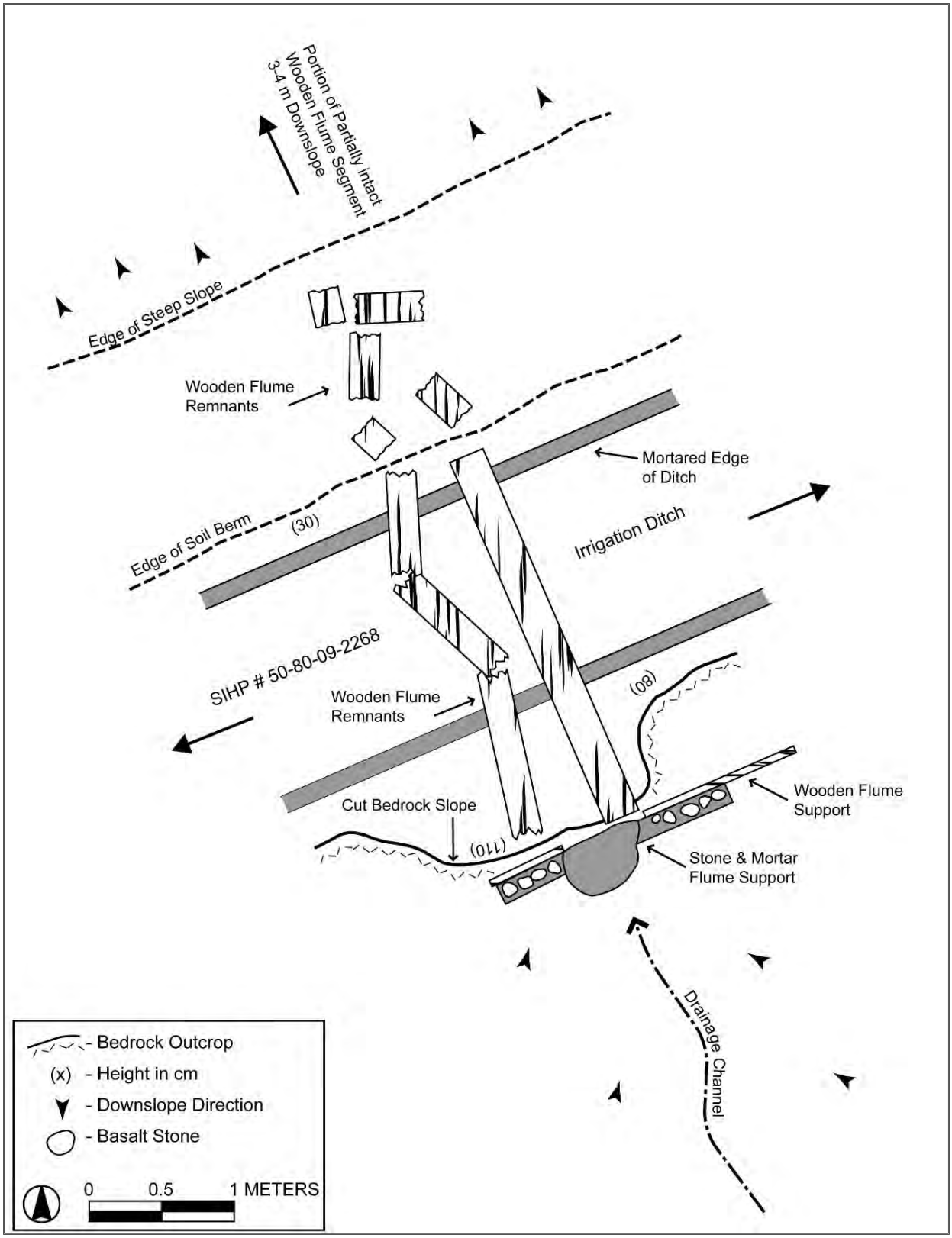


Figure 91. Plan view of SIHP # 50-80-09-2268 Feature C (Hunkin and Hammatt 2009:51)

Figure 92. SIHP # 50-80-09-2268 Feature D, earthen mound, view to southwest (Zapor et al. 2018:79)

Figure 93. SIHP # 50-80-09-2268 Feature D, stacked stone wall, view to southwest (Zapor et al. 2018:79)

Figure 94. Culvert of SIHP # 50-80-09-2268, Waiahole Ditch, northwest of (outside) the project area, view to southwest

Figure 95. Representative photo of SIHP # 50-80-09-2268, Waiahole Ditch outside (northwest) of the project area, view to east

Figure 96. Portion of SIHP # 50-80-09-2268, Waiahole Ditch outside (north) of project area, with date “1920” inscribed on basalt and mortar culvert, view to northeast

Figure 97. Portion of SIHP # 50-80-09-2268, Waiahole Ditch in northeastern project area, view to southwest

Figure 98. Representative photo of SIHP # 50-80-09-2268, Waiahole Ditch construction outside (northwest) of the project area, view to west

Figure 99. Representative photo of SIHP # 50-80-09-2268, Waiahole Ditch (left) in central project area, view to southwest

Figure 100. Representative photo of SIHP # 50-80-09-2268, Waiahole Ditch in southwest project area, dry-stacked basalt, view to north

Figure 101. Representative photo of SIHP # 50-80-09-2268, Waiahole Ditch in southwest project area, view to north

there is a formal concrete and mortared cut basalt blocks portion of the ditch with various components for water control, related to the pump station building that is southeast of the project area (see SIHP # 50-80-08-5593 Feature 2A discussion for description).

Portions of the Waiahole Ditch within and surrounding the project area have additional components related to water control including culverts, metal pipes, sluice gates, and bridges. The first designated feature of the Waiahole Ditch for the current project, **SIHP # 50-80-09-2268 Feature E**, consists of a culvert associated with the ditch, documented in the southwest portion of the project area (Figure 102 through Figure 105). The culvert consists of mortared cut basalt blocks, two to three courses high, constructed around a largely buried concrete drain pipe (see Figure 102). Both sides of the tunnel are faced, and a concrete slab extends over top of the culvert. The concrete slab is approximately 6.5 m long and 1.5 m wide (Figure 103). The faces of the culvert are approximately 3.5 m wide, and the height of the exposed portion is 1.3 m. The observed portion of the mouth of the pipe is 50 cm in diameter. These components are in fair condition. The southeast portion of the concrete slab is damaged due to partial collapse.

SIHP # 50-80-09-2268 Feature F of the ditch system was identified as part of a two-course mortared basalt portion of the ditch in the central portion of the southwest project area (Figure 106 through Figure 111). Feature F consists of a portion of the ditch with pipes, cross beams, and sluice gate components. A metal pipe extends north-south within the ditch, and two metal cross beams extend perpendicular across the ditch face, positioned under the metal pipe directly overlying the ditch surface (see Figure 107). The metal pipe extends beyond both of the cross beams. The metal cross beams are 10 cm wide and are spaced 7.1 m apart. Additionally, a channel extends southeast from the main ditch, which is blocked by a sluice gate feature, the wooden gate of which is still intact (see Figure 108 and Figure 109). The main ditch measures 1.2 m wide, and the channel extending from it is 0.7 m wide, widening to 1.7 m as it extends to the southeast. Depths of the ditch range from 40 to 80 cm, due to the accumulation of sediment in the base of the ditch. The sluice gate component is 0.7 m wide and 0.5 m tall. Notches for a second sluice gate are present in the concrete approximately 12 cm from the intact sluice gate component. The wood of this second sluice feature is no longer intact. Additional sluice notches were noted inside the main ditch as well, approximately 0.5 m southwest of the channel portion. A representative plan view and profile were completed for this section of the ditch (see Figure 110 and Figure 111). All of these components including this portion of the Waiahole Ditch are in fair condition.

SIHP # 50-80-09-2268 Feature G, a second, similar portion of the ditch was documented approximately 18 m northeast of Feature F (Figure 112 and Figure 113). Feature G consists of a mortared cut basalt portion of the ditch, with three pipes (one parallel and two perpendicular), and sluice gate remnants. Here the ditch is oriented north-south and measures 1.3 m wide and ranges from 33 cm to 45 cm deep. Note that much sediment has accumulated in the base of the ditch. A channel extends east off the main ditch which measures 0.7 m wide and 67 cm deep. The same metal pipe detailed above extends parallel along the east edge of the ditch. Additionally, two 5 cm pipes extend perpendicular across the ditch 30 cm north of the east-extending channel, spaced 1.2 m apart. There are notches for two sluice gate features in the east-extending channel.

SIHP # 50-80-09-2268 Feature H consists of a metal drainage flume feature documented in the northern portion of the southwest project area (Figure 115 and Figure 114). Feature H is

Figure 102. SIHP # 50-80-09-2268 Feature E, culvert and bridge components of the Waiahole Ditch in southern project area, view to northeast

Figure 103. SIHP # 50-80-09-2268 Feature E bridge overlying culvert of Waiahole Ditch in southern project area, view to east

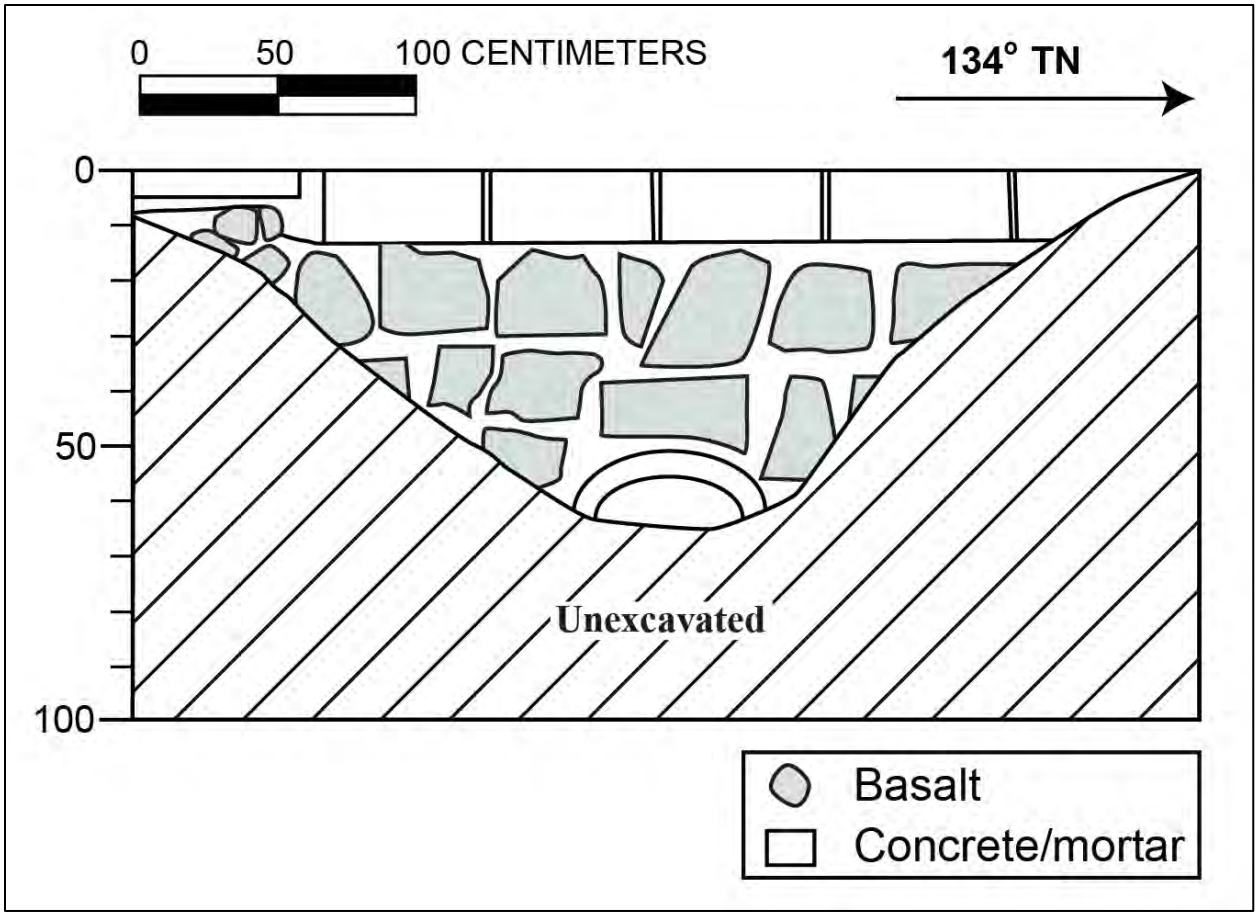


Figure 104. SIHP # 50-80-09-2268 Feature E southwest face of culvert profile

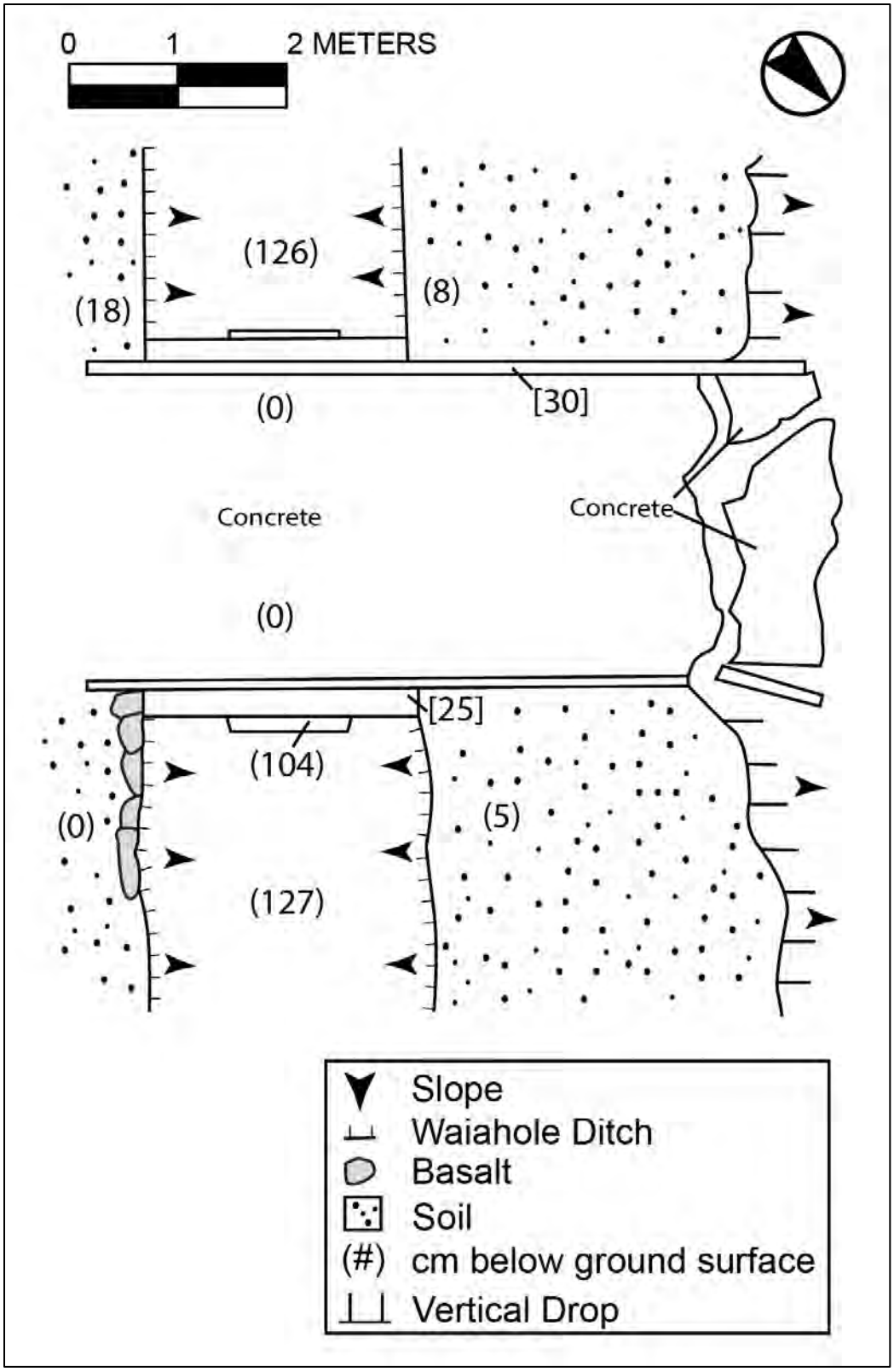


Figure 105. SIHP # 50-80-09-2268 Feature E culvert and ditch plan map

Figure 106. SIHP # 50-80-09-2268 Feature F, basalt and mortar-lined ditch, with metal cross beam (right background), view to north

Figure 107. SIHP # 50-80-09-2268 Feature F, basalt and mortar ditch portion, with metal pipe and cross beam, view to south

Figure 108. Plan view of SIHP # 50-80-09-2268 Feature F, showing pipe, southeast channel, and sluice gate components

Figure 109. SIHP # 50-80-09-2268 Feature F, close-up of southeast channel and sluice gate component, view to north

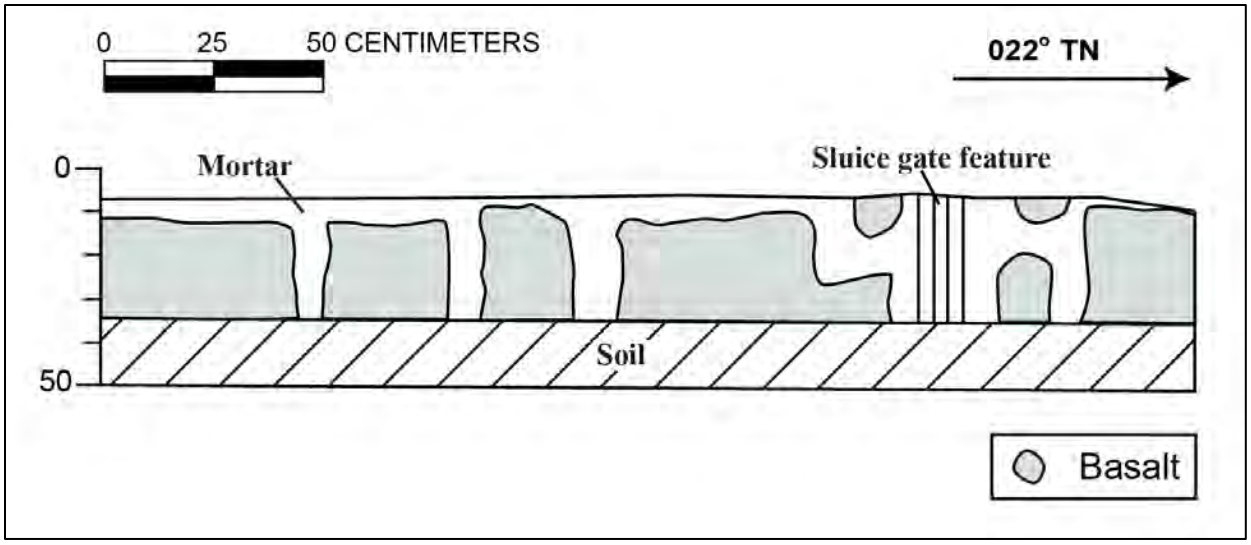


Figure 110. SIHP # 50-80-09-2268 Feature F, west wall of ditch representative profile

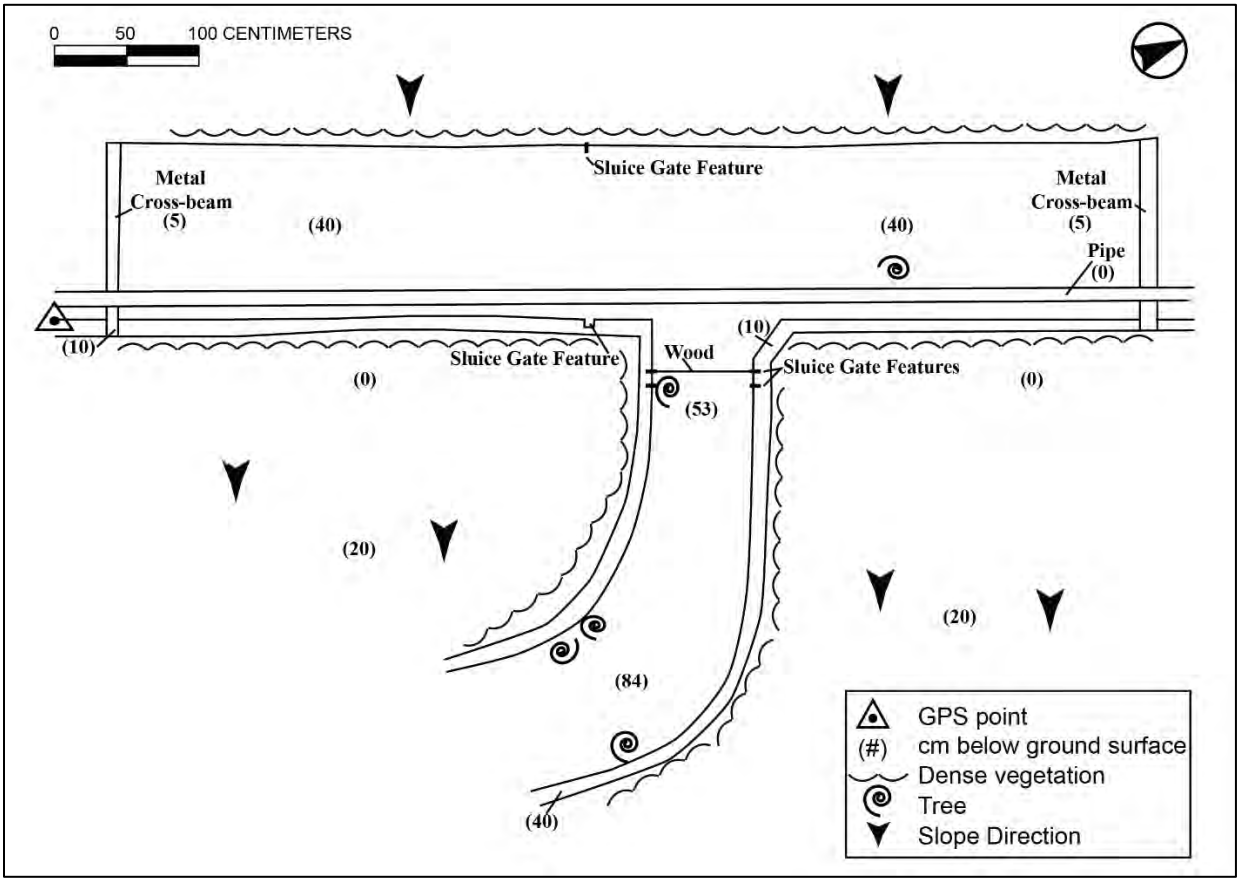


Figure 111. SIHP # 50-80-09-2268 Feature F plan map

Figure 112. SIHP # 50-80-09-2268 Feature G, showing sluice gate component and two metal pipes, view to east

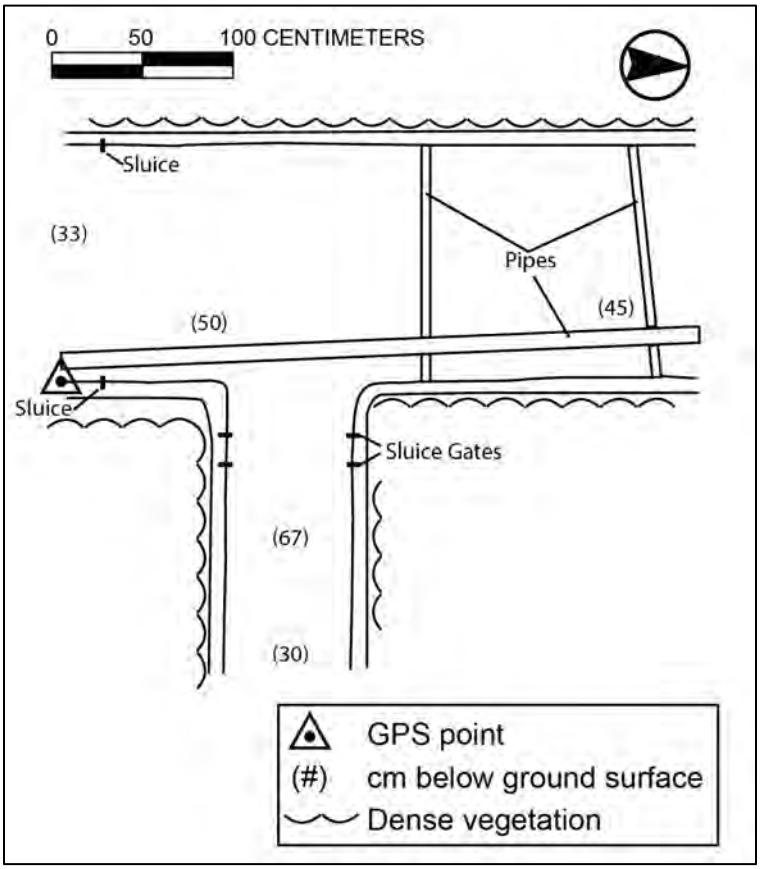


Figure 113. SIHP # 50-80-09-2268 Feature G plan map

Figure 114. Overview of SIHP # 50-80-09-2268 Feature H (left)

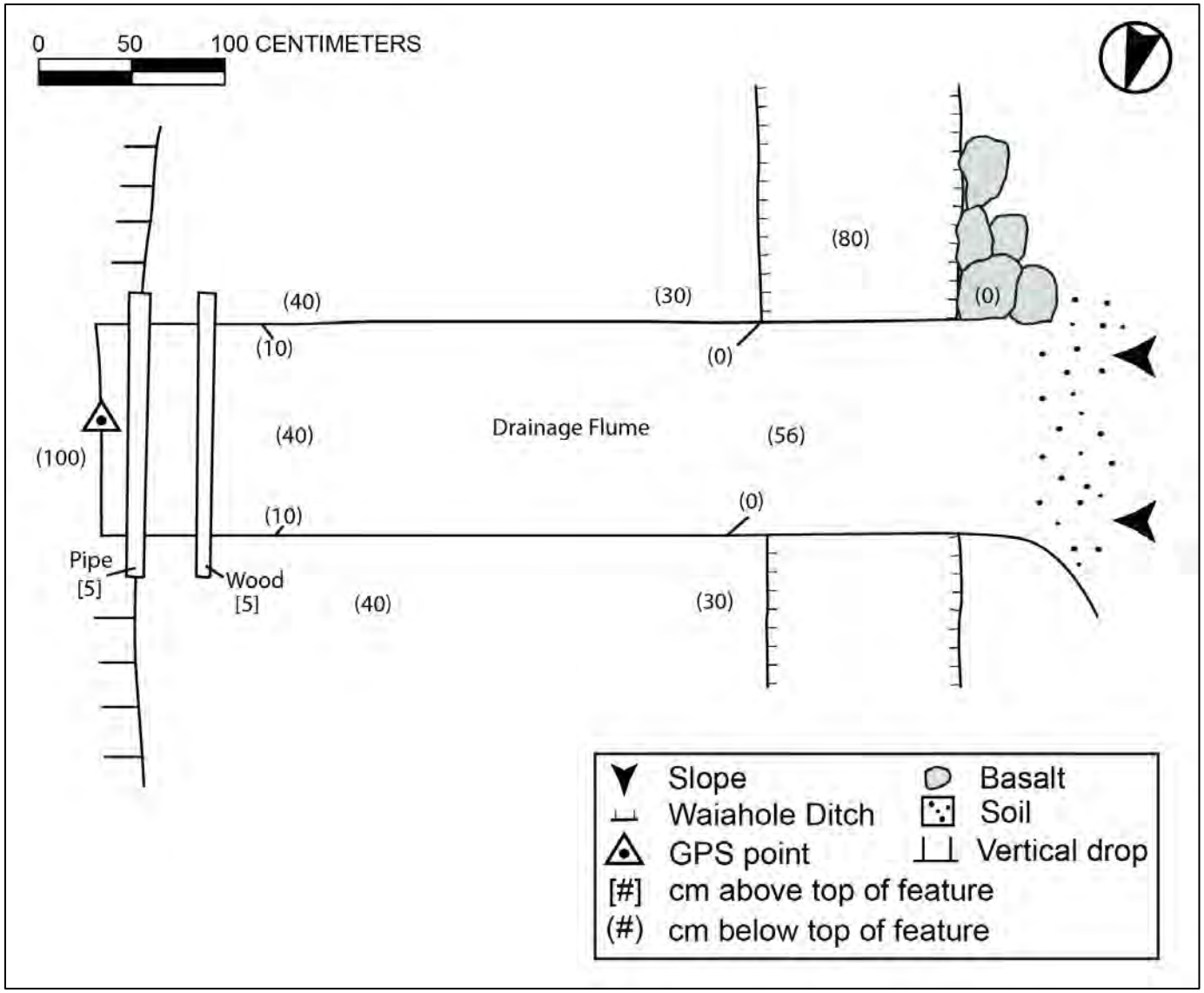


Figure 115. SIHP # 50-80-09-2268 Feature H plan map

oriented northeast-southwest and measures 1.1 m wide and 5.0 m long, and a maximum 56 cm deep (Figure 116). The flume extends toward a vertical drop, at one time funneling water into the gulch below. A decaying wood portion extends perpendicular over the northeast end of the metal chute. Approximately 20 cm from the wood, a metal pipe extends perpendicular over the top of the flume. At the southwest end of the chute, on the south side, there is a pile of mortar and basalt cobbles measuring 1 m wide and 90 cm tall (Figure 117). The flume extends over top of the Waiahole Ditch.

SIHP # 50-80-09-2268 Feature I consists of a portion of the ditch with several associated features, constructed to carry the water over the gulch in the area. This bridge component has four mortared basalt block pillars (Figure 119 through Figure 121). At one time an elevated metal half pipe connected the pillars, the middle of which appears to have collapsed. In the north end a portion of the metal in between the two pillars was still visible, and an incised line was noted, possibly a former space for a sluice gate or similar component (see Figure 120). The middle portion of this feature has largely collapsed, and with much of the footings obscured by earth. Approximately 3.5 m to the south, a basalt and mortar headwall and culvert were observed, measuring 2.5 m long, 20 cm wide, and 95 cm tall.

SIHP # 50-80-09-2268 Feature J is similar to Feature I, another area of components to carry the ditch over gulches in the area. The first component consists of four mortared basalt block pillars connected by an elevated concrete bridge (Figure 122 through Figure 124). The concrete has been entirely filled in with soil and is overgrown, and portions of the pillars are also obscured. A 12-cm metal pipe extends the entire length of this feature and beyond, resting on top of the *makai*/south pillars. The letters “B M +” are inscribed in the mortared surface of the northwestern pillar. Approximately 2 m east of this bridge component is a culvert constructed of mortared basalt, which measures 55 cm tall and 105 cm wide (see Figure 123). Only 80 cm of length is exposed, the remainder covered with earth; however, the tunnel appears to extend toward the ditch wall. Overall, the bridge components of Features J and K span an area approximately 53 m long.

SIHP # 50-80-09-2268 Feature K of the ditch system consists of a culvert and tunnel feature with intact metal sluice gate, along the northern boundary of the project area (Figure 125 through Figure 126). Feature K extends southeast off the ditch, extending under the access road, though the feature could not be identified on the other side of the road. Two concrete patches were noted in the road, which appear to have been used to cover collapsed portions of the tunnel. It is possible the entire tunnel has collapsed. The observable portion of the feature—from the head gate to the end of the second concrete patch—spans 3 m in length and is a maximum of 0.7 m wide. The first, fragmented concrete slab measures 95 cm long and 75 cm wide. The second concrete slab, which is in the middle of the road, measures 1.6 m long by 0.7 m wide. The head wall of Feature I measures 0.9 m long. Overall the feature is in fair condition, as portions of the concrete are fragmented and collapsing.

5.2.4 Significance

SIHP # 50-80-09-2268, Waiahole Ditch and associated features, has been previously assessed by a variety of studies under various criteria. See Section 7 for a full discussion of prior significance assessments. SIHP # 50-80-09-2268 is assessed as significant under HAR §13-284-6 Criteria a, c, and d. The Waiahole Ditch has yielded information on agricultural history of the area and contributed greatly to the development and evolution of the ‘Ewa Plain throughout its history,

Figure 116. SIHP # 50-80-09-2268 Feature H, drainage flume, along north edge of project area, view to northeast

Figure 117. Mortar and basalt pile south end of SIHP # 50-80-09-2268 Feature H, drainage flume, view to west

Figure 118. Collapsed bridge component of SIHP # 50-80-09-2268 Feature I, view to south

Figure 119. Collapsed bridge component of SIHP # 50-80-09-2268 Feature I, view to southwest

Figure 120. Close-up plan view showing metal portion, collapsed bridge component of SIHP # 50-80-09-2268 Feature I

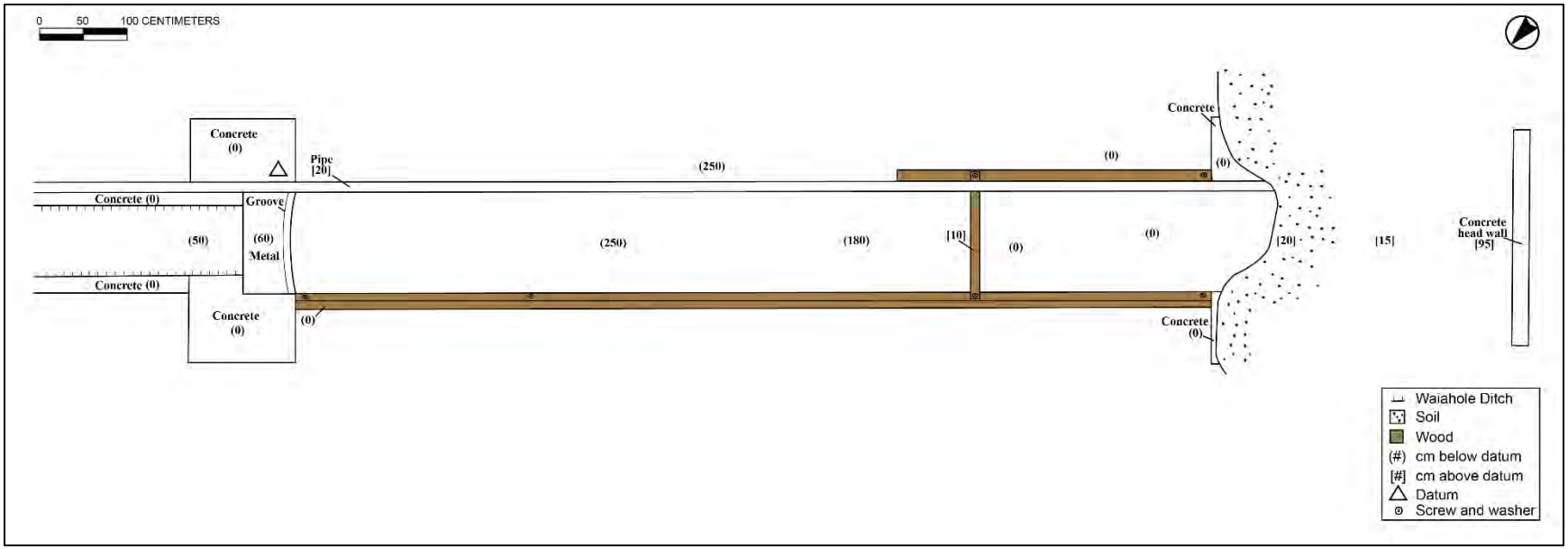


Figure 121. Plan map of SIHP # 50-80-08-2268 Feature I, showing portion of the Waiahole Ditch, collapsed bridge components, and head wall

Figure 122. Overview of bridge component of SIHP # 50-80-09-2268, Feature J, view to southwest

Figure 123. Culvert component of SIHP # 50-80-09-2268 Feature J documented east of bridge component, view to north

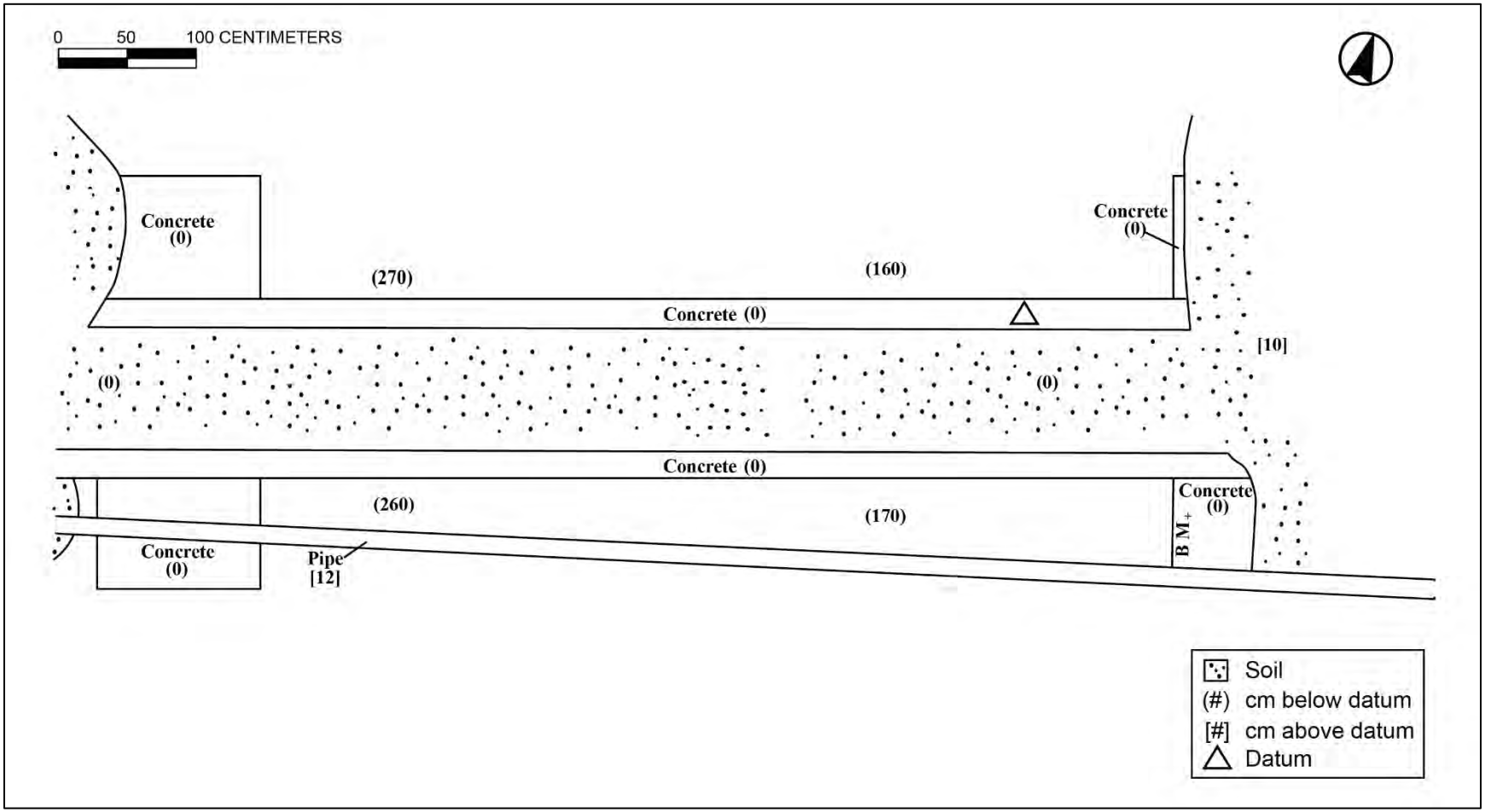


Figure 124. Plan map of SIHP # 50-80-09-2268 Feature J, bridge component

Figure 125. SIHP # 50-80-09-2268 Feature K, culvert and tunnel feature, view to north

Figure 126. SIHP # 50-80-09-2268 Feature K, showing culvert with intact sluice gate, view to east

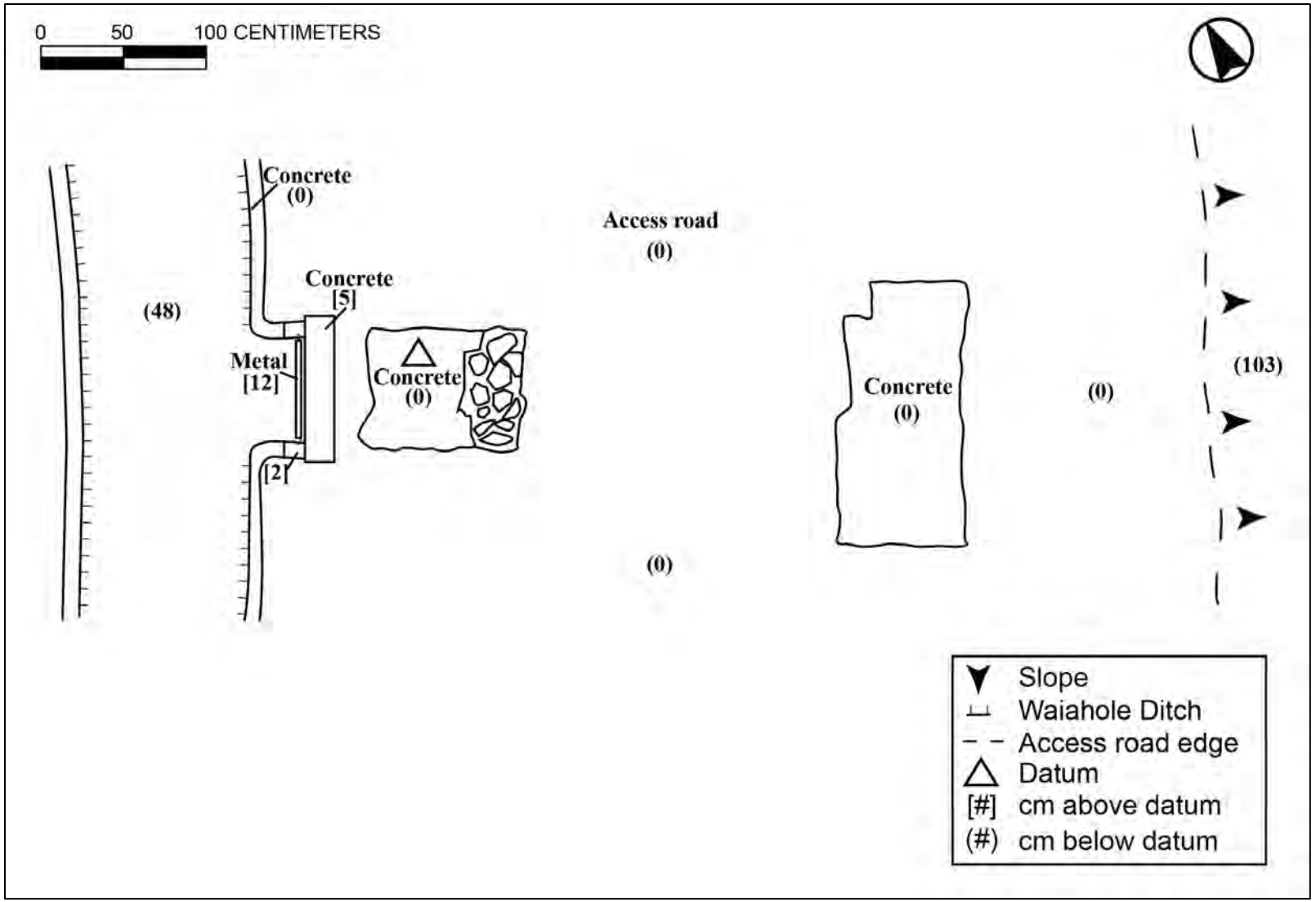


Figure 127. Plan map of SIHP # 50-80-09-2268 Feature K

and may continue to yield additional information on plantation-era history on O‘ahu. However, within the project area, the historic property only retains sufficient integrity of location, which is also diminished in portions of the project area due to erosion and neglect. While there are some portions that retain some integrity of design, materials, and workmanship within the project area, this integrity is diminished. The overall ditch is significant, however, the remnant portion of SIHP # 50-80-09--2268 within the project area does not retain sufficient integrity to be considered significant.

Section 6 Summary and Interpretation

At the request of Tetra Tech, Inc., and on behalf of AES Distributed Energy, CSH has prepared this AISR for the AES West O‘ahu Solar project, Honouliuli Ahupua‘a, ‘Ewa District, O‘ahu, TMK: [1] 9-2-002:007 (por.). The project area is on undeveloped lands in the southeastern foothills of the Wai‘anae Range, northeast of Pu‘u Makakilo and the Makakilo subdivision and about 600 m northwest of the intersection of the H-1 Freeway and the Kualaka‘i Parkway.

Background research indicates little traditional land use in the portion of Honouliuli Ahupua‘a in which the project area is situated. Large settlements were primarily concentrated near the coast, near marine and estuarine resources, or in the irrigated lowlands suitable for wetland cultivation. Any evidence of traditional land use in the area was likely wiped out by historic agricultural and ranching activities that lasted through the mid-twentieth century. The northeast portion of the project area and much of the surrounding land was occupied by Oahu Sugar Company fields by 1925. The Waiahole Ditch, constructed for much needed irrigation of the sugarcane fields, is known to extend through the current project area. Small plantation-related residential camps were the only settlements found in the upper slopes in the early twentieth century, with “Pump Camp 5” existing within the project area, according to historic maps. Various roads and fence lines related to agricultural and/or ranching activities in the region are known to have existed in the project area at one time. Archaeological studies in the vicinity of the project area have documented various plantation-era historic properties including walls, alignments, mounds, ditches and other irrigation features, as well as portions of the Waiahole Ditch (SIHP # 50-80-09-2268).

Fieldwork included 100% pedestrian inspection of the project area, GPS data collection, and documentation of surface historic properties. Two previously identified historic properties were documented within the project area: SIHP # 50-80-08-5593, historic irrigation and plantation infrastructure, and SIHP # 50-80-09-2268, the Waiahole Ditch System. The AIS documented two features of SIHP # 50-80-08-5593: drain-pipes (Feature 1) and a complex of components related to the pump house and mill located just southeast of the project area (Features 2A through 2E). No indications of traditional land use were observed. No remnants of Pump Camp 5 were identified. The majority of the SIHP # 50-80-08-5593 features were identified extending through the northern portion of the project area.

The Waiahole Ditch System (SIHP # 50-80-09-2268) and associated components were identified extending through the western portion of the project area. The AIS documented seven remnant features of SIHP # 50-80-09-2268: a culvert and bridge (Feature E), two ditch portions with metal pipes and sluice gate components (Features F and G), a metal drainage flume (Feature H), two bridge components (Features I and J), and a culvert feature with sluice gate (Feature K). The remnant portion of SIHP # 50-80-09-2268 within the project area is at the far west end of the ditch system. It is not a portion of the continuous transmission line Waiahole Ditch (most of which is still in use), but rather extends from a reservoir fed directly from the ditch that extends from Windward O‘ahu. From the reservoir, Ko‘olau water is fed into various ditches. While the remnant of the ditch within the project area is undoubtedly part of the Waiahole Ditch System as a whole, the portion within the project area and its components are in remnant condition. Additional portions of the remnant ditch and associated components are still extant in the vicinity, outside the project area.

The results of this AIS correspond with the history of the slopes of Honouliuli Ahupua‘a, representing historic agriculture, ranching, and related activities throughout the twentieth century.

Section 7 Significance Assessments

Historic property significance is evaluated and assessed based on the five State of Hawai‘i historic property significance criteria. To be considered significant, a historic property must possess integrity of location, design, setting, materials, workmanship, feeling, and/or association and meet one or more of the following broad cultural/historic significance criteria (in accordance with HAR §13-284-6):

a. Be associated with events that have made an important contribution to the broad patterns of our history;

b. Be associated with the lives of persons important in our past;

c. Embody the distinctive characteristics of a type, period, or method of construction, represent the work of a master, or possess high artistic value;

d. Have yielded, or is likely to yield, information important for research on prehistory or history; or

e. Have an important value to the native Hawaiian people or to another ethnic group of the state due to associations with cultural practices once carried out, or still carried out, at the property or due to associations with traditional beliefs, events or oral accounts—these associations being important to the group’s history and cultural identity.

Two previously identified historic properties were documented within the project area. Table 4 lists the historic properties along with their significance assessments and specific mitigation commitments. These mitigation commitments are included in this AISR for the review and concurrence of the SHPD.

SIHP # 50-80-08-5593, historic irrigation system and plantation infrastructure, was previously assessed by Dega et al. (1998) as significant under Hawai‘i State historic property significance Criteria a (be associated with events that have made an important contribution to the broad patterns of our history) and d (has yielded, or may be likely to yield, information important for research on prehistory or history). The current study assesses SIHP # 50-80-08-5593 as significant only under Criterion d. This historic property has yielded information on land utilization and agricultural history of the ‘Ewa Plain. However, it is not associated with specific, impactful events in the area, unlike the Waiahole Ditch, which immeasurably altered the entirety of the landscape. Much of the irrigation system has been buried and destroyed by erosion and livestock. Therefore, the historic property possesses diminished but sufficient integrity of location, design, materials, and workmanship, for which it’s significant.

SIHP # 50-80-09-2268, The Waiahole Ditch System, has a long history of significance evaluation (Table 5).

- The Bishop Museum Public Archaeology Section Applied Research Group (Goodman and Nees 1991) conducted archaeological reconnaissance and inventory surveys of 3,600 acres in the uplands of Waiawa Ahupua‘a, and touched on the Waiahole Ditch (SIHP # 50-80-09-2268) as it crossed their project area (Goodman and Nees 1991:64). The only

Table 4. Archaeological historic property integrity, significance, and project-specific mitigation commitments

SIHP #	Formal Type/ Description	Integrity							Significance	Mitigation Commitments
		Location	Design	Setting	Materials	Workmanship	Feeling	Association		
50-80-08-5593	Historic irrigation system and plantation infrastructure	Y	Y	N	Y	Y	N	N	d	No further work
50-80-09-2268	Waiahole Ditch System	Y	N	N	N	N	N	N	a, c, and d	No further work

Table 5. Significance evaluations for portions of the Waiahole Ditch

Study or Review	General Location	Evaluation in terms of HAR criteria	Evaluation in terms of National/Hawai‘i Register of Historic Places (NRHP/HRHP) criteria
Goodman and Need 1991	3,600 acres in uplands of Waiawa Ahupua‘a	Significance not evaluated: “significance […] has been realized through field and archival research and no further work is recommended”	
Hammatt et al. 1996	1,339 acres within portions of Waipio and Waiawa Ahupua‘a	Significance not evaluated: “If the portion of the Waiahole Ditch which crosses the two parcels of the project area is ever to be impacted by future development, the State Historic Preservation Division should be notified beforehand, so that appropriate mitigative measures, if necessary, can be established.”	
Dega et al. 1998	Proposed University of Hawai‘i West O‘ahu Campus project	Significance not evaluated: “The Waiahole Ditch System has previously been assessed as significant” (refers to Goodman and Nees 1991)	
Tulchin and Hammatt 2004	86-acres at Pālehua in Makakilo	Not evaluated under HAR criteria	Significant under NRHP and HRHP Criterion A and D
Tulchin et al. 2009	Koa Ridge project	HAR significance not evaluated	Significant under NRHP and HRHP Criteria A, C, and D
SHPD acceptance letter for Tulchin et al. 2009	Koa Ridge project	SHPD acceptance letter for this study makes no reference to site significance.	
Hunkin and Hammatt 2009	Makakilo Dr Extension project	HAR significance not evaluated	Significant under NRHP and HRHP Criteria A, C, and D
SHPD review letter for Hunkin and Hammatt 2009	Makakilo Dr Extension project	HAR significance not evaluated	Significant under NRHP and HRHP Criteria A, B, and D
Shideler and Hammatt 2018	Koa Ridge project	HAR significance not evaluated	Evaluated integrity; supports significance assessment made in Tulchin et al. 2009 as significant under NRHP and HRHP Criteria A, C, and D

Study or Review	General Location	Evaluation in terms of HAR criteria	Evaluation in terms of National/Hawai‘i Register of Historic Places (NRHP/HRHP) criteria
SHPD review letter for Shideler and Hammatt 2018	Koa Ridge project	Assessed as significant pursuant to HAR §13-284-6 Criteria a, c, and d	NRHP and HRHP significance not addressed
Zapor et al. 2018	Makakilo Dr Extension project	Assessed as significant pursuant to HAR §13-275-6, under Criteria a, c, and d	Evaluated for listing on the NRHP and HRHP pursuant to 36 CFR 60.4 and HAR §13-198-8

discussion of significance is in their statement “The significance of the following sites has been realized through field and archival research and no further work is recommended: State Sites […] 2268; B4-15 (the Waiahole Ditch)” (Goodman and Nees 1991:137). Thus, while the Waiahole Ditch is assigned an SIHP #, there is really no discussion of significance of the Waiahole Ditch in the Goodman and Nees (1991) study.

- A Hammatt et al. (1996) archaeological inventory survey of 1,339 acres of Castle & Cooke lands within portions of Waipio and Waiawa Ahupua‘a discusses that portion of the Waiahole Ditch within the Koa Ridge area west of the H-2 Freeway. At the time of that study, it was anticipated that a portion of the ditch (which conveyed large volumes of water of significant import) would not be impacted. While the significance of the Waiahole Ditch was noted, the significance was not formally evaluated. It was simply asserted that “If the portion of the Waiahole Ditch which crosses the two parcels of the project area is ever to be impacted by future development, the State Historic Preservation Division should be notified beforehand, so that appropriate mitigative measures, if necessary, can be established” (Hammatt et al. 1996:55).
- The Dega et al. study asserts (1998:22), “The Waiahole Ditch System has previously been assessed as significant (see Goodman and Nees 1991).” The Dega et al. study offers no further discussion of the significance of the Waiahole Ditch System (and avoids any substantive comment regarding the conclusion of the referenced Goodman and Nees 1991 study).
- A Tulchin and Hammatt 2004 AIS of an approximately 86-acre proposed Pālehua Community Association project identified a portion of the Waiahole Ditch System. SIHP # 50-80-09-2268 was evaluated as significant under NRHP and HRHP Criteria A and D (Tulchin and Hammatt 2004:65).
- The Tulchin et al. (2009:66–68) archaeological inventory survey addresses that portion of the Waiahole Ditch within the Koa Ridge project area east of the H-2 Freeway crossing a small northern tributary gulch of Pānakauahi Gulch. Two features have been designated for the Waiahole Ditch during the Koa Ridge project (but without any letter or numeric designations): one for the main ditch including both the open ditch and Pānakauahi siphon and one feature designation including two 1-m long basalt boulder support walls.

  The 2009 archaeological inventory survey provides the following assessment of significance:

  > SIHP # 50-80-09-2268 is assessed as significant under Criterion A (associated with events that have made an important contribution to the broad patterns of our history), Criterion C (embody the distinctive characteristics of a type period or method of construction), and Criterion D (have yielded, or may be likely to yield information important in prehistory or history) of the National and Hawai‘i Registers of Historic Places evaluation criteria. [Tulchin et al. 2009:66]

  The integrity of SIHP # 50-80-09-2268, Waiahole Ditch was not assessed at the time of identification (Hammatt et al. 1996:47–50; Tulchin et al. 2009:89–91). The SHPD acceptance letter for this study dated 10 February 2009 (LOG NO. 2009.0605, DOC. NO. 0902WT21) makes no reference to historic property significance.

- An archaeological inventory survey for a Makakilo Drive Extension project (Hunkin and Hammatt 2009) discusses a portion of the Waiahole Ditch and concludes, “The SIHP # 50-80-09-2268 alignment continues to be significant under criteria A, C, and D” with reference to the criteria established for the NRHP and HRHP (Hunkin and Hammatt 2009:65).

  The SHPD acceptance letter for this AIS dated 18 August 2009 (LOG NO. 2008.3209, DOC. NO. 0908NM28) asserts that SIHP # 50-80-09-2268, the Waiahole Ditch System is eligible for listing on the NRHP and HRHP under Criteria A, B, and D (the AIS declares significance under Criteria A, C, and D and the acceptance letter specifies A, B, and D).

- A preservation plan for the Koa Ridge project (Shideler and Hammatt 2018) addressed a portion of the SIHP # 50-80-09-2268, Waiahole Ditch System. The report evaluated the significance of the Waiahole Ditch System as follows:

  > SIHP # -7046 is evaluated as possessing integrity of location, design, materials, and workmanship. The setting is evaluated as lacking integrity as the character of the place as a locus of agriculture has been lost and the vegetation is much different. The feeling of agricultural life of the historic property has been lost. The historic property has lost its association with the events and activities of agriculture.
  >
  > The relationship of the historic property to the local history of agriculture and the integrity of location, design, materials, and workmanship is evaluated as supporting the site significance assessment made in 2009. [Shideler and Hammatt 2018:20]

  So while not spelled out per se in the 2018 preservation plan, the preservation plan supports the significance assessment made in 2009 “assessed as significant under Criterion A\[…] Criterion C […] and Criterion D of the NRHP and HRHP evaluation criteria.”

  The SHPD acceptance letter for this preservation plan dated 28 February 2018 (Log No. 2018.00220, Doc. No. 1802JA04) asserts slightly differently that “Site 2268 retains integrity of location, design, materials, and workmanship and is assessed as significant under HAR §13-284-6 Criteria a, c, and d.”

- A supplemental archaeological inventory survey for the Makakilo Drive Extension project (Zapor et al. 2018) further documented previously identified components of the Waiahole Ditch and documented one newly identified feature. Zapor et al. (2018) assess the ditch as significant pursuant to HAR §13-275-6, under Criteria a, c, and d.

Based on the findings of this AIS report, SIHP # 50-80-09-2268 is assessed as significant under HAR §13-284-6 Criteria a, c, and d. The historic property has yielded information on the agricultural history of the area and contributed greatly to the development and evolution of the ‘Ewa Plain throughout its history. However, within the project area, the historic property only retains sufficient integrity of location, which is also diminished in portions of the project area due to erosion and neglect. While there are some portions that retain some integrity of design, materials, and workmanship within the project area, this integrity is very diminished. While the overall ditch is significant, the remnant portion of SIHP # 50-80-09-2268 within the project area does not retain sufficient integrity to be considered significant.

Section 8 Project Effect and Mitigation Commitments

8.1 Project Effect

Two historic properties (SIHP #s 50-80-08-5593 and 50-80-09-2268) were identified within the project area (the same as identified in a prior Dega et al. 1998 study). The portion of SIHP # 50-80-09-2268 within the project area does not retain sufficient integrity to be considered significant, and therefore no further work is recommended for the historic property. This is in keeping with the conclusions of the Dega et al. 1998 study and the SHPD review(s) that accepted that study (see Appendix A).

Sufficient information regarding the location, extent, function, and age of the portion of SIHP # 50-80-08-5593 within the project area has been generated by the current archaeological inventory survey investigation to mitigate any adverse effect caused by the proposed project.

Therefore, pursuant to HAR §13-284-7, the project-specific effect determination is “No historic properties affected.”

8.2 Mitigation Commitments

The proposed project will have no effect on significant historic properties within the project area, therefore no mitigation commitments are required.

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Appendix A SHPD Acceptance of the Dega et al. 1998 AIS

BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII

STATE OF HAWAII

DEPARTMENT OF LAND AND NATURAL RESOURCES

HISTORIC PRESERVATION DIVISION
Kakuhihewa Building, Room 555
601 Kamokila Boulevard
Kapolei, Hawaii 96707

MICHAEL D. WILSON, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

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GILBERT COLOMA-AGARAN
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AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
CONSERVATION AND RESOURCES
ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
LAND
STATE PARKS
WATER RESOURCE MANAGEMENT

February 3, 1999

Mr. Michael Dega, MA
Scientific Consultant Services, Inc.
711 Kapiolani Boulevard, Suite 777
Honolulu, Hawaii 96813

LOG NO: 22959
DOC NO: 9901EJ28

Dear Mr. Dega:

SUBJECT: **Historic Preservation Review of An Archaeological Inventory Survey of the University of Hawai'i, West O'ahu Campus, District of 'Ewa, Island of O'ahu, Hawaii'i (1998 Dega et al.)**
Honouliuli, 'Ewa, O'ahu
TMK: 9-2-002:001 por.; 9-2-004:005 por.

Thank you for the submittal of the replacement pages for the above report which completes the historic preservation review for this project. We can now conclude that the inventory survey was successfully executed. The report has been added to our library for public use.

Should you have any questions, please feel free to call Sara Collins at 692-8026 or Elaine Jourdane at 692-8027.

Aloha,

Don Hibbard, Administrator
Historic Preservation Division

EJ:jk

FEB 9 1999

BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII

MICHAEL D. WILSON, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTIES

GILBERT COLOMA-AGARAN

AQUACULTURE DEVELOPMENT PROGRAM
AQUATIC RESOURCES
CONSERVATION AND RESOURCES ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION DIVISION
LAND DIVISION
STATE PARKS
WATER AND LAND DEVELOPMENT

STATE OF HAWAII

DEPARTMENT OF LAND AND NATURAL RESOURCES

STATE HISTORIC PRESERVATION DIVISION
33 SOUTH KING STREET, 6TH FLOOR
HONOLULU, HAWAII 96813

June 15, 1998

LOG NO: 21708
DOC NO: 9806SC02

Mr. Michael Dega, MA
Scientific Consultant Services, Inc.
711 Kapiolani Boulevard, Suite 777
Honolulu, Hawai'i, 96813

Dear Mr. Dega:

SUBJECT: Chapter 6E-8 Historic Preservation Review of a Draft Report on an Archaeological Inventory Survey of the Proposed University of Hawai'i, West O'ahu Campus Hono'uli'uli, 'Ewa, O'ahu
TMK: 9-2-002: 001 por.; 9-2-004: 005 por.

Thank you for the recent submission of a draft report documenting the results of an archaeological inventory survey of a 998-acre property near Makakilo, O'ahu (*An Archaeological Inventory Survey of the University of Hawai'i, West O'ahu Campus, District of 'Ewa, Island of O'ahu, Hawai'i [TMK: 9-2-2: 1 por.; 9-2-4: 5 por.]*. 1998. Dega et al.). We provide the following comments.

We believe that the survey was conducted acceptably, with a total of 2 historic sites found: 2268, the Waiahole Ditch, a historic irrigation feature; 5593, a complex of water transport and irrigation features related to 20th century sugar cane production. Before we can accept the report as final, however, we would like to see several minor corrections made. Once we receive these revisions (and they may be submitted on separate pages), we anticipate accepting the report and concluding that the survey was successfully executed.

Should you have any questions, please feel free to call Sara Collins at 587-0013.

Aloha,

DON HIBBARD, Administrator
State Historic Preservation Division

SC:amk

JUN 15 1998

M. Dega
Page 2

ATTACHMENT I: SPECIFIC COMMENTS ON A REPORT ON THE INVENTORY SURVEY OF THE PROPOSED WEST O'AHU CAMPUS SITE SCIENTIFIC CONSULTANT SERVICES, INC.

Research Results

Page 17, Paragraph 2: The Waiahole Ditch system has a SIHP No. (50-80-09-2268) and was previously reported in Goodman & Nees (1991. *Archaeological Reconnaissance and Inventory Surveys of 3,500 Acres in Waiawa Ahupua'a, 'Ewa, O'ahu*). Please add this information and also indicate the location of the site in the project area on Figure 2. Also, could you please provide a summary statement of the numbers and types of features that compose SIHP No. 5593?

Page 18, Figure 7: Is this flume part of SIHP 2268 or 5593?

Page 20, Settlement Pattern: While the project area appears to contain only post-contact sites relating exclusively to commercial agriculture, a couple of additional points should be made in this discussion: (1) Were traditional habitation sites in 'Ewa permanent or temporary? (2) Were agricultural sites of any kind reported in some of the studies you cite? For example, you refer to Wolforth's (1998) recently presented evidence for buried pondfields at the West Loch project area.

Recommendations

General: This section will need to be divided into two, separately headed parts: Significance Assessments and Recommendations.

Page 21, Paragraph 4: In view of the above comments, this section will need to be revised to reflect the presence of two, not one, historic sites in the project area.

Attachment G
Cultural Impact Assessment Report

FINAL
Cultural Impact Assessment for the West Oahu Solar Project, Honouliuli Ahupua‘a, ‘Ewa District, O‘ahu TMK: [1] 9-2-002:007

Prepared for
AES Distributed Energy

Prepared by
Kellen Tanaka, B.S.,
David W. Shideler, M.A.,
and
Hallett H. Hammatt, Ph.D.

Cultural Surveys Hawai‘i, Inc.
Kailua, Hawai‘i
(Job Code: HONOULIULI 172)

May 2020

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Management Summary

Reference	Cultural Impact Assessment for the West Oahu Solar Project, Honouliuli Ahupua‘a, ‘Ewa District, O‘ahu, TMK: [1] 9-2-002:007 (Tanaka et al. 2020)
Date	May 2020
Project Number(s)	Cultural Surveys Hawai‘i, Inc. (CSH) Job Code: HONOULIULI 172
Agencies	State of Hawai‘i, Department of Health, Office of Environmental Quality Control (DOH/OEQC) and State of Hawai‘i, Land Use Commission (LUC)
Land Jurisdiction	State of Hawai‘i
Project Proponent	AES Distributed Energy
Project Location	The project area is on undeveloped lands located in the southeastern foothills of the Wai‘anae Range, northeast of Pu‘u Makakilo and the Makakilo subdivision and about 600 m northwest of the intersection of the H-1 freeway and the Kualakai Parkway. The project area is depicted on a portion of the 2013 Ewa and Schofield Barracks U.S. Geological Survey (USGS) 7.5-minute topographic quadrangle.
Project Description	The West Oahu Solar project consists of an approximately 12.5-megawatt (MW) ground-mounted solar photovoltaic system, coupled with a 50 MW-hour battery energy storage system (BESS) and related interconnection and ancillary facilities. The solar photovoltaic system would include a series of panels arranged into arrays consisting of evenly spaced rows. The panels would be mounted on a racking system installed on posts. The battery storage system would consist of containerized lithium-ion battery units and inverters distributed throughout the project area. The project would connect to a substation via underground electrical conduit. The substation would be constructed adjacent to and would interconnect with an existing Hawaiian Electric Company (HECO) 46kV transmission line that traverses the site. The project would be accessed via the existing gated entry off Kualakai Parkway (near the intersection with Interstate H-1) and would utilize a network of existing and new onsite access roads. Some road improvements may be needed to facilitate access within the project area. In addition, some site grading would be needed to accommodate the project facilities and to comply with stormwater and civil engineering requirements. In December 2019, CSH was notified of a slight modification to the project area to include additional areas along the perimeter of the project area, as well as maintenance of the existing roadways approaching the project area from the southeast.
Project Acreage	The project area is approximately 101.62 acres (41.12 hectares)

Document Purpose	This cultural impact assessment (CIA) was prepared to comply with the State of Hawai‘i’s environmental review process under Hawai‘i Revised Statutes (HRS) §343, which requires consideration of the proposed project’s potential effect on cultural beliefs, practices, and resources. Through document research and cultural consultation efforts, this report provides information compiled to date pertinent to the assessment of the proposed project’s potential impacts to cultural beliefs, practices, and resources (pursuant to the Office of Environmental Quality Control’s *Guidelines for Assessing Cultural Impacts*) which may include traditional cultural properties (TCPs). These TCPs may be significant historic properties under State of Hawai‘i significance Criterion e, pursuant to Hawai‘i Administrative Rules (HAR) §13-275-6 and §13-284-6. Significance Criterion e refers to historic properties that “have an important value to the native Hawaiian people or to another ethnic group of the state due to associations with cultural practices once carried out, or still carried out, at the property or due to associations with traditional beliefs, events or oral accounts—these associations being important to the group’s history and cultural identity” (HAR §13-275-6 and §13-284-6). The document will likely also support the project’s historic preservation review under HRS §6E and §6E-8, and HAR §13-275 and §13-284. The document is also intended to support the discretionary land use permitting process including a State Special Use Permit (SUP) from the Land Use Commission (LUC).
Results of Background Research	Background research for this study yielded the following results, presented in approximate chronological order: 1. Honouliuli is the largest *ahupua‘a* (land division usually extending from the uplands to the sea) in the *moku* (district) of ‘Ewa. Honouliuli translates literally as “dark water,” “dark bay,” or “blue harbor,” and thus is named for the waters of Pearl Harbor which marks the eastern boundary of the *ahupua‘a* (Jarrett 1930:22). Another source translates Honouliuli as “The blue bays or inlets” (*Saturday Press*, 11 August 1883). Honouliuli appears in the “Mo‘olelo of Lepeamoa,” the chicken-girl of Pālama, where Honouliuli is the name of the husband of the chiefess Kapālama, and grandfather of Lepeamoa (Westervelt 1923:164–184). 2. Generally, Honouliuli was described as very hot and dry. Evidence for drought-like conditions are further supported by the relative lack of traditional rain names associated with Honouliuli Ahupua‘a. The Nāulu rain is the only known associated rain name for Honouliuli. Due to the lack of rainwater, freshwater resources were accessed via a karstic system. 3. In traditional Hawaiian times, the areas of exposed coral (Pleistocene limestone) outcrop were undoubtedly more extensive.

	According to McAllister (1933), holes and pits in the coral were generally accessed for water, while larger pits, often containing soil, were used for cultivation. McAllister additionally remarked that at the time of his 1930s survey *mai‘a* (banana; *Musaceae*) and *kō* (sugarcane; *Saccharum officinarum*) were being cultivated within the pit caves (sinkholes) (McAllister 1933:109). 4. The traditional *ka‘ao* (legends) associated with the area speak of the *akua* (godly) brothers, Kāne and Kanaloa. It was their supernatural feat of hurling *pōhaku* (stone) across the island that determined the boundaries of land divisions (Sterling and Summers 1987:1). Additional *mo‘olelo* (stories) speak of Hi‘iaka and her travels across the plains of ‘Ewa. In particular, the *wahi pana* (storied place) of Kaupe‘a (located south of the current project area) is described. Kamakau describes Kaupe‘a as a wide plain where a grove of *wiliwili* (*Erythrina sandwicensis*) stands (Kamakau 1991a:47). This plain is an *ao kuewa*, a realm belonging to homeless souls. In general, the *kama‘āina* (native born) of both Honouliuli Ahupua‘a and ‘Ewa District made a point to avoid this place. 5. Pu‘uokapolei is a prominent hill located on the ‘Ewa coastal plain that was the primary landmark for travelers on the trail running from Pearl Harbor to Wai‘anae. A *heiau* (pre-Christian place of worship) was once on the summit of the hill, however, by the time of McAllister’s survey of O‘ahu it had been destroyed (McAllister 1933:108). The hill was also used as a point of solar reference or as a place for celestial observations of the winter and summer solstice. A ceremony at a *heiau* on Pu‘uokapolei provides a vantage point to capture the sun setting directly behind Pu‘ula‘ila‘i, a peak farther west in the Wai‘anae Range. A coinciding ceremony at Kūpalaha Heiau in Waikīkī captures the same essence as the sun sets behind Pu‘uokapolei. 6. Additional *heiau* located within Honouliuli included Pu‘u Ku‘ua located at Palikea, in addition to two unidentified *heiau*. These two unidentified *heiau* are located at the foot of Pu‘u Kanehoa and Pu‘u Kuina, respectively. 7. In later historic times, a network of trails encircled and crossed the Wai‘anae Range, allowing passage from West Loch to the Honouliuli lowlands, past Pu‘uokapolei and Waimānalo Gulch to the Wai‘anae coast and onward circumscribing the shoreline of O‘ahu (‘Ī‘ī 1959:96–98). The main trail along the south shore of O‘ahu would have been approximately 1.5 km to the southeast. A main trail extending up the central valley of O‘ahu would have been approximately 3 km to the east. The 1825 Malden map shows

	a trail extending from the main trail along the south shore of O‘ahu into the uplands in the Pālehua area as passing just a couple hundred meters to the southwest of the project area. 8. The rich resources of Pu‘uloa—the fisheries in the lochs, the shoreline fishponds, the numerous springs, and the irrigated lands along the streams—made ‘Ewa a prize for competing chiefs. ‘Ewa Moku was also a political center and home to many chiefs in its day. Oral accounts of *ali‘i* (royalty) recorded by Hawaiian historian Samuel Kamakau date back to at least the twelfth century. *Ali‘i* associated with Honouliuli and greater ‘Ewa Moku included Kākuhihewa, Keaunui, Lakona, Mā‘ilikūkahi, and Kahahana. 9. In early historic times, the population of Honouliuli was concentrated at the western edge of West Loch in the vicinity of Kapapapuhi Point in the “Honouliuli Taro Lands.” This area was clearly a major focus of population due to the abundance of fish and shellfish resources in close proximity to a wide expanse of well-irrigated bottomland suitable for wetland taro cultivation. 10. Early foreign accounts describe the southwest coast of O‘ahu, including Honouliuli Ahupua‘a, as an area “a little distance from the sea, the soil is rich and all the necessaries of life are abundantly produced” (Vancouver 1798:215). A sailor among Vancouver’s crew observed, however, that “from the number of houses within the harbour it should seem to be very populous; but the very few inhabitants who made their appearance were an indication of the contrary” (Vancouver 1798:216). 11. Following the Māhele of 1848, 99 individual land claims in the *ahupua‘a* of Honouliuli were registered and awarded by King Kamehameha III. No *kuleana* land claims were made for land within the current project area or vicinity. The vast majority of the Land Commission Awards (LCA) were located in Honouliuli near the taro lands of the *‘ili* (land division, smaller than an *ahupua‘a*) of Pu‘uloa and the Pu‘uloa Salt Works. The largest award (Royal Patent 6071, LCA 11216, *‘Āpana* [parcel] 8) in Honouliuli Ahupua‘a was granted to Miriam Ke‘ahi-Kuni Kekau‘onohi on January 1848 (Native Register 1848) who acquired a deed to all unclaimed land within the *ahupua‘a*, including the present project area. 12. Beginning with the time of Western Contact, however, Hawaiian populations were introduced to many virulent western diseases which began to decimate the native populations. Thus, four years following the 1832 census, the ‘Ewa population had dropped to 3,423 (Schmitt 1973:9, 36), “a decrease of 592 in 4 years” (Ewa

	Station Reports 1836). Between 1848 and 1853, there was a series of epidemics of measles, influenza, and whooping cough that often wiped out whole villages. 13. With the increasing foreign interests on O‘ahu Island during the last half of the nineteenth century, an array of agricultural enterprises were attempted. In 1871, John Coney rented the lands of Honouliuli to James Dowsett and John Meek, who used the land for cattle grazing. In 1877, James Campbell purchased most of Honouliuli Ahupua‘a for a total of $95,000. 14. By 1889, the Ewa Plantation Company was established and lands throughout Honouliuli were designated for sugarcane cultivation. Sugar production exploded with the successful drilling of an artesian well by James Campbell on the ‘Ewa Plain. Campbell’s first well was named Waianiani (“crystal waters”) by the *kama‘āina* of Honouliuli (Nellist 1925). By 1930, Ewa Plantation had drilled 70 artesian wells to irrigate cane lands; artesian wells provided fresh water to Honouliuli for nearly 60 years (Ho‘okuleana 2014). 15. In 1897, B.F. Dillingham established the Oahu Sugar Company (OSC) on 12,000 acres leased from the estates of John Papa ‘Ī‘ī, Bishop, and Robinson. The Oahu Sugar Company had over 900 field workers, composed of 44 Hawaiians, 473 Japanese, 399 Chinese, and 57 Portuguese. The first sugar crop was harvested in 1899, ushering in the sugar plantation era in Waipahu (Ohira 1997). Prior to commercial sugar cultivation, these lands were described as being “of near desert proportion until water was supplied from drilled artesian wells and the Waiahole Water project” (Condé and Best 1973:313). 16. The Waiahole Water Company was formally incorporated in 1913 and was originally a subsidiary of the Oahu Sugar Company. The Waiahole Ditch was designed by engineer Jorgen Jorgensen, with recommendations by engineer J.B. Lippencott and assisted by W.A. Wall. Upon its completion in 1916, the Waiahole Ditch was 35 km (21.9 miles) long and cost $2.3 million. The 32 million gallons of daily water enabled the O‘ahu Sugar Company to grow to “some 20 square miles […] ranging in elevation from 10 ft at the Waipio Peninsula […] to 700 ft at the Waiahole Ditch” (Condé and Best 1973:313). The ditch system is included on the state inventory of archaeological sites as Site no. 50-80-09-2268. The Waiahole Ditch System crossed through the western portion of the present project area. 17. The early twentieth century saw the lands of Honouliuli heavily utilized by both civilians and the U.S. military for transportation.

	The U.S. Government began acquiring the coastal lands of ‘Ewa for development of a naval base at Pearl Harbor. In 1901, the U.S. Congress formally ratified annexation of the Territory of Hawaii, and the first 1,356.01 acres of Pearl Harbor land were transferred to U.S. ownership. 18. In 1937, 18 miles of roads were built in the coastal Honouliuli area, and in 1939-1940 the U.S. bought 3,500 acres of land in this area (Landrum et al. 1997:62–67), to build several other military camps and installations, including Barbers Point Naval Air Station. 19. Following the Japanese Navy’s attack on Pearl Harbor on 7 December 1941, the Territory of Hawaii was declared under martial law and the writ of *habeas corpus* (the requirement for a person under arrest to be brought before a judge or into court) was suspended (U.S. Department of the Interior 2014:6–7). Persons of Japanese and European ancestry in Hawai‘i suspected of disloyalty to the United States were rounded up and imprisoned by the U.S. military and the Federal Bureau of Investigations (FBI) (U.S. Department of the Interior 2014:xii). In 1943, the Honouliuli Internment Camp was constructed to intern citizens, resident aliens, and prisoners of war. Located in Honouliuli Gulch, east of the project area, the camp was the “last, largest, and longest-used World War II confinement site in Hawai‘i,” holding approximately 320 internees and nearly 4,000 prisoners of war (U.S. Department of the Interior 2014:xiv).
Results of Community Consultation	CSH attempted to contact 70 Hawaiian organizations, agencies, and community members. Of the 12 people that responded, one provided written testimony and three *kama‘āina* (Native-born) and/or *kūpuna* (elders) participated in formal interviews for more in-depth contributions to the CIA. Consultation was received from community members as follows: 1. Christian Kaimanu Yee, *kama‘āina* and knowledgeable of *mo‘olelo* and *wahi pana* 2. Shad Kāne, member of Kapolei Hawaiian Civic Club, Chair of the O‘ahu Council of Hawaiian Civic Clubs Committee on the Preservation of Historic Sites and Cultural Properties, Ali‘i Ai Moku of the Kapuāiwa Chapter of the Royal Order of Kamehameha Ekahi, and ‘Ewa Moku Representative on the State Aha Moku Advisory Committee. 3. Tom Berg, former Councilman, District 1 4. Lynette Paglinawan, cultural practitioner, educator, teaches a course on Native Hawaiian Healing at University of Hawai‘i West O‘ahu On 24 January 2020, an *In-Progress Draft Cultural Impact Assessment for the West O‘ahu Solar Project* was provided via email to two parties representing the Aha Moku Council, two parties at Nā Ala Hele, two

	parties at the State Historic Preservation Division (SHPD) History and Culture Branch, and Office of Hawaiian Affairs (OHA). The parties were invited to review and comment, or provide notification of their intent to comment, prior to the reports inclusion in the Draft Environmental Assessment. CSH followed up with the seven parties via email on 25 February 2020, and has not received any comments or notification of an intent to comment to date.
Impacts and Recommendations	Based on information gathered from the community consultation, participants voiced their concerns in a cultural context. 1. Mr. Shad Kāne stated he is not in opposition to the proposed project. He noted the project area has been previously disturbed by sugarcane production. 2. Mr. Tom Berg stated that the project has been "proposed on a pueo (owl) foraging and breeding ecosystem." He noted that records indicate that per earliest colonial contact, the *pueo* is most abundant on the slopes from Pu‘u Kapua‘i to West Loch, in the area where the project is slated. He added that "Hunehune Gulch, Kaloi Gulch, and Honouliuli Gulch are migratory routes used by the pueo to go from mountain to sea to court, mate, forage, and raise their brood." He stated that the proposed project will "encroach on prime pueo habitat-considered to be graded A+—"a ten (10)"—when it comes to the degree of pueo habitat in use on this project site." 3. Mr. Berg added that the *pueo* has "a direct connection to Native Hawaiian family lineage in Ewa Beach," noting the *pueo* is the *‘aumakua* for the Michael Lee family and their accounts which go back over seven generations are documented at the State Archives Building in Honolulu. 4. Mr. Berg also stated that the project site is "inhabited by the ōpe‘ape‘a [Hawaiian hoary bat, *Lasiurus cinereus semotus*] at various times of the seasons," noting that in 1910, the State of Hawai‘i documented *‘ōpe‘ape‘a* within a half-mile of the project area. 5. Mr. Berg stated his concern that the "property in question will not receive the proper protocol to conclude no endangered species inhabit the area." Mr. Berg recommended that "a thorough and complete protocol is adopted to repeat the inventory exercise for pueo and ‘ōpe‘ape‘a over the course of a calendar year would be in order so the project does not inadvertently contribute to more endangered species habitat loss." He also recommended inquiring with Dr. Melissa Price and Dr. Javier Cotin of the Project Pueo Biologist Team and Department of Fish and Wildlife (DOFAW) Biologist Afsheen Siddiqi regarding *pueo* protocol. 6. Mr. Berg also expressed his concern for the possible negative aspects of light at an adjacent parcel. He expressed concern that a

	solar panel may reflect neighboring lighting operations into “the flight patterns of migrating birds and the *‘ōpe‘ape‘a* and *pueo* in particular need to be addressed.” 7. Ms. Lynette Paglinawan stated that “the area from Waimānalo Gulch over to Kapolei to the location of University of Hawai‘i West O‘ahu (UHWO) was known by very early residents there to be the place where “*ao kuewa*,” wandering spirits, congregated from *makai* [toward the sea] to *mauka* [toward the mountains] up Pālehua and especially near the cluster of *wiliwili* [*Erythrina sandwicensis*] trees in Kaupe‘a.” She expressed her concerns regarding the effects that the proposed project will have on the *ao kuewa*, which she believes are attracted to energy. She also expressed her concerns of the effect of the spirits on the solar panels, noting “that’s high energy. It will be like going to the game room.” She also noted that UHWO experiences numerous electrical problems due to the presence of these spirits. 8. Ms. Paglinawan noted that “this area where the University [of Hawai‘i West O‘ahu] is located has a lot of trails that go from *mauka-makai*, come from Honolulu going towards Nānākuli.” She stated that project proponents should be mindful of the locations of ancient trails, noting that the ancient trails are still used by spirits to travel from *mauka* to *makai* within Honuliuli Ahupua‘a. 9. Ms. Paglinawan recommended planting “a wall of trees” surrounding the proposed project area as restitution to the spirits who may be displaced by the proposed project. She also noted that planting of “a wall of trees” around the proposed project area would have other benefits including the production of oxygen and providing a habitat for Native Hawaiian birds. 10. Ms. Paglinawan also expressed her concerns regarding the psychological impacts for the people that encounter the spirits, noting trauma on workers at the UHWO, as well as, families who live in the area. She was particularly concerned for the children who encounter these spirits, noting her belief that children “see many more things than adults do.” 11. Project construction workers and all other personnel involved in the construction and related activities of the project should be informed of the possibility of inadvertent cultural finds, including human remains. In the event that any potential historic properties are identified during construction activities, all activities will cease and the SHPD will be notified pursuant to HAR §13-280-3. In the event that *iwi kūpuna* (Native Hawaiian skeletal remains) are identified, all earth moving activities in the area will stop, the area will be cordoned off, and the SHPD and Police Department will be notified pursuant to HAR §13-300-40. In addition, in the event of an inadvertent discovery of human remains, the completion of a burial

	treatment plan, in compliance with HAR §13-300 and HRS §6E-43, is recommended. 12. In the event that *iwi kūpuna* and/or cultural finds are encountered during construction, project proponents should consult with cultural and lineal descendants of the area to develop a reinterment plan and cultural preservation plan for proper cultural protocol, curation, and long-term maintenance.
Analysis	The following analysis is a summary of Section 8.4. Based on information gathered from the cultural and historical background and community consultation, no culturally significant resources were identified within the project area. At present, there is no documentation or testimony indicating traditional or customary Native Hawaiian rights are currently being exercised “for subsistence, cultural and religious purposes and possessed by ahupua‘a tenants who are descendants of native Hawaiians who inhabited the Hawaiian Islands prior to 1778” (Hawai‘i State Constitution, Article XII, Section 7) within the project area. While no cultural resources, practices, or beliefs were identified as currently existing within the project area, Honouliuli Ahupua‘a maintains a rich cultural history in the exercising of traditional or customary Native Hawaiian rights within the project *ahupua‘a*. Honouliuli Ahupua‘a is the largest *ahupua‘a* in the *moku* of ‘Ewa. The environment of Honouliuli is very hot and dry. These environmental limitations forced ingenuity and innovation. *Kama‘āina* of Honouliuli used agricultural sinkholes that accumulated water within them via a subterranean water or karst system; this water also contained nutrient-rich sediment allowing plants such as *kalo, kī*, and *noni* to survive. The post-Contact period brought numerous changes to the *ahupua‘a* of Honouliuli. Traditional agricultural was rapidly replaced by large-scale commercial ventures. The discovery of artesian water beneath the ‘Ewa plains by James Campbell in 1879 led to the establishment of sugarcane plantations in Honouliuli including the Oahu Sugar Company. Much of the *mauka* (upland) lands in western Honouliuli, including ridges and deep gulches, were unsuitable for commercial sugar cultivation and remained pasture land for grazing livestock. The Donn 1906 map suggests the present project area was at the edge of sugarcane cultivation at that time (see Figure 15). By 1920, however, much of the lands of Honouliuli were used for commercial sugarcane cultivation (Frierson 1972:18). The project area is situated between Pu‘u Kapua‘i which is located 0.5 km to the northwest and Pu‘u Makakilo located 1.2 km to the southwest. These are understood as “very late cones [of the Wai‘anae volcano] […] composed of a varied mixture of cinder, spatter and lava flows” (Macdonald et al. 1983:429). Pukui et al. (1974:199) translate “Pu‘u Kapua‘i” as “footprint hill,” however, the association with that name is

	unknown. “Pu‘u Makakilo” is translated as “observing eyes” (Pukui et al. 1974:201). The association of this name is also unknown. The project area is also located between two deeply dissected gulches, Kalo‘i Gulch which is located 300 m to the southwest and Honouliuli Gulch located 700 m to the northeast of the project area. These gulches are at a comparable elevation and are believed to rarely run with water. The name “Ka-lo‘i” translates to “the taro patch” (Pukui et al. 1974:77). Sterling and Summers (1978:35) associate Kalo‘i Gulch with a number of vignettes regarding the “Waihuna” or “Punahuna” hidden spring. It was also noted that the hidden spring “had been one of the principal sources of water for all that country, which was quite heavily populated before the smallpox epidemic of 1840” (Ida E.K. von Holt in Sterling and Summers 1978:35). In traditional times, trails were well used for travel within the *ahupua‘a* between *mauka* and *makai* (shore) and laterally between *ahupua‘a*. A historical trail system existed on O‘ahu extending from Honolulu to Wai‘anae. A cross-*ahupua‘a* (east-west) trail passed through Honouliuli north of Pu‘uokapolei, and continued along the coast to Wai‘anae following the route of the modern Farrington Highway. Early historic maps depict a trail that branches off the cross-*ahupua‘a* trail into the uplands in the Pālehua area. The 1825 Malden map (see Figure 7) shows a trail extending into the Pālehua area a couple hundred meters to the southwest of the project area. A 1919 map (see Figure 16) shows an unimproved road alignment just south of the project area, understood as the Pālehua Road, approximating a traditional Hawaiian footpath into the uplands. However, a 1922 map (see Figure 17 and Figure 18 showing annotations), shows the Pālehua trail as arcing through the western portion of the project area before arcing north of Pu‘u Makakilo. This trail may have always been somewhat braided. The trail appears to only be depicted on the 1922 map (see Figure 17 and Figure 18) and appears to have been largely under Sugar Cane Field 30 in the 1925 map (Figure 19). This trail was not identified on the ground in either of the AIS studies of this area (Dega et al. 1998 and Welser et al. 2019). Interviewee Lynette Paglinawan stated that “this area where the University [of Hawai‘i West O‘ahu] is located has a lot of trails that go from *mauka-makai*, come from Honolulu going towards Nānākuli.” She noted that “spirits travel on ancient trails” which they use to “go from *mauka* going down to *makai*.” She added that these “ancient trails are still in use,” noting that people who live in homes that have been built on or near these ancient pathways have experienced “strange happenings” which she believes are due to the *‘uhane* (spirits) which still use these ancient trails to travel from *mauka* to *makai*. Ms. Paglinawan stated that as a result of the development of the *moku* of ‘Ewa including the *ahupua‘a* of Honouliuli, “we destroyed the habitat of

	the *ao kuewa* which is the *wiliwili* trees." She recommended planting "a wall of trees" surrounding the proposed project area which would provide a home for the displaced spirits. She also discussed the types of plants that were previously found in the area which include *noni* plants, coconut trees, *lauhala* trees, and *‘ulu* trees. She noted that these plants were "very plentiful but sparse not like a big grove where it's like a park of trees, it was interspersed throughout." The "Ewa Karst" which consists of limestone caves formed in the uplifted coral was undoubtedly more extensive during traditional Hawaiian times. Where not covered by alluvium or stockpiled material, this Pleistocene limestone outcrop has characteristic dissolution "pit caves" (Mylroie and Carew 1995) which were sometimes also used as burial caves. Burials have been encountered in the coastal areas of the Honouliuli Ahupua‘a, however, previous archaeological studies (Dega et al. 1998) within the project area have not documented any burials within the project area nor within the vicinity of the project area. An archaeological inventory survey conducted for the University of Hawai‘i West O‘ahu Campus that encompassed the entirety of the project area (Dega et al. 1998) identified no surface Hawaiian features. Dega et al. (1998:i) noted several plantation-era "flumes, aqueducts, ditches, pumps, and other irrigation features occurring within the heavily modified landscape of the project area." The features represented an irrigation complex (State Inventory of Historic Places [SIHP] # 50-80-08-5593) which was used for sugarcane cultivation from the 1920s through more recent times. A portion of the Waiahole Ditch System (SIHP # 50-80-09-2268) was also documented crossing through the northwest section of the project area and continuing southwest through the lower agricultural fields. In written testimony provided to CSH via email on 19 August 2019, Mr. Tom Berg, former City Councilman, stated the project has been "proposed on a pueo (owl) foraging and breeding ecosystem." The *pueo*, which are found on all of the main Hawaiian islands, are listed by the State of Hawai‘i as endangered on the island of O‘ahu (DLNR 2005). The Department of Land and Natural Resources (DLNR) states that *pueo* are most commonly found in "open habitats such as grasslands, shrublands, and montane parklands, including urban areas and those actively managed for conservation" (DLNR 2005). Mr. Berg also noted that records indicate that per earliest colonial contact, the *pueo* is most abundant on the slopes from Pu‘u Kapua‘i to West Loch, adding that "Hunehune Gulch, Kaloi Gulch, and Honouliuli Gulch are migratory routes used by the pueo to go from mountain to sea to court, mate, forage, and raise their brood." He also noted *pueo* are not forest dwellers, preferring "scrub, open fields/dirt landscapes with some grass." He stated that the proposed project will "encroach on prime pueo habitat-

	considered to be graded A+—“a ten (10)”—when it comes to the degree of pueo habitat in use on this project site.” Mr. Berg also stated that the project site is “inhabited by the ōpe‘ape‘a at various times of the seasons.” He noted that in 1910, the State of Hawai‘i documented ‘*ōpe‘ape‘a* within a half-mile of the project area. *‘Ōpe‘ape‘a* is “the only land mammal native to the Hawaiian archipelago” and is found on all of the main Hawaiian islands except for Ni‘ihau (DLNR 2005:3-13). Mr. Berg stated his concern that the “property in question will not receive the proper protocol to conclude no endangered species inhabit the area.” He recommended that “a thorough and complete protocol is adopted to repeat the inventory exercise for pueo and ‘ōpe‘ape‘a over the course of a calendar year would be in order so the project does not inadvertently contribute to more endangered species habitat loss.” He also recommended inquiring with Dr. Melissa Price and Dr. Javier Cotin of the Project Pueo Biologist Team and Department of Fish and Wildlife (DOFAW) Biologist Afsheen Siddiqi regarding *pueo* protocol. Mr. Berg also expressed his concern for the possible negative aspects of lighting operations at an adjacent parcel which may reflect off of a solar panel into “the flight patterns of migrating birds and the *‘ōpe‘ape‘a* and *pueo* in particular need to be addressed.”
Ka Pa‘akai Analysis	In Ka Pa‘akai v. Land Use Commission, 94 Hawai‘i 31, 74, 7 P.3d 1068, 1084 (2000), the Court held the following analysis also be conducted: 1. The identity and scope of valued cultural, historical, or natural resources in the project area, including the extent to which traditional and customary native Hawaiian rights are exercised in the project area; 2. The extent to which those resources—including traditional and customary native Hawaiian rights—will be affected or impaired by the proposed action; and 3. The feasible action, if any, to be taken by the LUC to reasonably protect native Hawaiian rights if they are found to exist. Based on information gathered from the cultural and historical background, and the community consultation, culturally significant resources have been identified within the *ahupua‘a*. Although not within the project area, documentation and testimony indicates traditional or customary Native Hawaiian rights are possessed and are currently being exercised within the *ahupua‘a* by *ahupua‘a* tenants who are descendants of Native Hawaiians who inhabited the Hawaiian Islands prior to 1778 (Hawai‘i State Constitution, Article XII, Section 7). While no cultural resources, practices, or beliefs were identified as currently existing within the project area, Honouliuli Ahupua‘a maintains a rich cultural history in

	the exercising of traditional or customary Native Hawaiian rights within the project *ahupua‘a*. The proposed action will not affect or impair traditional and customary Native Hawaiian rights exercised in the *ahupua‘a* in which the project area is located. Therefore no action needs to be taken by the LUC to reasonably protect native Hawaiian rights as a result of this project. Therefore, the information provided in the CIA demonstrates the proposed project will not have any adverse effect on traditional and customary Native Hawaiian rights within the *ahupua‘a*.

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Section 1 Introduction

1.1 Project Background

At the request of Tetra Tech, Inc., and on behalf of AES Distributed Energy, Cultural Surveys Hawai‘i, Inc. (CSH) has prepared this cultural impact assessment (CIA) for the West Oahu Solar Project, Honouliuli Ahupua‘a, ‘Ewa District, O‘ahu, TMK: [1] 9-2-002:007 (por.). The project area is on undeveloped lands in the southeastern foothills of the Wai‘anae Range, northeast of Pu‘u Makakilo and the Makakilo subdivision and 600 m northwest of the intersection of the H-1 Freeway and the Kualakai Parkway. The project area is depicted on a portion of the 2013 Ewa and Schofield Barracks U.S. Geological Survey (USGS) 7.5-minute topographic quadrangle (Figure 1), a tax map plat (Figure 2), and a 2018 aerial photograph (Figure 3).

The West Oahu Solar Project consists of an approximately 12.5-megawatt (MW) ground-mounted solar photovoltaic system, coupled with a 50 MW-hour battery energy storage system (BESS) and related interconnection and ancillary facilities. The solar photovoltaic system would include a series of panels arranged into arrays consisting of evenly spaced rows. The panels would be mounted on a racking system installed on posts. The battery storage system would consist of containerized lithium-ion battery units and inverters distributed throughout the project area.

The project would connect to a substation via underground electrical conduit. The substation would be constructed adjacent to and would interconnect with an existing Hawaiian Electric Company (HECO) 46kV transmission line that traverses the site. The project would be accessed via the existing gated entry off Kualakai Parkway (near the intersection with Interstate H-1) and would utilize a network of existing and new onsite access roads. Some road improvements may be needed to facilitate access within the project area. In addition, some site grading would be needed to accommodate the project facilities and to comply with stormwater and civil engineering requirements.

In December 2019, the project area was slighty modified to include additional areas along the perimeter of the project area, as well as maintenance of the existing roadways approaching the project area from the southeast.

1.2 Document Purpose

This CIA was prepared to comply with the State of Hawai‘i’s environmental review process under Hawai‘i Revised Statutes (HRS) §343, which requires consideration of the proposed project’s potential effect on cultural beliefs, practices, and resources. Through document research, this report provides information compiled to date pertinent to the assessment of the proposed project’s potential impacts to cultural beliefs, practices, and resources (pursuant to the Office of Environmental Quality Control’s *Guidelines for Assessing Cultural Impacts*) which may include traditional cultural properties (TCPs). These TCPs may be significant historic properties under State of Hawai‘i significance Criterion e, pursuant to Hawai‘i Administrative Rules (HAR) §13-275-6 and §13-284-6. Significance Criterion e refers to historic properties that “have an important value to the Native Hawaiian people or to another ethnic group of the state due to associations with cultural practices once carried out, or still carried out, at the property or due to associations with traditional beliefs, events or oral accounts—these associations being important to the group’s

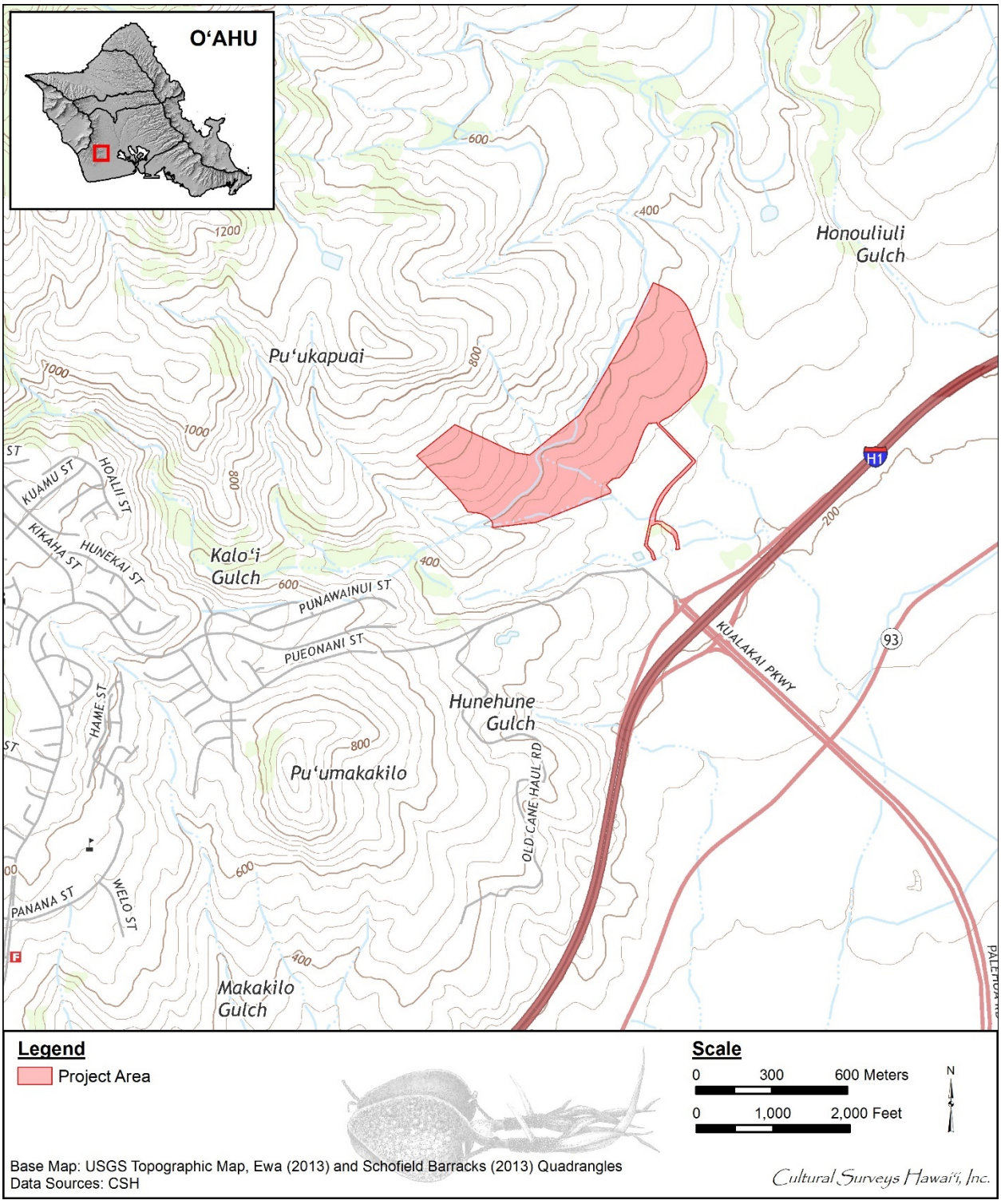

Figure 1. Portion of the 2013 Ewa and Schofield Barracks USGS 7.5-minute topographic quadrangles showing the location of the project area

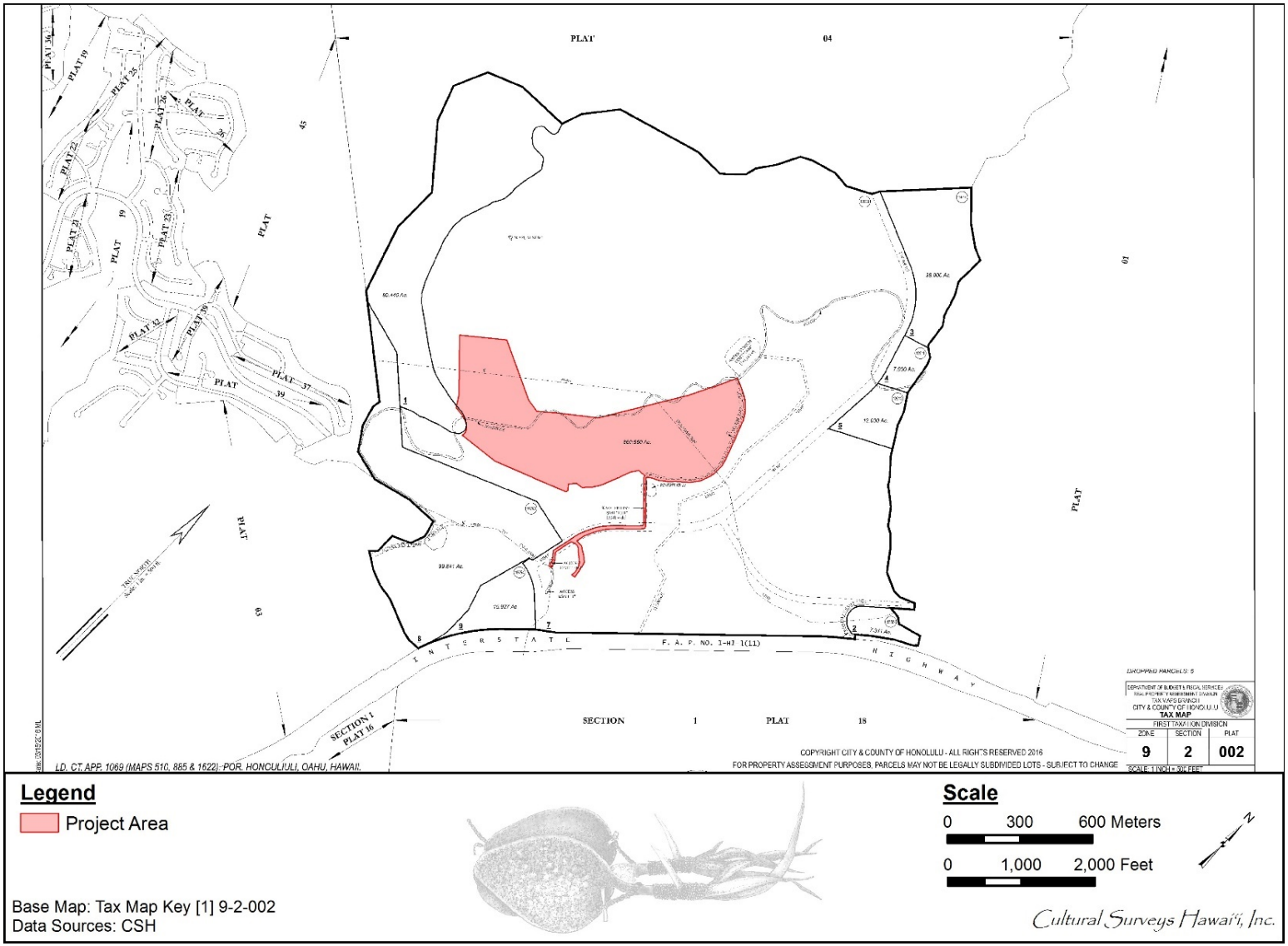

Figure 2. Tax Map Key (TMK) [1] 9-2-002 showing the location of the project area (Hawai‘i TMK Service 2014)

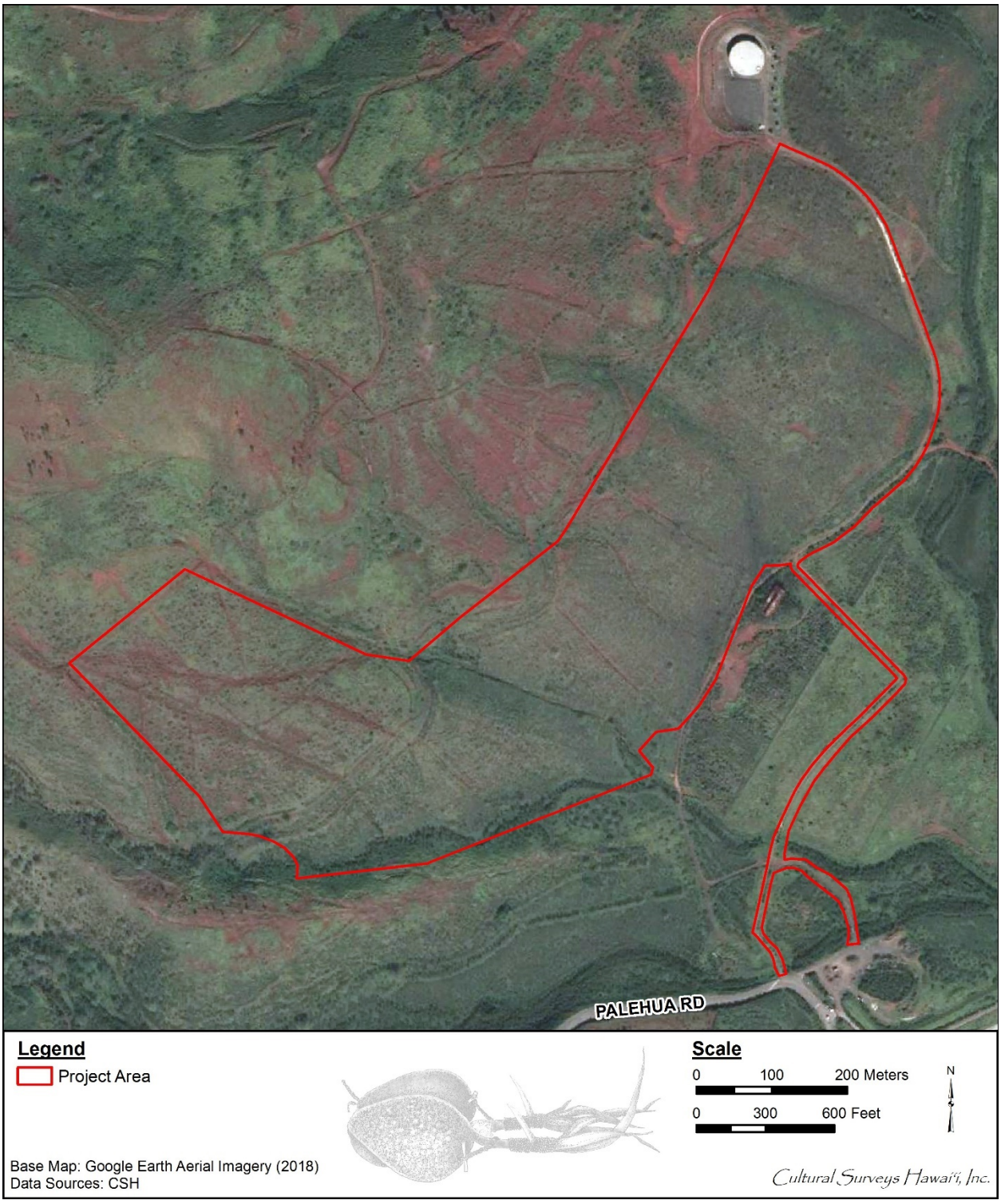

Figure 3. Aerial photograph of the project area (Google Earth 2018)

history and cultural identity" (HAR §13-275-6 and §13-284-6). The document will likely also support the project's historic preservation review under HRS §6E and HAR §13-275 and §13-284. The document is also intended to support the project's environmental review and the discretionary land use permitting process including a State Special Use Permit (SUP) from the Land Use Commission (LUC).

1.3 Scope of Work

The scope of work for this cultural impact assessment includes the following:

1. Examination of cultural and historical resources, including Land Commission documents, historic maps, and previous research reports, with the specific purpose of identifying traditional Hawaiian activities including gathering of plant, animal, and other resources or agricultural pursuits as may be indicated in the historic record.
2. Review of previous archaeological work at and near the subject parcel that may be relevant to reconstructions of traditional land use activities; and to the identification and description of cultural resources, practices, and beliefs associated with the parcel.
3. Consultation and interviews with knowledgeable parties regarding cultural and natural resources and practices at or near the parcel; present and past uses of the parcel; and/or other practices, uses, or traditions associated with the parcel and environs.
4. Preparation of a report that summarizes the results of these research activities and provides recommendations based on findings.

1.4 Environmental Setting

1.4.1 *Ka Lepo* (Soils)

According to the U.S. Department of Agriculture (USDA) Soil Survey Geographic (SSURGO) database (2001) and soil survey data gathered by Foote et al. (1972), the project area's soils consist of Kawaihapai clay loam, 2 to 6% slopes (KIB), Mahana silty clay loam, 6 to 12% slopes, eroded (McC2), Mahana silty clay loam, 12 to 20% slopes, eroded (McD2), Mahana silty clay loam, 20 to 35% slopes, eroded (McE2), Molokai silty clay loam, 7 to 15% slopes (MUC) and Molokai silty clay loam, 15 to 25% slopes (MUD) soils (Figure 4).

Kawaihapai series soils are described as follows:

> This series consists of well-drained soils in drainageways and on alluvial fans on the coastal plains on the islands of Oahu and Molokai. These soils formed in alluvium derived from basic igneous rock in humid uplands. They are nearly level to moderately sloping. Elevations range from nearly sea level to 300 feet. The annual rainfall amounts to 30 to 50 inches. […] These soils are used for sugarcane, truck crops, and pasture. The natural vegetation consists of kiawe, koa haole, lantana, and bermudagrass. [Foote et al. 1972:63–64]

Further, Kawaihapai clay loam, 2 to 6% slopes soils (KIB), are described as having slow runoff and a slight erosion hazard (Foote et al. 1972).

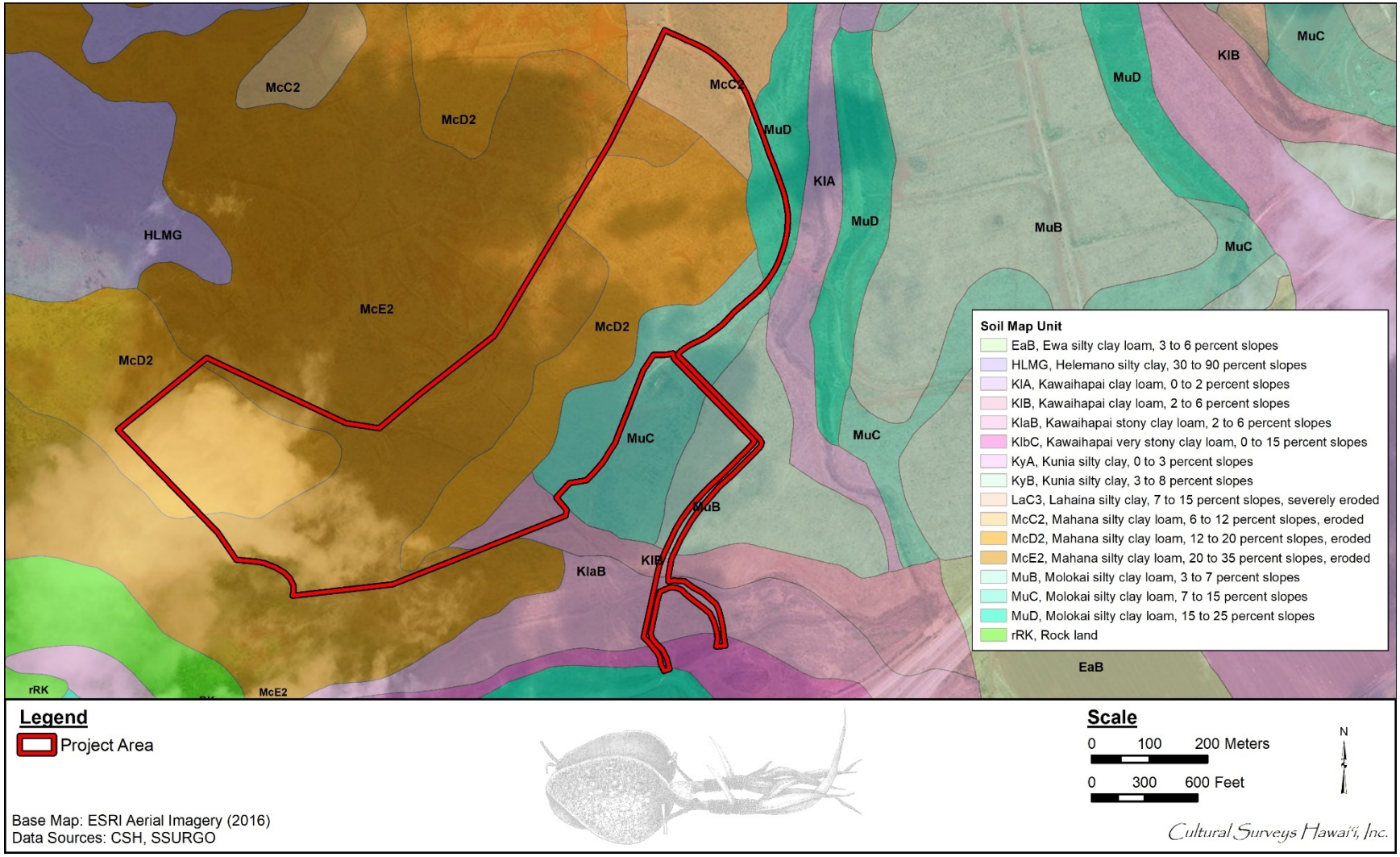

Figure 4. ESRI Aerial Imagery (2016) with overlay of Soil Survey of the State of Hawaii (Foote et al. 1972; USDA SSURGO 2001), indicating soil types within and surrounding the project area

Mahana series soils are described as follows:

> This series consists of well-drained soils on uplands on the islands of Kauai and Oahu. These soils developed in volcanic ash. They are gently sloping to very steep. Elevations range from 1,000 to 3,000 feet. The annual rainfall amounts to 30 to 45 inches. […] These soils are used for pasture, woodland, wildlife habitat, irrigated sugarcane, and water supply. The natural vegetation consists of puakeawe, aalii, ricegrass, molassesgrass, silver oak, yellow foxtail, lantana, joee, Japanese tea, passion flower, and associated plants. [Foote et al. 1972:85]

Mahana silty clay loam, 6 to 12% slopes, eroded (McC2) soils are described as follows:

> This soil occurs on ridgetops and moderately sloping uplands […] Permeability is moderately rapid. Runoff is slow, and the erosion hazard is slight. […] In places roots penetrate to a depth of 5 feet or more. […] This soil is used for pasture, woodland, wildlife habitat, pineapple, and sugarcane. [Foote et al. 1972:85–86]

Mahana silty clay loam, 12 to 20% slopes, eroded (McD2) soils, are described as having medium runoff and a moderate erosion hazard, used for pasture, woodland, wildlife habitat, and sugarcane (Foote et al. 1972).

Mahana silty clay loam, 20 to 35% slopes, eroded (McE2) soils are further described as follows:

> Most of the surface layer has been removed by erosion. Runoff is very rapid, and the erosion hazard is very severe. Included in mapping were areas where all of the surface layer and part of the subsoil have been removed by erosion. Also included were small, stony areas and reddish-colored upland soils that are underlain by a panlike layer at a depth of 15 to 50 inches. This soil is used for pasture, pineapple, and irrigated sugarcane. [Foote et al. 1972:86]

Molokai series soils are described as follows:

> This series consists of well-drained soils on uplands on the islands of Maui, Lanai, Molokai, and Oahu. These soils formed in material weathered from basic igneous rock. They are nearly level to moderately steep. Elevations range mainly from nearly sea level to 1,000 feet but are as much as 1,500 feet on Lanai. The annual rainfall amounts to 20 to 25 inches, most of which occurs between November and April. […] These soils are used for sugarcane, pineapple, pasture, wildlife habitat, and homesites. The natural vegetation consists of kiawe, ilima, uhaloa, feather fingergrass, and buffelgrass. [Foote et al. 1972:96]

Molokai silty clay loam, 7 to 15% slopes (MUC) soils, are described as occurring on knoll slope breaks, with medium runoff and a moderate erosion hazard (Foote et al. 1972). This material is used for sugarcane, pineapple, pasture, wildlife habitat, and home sites (Foote et al. 1972).

Molokai silty clay loam, 15 to 25% slopes (MUD) soils are further described as follows:

> This soil occurs on Oahu. In most places the slope does not exceed 20 percent. Runoff is medium, and the erosion hazard is severe. Workability is slightly difficult because of the slope. Included in mapping were small areas where boulder cores are exposed. This soil is used for sugarcane and pineapple. [Foote et al. 1972:97]

1.4.2 *Ka Makani* (Winds)

Makani is the general Hawaiian term for wind. Each land division was given a name for a specific wind. Names of wind were assigned based on but not limited to its direction of flow, strength, and geographic location. The four commonly known winds associated with the *moku* of ‘Ewa are Māunuunu of Pu‘uloa, Moa‘e kū of Ewaloa, Waikōloa of Līhu‘e, and Kona of Pu‘ukapolei (Alameida 1997). Māunuunu is a strong blistering sea breeze at Pu‘uloa (Andrews 1865; Pukui and Elbert 1986). Moa‘e kū is a northeasterly wind which means to resist, or a foreign wind (Andrews 1865; Pukui and Elbert 1986). Waikōloa is a cold northwest wind (Pukui and Elbert 1986). Kona is a name of the southwest wind (Andrews 1865). Another mentionable wind found in most chants associated with the *moku* of ‘Ewa is Wai‘ōpua. Its literal translation means the water of cloud banks (Pukui and Elbert 1986). Below are clips of chants that emphasize the importance of these winds.

In the traditional story *The Wind Gourd of La‘amaomao*, Pāka‘a and his son Kūapāka‘a are descendants of the wind goddess La‘amaomao whose traditional home was in a gourd that also contained all of the sacred winds of Hawai‘i. La‘amaomao controlled and called forth the winds by chanting their names (Nakuina 1992). Pāka‘a’s chant traces the winds from the *moku* of ‘Ewa. The winds of the region Moa‘e kū and Kona are poetically recalled:

He Moae-ku ko Ewaloa	*Moa‘e-ku is of Ewaloa*
He Kehau ko Waiopua	*Kēhau is of Waiopua*
He Waikoloa ko Lihue	*Waikōloa is of Līhu‘e*
He Kona ko Puuokapolei	*Kona is of Pu‘uokapolei.*

[Ke Au Okoa, Volume III, Number 30, 14 November 1867; Nakuina 1992:51]

In *The Epic Tale of Hi‘iakaikapoliopele*, the goddess Hi‘iaka, the youngest sister of the fire goddess Pele, born an egg and carefully warmed and nourished by Pele herself (Westervelt 1916:69), embarks on a quest to retrieve her older sister’s lover, Lohi‘au. While traversing the island chain, Hi‘iaka encounters various gods and demi-gods, spirits and shapeshifters, as well as chiefs and commoners. According to the *mo‘olelo* (story), Hi‘iaka watches as her beloved friend Hōpoe is killed by the embers of her sister Pele. She chants atop of Pōhākea and tells of the cold harsh wind of Waikōloa, Maunauna and Wai‘ōpua.

KAU HO‘OKAHI HANERI A	CHANT ONE HUNDRED
ME KANALIMAKUMAMĀKOLU	AND FIFTY-THREE
Aloha ku‘u hoa i ka pū‘ali lā	Alas my friend of the rugged mountain pass
A luna i Pōhākea, he luna o Kamaoha	On high at Pōhākea, above Kamaoha
He lae ‘ino ‘o Maunauna *‘O Līhu‘e ke hele ‘ia*	Maunauna is a dangerous escarpment Līhu‘e’s high plain yet to be traversed
Honi i ke ‘ala mau‘u	Inhaling the scent of the grasses
I ke ‘ala o ke kupukupu	The fragrance of kupukupu fern

E linoa ala e ka Waikōloa	Entwined by the Waikōloa breeze
E ka makani he Wai‘ōpua	By the wind called Wai‘ōpua
Ku‘u pua, me he pua lā i ku‘u maka	My blossom, like a flower in my sight
Ka ‘oni i ka haku ‘ōnohi, kā ka wai lā i li‘u	Moving before my eyes, washed salty by tears
I ku‘u maka lā, e uē au lā.	There in my sight, I weep.

[Ho‘oulumahiehie 2008a:280; Ho‘oulumahiehie 2008b:262]

1.4.3 *Ka Ua* (Rains)

Precipitation is a major component of the water cycle and is responsible for depositing *wai* (fresh water) on local flora. Pre-Contact *kānaka* (Native Hawaiians) recognized two distinct annual seasons. The first, known as *kau* (period of time, especially summer) lasts typically from May to October and is a season marked by a high-sun period corresponding to warmer temperatures and steady trade winds. The second season, *ho‘oilo* (winter, rainy season) continues through the end of the year from November to April and is a much cooler period when trade winds are less frequent, and widespread storms and rainfall become more common (Giambelluca et al. 1986:17). Being on the leeward side of O‘ahu, ‘Ewa is typically very hot and dry. Honouliuli receives an annual rainfall of about 550 mm (22 inches) on the coastal and inland region of the *ahupua‘a* and about 1,200 mm (39 inches) in the northern region up into the Wai‘anae Mountain Range (Giambelluca 2013). Each small geographic area on O‘ahu had a Hawaiian name for its own rains. According to Akana and Gonzalez (2015),

> Our kupuna had an intimate relationship with the elements. They were keen observers of their environment, with all of its life-giving and life-taking forces. They had a nuanced understanding of the rains of their home. They knew that one place could have several different rains, and that each rain was distinguishingable from another. They knew when a particular rain would fall, its color, duration, intensity, the path it would take, the sound it made on the trees, the scent it carried, and the effect it had on people. [Akana and Gonzalez 2015:XV]

Honouliuli was no exception to this naming practice. Despite the relative lack of rainfall in this area, the Nāulu rain is known to be associated with the *ahupua‘a* of Honouliuli. This rain is generally understood as a sudden shower, and more commonly associated with Kawaihae, Hawai‘i and Ni‘ihau (notoriously dry locations as well) (Akana and Gonzalez 2015:187). The Nāulu rain is mentioned in a *oli* (chant) offered by Hi‘iakaikapoliopele. During Hi‘iaka’s travel through ‘Ewa she recites this affectionate *oli* as she recalls the Kai‘okia edict placed on her and Lohi‘au by Pele:

‘A‘ole au e hele i ke kaha o Kaupe‘a	I shall not tread Kaupe‘a’s expanse
Kēlā kaha kūpā koili a ka lā i ke kula	That stretch where the sun beats down on the plain
Ua kūpono a‘ela ka lā i ka piko o Wākea	The sun is right overhead, at the navel of Wākea
Ola i ke ahe a ka makani Māunuunu	I am spared by the Māunuunu wind

I ka hapahapai mai a ka makani ‘Ao‘aoa	By the uplifting ‘Ao‘aoa breeze
Ke koi lā i ke ao o ka Nāulu *e hanini i ka wai*	Urging the Nāulu storm clouds to pour down their waters
Ola ihola nā kupa kama‘āina i ka wai *a ka ‘ōpua*	The natives here survive on water from the clouds
Ke halihali a‘ela nā ‘ōpua i ke awa lau	Which billowing clouds carry along to the branching lochs
E koi mai ana iā Hi‘iaka e kūo‘e hele *i ke kula*	Compelling Hi‘iaka to trudge that open stretch
I kuleana i lāhui ai ka moe i laila	Duty making rest forbidden there
I laila au lohe i ke kani leo le‘a a ka *‘ō‘ō i ke kula*	There I heard the happy trill of the *‘ō‘ō* bird on the plain
Ho‘āikāne ana lāua me ke kai o *Wāwaemoku*	Befriending the sea of Wāwaemoku
Mokumokuāhua loko, kupākupā koili *i ka ‘ino*	My heart grieves, thrashed by harm
I ‘ino ho‘i au i kēia kanaka i ka hiki *‘ana mai*	I may be harmed by this person upon arrival
I kāhela a‘ela ka ‘ai a ka manu	Leaving the birds to feed expansively
I ka pua o ka wiliwili	On the blossoms of the *wiliwili* trees
Wili a‘ela nā ‘ōpua i luna	The clouds spin above
No luna wau	I am from above
Wili a‘ela nā ‘ōpua i lalo	The clouds spin below
Lalo ē!	Below indeed!
Lilo i lalo ka hele ‘ana a ke kanaka	The movement of mankind is cast down
Kalakala ke ao no Hawai‘i	Craggy are the clouds from Hawai‘i
I ka pā ‘ia mai e kēia makani	Blown here by this wind
‘A‘ole a‘u makana i ka lā o ka hilahila	I have no gift to offer on this day of shame
E hili hewa paha auane‘i au	I shall perhaps end up astray
Wilia i na‘e, wilia i lalo	Spiraling windward, or to the lee
Wilia i kai, wilia i uka	Spinning toward the sea, toward the highlands
‘O kauhale a ka ‘ōlelo	O house made of words

Ho‘ohiki ihola i kānāwai	Utter as an edict
Kau ihola i kānāwai	Place as a law
He kānāwai ‘okia	An order of separation
‘Ālina ihola kā ‘o Pu‘uloa	Thus Pu‘uloa is branded by epithet
He ‘āina kauā.	A land of outcasts and slaves.

[Ho‘oulumāhiehie 2008a:294–295; Ho‘oulumāhiehie 2008b:275–276]

The general lack of rain names is indicative of historic environmental conditions within the *ahupua‘a*; these conditions, in turn, shaped agricultural practices in the area. Environmental limitations forced ingenuity and innovation. McAllister provides written evidence of the innovative ways in which Honouliuli's *kama‘āina* approached agricultural activities:

> […] It is probable that the holes and pits in the coral were formerly used by Hawaiians. Frequently the soil on the floor of the larger pits was used for cultivation, and even today one comes upon bananas and Hawaiian sugar cane still growing in them. They afford shelter and protection, but I doubt if previous to the time of Cook there was ever a large population here. [McAllister 1933:109]

1.4.4 *Nā Kahawai* (Streams)

Honouliuli Ahupua‘a, and the encompassing ‘Ewa District, are notoriously dry. Agricultural sinkholes were especially important on the ‘Ewa plain. In traditional Hawaiian times, the areas of exposed coral (Pleistocene limestone) outcrop were undoubtedly more extensive. Limestone outcrop, composed of detritus, calcareous sand, reef dwelling organisms, and coralline algae, is subject to dissolution from water. This dissolution has formed a series of connected and isolated caves under the ‘Ewa Plains. Although invisible to human eyes, streams flow under the surface of Honouliuli via the karsic system. “Sink holes” would accumulate water within them via a subterranean water or karst system; this water also contained nutrient-rich sediment that allowed plants such as *kalo* (taro; *Calocasia esculenta*), *kī* (ti; *Cordyline fruticosa*), and *noni* (Indian mulberry; *Morinda citrifolia*) to survive.

Proceeding *mauka* from this limestone plain is a series of gulches draining the Wai‘anae Mountains. The largest of these is Honouliuli Gulch toward the east side of the plain that drains into West Loch. The gulch is bisected by the Honouliuli Stream, the primary water body of the Honouliuli Watershed. The “perennial/intermittent” Honouliuli Stream and its tributaries “have a total stream length of 32.5 miles” (O‘ahu Resource Conservation and Development Council 2013:16).

To the west are fairly steep gradient gulches forming a more linear than dendritic drainage pattern. The major gulches from east to west are Kalo‘i, Hunehune, Makalapa, Makakilo, Awanui, Pālailai, Makaīwa, Waimānalo, and Limaloa. These gulches are steep-sided in the uplands and generally of a high gradient until they emerge onto the flat ‘Ewa plain. The alluvium they have carried has spread out in delta fashion over the *mauka* portions of the plain, which comprises a dramatic depositional environment at the stream gradient change. These gulches are generally dry, but during seasonal Kona storms they carry immense quantities of runoff onto the plain and into the ocean. As typical drainages in arid slopes, they are either raging uncontrollably or are dry, and

do not form stable water sources for traditional agriculture in their upper reaches. The western Honouliuli gulches, in contrast to those draining into Pearl Harbor to the east, do not have valleys suitable for extensive irrigated agriculture. However, this lack is more than compensated by the rich watered lowlands at the base of Honouliuli Gulch.

Topography of the area is moderately sloping. In terms of hydrology, the area is drained by two deeply dissected gulches, Kalo‘i Gulch 300 m to the southwest and Honouliuli Gulch 700 m to the northeast. These gulches at a comparable elevation are believed to rarely run with water. Historic maps indicate a spring located approximately 2.2 km to the north. Such infrequent springs may have been key to the early human activity on the southeast Wai‘anae slope.

The lowlands fronting the west loch of Pearl Harbor (Kaihuopala‘ai) were suitable for the cultivation of the traditional Hawaiian staple crop, *kalo*. For spiritual and dietary reasons, *kalo* was a sacred staple in the Hawaiian diet. According to Hawaiian mythology, man was born from the taro plant.

The *Kumulipo* (“origin, genesis”) details this kinship. Hāloa, “he of the long breath,” is the second son of Wākea and Papa. Wākea and Papa’s first born, Hāloa-naka was born premature and died shortly after his birth (Kanahele 1995:17). After burying Hāloa-naka, a *kalo* plant sprouted at his grave. Shortly after, a second son (Hāloa) was born. A human child, Hāloa symbolizes *kalo* and man. *Kalo* is a metaphor for life, Kanahele explains as follows:

> In the mythologies of many cultures, plants have been used to symbolize human spiritual growth. Hawaiians made taro a metaphor for life because, like the taro plant, it needs to be rooted in good soil and to be constantly nourished with the waters of *Kāne*. As the stalk grows taller with its leaves reaching toward the light of the sun, symbolized by *Wākea*, so Hawaiians grow aspiring to be closer to their heavenly spirit. Just as every young shoot can become a full-grown plant, so can they become gods as descendants of Hāloa. As every plant must die, however, they too must die. And from the remains a new plant lives again. In this continuity of life, both plant and man repeat the mystery of the unending cycle. [Kanahele 1995:18]

However, by the mid-nineteenth century traditional agriculture was becoming quickly supplanted by large-scale commercial ventures. The focus of agricultural production soon shifted toward sugarcane and pineapple, with concerted efforts made to turn open space into plantations. The drilling for artesian wells began in 1879 with cattle rancher James Campbell on the ‘Ewa Plains (Board of Water Supply, City and County of Honolulu 2017). Utilizing a well driller, Campbell drilled several hundred feet down until reaching a large supply of pure, fresh water (Board of Water Supply, City and County of Honolulu 2017). According to the Board of Water Supply (2017):

> This discovery led to a water boom on the island, as ranchers and plantation developers began drilling furiously for more of the precious resource. Within 20 years, the boom came to a bust. Artesian wells, abandoned and neglected, wasted millions of gallons of water. By the turn of the century, Oahu suffered a water panic. Wells were salting up. Water levels were dropping. The problem was that the system had grown too much, too fast and too haphazardly. [Board of Water Supply 2017]

Campbell’s first well was named Waianiani (“crystal waters”) by the *kama‘āina* of Honouliuli (Nellist 1925). By 1930, Ewa Plantation had drilled 70 artesian wells to irrigate cane lands; artesian wells provided fresh water to Honouliuli for nearly 60 years (Ho‘okuleana 2014). Campbell’s original Honouliuli well was finally sealed by the City and County of Honolulu in 1939 (Ho‘okuleana 2014).

1.4.5 *Lihikai a me ka Moana* (Seashore and Ocean)

There exist several naming traditions for Honouliuli. Invaraibly, there are several explanations for Honouliuli’s name. One tradition notes that Honouliuli means “dark water,” “dark bay,” or “blue harbor,” and was named for the waters of Pearl Harbor (Jarrett 1930:22), which marks the eastern boundary of the *ahupua‘a*. The Hawaiians called Pearl Harbor, Pu‘uloa (“long hill”). According to *mo‘olelo*, this location was a storied place, due to the presence of Ka‘ahupāhau. Ka‘ahupāhau, queen of all sharks of O‘ahu, dwelled in a large cavern on the Honouliuli side of Pearl Harbor (Clark 1977:69).

> The Hawaiians knew Pearl Harbor as Pu‘uloa, and they believed that there, dwelling in a large cavern on the Honouliuli side of the harbor, Ka‘ahupāhau, the queen of all sharks on O‘ahu, made her home. Her chief guard was a brother shark, who lived in a pit at the entrance to the lochs. The Hawaiian people said the drydock was built over the cavern of Ka‘ahupāhau’s son, who also lived in Pu‘uloa. Angered by the violation of his home, the shark prince destroyed the imposing structure. The engineers in charge of the project attributed the collapse of the foundation to hydrostatic pressure. Whatever the cause, several years’ work was wrecked within minutes […] this time, before starting to rebuild, they asked the Hawaiians to bless the site. After that the work continued without further trouble. [Clark 1977:69–70]

Both seashore and ocean provided physical and spiritual sustenance (NOAA 2017) for the people of Honouliuli. According to Malo, the ocean was divided into smaller divisions, stretching from *‘ae kai* (water’s edge) to *moana* (pelagic zone) (Malo 1951:25–26). Outside the coastal areas was the belt known as *kua-au*, where the shoal water ended (Malo 1951:26). Further out was the *kai-au*, deeper waters designated for surfing, swimming, or spearing squid (Malo 1951:26). For Honouliuli Ahupua‘a, specifically between Kalaeloa and Kūalaka‘i, the sea of this region was identified as Hilo-one. It appears the name is drawn from an on-shore locality known as Hilo-one. According to Maly and Maly (2012),

> That place, Hilo-one, […] is situated on the northern side of Kualakai, towards Kalaeloa. And the name of the spring in which Hiiaka looked and saw her reflection was Hoakalei (Reflection of a lei). It was at this place that Hiiaka saw the two lehua trees growing, from which she picked the blossoms too make her four garlands. [Maly and Maly 2012:125]

While walking the coastline between Kalaeloa and Kūalaka‘i, the goddess sang out the following,

O Hiiaka ka wahine,	Hiiaka is the woman
Ke ako la i ka pua o Hoakalei,	Who picked the flowers of Hoakalei,

Ke kui la, ke uo la i ka manai	And with a needle strung and made them into
Eha ka lei, ka apana lei lehua	four garlands, the sectioned lei of the
a ka wahine la,	woman
Kuu pokii.	O my younger sibling.
Kuu pokii mai ke ehu makani o lalo.	My younger sibling who came from the place where the dusty wind rises from below
Lulumi aku la i ke kai o Hilo-one.	Overturned in the sea of Hilo-one.
No Hilo ke aloha, Aloha wale ka lei—e.	The *aloha* is for Hilo, Love for the *lei.*

[Ka Na‘i Aupuni, Volume II, Number 6, 7 June 1906, Ka Moolelo o Hiiaka-i-ka-poli-o=Pele; Maly and Maly 2012:125]

Moving westward from Pu‘uloa are Iroquis Beach, Pu‘uloa Beach Park (formerly ‘Ewa Beach Park), One‘ula Beach Park, in addition to Keahi Point. These beaches comprise the coastal portion of Honouliuli; use of these beaches increased during the plantation era, when employees of the nearby sugar plantations utilized the coastal areas for subsistence and recreation.

Traditionally, the seashore and ocean areas were vitally important for resource extraction in the early days of settlement. Fishermen along the coast maintained a respected status within traditional Hawaiian society; Kanahele asserts that “early Hawaiians regarded fishing as the oldest, and hence the most prestigious, of professions” (Kanahele 1995:17).

According to Charles Howard Edmondson (1946:5), the coastal waters of Pearl Harbor were “a natural aquarium for many varieties of marine animals.” Titcomb (1952:7) identifies the Pearl Harbor area as the only large natural inland lagoon, famous for its fish and fishponds. The *nehu* (anchovy; *Anchoviella purpurea*) was said to fill the lochs of Pearl Harbor. Citing Kamakau, Margaret Titcomb writes that the *nehu*, “filled the lochs from the channel of Pu‘uloa (Pearl Harbor) inland to the Ewas” (Titcomb 1952:97). Due to the presence of the *nehu*, the *kama‘āina* of Honouliuli and ‘Ewa developed this saying,

> *He kai puhi nehu, puhi lala ke kai o ‘Ewa e, e noho i ka la‘i o ‘Ewa nui a La‘akona*
> (“A sea that blows up *nehu*, blows them up in rows, is ‘Ewa, until they rest in the calm of great ‘Ewa-a-La‘akona”). [Kamakau 1991a:84]

1.4.6 Built Environment

The project area was utilized for commercial sugarcane from the early twentieth century into the late 1970s. Some of the sugarcane plantation infrastructure in the vicinity was relatively elaborate with the Waiahole Ditch (partially within the project area) transporting irrigation water from windward O‘ahu into the foothills of the southern Wai‘anae Range. The sugarcane fields have remained fallow for decades. Some plantation infrastructure is still present in the form of cane haul roads and remnant irrigation features (see Figure 3). The project area is otherwise undeveloped. The H-1 Freeway is approximately 800 m south of the project area.

Section 2 Methods

2.1 Archival Research

Research centers on Hawaiian activities including *ka‘ao* (legends), *wahi pana* (storied places), *‘ōlelo no‘eau* (proverbs), *oli* (chants), *mele* (songs), traditional *mo‘olelo*, traditional subsistence and gathering methods, ritual and ceremonial practices, and more. Background research focuses on land transformation, development, and population changes beginning with the early post-Contact era to the present day.

Cultural documents, primary and secondary cultural and historical sources, historic maps, and photographs were reviewed for information pertaining to the study area. Research was primarily conducted at the CSH library. Other archives and libraries including the Hawai‘i State Archives, the Bishop Museum Archives, the University of Hawai‘i at Mānoa’s Hamilton Library, Ulukau, The Hawaiian Electronic Library (Ulukau 2014), the State Historic Preservation Division (SHPD) Library, the State of Hawai‘i Land Survey Division, the Hawaiian Historical Society, and the Hawaiian Mission Houses Historic Site and Archives are also repositories where CSH cultural researchers gather information. Information on Land Commission Awards (LCAs) were accessed via Waihona ‘Aina Corporation’s Māhele database (Waihona ‘Aina 2000), the Office of Hawaiian Affairs (OHA) Papakilo Database (Office of Hawaiian Affairs 2015), and the Ava Konohiki Ancestral Visions of ‘Āina website (Ava Konohiki 2015).

2.2 Community Consultation

2.2.1 Scoping for Participants

We begin our consultation efforts with utilizing our previous contact list to facilitate the interview process. We then review an in-house database of *kūpuna* (elders), *kama‘āina*, cultural practitioners, lineal and cultural descendants, Native Hawaiian Organizations (NHOs; includes Hawaiian Civic Clubs and those listed on the Department of Interior’s NHO list), and community groups. We also contact agencies such as SHPD, OHA, and the appropriate Island Burial Council where the proposed project is located for their response on the project and to identify lineal and cultural descendants, individuals and/or NHO with cultural expertise and/or knowledge of the study area. CSH is also open to referrals and new contacts.

2.2.2 “Talk Story” Sessions

Prior to the interview, CSH cultural researchers explain the role of a CIA, how the consent process works, the project purpose, the intent of the study, and how their *‘ike* (knowledge) and *mana‘o* (thought, opinion) will be used in the report. The interviewee is given an Authorization and Release Form to read and sign.

“Talk Story” sessions range from the formal (e.g., sit down and *kūkākūkā* [consultation, discussion] in participants choice of place over set interview questions) to the informal (e.g., hiking to cultural sites near the study area and asking questions based on findings during the field outing). In some cases, interviews are recorded and transcribed later.

CSH also conducts group interviews, which ranges in size. Group interviews usually begin with set, formal questions. As the group interview progresses, questions are based on interviewee’s

answers. Group interviews are always transcribed and notes are taken. Recorded interviews assist the cultural researcher in 1) conveying accurate information for interview summaries, 2) reducing misinterpretation, and 3) missing details to *mo‘olelo*.

CSH seeks *kōkua* (assistance) and guidance on identifying past and current traditional cultural practices of the study area. Those aspects include general history of the *ahupua‘a*; past and present land use of the study area; knowledge of cultural sites (for example, *wahi pana*, archaeological sites, and burials); knowledge of traditional gathering practices (past and present) within the study area; cultural associations (*ka‘ao* and *mo‘olelo*); referrals; and any other cultural concerns the community might have related to Hawaiian cultural practices within or in the vicinity of the study area.

2.2.3 Completion of Interview

After an interview, CSH cultural researchers transcribe and create an interview summary based on information provided by the interviewee. Cultural researchers give a copy of the transcription and interview summary to the interviewee for review and ask to make any necessary edits. Once the interviewee has made those edits, we incorporate their *‘ike* and *mana‘o* into the report. When the draft report is submitted to the client, cultural researchers then prepare a finalized packet of the participant’s transcription, interview summary, and any photos that were taken during the interview. We also include a thank you card and honoraria. This is for the interviewee’s records.

It is important to CSH cultural researchers to cultivate and maintain community relationships. The CIA report may be completed, but CSH researchers continuously keep in touch with the community and interviewees throughout the year—such as checking in to say hello via email or by phone, volunteering with past interviewees on community service projects, and sending holiday cards to them and their *‘ohana* (family). CSH researchers feel this is an important component to building relationships and being part of an *‘ohana* and community.

“*I ulu no ka lālā i ke kumu*—the branches grow because of the trunk,” an *‘ōlelo no‘eau* (#1261) shared by Mary Kawena Pukui with the simple explanation: “Without our ancestors we would not be here” (Pukui 1983:137). As cultural researchers, we often lose our *kūpuna* but we did not lose their wisdom and words. We routinely check obituaries and gather information from other informants if we have lost our *kūpuna*. CSH makes it a point to reach out to the *‘ohana* of our fallen *kūpuna* and pay our respects including sending all past transcriptions, interview summaries, and photos for families to have on file for genealogical and historical reference.

Section 3 *Ka‘ao* and *Mo‘olelo*

Hawaiian storytellers of old were greatly honored; they were a major source of entertainment and their stories contained lessons while interweaving elements of Hawaiian lifestyles, genealogy, history, relationships, arts, and the natural environment (Pukui and Green 1995:IX). According to Pukui and Green (1995), storytelling is better heard than read for much becomes lost in the transfer from the spoken to the written word and *ka‘ao* are often full of *kaona* or "double meanings."

Ka‘ao are defined by Pukui and Elbert (1986:108) as a "legend, tale […], romance, [and/or], fiction." *Ka‘ao* may be thought of as oral literature or legends, often fictional or mythic in origin, and have been "consciously composed to tickle the fancy rather than to inform the mind as to supposed events" (Beckwith 1970:1). Conversely, Pukui and Elbert (1986:254) define *mo‘olelo* as a "story, tale, myth, history, [and/or] tradition." The *mo‘olelo* are generally traditional stories about the gods, historic figures or stories which cover historic events and locate the events with known places. *Mo‘olelo* are often intimately connected to a tangible place or space (*wahi pana*).

In differentiating *ka‘ao* and *mo‘olelo* it may be useful to think of *ka‘ao* as expressly delving into the *wao akua* (realm of the gods), discussing the exploits of *akua* (gods) in a primordial time. *Mo‘olelo* on the other hand, reference a host of characters from *ali‘i* (royalty) to *akua*; *kupua* (supernatural beings) to *maka‘āinana* (commoners); and discuss their varied and complex interactions within the *wao kānaka* (realm of man). Beckwith elaborates, "In reality, the distinction between *ka‘ao* as fiction and *mo‘olelo* as fact cannot be pressed too closely. It is rather in the intention than in the fact" (Beckwith 1970:1). Thus a so-called *mo‘olelo*, which may be enlivened by fantastic adventures of *kupua*, "nevertheless corresponds with the Hawaiian view of the relation between nature and man" (Beckwith 1970:1).

Both *ka‘ao* and *mo‘olelo* provide important insight into a specific geographical area, adding to a rich fabric of traditional knowledge. The preservation and passing on of these stories through oration remains a highly valued tradition. Additionally, oral traditions associated with the study area communicate the intrinsic value and meaning of a place, specifically its meaning to both *kama‘āina* as well as others who also value that place.

The following section presents traditional accounts of ancient Hawaiians living in the vicinity of the project area. Many relate an age of mythical characters whose epic adventures inadvertently lead to the Hawaiian race of *ali‘i* and *maka‘āinana*. The *ka‘ao* in and around the project area shared below are some of the oldest Hawaiian stories that have survived; they still speak to the characteristics and environment of the area and its people.

3.1 *Ka‘ao*

3.1.1 The Naming of Honouliuli

Honouliuli is the largest *ahupua‘a* in the *moku* of ‘Ewa. One translation of the name for this district is given as "unequal" (*Saturday Press*, 11 August 1883). Others translate the word as "strayed" and associate it with the legends of the gods Kāne and Kanaloa:

> When Kane and Kanaloa were surveying the islands they came to Oahu and when they reached Red Hill saw below them the broad plains of what is now Ewa. To mark boundaries of land they would throw a stone and where the stone fell would

> be the boundary line. When they saw the beautiful land lying below them, it was their thought to include as much of the flat level land as possible. They hurled the stone as far as the Waianae range and it landed somewhere, in the Waimanalo section. When they went to find it, they could not locate the spot where it fell. So Ewa (strayed) became known by the name. The stone that strayed. [Told to E.S. by Simeon Nawaa, 22 March 1954 in Sterling and Summers 1978:1]

Honouliuli means “dark water,” “dark bay,” or “blue harbor,” and was named for the waters of Pearl Harbor (Jarrett 1930:22), which marks the eastern boundary of the *ahupua‘a*. Another source translates Honouliuli as “The blue bays or inlets” (Saturday Press, 11 August 1883). Another explanation for the name comes from the “Legend of Lepeamoa,” the chicken-girl of Pālama. In this legend, Honouliuli is the name of the husband of the chiefess Kapālama and grandfather of Lepeamoa. The land of Honouliuli was named for the grandfather of Lepeamoa (Thrum 1923:164–184).

It is likely that the boundaries of the westernmost *ahupua‘a* of ‘Ewa were often contested with people of the neighboring Wai‘anae District. The ‘Ewa people could cite divine sanction that the dividing point was between two hills at Pili o Kahe:

> This is a spot where two small hills of the Waianae range come down parallel on the boundary between Honouliuli and Nanakuli (Ewa and Waianae). The ancient Hawaiians said the hill on the Ewa side was the male and the hill on the Waianae side was female. The stone was found on the Waianae side hill and the place is known as Pili o Kahe (*Pili* = to cling to, *Kahe* = to flow). The name refers, therefore, to the female or Waianae side hill. And that is where the boundary between the two districts runs. [Told to E.S. by Simeon Nawaa, 22 March 1954 in Sterling and Summers 1978:1]

3.1.2 Kāne and Kanaloa and the *Loko I‘a* (Fishpond) of Pu‘uloa

According to an account in the Hawaiian newspaper *Ka Loea Kālai‘āina* (10 June 1899), several of the fishponds in the Pu‘uloa area were made by the brother gods, Kāne and Kanaloa. A fisherman living in Pu‘uloa, named Hanakahi, prayed to unknown gods until one day two men came to his house. They revealed to him that they were the gods to whom he should pray. Kāne and Kanaloa then built fishponds at Ke‘anapua‘a, but were not satisfied. Then they built the fishpond Kepo‘okala, but were still not satisfied. Finally, they made the pond Kapākule, which they stocked with all manner of fish. They gifted all of these fishponds to Hanakahi and his descendants (Handy and Handy 1972:473; *Ka Loea Kālai‘āina*, 8 July 1899, Volume III, Number 26).

Mary Pukui (1943:56–57), who visited Kapākule Fishpond when she was young, writes that the pond was built by the *menehune* (legendary race of small people who worked at night, building fishponds, roads, temples) under the direction of the gods Kāne and Kanaloa. Pukui describes several unique aspects of this pond:

> On the left side of the pond stood the stone called Hina, which represented a goddess of the sea by that name. Each time the sea ebbed, the rock became gradually visible, vanishing again under water at high tide. Ku, another stone on the right, was never seen above sea level. This stone represented Ku‘ula, Red Ku,

> a god for fish and fishermen. From one side of the pond a long wall composed of driven stakes of hard wood, ran toward the island [Laulaunui] in the lochs. When fish swam up the channel and then inside of this wall, they invariably found themselves in the pond. A short distance from the spot where the pond touched the shore was a small ko‘a or altar composed of coral rock. It was here that the first fish caught in the pond was laid as an offering to the gods. [Pukui 1943:56]

The fishpond contained many fish, especially the *akule* (bigeye scad; *Selar crumenophthalmus*), thus its name, “the enclosure for *akule* fish” (Pukui 1943:56–57). The pond was destroyed when the channel to Pearl Harbor was dredged in the early twentieth century. The caretaker of the pond took the stones Kū and Hina to a deep place in the ocean and sunk them so “none would harm or defile them.” Cobb (1905:733) writes that the pond was used to catch the larger *akule* (goggler), *‘ōpelu* (mackerel scad; *Decapterus macarellus*), *weke* (goat fish; *Mullidae*), *kawakawa* (bonito; *Euthynnus affinis*), and sharks. It was unusual for having walls made of coral. This contradicts much of the *mo‘olelo* saying that sharks were not killed in Pearl Harbor. However, Kamakau does relate that Kekuamanoha and Kauhiwawaeono, two conspirators against Kamehameha I, lived at Pu‘uloa. The chief Kauhiwawaeono was known to murder people and use their bodies as shark bait (Kamakau 1992:182, 232).

Samuel Kamakau adds more information on the pond Kapākule, and a second pond called Kepo‘okala.

> At Pu‘uloa on Oahu were two unusual ponds [fish traps]—Kapakule and Kepo‘okala. Kapakule was the better one. The rocks of its walls, *kuapa*, could be seen protruding at high tide, but the interlocking stone walls (*pae niho pohaku*) of the other pond were still under water at high tide […] It [Kapakule] was said to have been built by the *‘e‘epa* people [mysterious people] at the command of Kane *ma* [ma=and others, company] […]
>
> This is how the fish entered the pond. At high tide many fish would go past the *mauka* side of the pond, and when they returned they would reach the row of tree trunks seaward [of them]. The would become frightened by the projecting shadows of the trunks, and would go into the opening. The fish that went along the edge of the sand reached the seaward wall, then turned back toward the middle and entered the *anapuni* (the arced portion of the trap) A man ran out and placed a “cut-off” seine net (*‘omuku lau*) in the opening, and the fish shoved and crowded into it. The fish that were caught in the net were dumped out, and those not caught in the net were attacked with sharp sticks and tossed out, or were seized by those who were strong. [Kamakau 1976:88]

3.1.3 Pu‘okapolei, Astronomical Marker and Heiau

Pu‘uokapolei was the primary landmark for travelers on the cross-*ahupua‘a* trail that ran from Pearl Harbor in the east to Wai‘anae in the West (‘Ī‘ī 1959:27, 29; Nakuina 1992:54; E.M. Nakuina 1904 in Sterling and Summers 1978:34). *Pu‘u* means “hill” and Kapolei means “beloved Kapo,” a reference to the sister of the goddess, Pele. Kamakau says ancient Hawaiians used Pu‘uokapolei as an astronomical marker to designate the seasons:

> […] the Oahu people who reckoned the time (Oahu *po‘e helu*) called the season Kau for the setting of the sun from Pu‘uokapolei, a hill in Honouliuli, ‘Ewa, to the opening of Mahinaona (*i ke kawaha o Mahinaona*). When the sun moved south from Pu‘uokapolei—and during the season of the sun in the south—for the coming of coolness and for the sprouting of new buds on growing things—the season was called Ho‘oilo [winter, rainy season]. [Kamakau 1976:14]

A ceremony commemorating the changing of the seasons is still observed each year in the beginning of May at Waikīkī and Honouliuli. This ceremony was documented in a previous cultural impact assessment conducted by CSH (Genz et al. 2012). Sam ‘Ohukani‘ōhi‘a Gon III, Na Wa‘a Lalani Kahuna O Pu‘u Koholā, and the late Kumu Hula John Keola Lake’s *hula hālau* (*hula* instruction) perform *oli* and *hula* (dance), explaining that the *kilo hōkū* (astronomers) of O‘ahu observed how, from the perspective of Waikīkī, the sun sets in a southerly direction over the ocean during the winter solstice and in a northerly direction behind the ‘Ewa ridgeline during the summer solstice. During the springtime, the position of the setting sun marches steadily northward each day, and at the beginning of May, the sun sets behind Pu‘uokapolei, perfectly centered within its depression from the vantage point of Kūpalaha Heiau just west of the Waikīkī Aquarium. A coinciding ceremony at a *heiau* on Pu‘uokapolei similarly views the setting of the sun behind Pu‘ula‘ila‘i farther west, and a line of sight extending eastward from Pu‘ula‘ila‘i, Pu‘uokapolei, and the former site of Kūpalaha Heiau ends at the closely associated Papa‘ena‘ena Heiau. Mr. Gon suggests Papa‘ena‘ena Heiau may have been part of the ceremonies of this astronomical event.

3.1.4 Kamapua‘a and Kamaunuaniho at Pu‘uokapolei

Pu‘uokapolei was known to be the home of Kamapua‘a’s grandmother, Kamaunuaniho, one of the three migrants from Kahiki that were ancestors to the people of O‘ahu (Legend of Kamapuaa, Fornander 1919a:5[2]:318; Kahiolo 1978:81, 107). Kamapua‘a, the Hawaiian pig god, once lived in Kaluanui on the windward side of O‘ahu, but he escaped to ‘Ewa when he was pursued by the chief Olopana.

> Kamapuaa subsequently conquered most of the island of Oahu, and, installing his grandmother [Kamaunuaniho] as queen, took her to Puuokapolei, the lesser of the two hillocks forming the southeastern spur of the Waianae Mountain Range, and made her establish her court there. This was to compel the people who were to pay tribute to bring all the necessities of life from a distance, to show his absolute power over all. [Nakuina 1904:50–51]

Emma Nakuina goes on to note, “A very short time ago [prior to 1904] the foundations of Kamaunuaniho’s house could still be seen at Puuokapolei” (Nakuina 1904:51). Another account (*Ka Loea Kālai‘āina*, 13 January 1900 in Sterling and Summers 1978:34) speaks of Kekele‘aikū, the older brother of Kamapua‘a, who also lived on Pu‘uokapolei.

In Lilikalā Kame‘eleihiwa’s version of the *mo‘olelo* of Kamapua‘a, Pele and Kamapua‘a meet and a battle ensues on Hawai‘i Island between the two. Kamapua‘a tells Kekele‘aikū,

> ‘Listen to me, elder brother. You wait here. When you smell the stench of burning bristles, then you must assume I am dead. However, if indeed you do not smell the

> stench of the bristles, you will know that your younger brother has not been harmed and that he has “eaten of the cooked taro.” ’ [Kame‘eleihiwa 1996:62]

Kamapua‘a travels to Hawai‘i Island where Pele chases him with fire out of the *lehua* (*Metrosideros macropus, M. collina subsp. polymorpha*) forest. Kamapua‘a ran from Pele but could only cling to an *‘ama‘uma‘u* (*Sadleria cyatheoides*) fern (Kame‘eleihiwa 1996:95). The fire continued to burn around Kamapua‘a as he clung on for his life. His bristles began to burn as well, sending a stench of burning pig bristles around the Hawaiian Islands. Kekele‘aikū smelled the stench of burning pig bristles and began to cry, thinking that his brother perished in battle with Pele (Kame‘eleihiwa 1996:95). Kekele‘aikū then hung himself, deeply saddened for the loss of his beloved brother, Kamapua‘a. Kekele‘aikū’s body was left at Pu‘uokapolei with his grandmother.

3.1.5 Kahalaopuna at Pōhākea Pass

One of the most popular legends of O‘ahu is that of Kahalaopuna (or Kaha), a young woman of Mānoa who was slandered by others and then killed by her betrothed, Kauhi, a chief from Ko‘olau, O‘ahu. While the numerous accounts (e.g., Day 1906:1-11; Fornander 1919b:5:188–192; Kalākaua 1990:511–522; Nakuina 1904:41–45; Patton 1932:41–49; Skinner 1971:220–223; Thrum 1907:118–132) vary in details they typically have Kahalaopuna slain and then revived repeatedly with the aid of a protective owl spirit. Kauhi forces her to hike west from Mānoa through the uplands until they get to Pōhākea Pass through the southern Wai‘anae Range in north Honouliuli. At Pōhākea Pass, Kauhi beats her with a stick until she is very dead (“*Ia hahau ana a Kauhi i ka lā‘au, make loa o Kahalaopuna*”). Her spirit (*‘uhane*) flies up into a *lehua* tree and chants for someone to go notify her parents of her fate. Upon hearing the news, her parents fetched Kahalaopuna back to Mānoa and she was restored to life.

3.1.6 *Mo‘o* at Maunauna

Moses Manu in recounting the Legend of Keaomelemele makes a reference to a *mo‘o* (lizard or water spirit) named Maunauna who lived above Līhu‘e (presumably at the landform of that name in extreme northern Honouliuli) and who was regarded as a bad lizard (*Kuokoa* 25 April 1885 in Sterling and Summers 1978:37).

3.1.7 Coastal Village of Kūalaka‘i

“Legend of the Children” is a tale that foretold the breaking of the eating *kapu* (taboo) by the *ali‘i*. A young brother and sister always fished at Kūalaka‘i, a beach area on the southern coast of Honouliuli. On this day, they laid out their nets, but all they caught was one *palani* (surgeonfish; *Acanthurus dussumieri*), a fish that was *kapu* for men; only women could eat it.

> […] They fished again and again until the afternoon and nothing was caught. The children were weary and went home without fish. When they came as far as Puu-o-Kapolei where the blossoms of the ma‘o looked golden in the sunlight, the sister sat down to make ma‘o leis for themselves. When the leis were made they went across the breadth of Kaupe‘a to Waipio. [*Ka Loea Kālai‘āina*, 22 July 1899:15; translation in Sterling and Summers 1978:7]

They stopped at the stream of Ka‘aimalu on the way to their home and the sister convinced her brother to share the fish between the two, thus breaking the *kapu*. “Because these children ate fish secretly, the spot is called Kaai-malu (Secret eating) to this day” (Sterling and Summers 1978:7).

3.1.4 The First Breadfruit Brought from Kahiki

The chief Kaha‘i left from Kalaeloa, a coastal area in Honouliuli, for a trip to Kahiki. On his return to the Hawaiian Islands, he brought back the first breadfruit (Kamakau 1991b:110) and planted it near the waters of Pu‘uloa or “long hill,” now known as Pearl Harbor (Beckwith 1940:97).

3.1.5 The Traveling Mullet of Honouliuli

The story of (Ka) Ihuopala‘ai is largely associated with the tradition of the *‘anae-holo* or traveling mullet (Thrum 1907:270–272):

> The home of the anae-holo is at Honouliuli, Pearl Harbor, at a place called Ihuopalaai. They make periodical journeys around to the opposite side of the island, starting from Puuloa and going to windward, passing successively Kumumanu, Kalihi, Kou, Kalia, Waikiki, Kaalawai, and so on, around to the Koolau side, ending at Laie, and then returning by the same course to their starting-point. [Thrum 1907:271]

In Thrum’s account, Ihuopala‘ai is a male who possesses a *kū‘ula*, or fish god, which supplied the large mullet known as *‘anae* (also *‘ama‘ama*; *Mugil cephalus*; when 12 inches or more, they are referred to as *‘anae*). His sister lived in Lā‘ie and there came a time when there were no fish. She sent her husband to visit Ihuopala‘ai who was kind enough to send the fish following his brother-in-law on his trip back to Lā‘ie.

This story is associated with a poetical saying documented by Mary Kawena Pukui about Honouliuli:

> ***‘Ōlelo No‘eau* #1330**
>
> *Ka i‘a hali a ka makani*
>
> The fish fetched by the wind. [Pukui 1983:145]

Pukui (1983:145) explains, “The *‘anaeholo*, a fish that travels from Honouliuli, where it breeds, to Kaipāpa‘u on the windward side of O‘ahu. It then turns about and returns to its original home. It is driven closer to shore when the wind is strong.”

McAllister offers a variation of the *mo‘olelo*:

> The site is named for Kaihuopalaai, said to be a daughter of Konikonia and his wife Hinaaimalama. Fornander (37, vol. 5, p. 270) writes: ‘. . . on Oahu, Kaihuopalaai saw a godly man by the name of Kapapaapuhi [see Site 139] who was living at Honouliuli, Ewa; she fell in love with him and they were united, so Kaihuopalaai has remained in Ewa to this day. She was changed into that fishpond in which mullet are kept and fattened, and this fish is used for that purpose to this day.’ [McAllister 1933:108]

Kaihuopala‘ai, which means “the nose of Pala‘ai” (Pukui et al. 1974:68) is also the name the Hawaiians used for the west loch of Pearl Harbor. McAllister recorded that other Hawaiians say there never was a fishpond by that name.

> According to old Hawaiians, there never was a fishpond by this name. In another version (77, p. 270), Ihuopalaai is the brother of a woman living in Laie. As the fish were scarce in Laie, this woman sent her husband to Ihuopalaai, who had the mullet follow her husband on his return trip which was made along the shore around Makapuu Point with the mullet following in the water. Makea tells me that Kaihuopalaai's sister was named Malaekahana. Another story tells of a man who lured the mullet around the island by tossing sweet potatoes into the sea (68, p. 38). [McAllister 1933:108]

Beckwith (1918) says that Kaihuopala‘ai changed into the fishpond near Kapapapuhi Point, which means "the eel flats."

There is also a famous *pōhaku*, or rock, associated with the traveling mullet of Pearl Harbor.

> I […] asked the person sitting on my left, 'What place is this?' Answer – 'This is Pearl City.' It was here that mullets were bred in the ancient times and that flat stone there was called Mullet Rock or Pōhaku Anae. It lies near the beach by Ewa mill. [*Ka Nūpepa Kū‘oko‘a*, 2 October 1908 in Sterling and Summers 1978:53]

3.1.6 Ka-lua-ōlohe Caves of Honouliuli

'Ewa was famous for the many limestone caves formed in the uplifted coral, called the "Ewa Karst." This Pleistocene limestone outcrop, where not covered by alluvium or stockpiled material, has characteristic dissolution "pit caves" (Mylroie and Carew 1995), which are nearly universally, but erroneously, referred to as "sink holes" (Halliday 2005). These pit caves, or sinkholes, vary widely in areal extent and depth, with some of the more modest features comparable in volume to 5-gallon buckets, while some of the larger features, although usually irregularly shaped, are several meters wide and several meters deep. In traditional Hawaiian times, the areas of exposed coral outcrop were undoubtedly more extensive.

Some of these caves, called *ka-lua-‘ōlohe* were inhabited by the *‘ōlohe*, a type of people that looked like other humans but had tails like dogs (Beckwith 1940:343). These people were skilled in wrestling and bone-breaking and often hid along narrow passes to rob travelers; they were also reputed to be cannibals. One famous cannibal king, Kaupe, who lived in Līhu‘e in upland Honouliuli, was an *‘ōlohe*.

The caves of Pu‘uloa were sometimes also used as burial caves. In 1849, Keali‘iahonui, son of Kaua‘i's last king, Kaumuali‘i, died. He had once been married to the chiefess Kekau‘ōnohi, who had stayed with him until 1849. She wanted to bury her deceased-husband at sea.

> It seems that by Kekauonohi's orders, the coffin containing her late husband's remains was removed to Puuloa, Ewa, with the view of having it afterwards taken out to sea and there sunk. It was temporarily deposited in a cavern in the coral limestone back of Puuloa, which has long been used for a burial place, and has lately been closed up. [Alexander 1907:27]

After some initial objections by the niece of Keali‘iahonui, the body was removed from the outer coffin, the rest was sunk, and the coffin was later buried somewhere in Pu‘uloa.

3.1.7 Kanekua‘ana

Kanekua‘ana is a *kia‘i* (guardian) in the form of a *mo‘o* that took care of the people that lived from Honouliuli to Hālawa. Even those who were not her descendants were cared for in times of need. When *i‘a* (marine food) became scarce they would build a *waihau heiau* (a *heiau* for *mo‘o*) and pray for Kanekua‘ana’s blessing. She blessed them with an abundance of *i‘a*.

> The *pipi* (pearl oyster)—strung along from Namakaohalawa to the cliffs of Honouliuli, from the *kuapa* fishponds of inland ‘Ewa clear out to Kapakule. That was the oyster that came in from deep water to the mussel beds near shore, from the channel entrance of Pu‘uloa to the rocks along the edges of the fishponds. They grew right on the *nahawele* mussels, and thus was this *i‘a* obtained. Not six months after the *hau* branches [that placed a *kapu* on these waters until the *pipi* should come in] were set up, the *pipi* were found in abundance—enough for all ‘Ewa—and fat with flesh. Within the oyster was a jewel (*daimana*) called a pearl *(momi*), beautiful as the eyeball of a fish, white and shining; white as the cuttlefish, and shining with the colors of the rainbow—reds and yellows and blues, and some pinkish white, ranging in size from small to large. They were of great bargaining value (*he waiwai kumuku‘ai nui*) in the ancient days, but were just ‘rubbish’ (*‘opala*) in ‘Ewa. [Kamakau 1991b:83]

The people were also blessed with many other *i‘a* including *‘ōpae huna*, transparent shrimp (*pariambus typicus*), *‘ōpae kākala*, spiked shrimp (*caridina gracilirostris*), *nehu maoli*, *nehu pala*, types of anchovy, *mahamoe*, and *‘ōkupe*, types of bivalves. Some of these marine resources are no longer seen today (Maly and Maly 2003:60).

A clarification of the story of Kanekua‘ana and the pearl oysters of Pearl Harbor is given, in which it seems an overseer had set a ban on the *pipi* for several months a year so that they could increase. A poor widow, a relation of the *mo‘o*, took some of the *pipi* and hid them in a basket. The *konohiki* (overseer) found the hidden shells, and took them from her, emptying them back into the sea, which was proper. However, after this he followed the woman home and also demanded that she pay a stiff fine in cash, which she did not have. The *mo‘o* thought this was unjust and the next night she took possession of a neighbor who was a medium.

> […] After the overseer had gone back to Palea the lizard goddess possessed her aged keeper [a woman of ‘Ewa] and said to those in the house, ‘I am taking the pipi back to Kahiki and they will not return until all the descendants of this man are dead. Then shall the pearl oysters be returned. I go to sleep. Do not awaken my medium until she wakes up of her own accord.’ The command was obeyed and she slept four days and four nights before she awoke. During the time that she slept the pearl oysters vanished from the places where they were found in great numbers, as far as the shore […] The few found today are merely nothing […] [*Ka Loea Kālai‘āina*, 3 June 1899, translation in Sterling and Summers 1978:49–50]

3.1.8 Palila

In the *mo‘olelo* of the hero Palila, the famous warrior had a supernatural war club. He could throw the club a long distance, hang on to the end of it, and fly along the club’s path. Using this power, he touched down in several places in Honouliuli, Waipi‘o, and Waikele. One day he used

his supernatural war club to carry himself to Ka‘ena Point at Wai‘anae, and from there east across the district of ‘Ewa. Fornander writes:

> *Haalele keia ia Kaena, hele mai la a Kalena, a Pohakea, Maunauna, Kanehoa, a ke kula o Keahumoa, nana ia Ewa. Ku keia i laila nana i ke ku a ka ea o ka lepo i na kanaka, e pahu aku ana keia i ka laau palau aia nei i kai o Honouliuli, ku ka ea o ka lepo, nu lalo o ka honua, me he olai la, makau na kanaka holo a hiki i Waikele. A hiki o Palila i laila, e paapu ana na kanaka i ka nana lealea a ke ‘lii o Oahu nei, oai o Ahuapau.* [Fornander 1918:143]
>
> After leaving Kaena he came to Kalena, then on to Pohakea, then to Manuauna [a peak in Honouliuli], then to Kanehoa [a peak in Honouliuli], then to the plain of Keahumoa [upland plain from Honouliuli to Waipio] and looking toward Ewa. At this place he stood and looked at the dust as it ascended into the sky caused by the people who had gathered there; he then pushed his war club toward Honouliuli. When the people heard something roar like an earthquake they were afraid and they all ran to Waikele. When Palila arrived at Waikele he saw the people gathered there to witness the athletic games that were being given by the king of Oahu, Ahupau by name. [Fornander 1918:142]

3.1.9 Kākuhihewa

The Hawaiian *ali‘i* were also attracted to the region of the project area. One historical account of particular interest, appearing in the newspaper *Ke Au Hou*, refers to an *ali‘i* residing in Ko‘olina, southwest of the project area:

> Koolina is in Waimanalo near the boundary of Ewa and Waianae. This was a vacationing place for chief Kakuhihewa and the priest Napuaikamao was the caretaker of the place. Remember reader, this Koolina is not situated in the Waimanalo side of the Koolau side of the island but the Waimanalo in Ewa. It is a lovely and delightful place and the chief, Kakuhihewa loved this home of his. [*Ke Au Hou,* 13 July 1910, Volume I, Number II, Sterling and Summers 1978:41]

3.2 Wahi Pana

Wahi pana are legendary or storied places of an area. These legendary or storied places may include a variety of natural or human-made structures. Oftentimes dating to the pre-Contact period, most *wahi pana* are in some way connected to a particular *mo‘olelo*, however, a *wahi pana* may exist without a connection to any particular story. Davianna McGregor outlines the types of natural and human-made structures that may constitute *wahi pana*:

> Natural places have *mana* or spiritual power, and are sacred because of the presence of the gods, the *akua*, and the ancestral guardian spirits, the *‘aumakua*. Human-made structures for the Hawaiian religion and family religious practices are also sacred. These structures and places include temples, and shrines, or *heiau*, for war, peace, agriculture, fishing, healing, and the like; *pu‘uhonua*, places of refuge and sanctuaries for healing and rebirth; agricultural sites and sites of food production such as the *lo‘i* pond fields and terraces slopes, *‘auwai* irrigation ditches, and the

> fishponds; and special function sites such as trails, salt pans, *hōlua* slides, quarries, petroglyphs, gaming sites, and canoe landings. [McGregor 1996:22]

As McGregor makes clear, *wahi pana* can refer to natural geographic locations such as streams, peaks, rock formations, ridges, offshore islands and reefs, or they can refer to Hawaiian land divisions such as *ahupua‘a* or *‘ili*, and man-made structures such as fishponds. In this way, the *wahi pana* of Honouliuli tangibly link the *kama‘āina* of Honouliuli to their past. It is common for places and landscape features to have multiple names, some of which may only be known to certain *‘ohana* or even certain individuals within an *‘ohana*, and many have been lost, forgotten or kept secret through time. Place names also convey *kaona* and *huna* (secret) information that may even have political or subversive undertones. Before the introduction of writing to the Hawaiian Islands, cultural information was exclusively preserved and perpetuated orally. Hawaiians gave names to literally everything in their environment, including individual garden plots and *‘auwai* (water courses), house sites, intangible phenomena such as meteorological and atmospheric effects, *pōhaku*, *pūnāwai* (freshwater springs), and many others. According to Landgraf (1994), Hawaiian *wahi pana* "physically and poetically describes an area while revealing its historical or legendary significance" (Landgraf 1994:v). Place names and *wahi pana* of Honouliuli are identified on Figure 5.

3.2.1 *Heiau* (Pre-Christian Place of Worship)

Heiau were pre-Christian places of worship. Construction of some *heiau* was elaborate, consisting of large communal structures, while others were simple earth terraces or shrines (McAllister 1933:8). *Heiau* are most commonly associated with important religious ceremony; large structures with platforms or altars of one or more terraces were indicative of such function (McAllister 1933:8). Archaeologist Gilbert McAllister reports on two known *heiau* in the *ahupua‘a* of Honouliuli, as well as two other sites that could have possibly been *heiau*. These *heiau* were located on Pu‘u o Kapolei, on Pu‘u Ku‘ua, at the foot of Pu‘u Kanehoa, and at the foot of Mauna Kapu (McAllister 1933).

3.2.1.1 Pu‘u o Kapolei

A *heiau* was once located on Pu‘u o Kapolei, but it had been destroyed by the time of McAllister's (1933:108) survey of the island in the early 1930s. The hill was used as a point of solar reference or as a place for such observations (Fornander 1919c:6[2]:297). Pu‘uokapolei may have been regarded as the gate of the setting sun, just as the eastern gate of Kumukahi in Puna is regarded as the gate of the rising sun; both places are associated with the Hawaiian goddess Kapō (Emerson 1915:41). This somewhat contradicts some Hawaiian cosmologies, in which Kū was the god of the rising sun, and Hina, the mother of Kamapua‘a, was associated with the setting of the sun. Fornander (1919:6[2]:292) states that Pu‘uokapolei may have been a *leina,* jumping off point associated with the wandering souls who roamed the plains of Kaupe‘a and Kānehili, *makai* (toward the sea) of the hill.

McAllister writes that the stones from the *heiau* supplied the rock crusher located on the side of this elevation, about 100 ft away on the sea side. There was once a large rock shelter on the *makai* side where it is said to have been the residence of Kamapua‘a and his grandmother. (McAllister 1933:108). After conquering the majority of O‘ahu, he established his grandmother as queen of this *wahi* (Pukui et al. 1974:203).

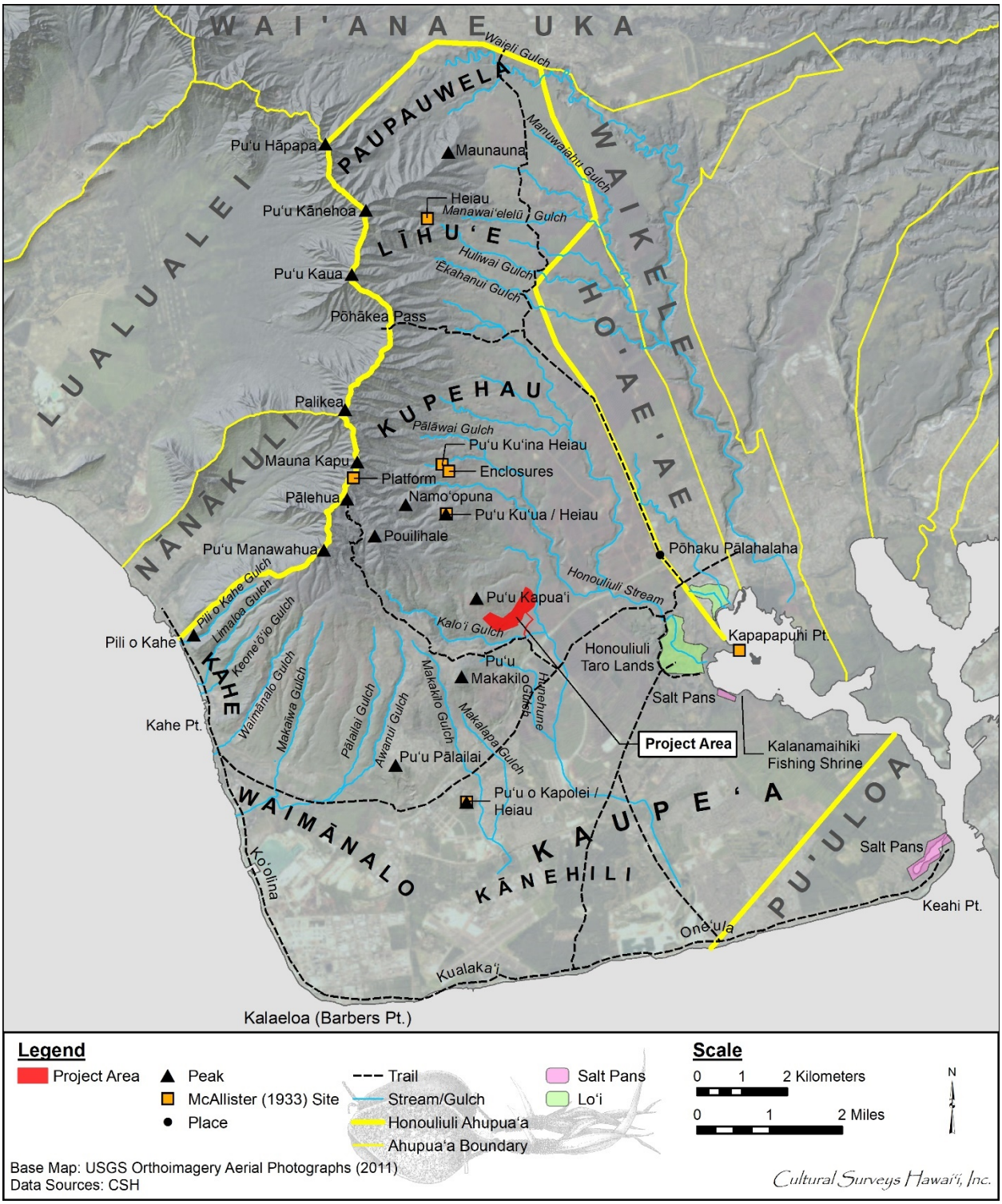

Figure 5. Portion of a 2011 USGS Orthoimagery aerial photograph showing place names, trails and streams of Honouliuli Ahupua‘a and the location of the project area

3.2.1.2 Pu‘u Ku‘ua

Pu‘u Ku‘ua Heiau located in Palikea, Honouliuli, overlooks both Honouliuli and Nānākuli, and is at the height of approximately 1,800 feet (ft). Most of the stones from the *heiau* were used for a cattle pen located on the *makai* side of the site. The part of the *heiau* that hadn't been cleared for pineapples has been planted in ironwoods (McAllister 1933:108).

3.2.1.3 Unidentified heiau at the foot of Pu‘u Kanehoa

Located at the foot of Pu‘u Kanehoa is a small enclosure thought to have possibly been a *heiau*. McAllister writes:

> My informant, Reiney, recalls the respect the old Hawaiians had for the place when he was punching cattle with them in his youth. It is a walled inclosure 25 by 35 feet. On the inside the walls are between 2 and 3 feet high, and on the outside they range from 2 to 5 feet, depending upon the slope of the land. On three sides the walls are 2 feet wide, but the fourth is 3 feet wide. The walls are evenly faced with a fill of smaller stones. At present the site is surrounded with a heavy growth of *Lantana*; but only a thick growth of grass and two small guava bushes are in the interior, which is most unusual unless human hands keep the interior clear. Possibly this is not a *heiau* but a small inclosure considered sacred for some reason. [McAllister 1933:107]

3.2.1.4 Unidentified heiau at the foot of Pu‘u Kuina

Located in Aikukai, Honouliuli, at the foot of Pu‘u Kuina what looked to be a terrace is all that remained when McAllister cataloged Site 134. He notes of the inability to determine the size of the *heiau* or the number of terraces that once stood (McAllister 1933:107).

3.2.2 Plains of ‘Ewa

3.2.2.1 The Plains of Kaupe‘a

Several places on the ‘Ewa coastal plain are associated with *ao kuewa*, the realm of the homeless souls. Samuel Kamakau explains Hawaiian beliefs in the afterlife:

> There were three realms (*ao*) for the spirits of the dead […] There were, first, the realm of the homeless souls, the *ao kuewa*; second, the realm of the ancestral spirits, the *ao ‘aumakua*; and third, the realm of Milu, *ke ao o Milu.*
>
> The *ao kuewa*, the realm of homeless souls, was also called the *ao ‘auwana*, the realm of wandering souls. When a man who had no rightful place in the *‘aumakua* [family or personal gods] realm (*kanaka kuleana ‘ole*) died, his soul would wander about and stray amongst the underbrush on the plain of Kama‘oma‘o on Maui, or in the *wiliwili* grove of Kaupe‘a on Oahu. If his soul came to Leilono [in Hālawa, ‘Ewa near Red Hill], there it would find the breadfruit tree of Leiwalo, *ka‘ulu o Leiwalo*. If it was not found by an *‘aumakua* soul who knew it (*i ma‘a mau iaia*), or one who would help it, the soul would leap upon the decayed branch of the breadfruit tree and fall down into endless night, the *po pau ‘ole o Milu*. Or, a soul that had no rightful place in the *‘aumakua* realm, or who had no relative or friend

> (*makamaka*) there who would watch out for it and welcome it, would slip over the flat lands like a wind, until it came to a leaping place of souls, *a leina a ka ‘uhane*.
>
> On the plain of Kaupe‘a beside Pu‘uloa [Pearl Harbor], wandering souls could go to catch moths (*pulelehua*) and spiders (*nanana*). However, wandering souls could not go far in the places mentioned earlier before they would be found catching spiders by *‘aumakua* souls, and be helped to escape. [Kamakau 1991a:47, 49]

This association of Pu‘uokapolei and Kānehili with wandering souls is also illustrated in a lament on the death of Kahahana, the paramount chief of O‘ahu, who was killed by his father, Kahekili, after Kahahana became treacherous and killed the high priest Ka‘opulupulu.

E newa ai o hea make i ka lā,	Go carefully lest you fall dead in the sun,
Akua noho la i Pu‘uokapolei.	The god that dwells on Kapolei hill.
E hanehane mai ana ka lā i nā	The sun is wailing on account of the
wahine o Kamao,	women of Kamao,
Akua pe‘e, pua ‘ohai o ke kaha,	A hiding god, blossoming ohai of the banks
I walea wale i ke a-	Contented among the stones
I ka ulu kanu a Kahai.	Among the breadfruit planted by Kahai.
Haina ‘oe e ka oo-	Thou hast spoken of by the oo-
E ka manu o Kānehili.	By the bird of Kānehili.

> [*Ka Nupepa Kuokoa*, Volume VII, Number 23, 6 June 1868, He Mele Kanikau no Walia Kahaha na ka moi o Oahu; Fornander 1919c:6[2]:297]

Fornander provides some notes on this lament. The god dwelling at Kapolei is the god Kahahana, stating that this is where his soul has gone. Kamao is one of the names to the door of the underworld. This lament draws an association with wandering souls and the place where the first breadfruit tree was planted by Kaha‘i at Pu‘uloa (Fornander 1919c:6[2]304).

Pukui (1983) offers this Hawaiian saying, which places the wandering souls in a *wiliwili* (*Erythrina sandwicensis*) grove at Kaupe‘a:

> *Ka wiliwili o Kaupe‘a.*
>
> The *wiliwili* grove of Kaupe‘a
>
> In ‘Ewa, O‘ahu said to be where homeless ghosts wander among the trees.
>
> [Pukui 1983:180]

Pukui also shared her personal experience with the wandering spirits on the plain of Kaupe‘a.

> A wide plain lies back of Keahi and Pu‘uloa where the homeless, friendless ghosts were said to wander about. These were the ghosts of people who were not found by their family *‘aumakua* or gods and taken home with them, or had not found the leaping places where they could leap into the nether world. Here [on the plain of Honouliuli] they wandered, living on the moths and spiders they caught. They were often very hungry for it was not easy to find moths or to catch them when found.

> Perhaps I would never have been told of the plain of homeless ghosts if my cousin's dog had not fainted there one day. My cousin, my aunt and I were walking to Kalaeloa, Barber's Point, from Pu‘uloa accompanied by Teto, the dog. She was a native dog, not the so-called poi dog of today, with upright ears and body the size of a fox terrier. For no accountable reason, Teto fell into a faint and lay still. My aunt exclaimed and sent me to fetch sea water at once which she sprinkled over the dog saying, '*Mai hana ino wale ‘oukou i ka holoholona a ke kaikamahine. U oki ko ‘oukou makemake ‘ilio*.' 'Do not harm the girl's dog. Stop your desire to have it.' Then with a prayer to her *‘aumakua* for help she rubbed the dog. It revived quickly and, after being carried a short way, was as frisky and lively as ever.
>
> Then it was that my aunt told me of the homeless ghosts and declared that some of them must have wanted Teto that day because she was a real native dog, the kind that were roasted and eaten long before foreigners ever came to our shores. [Pukui 1943:60–61]

Beckwith (1970:154) has stressed that "the worst fate that could befall a soul was to be abandoned by its ‘aumakua (ancestral spirit) and left to stray, a wandering spirit (kuewa) in some barren and desolate place." These wandering spirits were often malicious, so the places where they wandered were avoided.

3.2.2.2 The Plains of Pukaua

The Hawaiian language newspaper *Ka Loea Kālai‘āina* (13 January 1900) relates that near Pu‘uokapolei, on the plain of Pukaua, on the *mauka* side of the road, there was a large rock. This *mo‘olelo* suggests the plain around Pu‘uokapolei was called Pukaua. The *mo‘olelo* is as follows:

> If a traveler should go by the government road to Waianae, after leaving the village of gold, Honouliuli, he will first come to the plain of Puu-ainako and when that is passed, Ke-one-ae. Then there is a straight climb up to Puu-o-Kapolei and there look seaward from the government road to a small hill. That is Puu-Kapolei […] You go down some small inclines, then to a plain. This plain is Pukaua and on the mauka side of the road, you will see a large rock standing on the plain […] There were two supernatural old women or rather peculiar women with strange powers and Puukaua belonged to them. While they were down fishing at Kualakai [near Barbers Point] in the evening, they caught these things, aama crabs (Grapsus tenuicrustatus), pipipi shellfish (Nerita picea), and whatever they could get with their hands. As they were returning to the plain from the shore and thinking of getting home while it was yet dark, they failed for they met a one-eyed person [bad omen]. It became light as they came near to the plain, so that passing people were distinguishable. They were still below the road and became frightened lest they be seen by men. They began to run—running, leaping, falling, sprawling, rising up and running on, without a thought of the aama crabs and seaweeds that dropped on the way, so long as they would reach the upper side of the road. They did not go far for by then it was broad daylight. One woman said to the other, 'Let us hide lest people see us,' and so they hid. Their bodies turned into stone and that is one of the famous things on this plain to this day, the stone body. This is the end of these strange women. When one visits the plain, it will do no harm to glance on the upper

> side of the road and see them standing on the plain. [*Ka Loea Kālai‘āina*, 13 January 1900, translation in Sterling and Summers 1978:39]

In another version of this story, the two women met Hi‘iaka as she journeyed toward the ‘Ewa coast. The women were *mo‘o* and were afraid that Hi‘iaka would kill them, so they changed into their lizard form. One of the lizards hid in a little space on a stone beside the coastal trail, and the other hid nearby (*Ka Hōkū o Hawai‘i*, 15 February 1927, translated in Maly 1997:19). From that time on the stone was known as “Pe‘e-kāua,” meaning “we two hidden.” Hi‘iaka greeted the two women but did not harm them, and passed on.

When she reached Pu‘uokapolei, she also greeted two old women who lived at an *‘ohai* (*Sesbania tomentosa*) grove on the hill. These women were named Pu‘uokapolei and Nāwahineokama‘oma‘o (*Ka Hōkū o Hawai‘i*, 22 February 1927, translated in Maly 1997:19). As she continued her travels, she looked to the ocean and saw the canoe carrying Lohi‘au:

Kuu kane i ke awa lau o Puuloa	My man on the many harbored sea of Pu‘uloa
Mai ke kula o Peekaua ke noho	As seen from the plain of Pe‘ekāua
E noho kaua i ke kaha o ka ohai	Let us dwell upon the *‘ōhai* covered shore
I ka wiliwili i ka pua o ka lau noni	Where the *noni* blossoms are twisted together
O ka ihona i Kanehili la	Descending along Kānehili
Ua hili hoi au-e	I am winding along.

[*Ka Hōkū o Hawai‘i,* 22 February 1927, translated in Maly 1997:20]

3.2.2.3 The Inland Plain of Keahumoa

In several legends of ‘Ewa, mention is made of the “plain of Keahumoa.” John Papa ‘Ī‘ī (1959:96) has this plain opposite the trail to Pōhakea Pass, stretching across the *ahupua‘a* of Honouliuli and Hō‘ae‘ae. McAllister (1933:107) states that the plain was west of Kīpapa Gulch in Waikele. It is also mentioned in legends of Waipi‘o. Thus, this is probably a general name for the flat plain *mauka* of the productive floodplain area directly adjacent to Pearl Harbor. This plain would have been east of the present corridor alignment.

3.2.2.3.1 Legend of Nāmakaokapao‘o

Nāmakaokapao‘o was a Hawaiian hero of legendary strength. Nāmakaokapao‘o’s mother was Pokai and his father was Kaulukahai, a great chief of Kahiki, the ancestral home of the Hawaiians. The two met in Hō‘ae‘ae and conceived their child there. The father returned to his home in Kahiki before the birth of his son, leaving his O‘ahu family destitute. A man named Puali‘i saw Pokai and married her. The couple then resided on the plains of Keahumoa, planting sweet potatoes. Nāmakaokapao‘o was a small, brave child who took a dislike to his stepfather, and pulled up the sweet potatoes Puali‘i had planted at their home in Keahumoa. When Puali‘i came after Nāmakaokapao‘o with an axe, Nāmakaokapao‘o delivered a death prayer against him, and slew Puali‘i, hurling his head into a cave in Waipouli, near the beach at Honouliuli (Fornander 1919d:5[2]:274–276).

3.2.2.3.2 Legend of Pikoi

Pikoi was a legendary hero, the son of a crow (*‘alalā*) and brother to five god-sisters in the form of rats. He was famous for his ability to shoot arrows, and often made bets that he could hit rats from a long distance (Fornander 1917a:4[3]:450–463). Pikoi’s skill was commemorated in a saying (Pukui 1983:200):

Ku aku la i ka pana a	Shot by the arrow of Pikoi-[son]
Pikoi-a-ka-‘alalā, keiki pana	of-the-crow, the expert rat-shooter
‘iole o ke kula o Keahumoa.	Of the plain of Keahumoa.

3.2.2.3.3 The Demi-god Māui

In the stories of the demi-god Māui, Keahumoa is the home of Māui‘s grandfather, Kūolokele (Kū-honeycreeper). One day, Māui’s wife, Kumulama, was stolen by the chief Pe‘ape‘amakawalu, called the eight-eyed-bat, who is identified in the creation chant, *Kumulipo*, as the octopus god (Beckwith 1951:136). The chief disappeared with Kumulama in the sky beyond the sea, and escaped so quickly that Māui could not catch him. To recover his wife, Māui’s mother advised him to visit the hut of his grandfather at Keahumoa:

> Maui went as directed until he arrived at the hut; he peeped in but there was no one inside. He looked at the potato field on the other side of Poha-kea, toward Hono-uli-uli, but could see no one. He then ascended a hill, and while he stood there looking, he saw a man coming toward Waipahu with a load of potato leaves, one pack of which, it is said, would cover the whole land of Keahumoa. [Thrum 1923:253–254]

Kūolokele made a *moku-manu* (“bird-ship”) for Māui, who entered the body of the bird and flew to Moanaliha, the land of the chief Pe‘ape‘amakawalu. This chief claimed the bird as his own when it landed on a sacred box, and took it with him into the house he shared with Māui’s wife. When Peapeamakawalu fell asleep, Māui killed him, cut off his head, and flew away back to O‘ahu with his wife and the chief’s head (Thrum 1923:252–259).

3.2.3 Paupauwela and Līhu‘e

Paupauwela, also spelled Popouwela (derivation unknown), is the name of the land area in the extreme *mauka* section of Honouliuli Ahupua‘a. The land area of Līhu‘e is just *makai* of this land, and extends into the *ahupua‘a* of Waipi‘o (adjacent to the eastern border of Honouliuli). Both place names are mentioned in a chant recorded by Abraham Fornander, which was composed as a *mele* for the O‘ahu king, Kūali‘i, as he was preparing to battle Kuiaia, the chief of Wai‘anae:

*Ihea, ihea la ke kahua,*Where?	Where is the battle field
Paio ai o ke koa-a?	Where the warrior is to fight?
I kai i kahua i Kalena,	On the field of Kalena,
I Manini, i Hanini	At Manini, at Hanini,
I ninia i ka wai akua,	Where was poured the water of the god
I ko hana i Malamanui	By your work at Malamanui;
Ka luna o Kapapa, i Paupauwela,	On the heights of Kapapa, at Paupauwela,

I ka hilinai i ke kalele,	Where they lean and rest;
Ka hala o Halahalanui maauea,	At the hala trees of indolent Halahalanui,
E kula ohia ke Pule-e,	At the ohia grove of Pule-e
Ke ‘kua o Lono o Makalii	The god of Lono, of Makalii
Ka lala aalao Ukulonoku,	The fragrant branch of the Ukulonoku,
No Kona paha, no Lihue.	Mayhap from Kona, from Lihue,
No ka la i Maunauna,	For the day at Maunauna
No ka wai i Paupauwela.	For the water at Paupauwela.
Ula ka wai i Paupauwela,	Red is the water of Paupauwela,
Ke kilau o Malamani	,From the slain at Malamani,
Ka moo kilau I Kapapa.	The slain on the ridge at Kapapa.

[Fornander 1917b:4[2]:384–386]

3.2.4 Maunauna

The hill Maunauna lies between the lands Paupauwela and Līhu‘e. One translation of Maunauna is “mountain sent [on errands].” Two servant *mo‘o* who lived here had no keepers to supply their needs” (Pukui et al. 1974:149). It was at Maunauna, according to one tradition, that the forces of the chiefs Kūali‘i and Kuiaia of Wai‘anae met to do battle, which was averted when a *mele* honoring the god Kū was chanted (see Section 3.5.1). (Fornander 1917b:4[2]:348). In the Legend of Ke-ao-melemele, a woman named Paliuli traveled in this area.

> In a very short time she [Paliuli] walked over the plain of Ewa; Ewa that is known as the land of the silent fish (pearl oysters) […] She went on to the plain of Punalu‘u and turned to gaze at Maunauna point and the plain of Lihue. [Manu 1885, translation in Sterling and Summers 1978:21]

Certain place names in the uplands, including Maunauna, are also mentioned in the story of Lolale’s Lament. The place of Lolale’s residence is given in King Kalākaua’s version of this story (Kalākaua 1990:232): “There lived there at that time in Lihue, in the district of Ewa, on the island of O‘ahu, a chief named Lo-Lale, son of Kalona-iki, and brother of Piliwale, the *alii-nui*, or nominal sovereign, of the island, whose court was established at Waialua.”

In this story, Lolale was a chief of O‘ahu who asked his friend Kalamakua to find him a bride (Kalākaua 1990:228–246; Skinner 1971:217–219). Kalamakua traveled to Maui and chose Kelea, the chief’s sister, and returned with her to O‘ahu; during this time the two grew close. Kelea lived with Lolale for a while, but he was a silent type who was often away from home playing sports and walking in the woodlands. Longing for Kalamakua, Kelea decided to leave her husband, Lolale voiced no “spoken bitterness;” however, after she left, he sang this lament:

> Farewell, my partner of the lowland plains,
>
> On the waters of Pohakeo,
>
> Above Kanehoa,
>
> On the dark mountain spur of Mauna-una!
>
> O, Lihue, she is gone!

Sniff the sweet scent of the grass,
The sweet scent of the wild vines
That are twisted by Waikoloa,
By the winds of Waiopua,
My flower!
As if a mote were in my eye.
The pupil of my eye is troubled;
Dimness covers my eyes. Woe is me!
[Kalākaua 1990:228–246]

3.2.5 Kūalaka‘i

Kūalaka‘i is the name of an area near Barbers Point, located on the southwestern side of Honouliuli Ahupua‘a. Clark (1977:74) says it is named for a type of sea cucumber that squirts a purple fluid when squeezed. Pukui identifies the sea creature as *Tethys* a member of the invertebrate family *Aplysiidae* commonly called sea hares (Pukui et al. 1974:119). Pukui adds this area was once the site of a spring called Hoaka-lei ("lei reflection") "because Hi‘iaka picked *lehua* flowers here to make a *lei* (garland) and saw her reflection in the water" (Pukui et al. 1974:119).

3.2.6 Kalaeloa

Kalaeloa literally means "the long point" (Pukui et al. 1974:72). Kalaeloa Point was the home of Uhu Makaikai, a *kupua* who could take the form of a man or a giant parrotfish (*uhu).* He is mentioned in several legends concerning the hero Kawelo and with Kawelo's struggles with the ruling chief of Kaua‘i, ‘Aikanaka.

> This friend was Kauahoa also an alii of Wailua (Kauai). Their king, Aikanaka, in the time of Kakuhihewa of Oahu and Lonoikamakahiki of Hawaii. Aikanaka got offended with Kawelo and sent him to live at Waikiki. Cause. The king at a surf bathing told Kawelo to get a calabash of water for him to wash off with, but on Kawelo's failing to do it, he took a calabash of soft poi and threw it over Kawelo and sent him off as already stated. At Waikiki, Kawelo studied the art of fighting to be revenged on Aikanaka. A kupua, Uhu makaikai, a fish was his teacher. Makuakeke was his helper in the canoe. The fish lived at Pohaku o Kawai near Kalailoa (Kalaeloa), Oahu (Barber's Point) . . . [Hawaiian Ethnological Notes, Bishop Museum Vol. II:114, translation in Sterling and Summers 1978:41]

3.2.7 *Ala Hele* (Trails)

John Papa ‘Ī‘ī describes a network of Leeward O‘ahu trails (Figure 6 through Figure 8) which in later historic times encircled and crossed the Wai‘anae Range, allowing passage from West Loch to the Honouliuli lowlands, past Pu‘uokapolei and Waimānalo Gulch to the Wai‘anae coast and onward circumscribing the shoreline of O‘ahu (‘Ī‘ī 1959:96–98). The main trail along the south shore of O‘ahu would have been approximately 1.5 km to the southeast. A main trail extending up the central valley of O‘ahu would have been approximately 3 km to the east. The

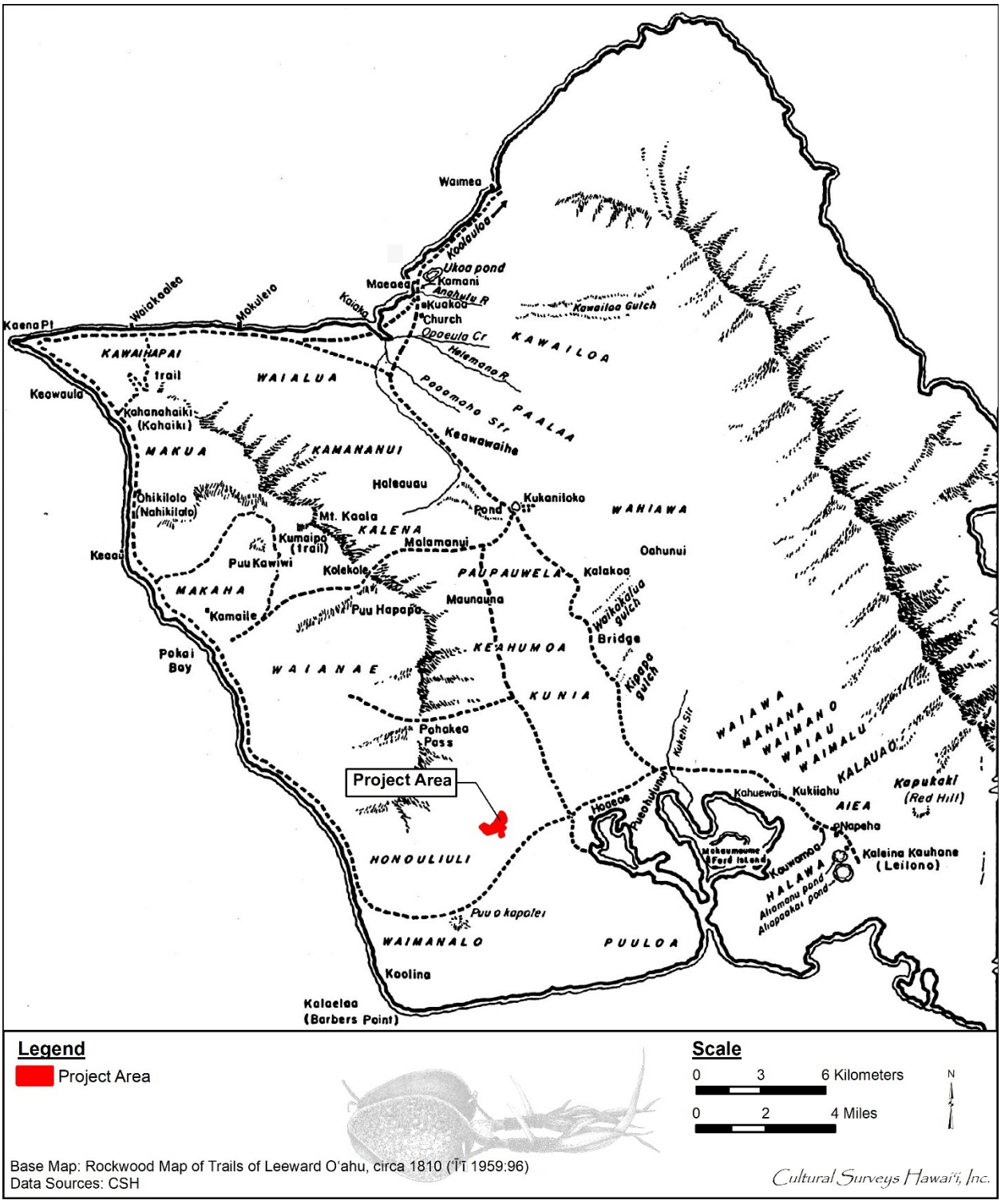

Figure 6. Portion of the 1810 Rockwood map of trails of Leeward O‘ahu with overlay of project area (Ī‘ī 1959:96)

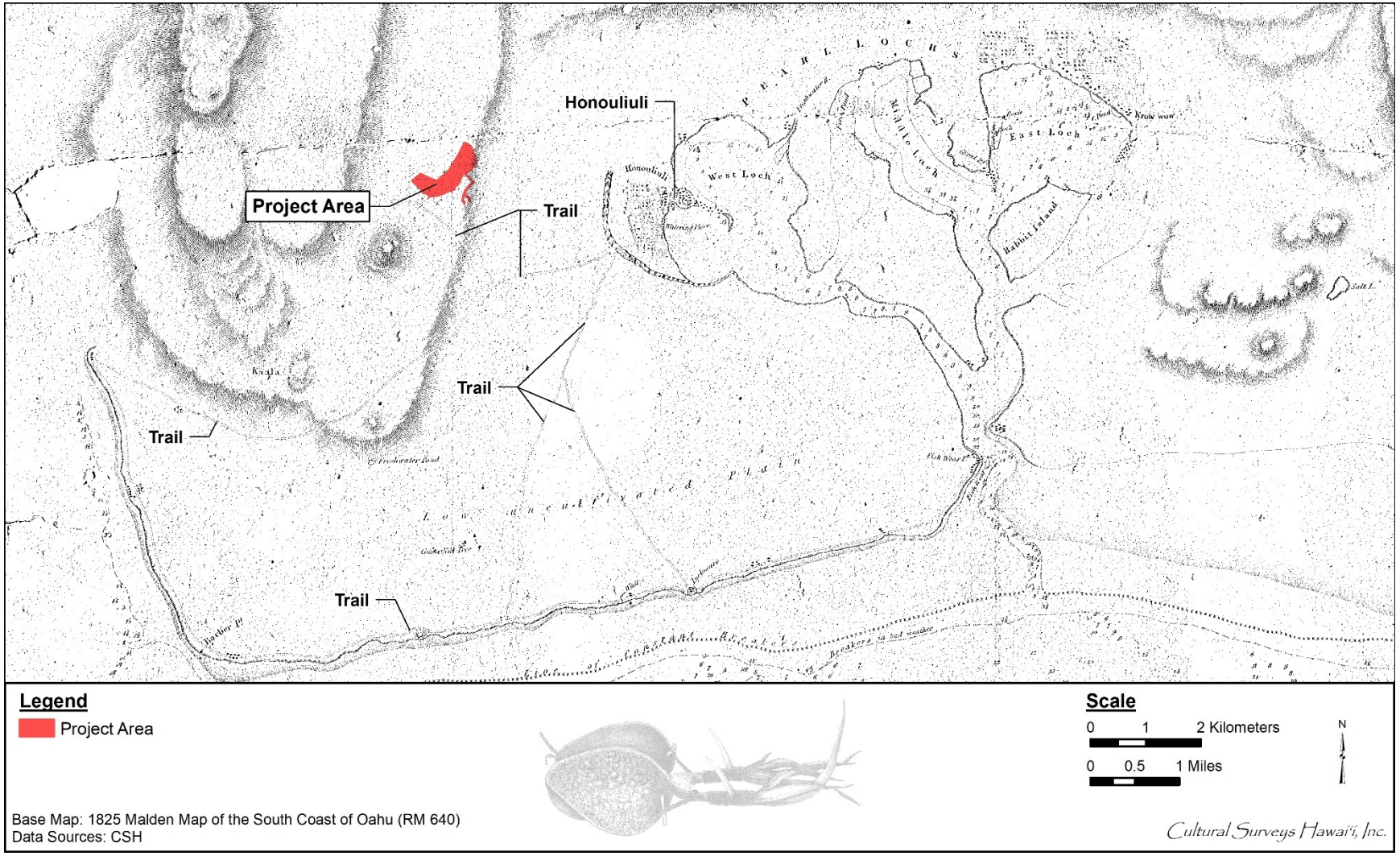

Figure 7. Portion of 1825 Malden map of the South Coast of Oahu showing the location of the project area (note: a trail into the southern Wai‘anae Mountain Range is shown as passing just south of the project area)

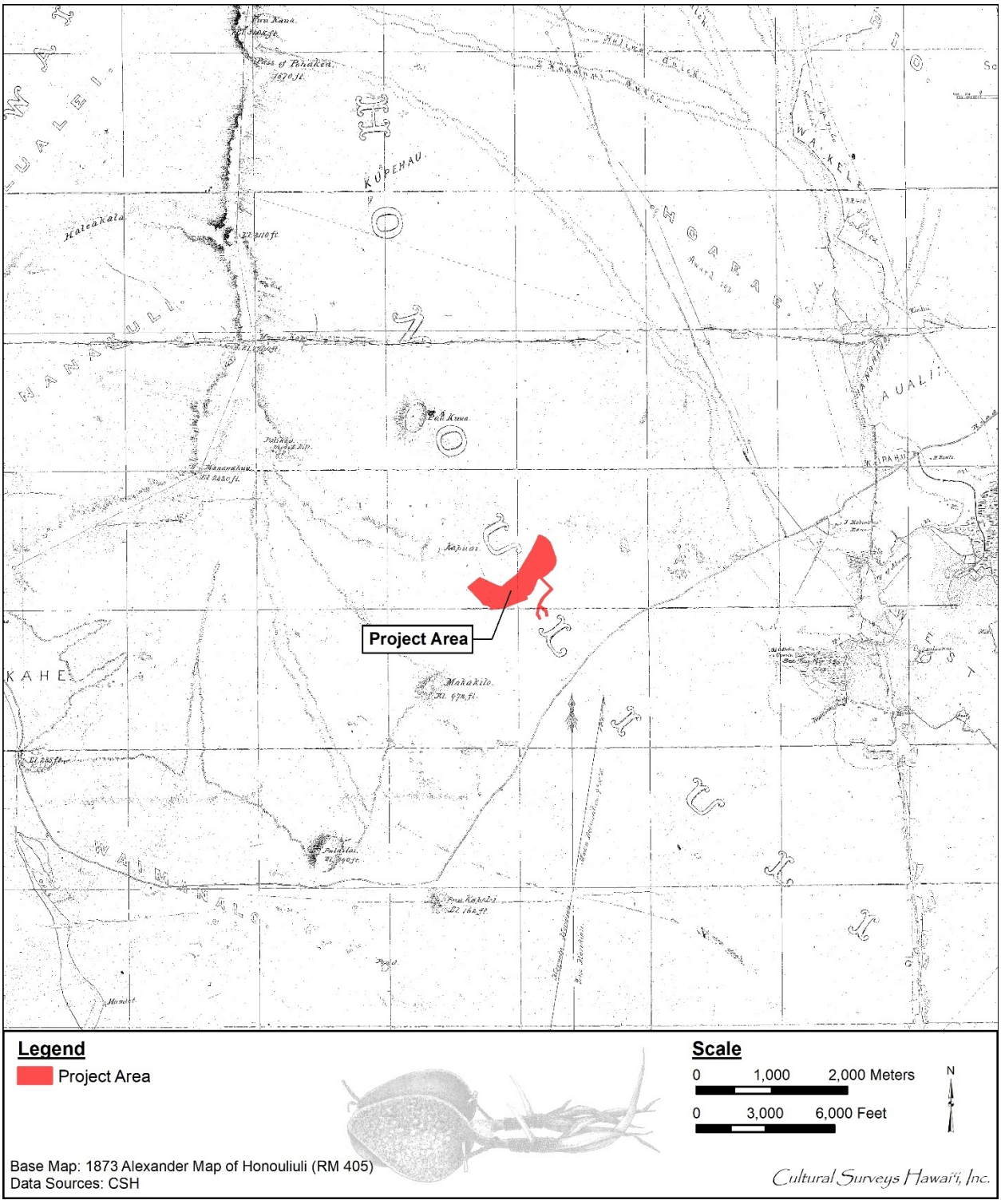

Figure 8. Portion of 1873 Alexander map of Honouliuli showing trail network in vicinity of project area

1825 Malden map (see Figure 7) shows a trail extending from the main trail along the south shore of O‘ahu into the uplands in the Pālehua area as passing just a couple hundred meters to the southwest of the project area. The 1873 Alexander map (see Figure 8), one of the earliest detailed maps of the vicinity, shows no development near the project area.

3.2.7.1 Pōhākea Pass

Pōhākea Pass, on the Wai‘anae Mountain Range, has an elevation of 671 m (2,200 ft) amsl. Pōhākea literally translates to “white stone” (Pukui et al. 1974:185). Pōhākea serves as a passage between *ahupua‘a* of Honouliuli and Lualualei. This is also the location where Hi‘iaka saw cloud omens that her *lehua* (flower of the *‘ōhia* tree [*Metrosideros polymorpha*]) groves had been burned by her sister Pele, and her friend Hōpoe had been turned into stone.

In *The Epic Tale of Hi‘iakaikapoliopele*, Hi‘iaka watches as her beloved friend Hōpoe is killed by the embers of her sister Pele. She chants atop Pōhākea and tells of the winds of Waikōloa and Wai‘ōpua:

KAU HO‘OKAHI HANERI A	CHANT ONE HUNDRED
ME KANALIMAKUMAMĀKOLU	AND FIFTY-THREE
Aloha ku‘u hoa i ka pū‘ali lā	Alas my friend of the rugged mountain pass
A luna i Pōhākea, he luna o Kamaoha	On high at Pōhākea, above Kamaoha
He lae ‘ino ‘o Maunauna	Maunauna is a dangerous escarpment
‘O Līhu‘e ke hele ‘ia	Lihu‘e’s high plain yet to be traversed
Honi i ke ‘ala mau‘u	Inhaling the scent of the grasses
I ke ‘ala o ke kupukupu	The fragrance of kupukupu fern
E linoa ala e ka Waikōloa	Entwined by the Waikoloa breeze
E ka makani he Wai‘ōpua	By the wind called Wai‘ōpua
Ku‘u pua, me he pua lā i ku‘u maka	My blossom, like a flower in my sight
Ka ‘oni i ka haku ‘ōnohi, kā ka wai lā i li‘u	Moving before my eyes, washed salty by tears
I ku‘u maka lā, e uē au lā.	There in my sight, I weep.

[Ho‘oulumahiehie 2008a:262; Ho‘oulumahiehie 2008b:262]

3.3 *‘Ōlelo No‘eau*

Hawaiian knowledge was shared by way of oral histories. Indeed, one’s *leo* (voice) is oftentimes presented as *ho‘okupu* (“a tribute or gift” given to convey appreciation, to strengthen bonds, and to show honor and respect); the high valuation of the spoken word underscores the importance of the oral tradition (in this case, Hawaiian sayings or expressions), and its ability to impart traditional Hawaiian “aesthetic, historic, and educational values” (Pukui 1983:vii). Thus, in many ways these expressions may be understood as inspiring growth within reader or between speaker and listener:

> They reveal with each new reading ever deeper layers of meaning, giving understanding not only of Hawai‘i and its people but of all humanity. Since the sayings carry the immediacy of the spoken word, considered to be the highest form of cultural expression in old Hawai‘i, they bring us closer to the everyday thoughts and lives of the Hawaiians who created them. Taken together, the sayings offer a basis for an understanding of the essence and origins of traditional Hawaiian values. The sayings may be categorized, in Western terms, as proverbs, aphorisms, didactic adages, jokes, riddles, epithets, lines from chants, etc., and they present a variety of literary techniques such as metaphor, analogy, allegory, personification, irony, pun, and repetition. It is worth noting, however, that the sayings were spoken, and that their meanings and purposes should not be assessed by the Western concepts of literary types and techniques. [Pukui 1983:vii]

Simply, *‘ōlelo no‘eau* may be understood as proverbs. The Webster dictionary notes it as “a phrase which is often repeated; especially, a sentence which briefly and forcibly expresses some practical truth, or the result of experience and observation.” It is a pithy or short form of folk wisdom. Pukui equates proverbs as a treasury of Hawaiian expressions (Pukui 1995:xii). Oftentimes within these Hawaiian expressions or proverbs are references to places. This section draws from the collection of author and historian Mary Kawena Pukui and her knowledge of Hawaiian proverbs describing *‘āina* (land), chiefs, plants, and places.

3.3.1 Concerning Sharks

The eastern coast of Honouliuli lies adjacent to Pu‘uloa which has many *mo‘olelo* about sharks, particularly Ka‘ahupāhau, the queen shark of O‘ahu and the most famous guardian shark who lived in Pu‘uloa. Thus, Honouliuli is closely associated with shark *‘aumakua* and *mo‘olelo* which say the people of ‘Ewa were protected by sharks. The following *‘ōlelo no‘eau* are associated with sharks.

3.3.1.1 ‘Ōlelo No‘eau #105

> *Alahula Pu‘uloa, he alahele na Ka‘ahupāhau.*
>
> Everywhere in Pu‘uloa is the trail of Ka‘ahupāhau.
>
> Said of a person who goes everywhere, looking, peering, seeing all, or of a person familiar with every nook and corner of a place. Ka‘ahupāhau is the shark goddess of Pu‘uloa (Pearl Harbor) who guarded the people from being molested by sharks. She moved about, constantly watching. [Pukui 1983:14]

3.3.1.2 ‘Ōlelo No‘eau #1014

> *Ho‘ahewa na niuhi ia Ka‘ahupāhau*
>
> The man-eating sharks blamed Ka‘ahupāhau
>
> Evil-doers blame the person who safeguards the rights of others. Ka‘ahupāhau was the guardian shark goddess of Pu‘uloa (Pearl Harbor) who drove out or destroyed all the man-eating sharks. [Pukui 1983:108]

3.3.1.3 ‘Ōlelo No‘eau #2152

Mehameha wale no o Pu‘uloa, i ka hele a Ka‘ahupāhau

Pu‘uloa became lonely when Ka‘ahupāhau went away

The home is lonely when a loved one has gone. Ka‘ahupāhau, guardian shark of Pu‘uloa (Pearl Harbor), was dearly loved by the people. [Pukui 1983:234]

3.3.1.4 ‘Ōlelo No‘eau #2111

Make o Mikololou a ola i ke alelo

Mikololou died and came to life again through his tongue

Said of one who talks himself out of a predicament. [Pukui 1983:229–230]

3.3.2 Concerning the *Pipi* or Pearl Oyster of Pu‘uloa

Pearl Harbor or Pu‘uloa, derived from the name Waimomi, or “water of the pearl,” an alternate name for the Pearl River. The harbor was thus named after pearl oysters of the family Pteriidae (mainly *Pinctada radiata*), which were once abundant on the harbor reefs and after which many *‘ōlelo no‘eau* were generated.

3.3.2.1 ‘Ōlelo No‘eau #1331

Ka i‘a hāmau leo o ‘Ewa

The fish of ‘Ewa that silences the voice

The pearl oyster, which has to be gathered in silence. [Pukui 1983:145]

Handy and Handy (1972:471) offer a different interpretation: “The pipi was sometimes called ‘the silent fish,’ or, *‘i‘a hamau leo o ‘Ewa*,’ ‘Ewa’s silent sea creature since the collectors were supposed to stay quiet while harvesting the shells.”

3.3.2.2 ‘Ōlelo No‘eau #493

Haunāele ‘Ewa i ka Moa‘e

‘Ewa is disturbed by the Moa‘e wind

Used about something disturbing, like a violent argument. When the people of ‘Ewa went to gather the *pipi* (pearl oyster), they did so in silence, for if they spoke, a Moa‘e breeze would suddenly blow across the water, rippling it, and the oysters would disappear. [Pukui 1983:59]

3.3.2.3 ‘Ōlelo No‘eau #274

E hāmau o makani mai auane‘i

Hush, lest the wind rise

Hold your silence or trouble will come to us. When the people went to gather pearl oysters at Pu‘uloa, they did so in silence, for they believed that if they spoke, a gust of wind would ripple the water and the oysters would vanish. [Pukui 1983:34]

3.3.2.4 ‘Ōlelo No‘eau #1357

Ka i‘a kuhi lima o ‘Ewa

The gesturing fish of ‘Ewa

The pipi, or pearl oyster. Fishermen did not speak when fishing for them but gestured to each other like deaf-mutes. [Pukui 1983:148]

3.3.3 Concerning the *‘Anae-holo* of Honouliuli

The migration of the *‘anae-holo* of Honouliuli is described in the following excerpt from which the *‘ōlelo no‘eau* below derives:

> The home of the *‘anae-holo* is at Honouliuli, Pearl Harbor, at a place called Ihuopala‘ai. They make periodical journeys around to the opposite side of the island, starting from Pu‘uloa and going to windward, passing successively Kumumanu, Kalihi, Kou, Kālia, Waikīkī, Ka‘alāwai, and so on, around to the Ko‘olau side, ending at Lā‘ie, and then returning by the same course to their starting point. [Nakuina 1998:271]

3.3.3.1 ‘Ōlelo No‘eau #1330

Ka i‘a hali a ka makani

The fish fetched by the wind

The ‘anaeholo, a fish that travels from Honouliuli, where it breeds, to Kaipāpa‘u, on the windward side of O‘ahu. It then turns about and returns to its original home. It is driven closer to shore when the wind is strong. [Pukui 1983:145]

3.3.4 Concerning *Kalo*

A rare taro called the *“kāī o ‘Ewa*,” was grown in mounds in marshy locations in ‘Ewa (Handy and Handy 1972:471). The cultivation of this prized and delicious taro led to the following saying:

3.3.4.1 ‘Ōlelo No‘eau #2770

Ua ‘ai i ke kāī-koi o ‘Ewa

He has eaten the kāī-koi taro of ‘Ewa

Kāī is O‘ahu’s best eating taro; one who has eaten it will always like it. Said of a youth of a maiden of ‘Ewa, who, like the kāī taro, is not easily forgotten. [Pukui 1983:305]

3.3.5 Concerning the *Ao Kuewa*, Realm of the Homeless Souls

3.3.5.1 ‘Ōlelo No‘eau #1666

Ka wiliwili o Kaupe‘a

The wiliwili grove of Kaupe‘a

In ‘Ewa, O‘ahu. Said to be where homeless ghosts wander among the trees. [Pukui 1983:180]

Pukui (1983:180) offers this Hawaiian saying, which places the wandering souls in a "*wiliwili*" grove at Kaupe‘a, a place in Honouliuli where homeless ghosts wandered among the trees.

3.3.6 Concerning the landscape of ‘Ewa

3.3.6.1 ‘Ōlelo No‘eau #80

The following proverb describes the red landscape of the ‘Ewa plain.

‘Āina koi ‘ula i ka lepo.

Land reddened by the rising dust.

Said of ‘Ewa, O‘ahu. [Pukui 1983:11]

3.3.6.2 ‘Ōlelo No‘eau #2542

The expression below describes the residents of Kaupe‘a ‘Ili.

‘Ō‘ū ō loa na manu o Kaupe‘a.

The birds of Kaupe‘a trill and warble.

Said of the chatter of happy people. [Pukui 1983:278]

3.3.6.3 ‘Ōlelo No‘eau #1855

The expression below discusses the boundaries between *ali‘i* and *maka‘āinana* lands in ‘Ewa.

Ku a‘e ‘Ewa; Noho iho ‘Ewa.

Stand-up ‘Ewa; Sit-down ‘Ewa.

The names of two stones, now destroyed, that once marked the boundary between the chiefs' land (Kua‘e ‘Ewa) and that of the commoners (Noho iho ‘Ewa) in ‘Ewa, O‘ahu. [Pukui 1983:200]

3.4 *Oli* (Chants)

Oli, according to Mary Kawena Pukui (Pukui 1995:xvi–xvii) are often grouped according to content. Chants often were imbued with *mana* (divine power); such *mana* was made manifest through the use of themes and *kaona*. According to Pukui, chants for the gods (*pule*; prayers) came first, and chants for the *ali‘i*, "the descendants of the gods," came second in significance. Chants "concerning the activities of the earth peopled by common humans," were last in this hierarchy (Pukui 1995:xvi–xvii). Emerson conversely states:

> In its most familiar form the Hawaiians–many of whom [were lyrical masters]–used the oli not only for the songful expression of joy and affection, but as the vehicle of humorous or sarcastic narrative in the entertainment of their comrades. The dividing line, then, between the oli and those other weightier forms of the mele, the inoa, the kanikau (threnody), the pule, and that unnamed variety of mele in which the poet dealt with historic or mythologic subjects, is to be found almost wholly in the mood of the singer. [Emerson 1965:254]

While *oli* may vary thematically, subject to the perspective of the *ho‘opa‘a* (chanter), it was undoubtedly a valued art form used to preserve oral histories, genealogies, and traditions, to recall

special places and events, and to offer prayers to *akua* and *‘aumākua* alike. Perhaps most importantly, as Alameida (1993:26) writes, “chants […] created a mystic beauty […] confirming the special feeling for the environment among Hawaiians: their *one hānau* (birthplace), their *kula iwi* (land of their ancestors).”

3.4.1 *Oli* for Kūali‘i

A chant for the chief Kūali‘i, an ancient chief of O‘ahu, mentions the *ahupua‘a* names of the ‘Ewa District including Honouliuli Ahupua‘a. Each phrase usually contains a play on words, as the place name and one meaning of the word, or portion of the word, appears on each line, for example, *kele* in Waikele means “slippery.” However, these word plays are not necessarily related to the actual place name meanings of the *ahupua‘a*.

Uliuli ka poi e piha nei—o Honouliuli;	Blue is the *poi* [pounded taro] which appeases [the hunger] of Honouliuli;
Aeae ka paakai o Kahuaiki—Hoaeae;	Fine the salt of Kahuaike—Hoaeae;
Pikele ka ia e waikele—o Waikele;	Slippery the fish of Waikele—
	of Waikele;
Ka hale pio i Kauamoa—o Waipio;	The arched house at Kauamoa—
	of Waipio;
E kuu kaua i ka loko awa—o Waiawa;	Let us cast the net in the *awa*-pond—
	of Waiawa;
Mai hoomanana ia oe—o Manana.	Do not stretch yourself at—Manana.
He kini kahawai,	Many are the ravines,
He lau kamano—o Waimano;	Numerous the sharks, at Waimano;
Ko ia kaua e ke au—o Waiau;	We are drawn by the current—
	of Waiau;
Kukui malumalu kaua—Waimalu;	In the *kukui* grove we are sheltered—
	in Waimalu;
E ala kaua ua ao-e—o Kalauao;	Let us arise, it is daylight—
	at Kalauao;
E kipi kaua e ai—o Aiea,	Let us enter and dine—at Aiea;
Mai hoohalawa ia oe—o Halawa.	Do not pass by—Halawa.

[*Ka Nupepa Kuokoa*, Book 7, Number 21, 23 May 1868, He mele no Kualii, Kulanipipili, Kulanioka, Kunuiakea; Fornander 1917b:4[2]:400–401]

A chant for the Kaua‘i chief of Kaumuali‘i, a rival of Kamehameha I, also mentions place names of the ‘Ewa District. In a portion of this chant, the wind that blows from one end of ‘Ewa to the other is compared to love.

3.4.2 Hi‘iaka and the Plains of Keahumoa

While passing through ‘Ewa, Hi‘iaka, sister of the goddess Pele, met women stringing *lei* with *ma‘o* flowers. Desiring a *lei* of her own, Hi‘iaka offered a chant:

E lei ana ke kula o Keehumoa i ka ma‘o	The plains of Ke‘ehumoa are garlanded with ma‘o
Ohuohu wale na wahine kui lei o ka nahele	The lei-stringing women of the forest are festively adorned

[Ho‘oumāhiehiemalie 2008a:287; 2008b:268]

In the chant, Hi‘iaka mentions the plains of Ke‘ehumoa which according to McAllister (1933:107) are located west of Kīpapa Gulch in Waikele. Ke‘ehumoa was also possibly a general name for the flat plain *mauka* of the productive floodplain area directly adjacent to Pearl Harbor.

3.4.3 Hi‘iaka and the Plains of Kaupe‘a

Hi‘iaka sang this bitter chant addressed to Lohi‘au and Wahine‘ōma‘o, which uses the association of the Plains of Kaupe‘a as a place for the wandering of lost souls:

Ku‘u aikana i ke awa lau o Pu‘uloa,
Mai ke kula o Pe‘e-kaua, ke noho oe,
E noho kaua e kui, e lei i ka pua o ke kauno‘a,
I ka pua o ke akuli-kuli, o ka wili-wili;
O ka iho‘na o Kau-pe‘e i Kane-hili,
Ua hili au; akahi no ka hili o ka la pomaika‘i;
E Lohiau ipo, e Wahine-oma‘o,
Hoe ‘a mai ka wa‘a i a‘e aku au.

We meet at Ewa’s leaf-shaped lagoon, friends;
Let us sit, if you will on this lea
And bedeck us with wreaths of Kauno‘a,
Of *akuli-kuli* and *wili-wili*,
My soul went astray in this solitude;
It lost the track for once, in spite of luck,
As I came down the road to Kau-pe‘a.
No nightmare dream was that which tricked my soul.
This way, dear friends; turn the canoe this way;
Paddle hither and let me embark.
[Emerson 1915:167–168]

Several other Honouliuli places are mentioned in this chant, including Pe‘ekaua, which may be a variation of Ka-pe‘e or Kaupe‘a, and the plains of Kānehili, the last of which again refers to wandering, as the word *hili* means “to go astray” (Emerson 1993:162). In the chant, Hi‘iaka is moving downhill from Kaupe‘a, probably the plains adjacent to Pu‘uokapolei, toward the coast, the plain of Kānehili.

3.4.1 Ka‘ao no Halemano

In the Legend of Halemano, the romantic O‘ahu anti-hero, he chants a love song with a reference to Honouliuli:

> *Huli a‘e la Ka‘ala kau i luna, Waiho wale kai o Pōka‘ī, Nānā wale ke aloha i Honouliuli, Kokolo kēhau he makani no Līhu‘e* […]
>
> Search is made to the top of Ka‘ala, the lower end of Pōka‘ī is plainly seen. Love looks in from Honouliuli, The dew comes creeping, it is like the wind of Līhu‘e […] [Fornander 1919e:5(2):252]

3.5 *Mele* (Songs)

The following section draws from the Hawaiian art of *mele*, poetic song intended to create two styles of meaning.

> Words and word combinations were studied to see whether they were auspicious or not. There were always two things to consider the literal meaning and the *kaona*, or ‘inner meaning.’ The inner meaning was sometimes so veiled that only the people to whom the chant belonged understood it, and sometimes so obvious that anyone who knew the figurative speech of old Hawai‘i could see it very plainly. There are but two meanings: the literal and the *kaona*, or inner meaning. The literal is like the body and the inner meaning is like the spirit of the poem. [Pukui 1949:247]
>
> The Hawaiians were lovers of poetry and keen observers of nature. Every phase of nature was noted and expressions of this love and observation woven into poems of praise, of satire, of resentment, of love and of celebration for any occasion that might arise. The ancient poets carefully selected men worthy of carrying on their art. These young men were taught the old *meles* and the technique of fashioning new ones. [Pukui 1949:247]

There exist a few *mele* that concern or mention Honouliuli. These particular *mele* may also be classified as *mele wahi pana* (songs for legendary or historic places). *Mele wahi pana* such as those presented here may or may not be accompanied by *hula* or *hula wahi pana* (dance for legendary or historic places). As the Hula Preservation Society notes:

> *Hula Wahi Pana* comprise a large class of dances that honor places of such emotional, spiritual, historical, or cultural significance that chants were composed for them. Only the composers of the chants could know the deepest meanings, as they would be reflections of their feelings and experiences […] Since the subjects of *Wahi Pana* compositions are extremely varied, their implementation through hula are as well. Coupled with the differences from one *hula* style and tradition to the next, *Hula Wahi Pana* can be exceptionally diverse. They can be done sitting or standing, with limited body movement or wide free movement; with or without the use of implements or instruments; with the dancers themselves chanting and/or playing an implement or being accompanied by the *ho‘opa‘a* [drummer and *hula* chanter (memorizer)]. Beyond the particular *hula* tradition, what ultimately determines the manner in which a *Hula Wahi Pana* is performed are the specific

> place involved, why it is significant, the story being shared about it, and its importance in the composer’s view. [Hula Preservation Society 2014]

3.5.1 Mele no Kūali‘i

The celebrated chief, Kūali‘i, is said to have led an army of twelve thousand against the chiefs of Ko‘olauloa with an army of twelve hundred upon the plains of Keahumoa (Fornander 1917b:4[2]:364-401) which according to McAllister (1933:107) are located west of Kīpapa Gulch in Waikele. Perhaps because the odds were so skewed, the battle was called off and the *ali‘i* of Ko‘olau ceded the districts of Ko‘olauloa, Ko‘olaupoko, Waialua, and Wai‘anae to Kūali‘i. When the *ali‘i* of Kaua‘i heard of this victory at Honouliuli they gave Kaua‘i to Kūali‘i as well and thus he became possessed of all the islands. The strife at Honouliuli was the occasion of the recitation of a song for Kūali‘i by a certain Kapa‘ahulani. This *mele* compares the king to certain places and objects in the islands, in this instance to the first breadfruit planted by Kaha‘i at Pu‘uloa, and a pig and a woman on Pu‘uokapolei, possibly a reference to Kamapua‘a and his grandmother.

In this *mele*, the cold winds of Kumomoku and Leleiwe, near Pu‘uloa in Honouliuli are compared unfavorably to the god Kū:

Aole i like Ku.	Not like these are thou, Ku
Ia ua hoohali kehau,	[Nor] the rain that brings the land breeze,
Mehe ipu wai ninia la,	Like a vessel of water poured out.
Na hau o Kumomoku;	Nor to the mountain breeze of Kumomoku,
Kekee na hau o Leleiwi,	[The] land breeze coming round to Leleiwi.
Oi ole ka oe i ike	Truly, have you not known?
I ka hau kuapuu,	The mountain breezes, that double up your back,
Kekee noho kee, o Kaimohala,	[That make you] sit crooked and cramped at Kaimohala,
O Kanehili i Kaupea-la	The Kanehili at Kaupea?
Aole i like Ku.	Not like these are thou, Ku

[Fornander 1917b:4[2]:390–391]

A later section of this *mele* also refers to Pu‘uokapolei and makes mention of the famous blue *poi* of Honouliuli.

O Kawelo-e, e Kawelo-e,	O Kawelo! Say, Kawelo!
O Kaweloiki puu oioi,	Kawelokiki, the sharp-ponted hill,
Puu o Kapolei-e-	Hill of Kapolei.
Uliuli ka poi e piha nei-o Honouliuli.	Blue is the poi which appeases

[the hunger] of Honouliuli.

[Fornander 1917b:4[2]:400–401]

3.5.2 Eia Mai Au ‘o Makalapua

This particular *mele* pays homage to the royal train called *Lanakila*. In paying homage to this train, the *mele* also pays homage to its most honored and well-known passenger, Queen Lili‘uokalani. This *mele* may also be understood as a protest song.

In analyzing this *mele*, cultural historian Kīhei de Silva notes that “Eia mai Au ‘o Makalapua” is the second of three chants that make up *hō‘alo i ka ihu o ka Lanakila* (Three Train Chants for Lili‘uokalani). He adds that these songs, “when considered in chronological succession […] add a Hawaiian dimension to the story of Benjamin Franklin (B.F.) Dillingham’s Oahu Railway and Land Company (OR&L), a story that otherwise reads far too much like an early script of *How the West was Won*” (de Silva 2003). De Silva provides a chronology of B.F. Dillingham’s rise to influence within Hawaiian political spheres, and his eventual founding and construction of the OR&L line. Dillingham also figures prominently within Honouliuli Ahupua‘a (see Section 4.3.2). Dillingham’s personal history is described by de Silva as follows:

- Arrived in Honolulu in 1865 as first mate of the *Whistler*.
- He promptly fell off a horse and broke his leg. When his ship left without him, he took a job as a clerk in a hardware store.
- 20 years later, in 1885, he had become Hawai‘i’s first big-time land speculator, buying and leasing vast tracts of property in West O‘ahu in hopes of reselling it to housing and ag. interests.
- When no one, in fact, took interest in his largely inaccessible property, he decided to build a railroad through it.
- In 1888, Dillingham convinced Kalākaua to sign a franchise giving him three years to build a line running from Honolulu to the far end of Pearl River Lagoon. His critics called it ‘Dillingham’s Folly,’ but Dillingham boasted that he would put his railroad into operation by Sept. 4, 1889, his 45th birthday.
- Things did not go well in the early months of construction, and in order to fulfill this boast, Dillingham had to fire up a miniscule saddle-tank engine named *Kauila*, hitch it to a flatcar that carried his passengers on jury-rigged seats, and send it bucking, wheezing, and spewing greasy foam down a mile-and-a-half of track that ended in the rice paddies of Pālama.
- Despite this farcical beginning, the construction of Dillingham’s railroad then proceeded in rather impressive fashion: the line was opened to ‘Aiea in November 1889, to Mānana in January 1890, to Honouliuli and ‘Ewa Mill in June and July 1890, to Wai‘anae in July 1895, to Waialua in June, 1898, and to Kahuku in January 1899. [de Silva 2003]

In 1890, as construction of the railway moved forward, B.F. Dillingham bought and shipped to Hawai‘i a passenger coach named *The Pearl* and a locomotive named *General Valleho.* According to de Silva (2003), the *Pearl* was built in San Francisco and was “paneled in rich woods and

outfitted with plush chairs, velvet drapes, electric lights, a kitchen, a lānai with a striped canvas awning, and a new-fangled contraption called a flush toilet.” The *General Valleho* was renamed the *Lanakila* by Dillingham:

> […] [He] gave it the number 45, a tribute to his 45th birthday boast and erstwhile victory in the rice paddies of Pālama. The Lanakila became Dillingham’s 4th locomotive—after the Kauila, Leahi, and Ka‘ala—and for many years it was regarded as the most attractive engine in the OR&L stable. Dillingham apparently wasted no time in hitching the Pearl to the Lanakila and using the pair as his wine-‘em and dine-‘em celebrity train, the vehicle in which he wooed financial and political support for his business ventures. [de Silva 2003]

As part of Dillingham’s plans to woo the influential, he invited King Kalākaua on the inaugural ride on the *Lanakila*. Dillingham also insisted the luxury coach *Pearl* serve as the king’s own royal car. De Silva (2003) notes it is “safe for us to assume that Queen Lili‘u[okalani] rode in the Pearl when the *Lanakila* took her on the train rides.” With the opening of the ‘Ewa Mill station, Queen Lili‘uokalani once again embarked on a journey on the *Lanakila*; this particular journey took her through “the lowlands of Honouliuli, and finally to the exposed coral plain of Pōlea on which the ‘Ewa Mill Station was located” (de Silva 2003).

Eia mai au ‘o Makalapua	Here I am, Makalapua
Hō‘alo i ka ihu o ka Lanakila.	Traveling where the *Lanakila* goes.
‘O ke ku‘e a ka hao a i Kūwili	The piston works at Kūwili
Ka hiona ‘olu a‘o Hālawa.	And down the pleasant descent of Hālawa.
Ua lawa ka ‘ikena i ke awalau	Satisfying is the view of the lochs
Iā ‘Ewa ka i‘a hāmau leo.	Of ‘Ewa, “land of the silent fish.”
Ua piha ka uahi a i Mānana	The smoke rises at Mānana
Aweawe i ke kula o Waipi‘o.	And streams along at Waipi‘o.
I kai ho‘i au a Honouliuli	Then I reached the lowlands of Honouliuli
Ahuwale ke ko‘a o Pōlea.	Where the corals of Pōlea lie exposed.
Ha‘ina ‘ia mai ana ka puana	This is the conclusion of the song
Hō‘alo i ka ihu a ka Lanakila.	Of traveling where the *Lanakila* goes.

[de Silva 2003]

De Silva (2003) provides a remarkable breakdown of this *mele*, delving into the subtext to reveal another layer of understanding, of *kaona*:

> ‘Makalapua’ shares […] the sense of awesome efficiency and harmony […] These are apparent in ‘Makalapua’s’ description of the working of the train’s piston at Kūwili, in the rising and billowing of steam at Mānana and Waipi‘o, and especially in the sense of speed with which the mele whisks us from Honolulu to Pōlea in the space of its six, two-line verses. Efficiency and harmony, however, are not at the heart of ‘Makalapua;’ it is inspired and driven, instead, by *aloha ‘āina*—love for

the land—and by *kū‘ē ho‘ohui ‘āina*—resistance to annexation. In my reading of the mele, the dominant imagery is that of flower-stringing. The train and track serve as the contemporary equivalent of lei needle and thread; with them, Lili‘u sews a series of beloved place-names and place-associations into a lei of adornment and protection for Ke-awalau-o-Pu‘uloa. Keawalauopu‘uloa, the many-harbored sea of Pu‘uloa, is the old name for Pearl Harbor. The cession of Pearl Harbor to America in return for sugar reciprocity was one of the hottest political issues of ‘Makalapua’s’ day. Lili‘u was absolutely opposed to any Keawalau deals; her brother, on the other hand, had regularly waved this bait at the American nose; he was even rumored, on his Nov. 1890 departure to San Francisco, to have harbored a hidden Pearl Harbor agenda. The key lines of ‘Makalapua’ are ‘Ua lawa ka ‘ikena i ke awalau / Iā ‘Ewa ka i‘ā hāmau leo […] I kai ho‘i au a Honouliuli / Ahuwale ke ko‘a o Pōlea.’ In my reading, these lines say: ‘We hold to our knowledge of Keawalau, we are like its closed-mouthed pipi, its oysters; we will never give up the pearl that we contain; here at the shoreline of Honouliuli we normally silent fish reveal this deeply held conviction.’ [de Silva 2003]

Section 4 Traditional and Historical Background

4.1 Pre-Contact to Early Post-Contact Period

4.1.1 Traditional Agricultural Resources

Various Hawaiian legends and early historical accounts indicate the *ahupua‘a* of Honouliuli was once widely inhabited by pre-Contact populations, including the Hawaiian *ali‘i.* This would be attributable for the most part to the plentiful marine and estuarine resources available at the coast, along which several sites interpreted as permanent habitations and fishing shrines have been located. Other attractive subsistence-related features of the *ahupua‘a* include irrigated lowlands suitable for wetland taro cultivation, as well as the lower forest area of the mountain slopes for the procurement of forest resources. Handy and Handy (1972) report:

> The lowlands, bisected by ample streams, were ideal terrain for the cultivation of irrigated taro. The hinterland consisted of deep valleys running far back into the Ko‘olau range. Between the valleys were ridges, with steep sides, but a very gradual increase of altitude. The lower parts of the valley sides were excellent for the cultture of yams and bananas. Farther inland grew the *‘awa* for which the area was famous. [Handy and Handy 1972:429]

In addition, breadfruit, coconuts, *wauke* (paper mulberry; *Broussonetia papyrifera*), bananas, and *olonā* (*Touchardia latifolia*) and other plants were grown in the interior. ‘Ewa was known as one of the best areas to grow gourds and was famous for its *māmaki* (*Pipturus*). It was also famous for a rare taro called the *kāī o ‘Ewa*, which was grown in mounds in marshy locations (Handy and Handy 1972:471). The cultivation of this prized and delicious taro led to the saying:

> *Ua ‘ai i ke kāī-koi o ‘Ewa.*
>
> He has eaten the kāī-koi taro of ‘Ewa.
>
> Kāī is O‘ahu’s best eating taro; one who has eaten it will always like it. Said of a youth of a maiden of ‘Ewa, who, like the kāī taro, is not easily forgotten.
>
> [Pukui 1983:305].

Exploitation of the forest resources along the slopes of the Wai‘anae Range—as suggested by E.S. and E.G. Handy—probably acted as a viable subsistence alternative during times of famine:

> The length or depth of the valleys and the gradual slope of the ridges made the inhabited lowlands much more distant from the *wao*, or upland jungle, than was the case on the windward coast. Yet the *wao* here was more extensive, giving greater opportunity to forage for wild foods in famine time. [Handy and Handy 1972:469]

These upper valley slopes may have also been a significant resource for opportunistic quarrying of basalt for the manufacturing of stone tools. This is evidenced in part by the existence of a probable quarrying site (State Inventory of Historic Places [SIHP] # 50-80-12-4322) in Makaīwa Gulch at 152 m (500 ft) above mean sea level, west of the current project area (Hammatt et al. 1991).

Subsequent to Western Contact in the area, the landscape of the ‘Ewa Plain and Wai‘anae slopes was adversely affected by the removal of the sandalwood and other trees, and the introduction of domesticated animals and new vegetation. Goats, sheep, and cattle were brought to the Hawaiian Islands by Vancouver in the early 1790s and allowed to graze freely about the land for some time after. L.A. Henke reports the existence of a longhorn cattle ranch in Wai‘anae by at least 1840 (Frierson 1972:10). During this time, perhaps as early as 1790, exotic vegetation species were introduced to the area. These typically included vegetation best suited to a terrain disturbed by the logging of sandalwood forest and eroded by animal grazing. The following dates for the introduction of exotic vegetation are given by R. Smith and outlined by Frierson (1972:10–11):

1. ‘early,’ c. 1790: for the establishment of Prickly pear cactus, (*Opuntia tuna), Haole koa, (Leucaena leucocephala)* and Guava (*Psidium guajava)*
2. 1835-1840: Burmuda [*sic*] grass (Cynodon dactylon) and Wire grass (Eleusine indica)
3. 1858: Lantana (*Lantana camara)*

The *kiawe* tree (*Prosopis pallida*) was also introduced during this period, either in 1828 or 1837 (Frierson 1972:11).

4.1.2 Traditional Settlement Patterns

Early historical accounts of the general region typically refer to the more populated areas of the ‘Ewa district, where missions and schools were established and subsistence resources were perceived to be greater. However, the presence of archaeological sites along the barren coral plains and coast of southwest Honouliuli Ahupua‘a indicates pre-Contact and early historic populations also adapted to less inviting areas, despite the environmental hardships.

Oral traditions related to the ‘Ewa line of chiefs recall battles and chiefly claims upon valuable territories. The rich resources of Pu‘uloa—the fisheries in the lochs, the shoreline fishponds, the numerous springs, and the irrigated lands along the streams—made ‘Ewa a prize for competing chiefs. Battles were fought for the ‘Ewa lands, sometimes by competing O‘ahu chiefs and invading chiefs from other islands.

‘Ewa was a political center and home to many chiefs in its day. Oral accounts of *ali‘i* recorded by Hawaiian historian Samuel Kamakau date back to at least the twelfth century:

> The chiefs of Līhu‘e [upland area in ‘Ewa], Wahiawā, and Halemano on O‘ahu were called *lō ali‘i*. Because the chiefs at these places lived there continually and guarded their *kapu*, they were called *lō ali‘i* [from whom a ‘guaranteed’ chief might be obtained, *loa‘a*]. They were like gods, unseen, resembling men. [Kamakau 1991b:40]

In the mid-eleventh century, Māweke, a direct lineal descendant of the illustrious Nanaulu, ancestor of Hawaiian royalty, was a chief of O‘ahu (Fornander 1996:47). Keaunui, the second of his three sons, became the head of the powerful ‘Ewa chiefs. Tradition tells of him cutting a navigable channel through the Pearl River using his canoe. Keaunui’s son, Lakona, became the progenitor of the ‘Ewa chiefs around 1400 (Fornander 1996:224–226). Chiefs within his line, the Māweke-Kumuhonua line, reigned until about 1520-1540, with their major royal center in Līhu‘e in ‘Ewa (Cordy 2002:24). Haka was the last chief of the Māweke-Kumuhonua line. He was slain by his men at the fortress of Waewae near Līhu‘e (Fornander 1996:88; Kamakau 1991b:54).

Mā‘ilikūkahi was born *ali‘i kapu* (sacred chief) at the birthing stones of Kūkaniloko (Kamakau 1991b:53) and became *mō‘ī* (king) of O‘ahu between 1520-1540 (Cordy 2002:19). Mā‘ilikūkahi was popular during his reign and was remembered for initiating land reforms that brought about peace, and for encouraging agricultural production, which brought about prosperity. He also prohibited the chiefs from plundering the *maka‘āinana*, a prohibition that was punishable by death (Kamakau 1991b:55).

Upon consenting to become *mō‘ī* at the age of 29, Mā‘ilikūkahi was taken to Kapukapuākea Heiau at Pa‘ala‘akai in Waialua to be consecrated. Soon after becoming king, Mā‘ilikūkahi was taken by the chiefs to live at Waikīkī. He was probably one of the first chiefs to live there, as the chiefs had previously always lived at Waialua and ‘Ewa. Under his reign, the land divisions were reorganized and redefined (Pukui et al. 1974:113).

In reference to the productivity of the land and the population during Mā‘ilikūkahi’s reign, Kamakau writes,

> In the time of Mā‘ili-kūkahi, the land was full of people. From the brow, lae, of Kulihemo to the brow of Maunauna in ‘Ewa, from the brow of Maunauna to the brow of Pu‘ukua [Pu‘u Ku‘ua] the land was full of chiefs and people. From Kānewai to Halemano in Wai‘alua, from Halemano to Paupali, from Paupali to Hālawa in ‘Ewa the land was filled with chiefs and people. [Kamakau 1991b:55]

Mā‘ilikūkahi’s peaceful reign was interrupted by an invasion which would change ‘Ewa forever. Fornander describes the Battle of Kīpapa (to be paved [with the corpses of the slain]) at Kīpapa Gulch in Waipi‘o Ahupua‘a:

> I have before referred to the expedition by some Hawaii chiefs, *Hilo-a-Lakapu*, *Hilo-a-Hilo-Kapuhi*, and *Punaluu*, joined by *Luakoa* of Maui, which invaded Oahu during the reign of *Mailikukahi*. It cannot be considered as a war between the two islands, but rather as a raid by some restless and turbulent Hawaii chiefs […] The invading force landed at first at Waikiki, but, for reasons not stated in the legend, altered their mind, and proceeded up the Ewa lagoon and marched inland. At Waikakalaua they met *Mailikukahi* with his forces, and a sanguinary battle ensued. The fight continued from there to the Kipapa gulch. The invaders were thoroughly defeated, and the gulch is said to have been literally paved with the corpses of the slain, and received its name ‘Kipapa,’ from this circumstance. *Punaluu* was slain on the plain which bears his name, the fugitives were pursued as far as Waimano, and the head of *Hilo* was cut off and carried in triumph to Honouliuli, and stuck up at a place still called *Poo-Hilo*. [Fornander 1996:89–90]

Power shifted between the chiefs of different districts from the 1500s until the early 1700s, when Kūali‘i achieved control of all of O‘ahu by defeating the Kona chiefs. He then defeated the ‘Ewa chiefs and expanded his control on windward Kaua‘i. Peleihōlani, the heir of Kūali‘i, gained control of O‘ahu about 1740, and later conquered parts of Moloka‘i. He ruled O‘ahu until his death in about 1778 when Kahahana, of the ‘Ewa line of chiefs, was selected as the ruler of O‘ahu (Cordy 2002:24–41). Somewhere between 1883 and 1885, Kahahana was killed by Kahekili of Maui. The subsequent rebellion amongst the chiefs resulted in a near genocide of the monarchy line on O‘ahu. Oral reports also tell of the stream of Hō‘ai‘ai (Hō‘ae‘ae) in the *ahupua‘a* immediately east of Honouliuli, choked with the bodies of the slain (Fornander 1996:224–226). Kahekili and the Maui

chiefs retained control of O‘ahu until the 1790s. Kahekili died at Waikīkī in 1794. His son, Kalanikūpule, was defeated the following year at the Battle of Nu‘uanu by Kamehameha (Kamakau 1992:376–377). Thus, the supremacy of the ‘Ewa chiefs came to a final end.

4.2 Early Historic Period

4.2.1 Observations of Early Explorers and Visitors

Captain James Cook arrived in the Hawaiian Islands in 1778, and ten years later the first published description of Pearl Harbor appeared. Captain Nathaniel Portlock, observing the coast of Honolulu for Great Britain, recorded the investigation of a “fine, deep bay running well to the northward” around the west point of “King George’s Bay” in his journal (Portlock 1789:74). Portlock’s description matches the entire crescent-shaped shoreline from Barbers Point to Diamond Head.

Captain George Vancouver made three voyages to the Hawaiian Islands between 1792 and 1794. In 1793, the British captain recorded the name of the harbor opening as “O-poo-ro-ah” (Pu‘uloa) and sent several boats across the sand bar to venture into the harbor proper (Vancouver 1798:884). The area known as “Pu‘u-loa” was comprised of the eastern bank at the entrance to Pearl River. George Vancouver anchored off the entrance to West Loch in 1793, and the Hawaiians told him of the area at “a little distance from the sea, [where] the soil is rich, and all the necessaries of life are abundantly produced” (Vancouver 1798 in Sterling and Summers 1978:36). Mr. Whitbey, one of Vancouver’s crew, observed, “from the number of houses within the harbor it should seem to be very populous; but the very few inhabitants who made their appearance were an indication of the contrary” (Vancouver 1798 in Sterling and Summers 1978:36).

Captain Vancouver sailed by Kalaeloa (Barbers Point) in 1792, and recorded his impression of the small coastal village of Kūalaka‘i and the arid Honouliuli coast:

> The point is low flat land, with a reef round it […] Not far from the S.W. point is a small grove of shabby cocoa-nut trees, and along these shores are a few fishermen’s huts. [Vancouver 1798:1:167]
>
> […] from the commencement of the high land to the westward of Opooroah [Pu‘uloa], was composed of one barren rocky waste, nearly destitute of verdure, cultivation or inhabitants, with little variation all the way to the west point of the island. [Vancouver 1798:2:217]
>
> This tract of land was of some extent but did not seem to be populous, nor to possess any great degree of fertility; although we were told that at a little distance from the sea, the soil is rich, and all necessaries of life are abundantly produced. [Vancouver 1798:3:361–363]

Henry Barber was an English sea captain who traveled around the Hawaiian Islands during 1794 to 1807. Barber is the namesake for the common place name known today as Barbers Point, traditionally Kalaeloa.

> In 1795 he left China in the ship Arthur for the northwest going again by way of Australia. In the following summer he was trading along the Alaskan and British Columbian coast. In Sept. 1796, he left Nootka Sound for Canton via ‘the Island.’ The Arthur called in at Honolulu at the end of October for provisions and re-fittings.

> At 6 p.m. on October 31, 1796, Barber sailed the Arthur out of Honolulu harbor for Kauai to get a supply of yams. Two hours later the brig hit a shoal about an acre in extent with 12 feet of water over it, and close to the breakers. The shoal was probably a little to the westward of Pearl Harbor. But as Judge Howay says, how the skipper steered his brig into such a position is a mystery. [Sterling and Summers 1978:40]

Kamakau recalls the same incident as follows:

> In October, 1796, a ship [*Arthur*, under Henry Barber] went aground at Kalaeloa, Oahu. This ship had visited the island on several occasions during the rule of Ka-lani-ku-pule. This was the first time a foreign ship had grounded on these shores, Kamehameha was on Hawaii, but Young had remained on Oahu. All the men on the ship came ashore at night in their boats. At daylight when the ship was seen ashore Ku-i-helani placed a ban on the property of the ship and took care of the foreigners. Hawaiian divers recovered the valuables, and they were given over to the care of Ku-i-helani, but part were given by Captain Barber to the men who had recovered them. [Kamakau 1992:174]

During the first decades of the nineteenth century, several western visitors described the ‘Ewa landscape near Pearl Harbor. Archibald Campbell, an English sailor, spent some time in Hawai‘i during 1809-1810. He had endured a shipwreck off the Island of Sannack on the northwest coast of America. As a result, both his feet became frostbitten and were amputated. He spent over a year recuperating in the Hawaiian Islands. His narrative is considered noteworthy because it describes life in the ‘Ewa District before the missionaries arrived. During part of his stay, he resided with King Kamehameha I, who granted him 60 acres in Waimano Ahupua‘a in 1809. Campbell described his land:

> In the month of November the king was pleased to grant me about sixty acres of land, situated upon the Wymummee [traditional Hawaiian name for Pearl River], or Pearl-water, an inlet of the sea about twelve miles to the west of Hanaroora [Honolulu]. I immediately removed thither; and it being Macaheite time [Makahiki], during which canoes are tabooed, I was carried on men’s shoulders. We passed by footpaths winding through an extensive and fertile plain, the whole of which is in the highest state of cultivation. Every stream was carefully embanked, to supply water for taro beds. Where there was no water, the land was under crops of yams and sweet potatoes. The roads and numerous houses are shaded by cocoa-nut trees, and the sides of the mountains are covered with wood to a great height. We halted two or three times, and were treated by the natives with the utmost hospitality. My farm, called Wymannoo [Waimano], was upon the east side of the river, four or five miles from its mouth. Fifteen people with their families resided upon it, who cultivated the ground as my servants. There were three houses upon the property; but I found it most agreeable to live with one of my neighbours, and get what I wanted from my own land. This person’s name was William Stevenson a native of Borrowstouness. [Campbell 1967:103–104]

Of the Pearl River area, Campbell wrote,

> Wymumme, or Pearl River, lies about seven miles farther to the westward. This inlet extends ten or twelve miles up the country. The entrance is not more than a quarter of a mile wide, and is only navigable for small craft; the depth of water on the bar, at the highest tides, not exceeding seven feet; farther up it is nearly two miles across. There is an isle in it, belonging to Manina, the king's interpreter, in which he keeps a numerous flock of sheep and goats. [Campbell 1967:114]
>
> The flat land along shore is highly cultivated; taro root, yams, and sweet potatoes, are the most common crops; but taro forms the chief object of their husbandry, being the principal article of food amongst every class of inhabitants. [Campbell 1967:115]

Botanist F.J.F. Meyen visited Hawai‘i in 1831 and writes of the abundant vegetation described by Campbell in the vicinity of Pearl Harbor. His account of large stretches of cultivated land surrounding Pearl Harbor suggests the presence of a viable population settlement in the area.

> At the mouth of the Pearl River the ground has such a slight elevation that at high tide the ocean encroaches far into the river, helping to form small lakes which are so deep, that the long boats from the ocean can penetrate far upstream. All around these water basins the land is extraordinarily low but also exceedingly fertile and nowhere else on the whole island of Oahu are such large and continuous stretches of land cultivated. The taro fields, the banana plantations, the plantations of sugar cane are immeasurable. [Meyen 1981:63]

However, a contrasting picture of ‘Ewa is recorded by the missionary William Ellis in 1823-1824, of the ‘Ewa lands away from the coast:

> The plain of Eva is nearly twenty miles in length, from the Pearl River to Waiarua [Wailua], and in some parts nine or ten miles across. The soil is fertile, and watered by a number of rivulets, which wind their way along the deep water-courses that intersect its surface, and empty themselves into the sea. Though capable of a high state of improvement, a very small portion of it is enclosed or under any kind of culture, and in travelling across it, scarce a habitation is to be seen. [Ellis 1963:7]

4.2.2 Missionaries

The first company of Protestant missionaries from America, part of the American Board of Commissioners of Foreign Missions (ABCFM), arrived in Honolulu in 1820. They quickly established churches in Kona on Hawai‘i, Waimea on Kaua‘i, and Honolulu on O‘ahu. Although the missionaries were based in Honolulu, they traveled around the islands intermittently to preach to rural Native Hawaiians and to check on the progress of English and Bible instruction schools set up by local converts.

In 1828, the missionary Levi Chamberlain (1956:39–40) made a circuit of O‘ahu, stopping wherever there was a large enough population to warrant a sermon or a school visit. In his trek through the ‘Ewa District from Wai‘anae, he stopped at Waimānalo, an *‘ili* in Honouliuli, on the western border of ‘Ewa. At around 11 o'clock the next day, on a Saturday, Chamberlain and his companions set out toward the east, reaching Waikele at three or four o'clock. The group did not

stop in Hō‘ae‘ae, suggesting that the population was too small for a school, but Waikele had two schools, an obviously larger population than Hō‘ae‘ae. In fact, Chamberlain decided to stay in Waikele until the next day, the Sabbath, and preach to the Native Hawaiians who lived there. A crowd of 150 to 200 gathered for the sermon. The next day at six o’clock they set out for the village of Waipi‘o, which had one school. They left Waipi‘o at about 8:30, and walked to Waiawa, where there were two schools. Around ten o’clock, they began their circuit again, stopping only in the *ahupua‘a* of Kalauao in the ‘Ewa District before they reached Moanalua Ahupua‘a in the Kona District. The account does not give much information on the surroundings, but does indicate the relatively populated areas of ‘Ewa, in western Honouliuli, Waikele, Waipi‘o, Waiawa, and Kalauao, and the time it took to travel by foot along the trails across the ‘Ewa District.

The first mission station in ‘Ewa was established in 1834 at Kalua‘aha near Pearl Harbor. Charles Wilkes, of the U.S. Exploring Expedition visited the missionary enclave at Honouliuli town in 1840.

> At Ewa, Mr. Bishop has a large congregation. The village comprises about fifty houses, and the country around is dotted with them […] The natives have made some advance in the arts of civilized life; there is a sugar-mill which, in the season, makes two hundred pounds of sugar a day […] In 1840, the church contained nine hundred members, seven hundred and sixty of whom belonged to Ewa, the remainder to Waianae; but the Catholics have now established themselves at both these places, and it is understood are drawing off many from their attendance on Mr. Bishop’s church. [Wilkes 1970:80–81]

4.2.3 Honouliuli Taro Lands

In early historic times, the population of Honouliuli was concentrated at the western edge of West Loch in the vicinity of Kapapapuhi Point in the “Honouliuli Taro Lands.” This area was clearly a major focus of population due to the abundance of fish and shellfish resources in close proximity to a wide expanse of well-irrigated bottomland suitable for wetland taro cultivation. Dicks et al. (1987:78–79) concludes, on the basis of 19 radiocarbon dates and three volcanic glass dates that “Agricultural use of the area spans over 1,000 years.”

Undoubtedly, Honouliuli was a locus of habitation for thousands of Hawaiians. Prehistoric population estimates are a matter of some debate but it is worth pointing out that in the earliest mission census (1831-1832) the land of Honouliuli contained 1,026 men, women, and children (Schmitt 1973:19). It is not clear whether this population relates to Honouliuli Village or district but the village probably contained the vast majority of the district’s population. The nature of the reported population structure for Honouliuli (less than 20% children under 12 years of age) and the fact that the population decreased more than 15% in the next four years (Schmitt 1973:22) suggests the pre-Contact population of Honouliuli Village may well have been significantly greater than it was in the 1830s.

4.2.4 The Māhele and the Kuleana Act

During the Māhele of 1848, 99 individual land claims in the *ahupua‘a* of Honouliuli were registered and awarded by King Kamehameha III. No *kuleana* land claims were made for land within the current project area or vicinity. The vast majority of the Land Commission Awards (LCA) were located in Honouliuli near the taro lands of the *‘ili* of Pu‘uloa and the Pu‘uloa Salt

Works. The largest award (Royal Patent 6071, LCA 11216, *‘Āpana* [parcel] 8) in Honouliuli Ahupua‘a was granted to Miriam Ke‘ahi-Kuni Kekau‘onohi on January 1848 (Native Register 1848). Kekau‘onohi acquired a deed to all unclaimed land within the *ahupua‘a*, including a total of 43,250 acres encompassing the present project area.

Samuel Kamakau relates the following about Kekau‘onohi as a child:

> Kamehameha’s granddaughter, Ke-ahi-Kuni Ke-kau-‘onohi […] was also a tabu chiefess in whose presence the other chiefesses had to prostrate and uncover themselves, and Kamehameha would lie face upward while she sat on his chest. [Kamakau 1992:208–209]

Kekau‘onohi was one of Liholiho’s (Kamehameha II’s) wives, and after his death, she lived with her half-brother, Luanu‘u Kahala‘i‘a, who was governor of Kaua‘i (Kamakau 1992:346). Subsequently, Kekau‘onohi ran away with Queen Ka‘ahumanu’s stepson, Keli‘i-ahonui, and then became the wife of Chief Levi Ha‘alelea (Kamakau 1992:280). Upon her death on 2 June 1851, all her property passed to her husband and his heirs. When Levi Ha‘alelea died, the property went to his surviving wife, who in turn leased it to James Dowsett and John Meek in 1871 for stock running and grazing.

4.2.5 Population Decline

At Contact, the most populous *ahupua‘a* on the island of O‘ahu was Honouliuli, with the majority of the population centered on Pearl Harbor. In 1832, a missionary census of Honouliuli recorded the population as 1,026, which represented 25% of the total ‘Ewa district population of 4,015 (Schmitt 1973:19).

Beginning with the time of Western Contact, however, Hawaiian populations were introduced to many virulent western diseases which began to decimate the native populations. Thus, four years following the 1832 census, the ‘Ewa population had dropped to 3,423 (Schmitt 1973:9, 36), “a decrease of 592 in 4 years” (Ewa Station Reports 1836). Reverend Lowell Smith noted,

> The people of Ewa are a dying people. I have not been able to obtain an exact count of all the deaths & births since the last general meeting. But my impression is that there have been as many as 8 or 10 deaths to one birth. I have heard of but 4 births on Waiawa during the year, & all of these children are dead. I have attended about 20 funerals on that one land, & 16 of these were adults. [Ewa Station Reports 1836]

Between 1848 and 1853, there was a series of epidemics of measles, influenza, and whooping cough that often wiped out whole villages. In 1853, the population of ‘Ewa and Wai‘anae combined was 2,451 people. In 1872, it was 1,671 (Schmitt 1968:71). The inland area of ‘Ewa was probably abandoned by the mid-nineteenth century due to population decline and consolidation of the remaining people in town.

4.3 Mid- to Late 1800s

4.3.1 Ranching in Lower Honouliuli

In 1871, John Coney rented the lands of Honouliuli to James Dowsett and John Meek, who used the land for cattle grazing. In 1877, James Campbell purchased most of Honouliuli Ahupua‘a, except the *‘ili* of Pu‘uloa, for a total of $95,000. He then drove off 32,347 head of cattle belonging

to Dowsett, Meek, and James Robinson, and constructed a fence around the outer boundary of his property (Bordner and Silva 1983:C-12), as shown in Figure 9. He let the land rest for one year and then began to restock the ranch, so that he had 5,500 head after a few years (Dillingham 1885 in Frierson 1972:14).

In 1881, a medical student providing smallpox vaccinations around the island wrote about Campbell's property which was called the Honouliuli Ranch.

> I took a ride over the Honouliuli Ranch which is quite romantic. The soil is a deep, reddish loam, up to the highest peaks, and the country is well-grassed. Springs of water abound. The ‘ilima, which grows in endless quantities on the plains of this ranch, is considered excellent for feeding cattle; beside it grows the indigo plant, whose young shoots are also good fodder, of which the cattle are fond. Beneath these grows the manieizie grass, and Spanish clover and native grasses grow in the open; so there is abundant pasturage of various kinds here. As I rode, to the left were towering mountains and gaping gorges; ahead, undulating plains, and to the right, creeks and indentations from the sea. A wide valley of fertile land extends between the Nuuanu Range and the Waianae Mountains and thence to the coast of Waialua. There are many wild goats in this valley, which are left more or less undisturbed because they kill the growth of mimosa bushes, which would otherwise overrun the country and destroy the pasturage for cattle. [Briggs 1926:62-63]

The following excerpts were also written in 1880-1881, describing Honouliuli Ranch:

> Acreage, 43,250, all in pasture, but possessing fertile soils suitable for agriculture; affords grazing for such valuable stock. The length of this estate is no less than 18 miles. It extends to within less than a mile of the sea coast, to the westward of the Pearl River inlet […] There are valuable fisheries attached to this estate […] [Bowser 1880:489]

> From Mr. Campbell's veranda, looking eastward, you have one of the most splendid sights imaginable. Below the house there are two lochs, or lagoons, covered with water fowl, and celebrated for their plentiful supply of fish, chiefly mullet […] Besides Mr. Campbell's residence, which is pleasantly situated and surrounded with ornamental and shade trees, there are at Honouliuli two churches and a school house, with a little village of native huts. [Bowser 1880:495]

Most of Campbell's lands in Honouliuli were used exclusively for cattle ranching. At that time, one planter remarked that "the country was so dry and full of bottomless cracks and fissures that water would all be lost and irrigation impracticable" (Ewa Plantation Company 1923:6–7). In 1879, Campbell brought in a well-driller from California to search the ‘Ewa plains for water, and the well, drilled to a depth of 240 ft near Campbell's home in ‘Ewa, resulted in "a sheet of pure water flowing like a dome of glass from all sides of the well casing" (*The Legacy of James Campbell* n.d. in Pagliaro 1987:3). Following this discovery, plantation developers and ranchers drilled numerous wells in search of the valuable resource.

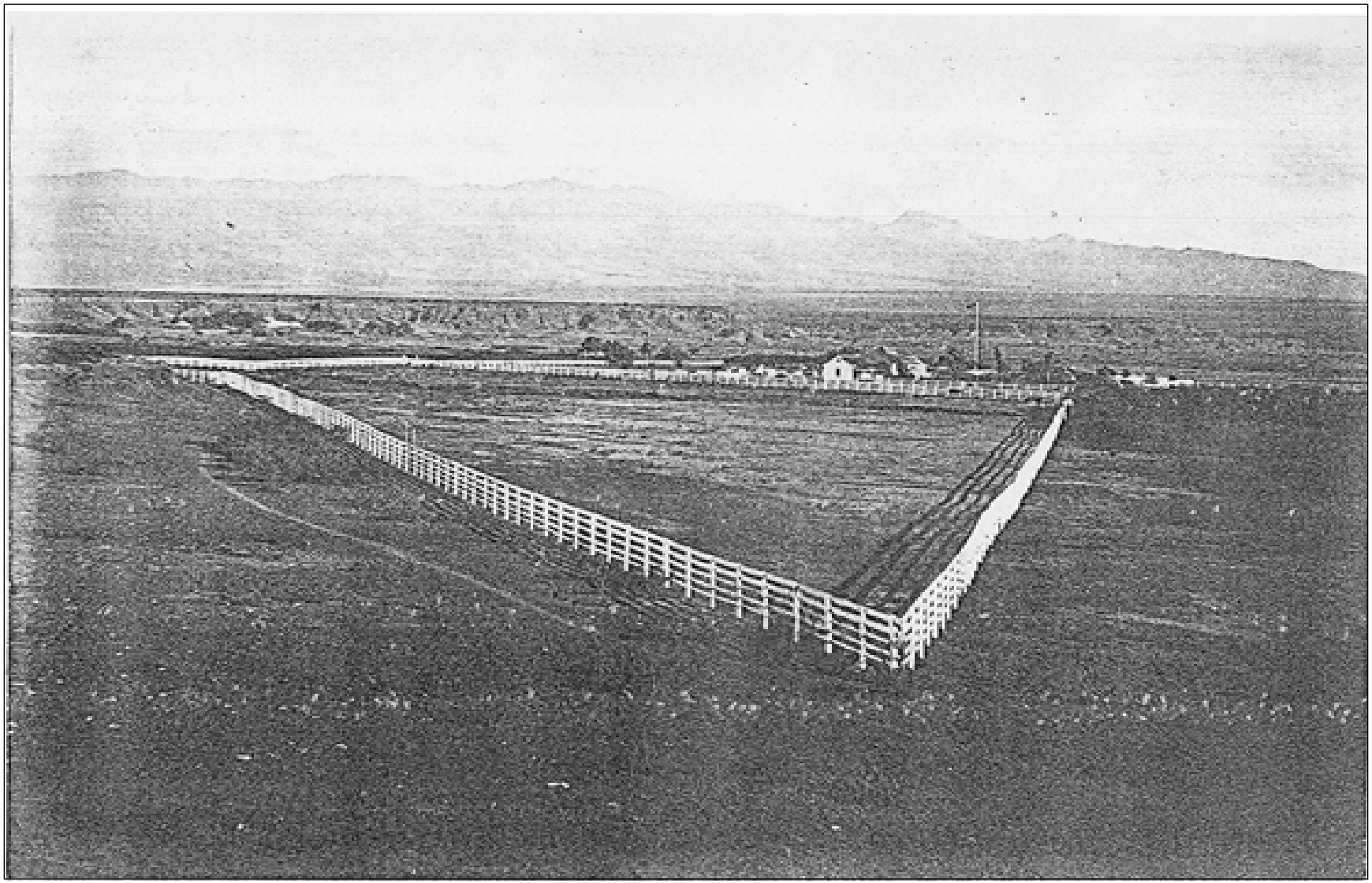

Figure 9. 1880s photograph of James Campbell‘s residence on the ‘Ewa Plain (Hawai‘i State Archives)

4.3.2 Oahu Railway and Land Company (OR&L)

In 1886, Campbell and B.F. Dillingham put together the "Great Land Colonization Scheme," which was an attempt to sell Honouliuli land to homesteaders (Thrum 1887:74). This homestead idea failed. The failure was attributed to the lack of water and the distance from ‘Ewa to Honolulu. The water problem was solved by the drilling of artesian wells, and Dillingham decided the area could be used instead for large-scale cultivation (Pagliaro 1987:4). The transportation problem was to be solved by the construction of a railroad, which Dillingham soon began to finance under the company name Oahu Railway and Land Company (OR&L).

During the last decade of the nineteenth century, the railroad reached from Honolulu to Pearl City in 1890, Wai‘ānae in 1895, Waialua Plantation in 1898, and Kahuku in 1899 (Kuykendall 1967:III, 100). This railroad line eventually ran across the center of the ‘Ewa Plain at the lower boundary of the sugar fields (Figure 10). To attract business to his new railroad system, Dillingham subleased all land below 200 ft to William Castle, who in turn sublet the area to the newly formed Ewa Plantation Company (Frierson 1972:15). Dillingham's Honouliuli lands above 200 ft that were suitable for sugarcane cultivation were sublet to the Oahu Sugar Company. Throughout this time, and continuing into modern times, cattle ranching continued in the area, and Honouliuli Ranch, established by Dillingham, was the "fattening" area for the other ranches (Frierson 1972:15).

Operations at the OR&L began to slow down in the 1920s, when electric streetcars were built for public transportation within the city of Honolulu and automobiles began to be used by families for transportation outside the city (Chiddix and Simpson 2004:185). The build-up to World War II turned this decline around, as the U.S. military utilized the OR&L lines to transport materials to build defense projects around the island. Historians have noted that one of the most serious mistakes made by the Japanese in their 1941 attack on Pearl Harbor was their decision not to bomb the railway infrastructure. Soon after the attack, the OR&L operated 24 hours a day, transporting war materials and troops from Honolulu to the new and expanded army, naval, and air bases. The huge navy base at Pearl Harbor had its own rail lines that connected to the OR&L rail lines.

In August 1945 the war ended, and so did OR&L's heyday as a military transport line.

> She had served her country well and proudly during the war, but operating round-the-clock on what little maintenance could be squeezed in, had taken a prodigious hit on the locomotives and track. Traffic stayed steady for a short time, but soon dropped precipitously as soldiers and sailors went home, military posts were shrunk or razed, and civilians could again get tires, gasoline and new cars. [Chiddix and Simpson 2004:257]

There was no choice but to abandon the OR&L main line, and in 1946 Walter F. Dillingham, son of B.F. Dillingham, wrote,

> The sudden termination of the war with Japan changed not only the character of our transportation, but cut the freight tonnage to a third and the passenger business to a little above the pre-war level. With the increased cost of labor and material and the shrinkage in freight tonnage and passenger travel, it was definite that the road could not be operated as a common carrier. With no prospect of increased tonnage, and the impossibility of increasing rates against truck competition, your management

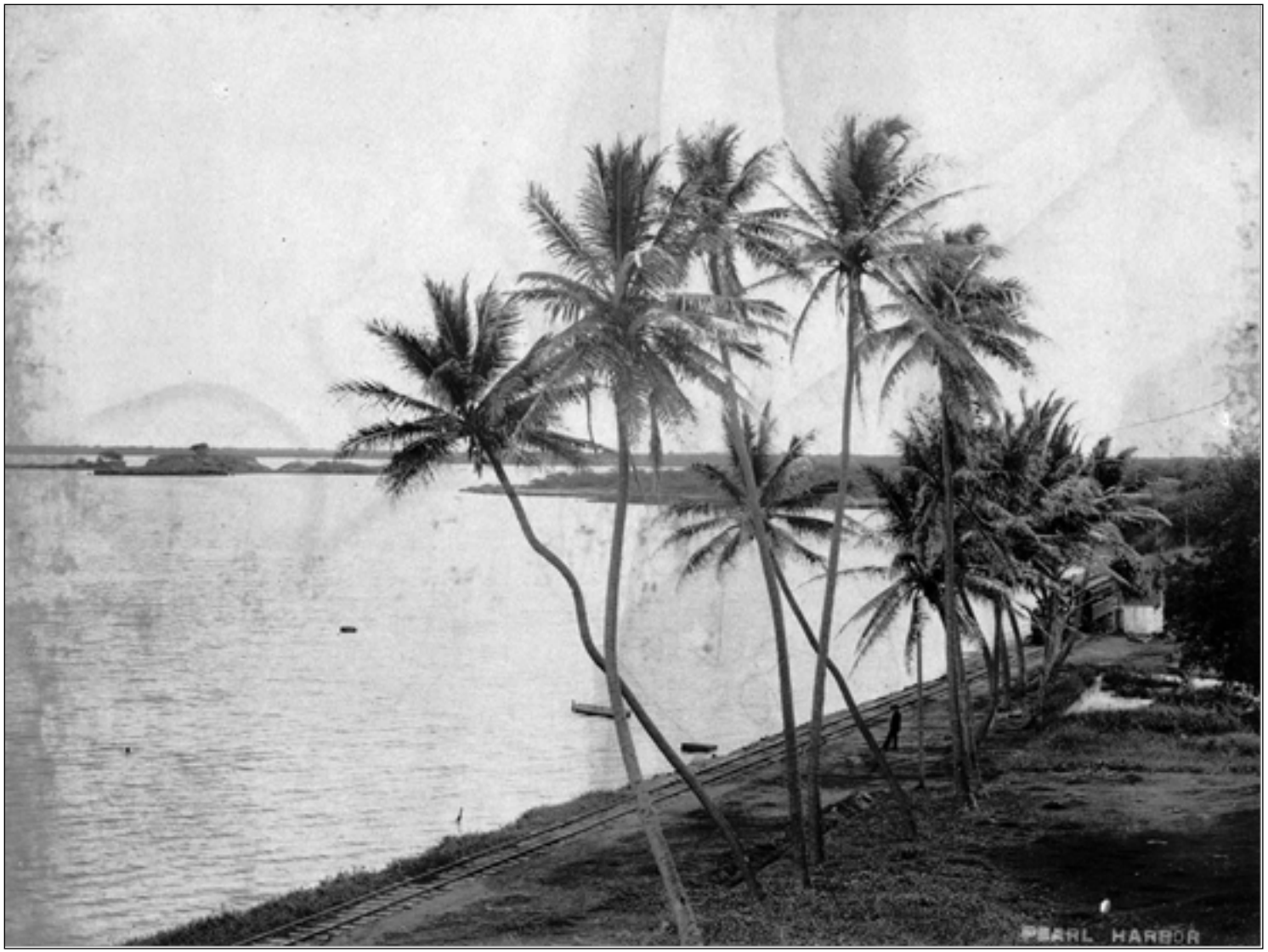

Figure 10. 1890 photograph of Pearl Harbor with OR&L railroad tracks along the coast (Honolulu Advertiser Archives)

> has applied to the Interstate Commerce for authority to abandon its mainline. [Chiddix and Simpson 2004:257]

After the war, most of the 150 miles or more of OR&L track were pried up, locomotives were sold to businesses on the U.S. mainland, and railway cars were scrapped. In 1947, the U.S. Navy took over a section of the OR&L track for their own use, to transport bombs, ammunition, and torpedoes from the ammunition magazines at Lualualei, West Loch in Pearl Harbor, and Waikele on OR&L's Wahiawā Branch to Pearl Harbor Naval Base (Treiber 2005:25–26). The track to Waipahu was abandoned in the 1950s, but the line from the magazines in Lualualei to the wharves in West Loch at Pearl Harbor remained open until 1968. Additionally, the still- existing OR&L rail line through Honouliuli has been placed on the National Register of Historic Places (Site 50-80-12-9714).

4.3.3 The Sugar Plantations of ‘Ewa

Although sugarcane was already being grown as long ago as the early 1800s, the industry revealed its economic potential in 1879 when the first artesian well was drilled in ‘Ewa (Ellis 1995:22). The availability of subsurface water resources enabled greater irrigation possibilities for expanding plantations besides the use of water diversions from the surrounding stream systems. This prompted the drilling of many other wells throughout the Hawaiian Islands, thereby commencing the Hawai‘i sugar plantation era. By the early 1900s, all of the main Hawaiian Islands had land devoted to sugarcane production.

Agricultural field systems, railroads, and residential areas in ‘Ewa were developed by three sugarcane companies, the Ewa Plantation Company, located largely in the *ahupua‘a* of Honouliuli and Hō‘ae‘ae in the western section of ‘Ewa; the Oahu Sugar Company, extending in the areas upland of the Ewa Plantation Company in central ‘Ewa, including a portion of the uplands of Waiawa; and the Honolulu Plantation Company, with fields extending through Mānana to Hālawa in the eastern section of ‘Ewa.

4.3.3.1 The Ewa Plantation Company

The Ewa Plantation Company was incorporated in 1890 for sugarcane cultivation (Figure 11). The first crop, 2,849 tons of sugar, was harvested in 1892. The Ewa Plantation Company was the first all-artesian plantation, and it gave an impressive demonstration of the part artesian wells were to play in the later history of the Hawaiian sugar industry (Kuykendall 1967:III, 69). As a means to generate soil deposition on the coral plain and increase arable land in the lowlands, the Ewa Plantation Company installed ditches running from the lower slopes of the mountain range to the lowlands. When the rainy season began, they plowed ground perpendicular to the slope so that soil would be carried down the drainage ditches into the lower coral plain. After a few years, about 373 acres of coral wasteland were reclaimed in this manner (Immisch 1964:3). By the 1920s, Ewa Plantation Company was generating large profits and was the "richest sugar plantation in the world" (*Paradise of the Pacific,* December 1902:19–22 in Kelly 1985:171). Figure 11 is an aerial shot taken ca. 1925.

During the twentieth century, the Ewa Plantation Company continued to grow and, by the 1930s, encompassed much of the eastern half of Honouliuli Ahupua‘a. This growth impelled the creation of plantation villages to house the growing immigrant labor force working the fields. After the outbreak of World War II, which siphoned off much of the plantation's manpower, along with

Figure 11. Ewa Plantation Company sugar cane fields, Filipino Camp area, cs. 1925 (University of Hawai‘i at Mānoa)

the changeover to almost complete reliance on mechanical harvesting in 1938, there was little need for the large multi-racial (Japanese, Chinese, Okinawan, Korean, Portuguese, Spanish, Hawaiian, Filipino, European) labor force that had characterized most of the early history of the plantation. The Oahu Sugar Company took control over the Ewa Plantation lands in 1970 and continued operations until 1995, when they decided to shut down sugarcane production in the combined plantation areas (Dorrance and Morgan 2000:45, 50).

During the subsequent decades of the twentieth century, sugarcane operations in ‘Ewa phased out and, more recently, former cane lands have been rezoned for residential development. Structures in the area of the former plantation villages have fallen into disrepair or have been demolished. However, portions of the area including Varona Village, Tenney Village, and Renton Village have been designated the ‘Ewa Villages Historic District (SIHP # 50-80-12-9786), which has been nominated for National Historic Landmark status. The Oahu Sugar Company took control over the Ewa Plantation lands in 1970 and continued operations into the 1990s.

4.3.3.2 The Oahu Sugar Company and the Waiahole Ditch

In 1889, Benjamin Dillingham organized the OR&L Company which connected the outlying areas of O‘ahu to Honolulu. By 1890, the railroad reached from Honolulu to Pearl City and continued on to Wai‘anae in 1895, to Waialua Plantation in 1898, and to Kahuku in 1899 (Kuykendall 1967:100).

In 1897, B.F. Dillingham established the Oahu Sugar Company (OSC) on 12,000 acres leased from the estates of John Papa ‘Ī‘ī, Bishop, and Robinson. The Oahu Sugar Company had over 900 field workers, composed of 44 Hawaiians, 473 Japanese, 399 Chinese, and 57 Portuguese. The first sugar crop was harvested in 1899, ushering in the sugar plantation era in Waipahu (Ohira 1997).

Prior to commercial sugar cultivation, these lands were described as being “of near desert proportion until water was supplied from drilled artesian wells and the Waiahole Water project” (Condé and Best 1973:313). Dillingham had successfully promoted the Ewa Plantation Company in 1890; the sprawling sugar company was just south of and adjacent to the OSC. Artesian wells had converted those arid ‘Ewa lands into a thriving plantation, and Dillingham recognized the same potential in the northern area.

Water to irrigate the upper cane fields was initially pumped to levels of 500 ft by some of the “largest steam pumps ever manufactured” (Dorrance and Morgan 2000:49). The expense of pumping water to the high elevations of the plantation led to the proposal to transport water from the windward side of the Ko‘olau Mountains. The Waiahole Water Company was formally incorporated in 1913 and was originally a subsidiary of the Oahu Sugar Company. The Waiahole Ditch was designed by engineer Jorgen Jorgensen, with recommendations by engineer J.B. Lippencott and assisted by W.A. Wall. The original system, when completed, included 27 tunnels connecting with 37 stream intakes on the north side of the Ko‘olau, with the main bore through Waiāhole Valley, then connecting it to the 14 tunnels on the southern side of the Ko‘olau at Waiawa, and thence by ditch westward to Honouliuli, covering a total of 13.6 km (Condé and Best 1973:37). Upon its completion in 1916, the Waiahole Ditch was 35 km (21.9 miles) long and cost $2.3 million. The 32 million gallons of daily water enabled the Oahu Sugar Company to grow to “some 20 square miles […] ranging in elevation from 10 ft at the Waipio Peninsula […] to 700 ft

at the Waiahole Ditch" (Condé and Best 1973:313). The ditch system, with some modifications, is still in use. It is included on the state inventory of historic places as SIHP # 50-80-09-2268.

This ditch complex first passed through Hō‘ae‘ae, bringing much needed water to the area. Kluegel describes the area:

> West of Waikakalaua Gulch, through Hoaeae and to the upper boundary of Oahu Plantation in Honouliuli, the conduit consists of 12,650 feet of cement-lined ditches, and three redwood pipes 5 feet in diameter, having an aggregate length of 2,830 feet. [Kluegel 1917:96]

> The Waiahole Water Co. has taken over from the Oahu Sugar Co. the Ahrens Ditch in Waiawa, the Kipapa Ditch, the Waikakalaua Ditch in Waipio, and the Hoaeae Ditch. Two redwood pipes having a total length of 1,223 feet have been laid across two gulches on the line of Hoaeae Ditch, cutting out 21/4 miles of ditch. The water delivered by the Waiahole System is chiefly used on newly planted cane on land above the lift of the pumps. [Kluegel 1917:107]

The Waiahole Ditch System crossed through the western portion of the present project area.

Dillingham's *mauka* lands in western Honouliuli that were unsuitable for commercial sugar production remained pasture for grazing livestock. From 1890 to 1892, the Ranch Department of the OR&L Company desperately sought water for their herds of cattle, tapping plantation flumes and searching for alternative sources of water. Ida von Holt shared this account of her husband Harry's (Superintendent of the OR&L Ranch Department) search for water in the foothills of the Wai‘anae Range:

> One of those places is on the old trail to Pālehua, and had evidently been a place of which the Hawaiians had known, for its name is Kalo‘i (the taro patch), and even in dry weather water would be standing in the holes made by the cattle, as they tried to get a drop or two. [von Holt 1985:136]

The spring was located along the upper slopes of the southern face of Kalo‘i Gulch. A second account is given of the discovery of spring water in an area over the ridge on the north side of Kalo‘i Gulch:

> Shouting to the men to come over with their picks and shovels, he [Harry von Holt] soon got them busy clearing away lots of small stones and earth. Almost at once they could see that there were evidences of a paved well, and at about three feet down they came upon a huge flat rock, as large around as two men could span with their arms. Digging the rock loose and lifting it to one side, what was their astonishment to find a clear bubbling spring! [von Holt 1985:138]

Following the discovery, two old Hawaiians began to explain to Von Holt about the spring:

> Finally he [Harry von Holt] got them to explain that the spring, called 'Waihuna' (Hidden Spring) had been one of the principal sources of water for all that country, which was quite heavily populated before the smallpox epidemic of 1840 […] A powerful Kahuna living at the spring had hidden it before he died of the smallpox, and had put a curse on the one who disturbed the stone, that he or she would surely die before a year was out. [von Holt 1985:138–140]

4.4 1900s

4.4.1 The U.S Military Development of Pearl Harbor

In 1876, the Reciprocity Treaty between the United States and the Kingdom of Hawai‘i concluded with the provision that Hawai‘i would not “lease or relinquish sovereignty to another country or any harbor, etc.” In 1887, the treaty was renewed and amended and allowed the United States the “exclusive right to enter the harbor of Pearl River, in the Island of Oahu, and to establish and to maintain there a coaling and repair station for the use of vessels of the United States” (Judd 1971:128).

After Hawai‘i became a territory of the United States in 1899, a Pacific base that could be used as a staging area for the Spanish-American war began to be developed. Early in the twentieth century, the U.S. Government began acquiring the coastal lands of ‘Ewa for development of a naval base at Pearl Harbor. In 1901, the U.S. Congress formally ratified annexation of the Territory of Hawai‘i, and the first 1,356.01 acres of Pearl Harbor land were transferred to U.S. ownership. The U.S. Navy began a preliminary dredging program in 1901, which created a 30-ft-deep entrance channel measuring 200 ft wide and 3,085 ft long. In 1908, money was appropriated for 5 miles of entrance channel dredged to an additional 35 ft down (Downes 1953) (Figure 12). Funding for the construction of dry docks and other support facilities was also approved in 1908. In 1909, the government appropriated the entire Waipi‘o peninsula from the ‘Ī‘ī estate for the Pearl Harbor Naval Station and Shipyard.

Additional dredging to deepen and widen the channel was conducted in the 1920s. In 1931, the Navy built an ammunition depot at West Loch on a 213-acre parcel it had bought from the Campbell Estate. Construction of a new depot in Lualualei Valley and at West Loch Harbor began in 1931.

In the early 1930s, the U.S. Navy leased 700 acres of the Campbell Estate to build Ewa Field in Honouliuli, a base with a mooring mast for Navy dirigibles. Although the mast was completed, the program was abandoned before the *Akron*, the airship designated for the mast, was built. In 1937, 18 miles of roads were built in the coastal Honouliuli area, and in 1939-1940 the U.S. bought 3,500 acres of land in this area (Landrum et al 1997:62–67), to build several other military camps and installations, including Barbers Point Naval Air Station, at the site of the old mooring mast.

4.4.2 History of Camp Malakole

The wartime history of Camp Malakole (1940–1946) has been well described by Robert H. Albert (1980). The Camp Malakole Military Reservation, also known as the Honouliuli Military Reservation (Malakole Campsite), included 30 ha (75.01 acres) acquired by the Secretary of War in the late 1930s. In 1939, the area was chosen as a firing range for the Sixty-Fourth Coast Artillery (AA) Regiment, stationed out of Fort Shafter (Albert 1980:303). Under the command of Colonel Charles W. Wing, the regiment cleared the land and set up six batteries along the coast (Bennett 2003:50).

The camp was selected to be the base of the 251st Coast Artillery (Anti-Aircraft) Regiment on 16 September 1940. This camp was to function as a defensive gun and firing position sector for the regiment. Based out of California, this unit was the first National Guard Unit to be ordered outside the continental United States during peace time (Albert 1980:303). By the end of 1940, the

Figure 12. Dredging in Pearl Harbor ca. 1908 (Hawai‘i State Archives)

soldiers stationed at Camp Malakole spent half the day setting up the field defensive gun and half the day building the camp (Albert 1980:304) (Figure 13 and Figure 14). The camp construction was officially finished in February 1941 (Bennett 2003:55).

The camp was meant to house approximately 2,000 men and included 48 barracks buildings, 12 mess halls, nine magazines and storage houses, five officers' quarters, seven showers, latrines, dispensary, officers' mess, headquarters buildings, fire house, post office, regimental day room, movie theater, laundry, car repair shop, gas station, guard houses, and photo lab (Bennett 2003:55).

By 1941, the imminent threat of war was becoming more apparent. During the first half of 1941, the population of the camp grew from 1,200 to 2,400. On 7 December 1941, the soldiers stationed at Camp Malakole had just come back from a week-long island alert and had placed the guns and ammunition in storage bunkers (Albert 1980:304). Nevertheless, a hasty defense effort was able to defend against Japanese dive bombers attacking the camp and the unit is credited with shooting down two Japanese bombers. Three soldiers stationed at Camp Malakole—Sargent Henry Blackwell, Sargent Warren Rassmusen, and Corporal Clyde Brown—were the first American soldiers killed in the attack. They were taking private flying lessons that morning out of John Rodgers Airport (Harding 2013).

In 1942, the Regiment deployed to the Fiji Islands to establish anti-aircraft defense for the airfield there. From there, they participated in campaigns in Guadalcanal, Bougainville, and Luzon in the Philippines (Albert 1980:305).

After the Regiment left in 1942, Camp Malakole became a weapons training school for live-firing ranges of anti-aircraft and anti-tank training. By 1943, the camp became an important staging area for cargo coming into and out of O‘ahu, as well as solider replacement for personnel entering oversea theaters. Service reports from the camp report that over 43,000 troops were billeted and staged through the camp in the final 32 months of war, averaging over 1,100 troops a month (Albert 1980:306). The camp was a strategic tool during the United States' involvement in the war. It served as an important area for the logistical effort in the war and the main anti-aircraft gunnery school on O‘ahu. After the end of World War II, the camp was abandoned. There is little information available about exactly when or why the camp was abandoned. Due to the construction of the adjacent industrial park and Chevron Oil Refinery, little remains of the camp.

4.4.3 Honouliuli National Monument (Honouliuli Internment Camp)

Following the Japanese Navy's attack on Pearl Harbor on 7 December 1941, Lieutenant General Walter C. Short of the Army and Joseph Poindexter, Governor of Hawai‘i, issued a proclamation declaring the Territory of Hawai‘i under martial law and suspending the writ of *habeas corpus* (the requirement for a person under arrest to be brought before a judge or into court) (U.S. Department of the Interior 2014:6-7). Civilian courts were closed and the military established its own courts with authority over civilians (Kashima 2003:69). While under martial law, the territory of Hawai‘i was governed by Army generals Walter Short, Delos Emmons, and Robert C. Richardson, Jr. (U.S. Department of the Interior 2014:6–7).

> The military conducted some 50,000 trials of civilians throughout the islands during the war, with a 99 percent conviction rate in the 22,000 cases on the island of O‘ahu in 1942 and 1943. The average trial lasted five minutes, and legal counsel was seldom at hand once it became common knowledge that the presence of a defense

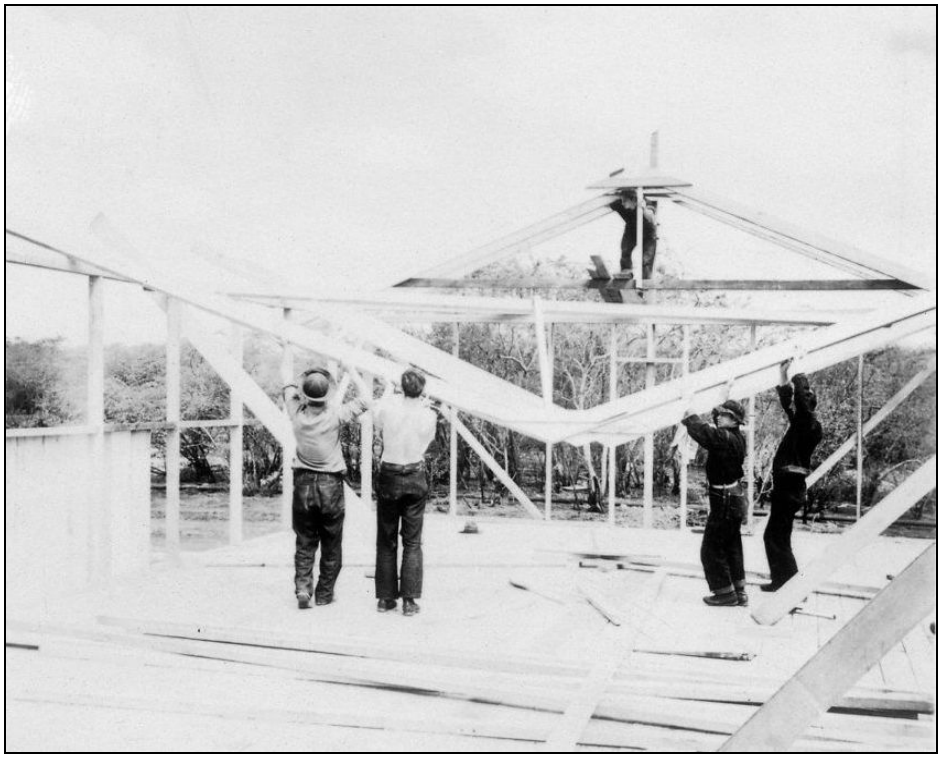

Figure 13. Camp Malakole soldiers raising the barracks roof (Bandel in Albert 1980:336)

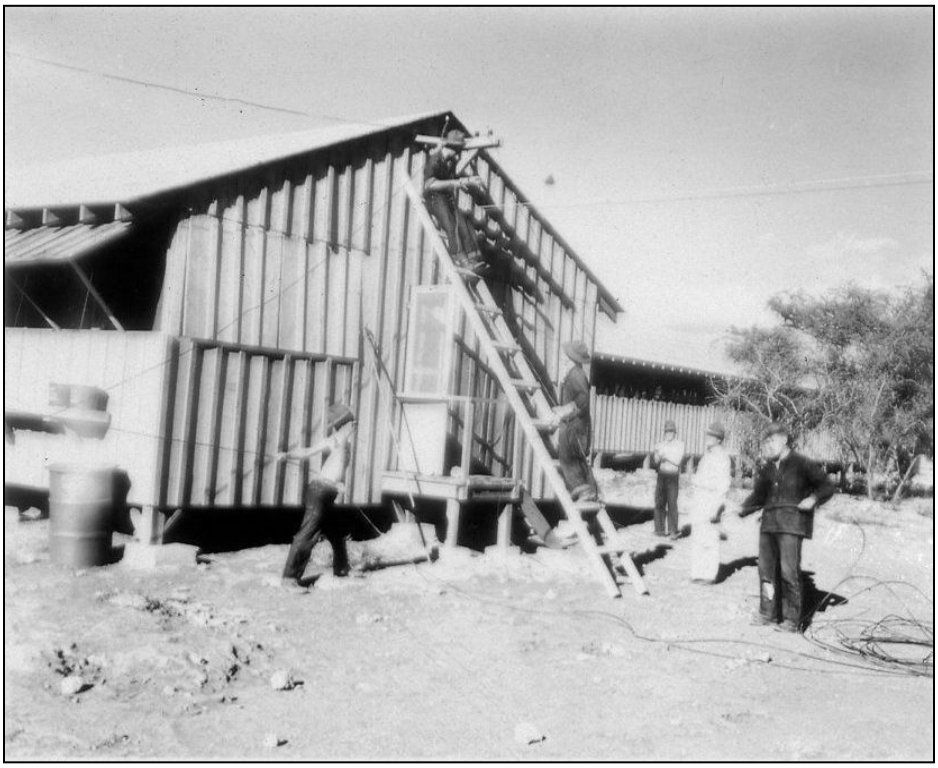

Figure 14. Camp Malakole soldiers wiring the barracks (Bandel in Albert 1980:336)

> lawyer would ensure a harsh sentence (Scheiber and Scheiber 2003). [U.S. Department of the Interior 2014:6-7]

Persons of Japanese and European ancestry in Hawai‘i suspected of disloyalty to the United States were rounded up and imprisoned by the U.S. military and the Federal Bureau of Investigations (FBI) (U.S. Department of the Interior 2014:xii). Most internees were held at the U.S. Immigration Station on O‘ahu prior to being transferred to internment camps on the U.S. mainland (U.S. Department of the Interior 2014:xii).

> The War Department ordered the internment of all individuals who had been identified on the custodial detention list (Kashima 2003, 69). These included leaders in the Japanese community who had significant community influence, were educated, were teachers, or had access to transportation or communications. They included members of the Japanese consulate, and community members who served in an unofficial consular capacity for those wanting to communicate officially with Japan on legal issues of births, deaths, marriage, and other business. They also included Shinto and Buddhist priests, Japanese language teachers, those with radios, and farmers and fishermen with access to boats and other transport. Martial arts instructors, travel agents, those with access to the press, and Kibei (American citizens of Japanese ancestry who had been educated in Japan) were also targeted. In some cases, those arrested were considered ‘guilty by association’ or were identified by informants, some without just cause. [U.S. Department of the Interior 2014:6–7]

In 1943, the Honouliuli Internment Camp was constructed to intern citizens, resident aliens, and prisoners of war. Located in Honouliuli Gulch, east of the project area, the camp was the “last, largest, and longest-used World War II confinement site in Hawai‘i,” holding approximately 320 internees and nearly 4,000 prisoners of war (U.S. Department of the Interior 2014:xiv).

4.4.4 Development in the Vicinity of the Project Area

Much of the *mauka* lands in western Honouliuli, including ridges and deep gulches, were unsuitable for commercial sugar cultivation and remained pasture land for grazing livestock. The Donn 1906 map suggests the present project area was at the edge of sugarcane cultivation at that time (Figure 15). By 1920, however, much of the lands of Honouliuli were used for commercial sugarcane cultivation (Frierson 1972:18).

A 1919 map (Figure 16) shows ditches, reservoirs, roads, and railroad lines downslope of the project area. This map shows an unimproved road alignment just south of the project area, understood as the Pālehua Road, approximating a traditional Hawaiian footpath into the uplands.

A 1922 map (Figure 17 and Figure 18 showing annotations), however, shows the called out Pālehua trail as jogging into the southwest portion of the project area. This 1922 map shows pineapple fields in at least 13 locations among the foothills of the southeast Wai‘anae Range. The nearest of these pineapple fields wrapped around Pu‘u Kapua‘i some 500 m to the northwest. At least six (typically quite small) plantation camps were scattered along the bottom of these foothills with the nearest being about 500 m to the north of the project area. The Kupihau Ranch Station is shown about 2.6 km to the north. The water troughs and tanks shown upslope of the ranch station attest to the cattle operations in the vicinity at that time.

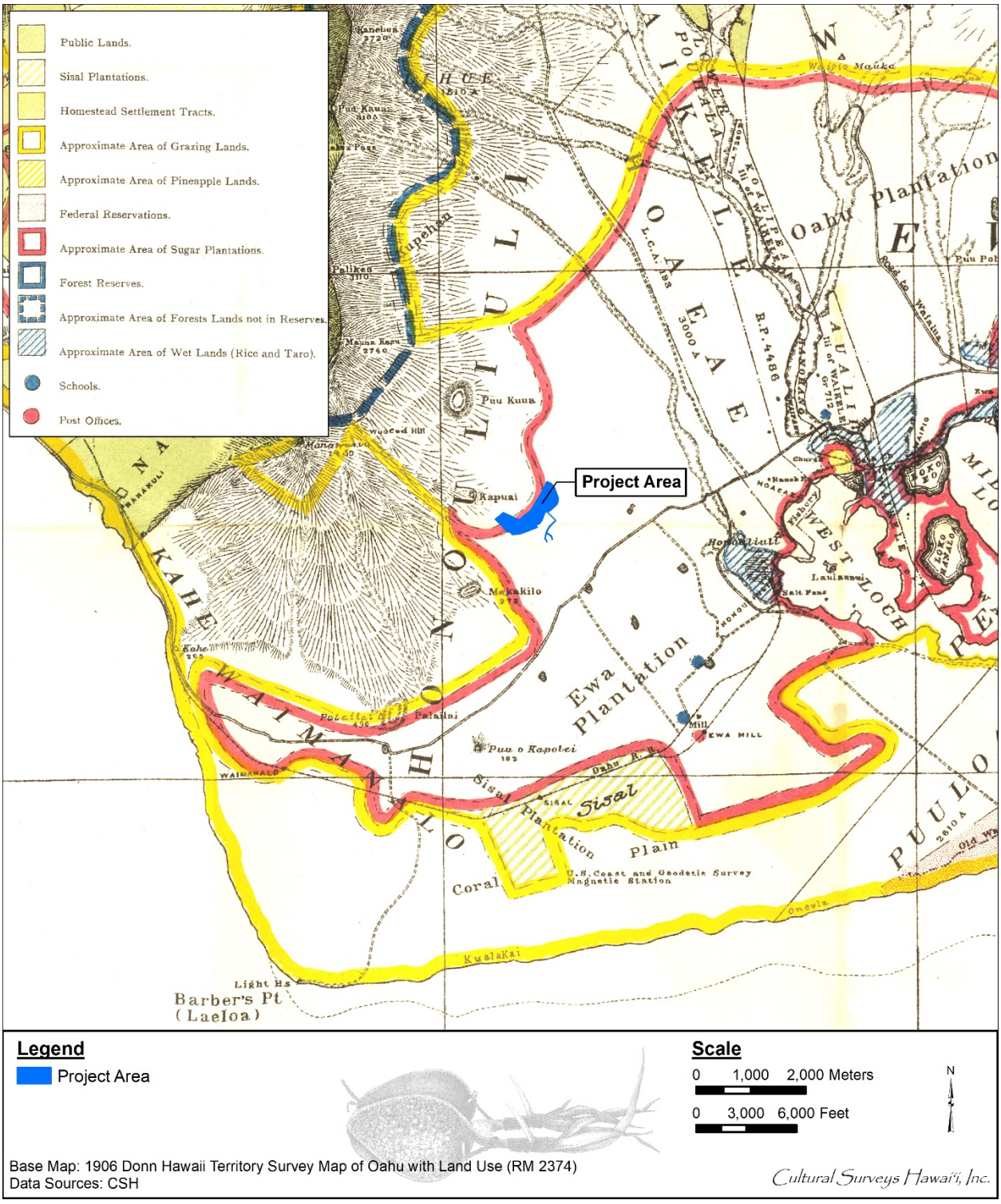

Figure 15. Portion of the 1906 Donn Hawaii Territory Survey map showing breakdown of land use in southwest O‘ahu

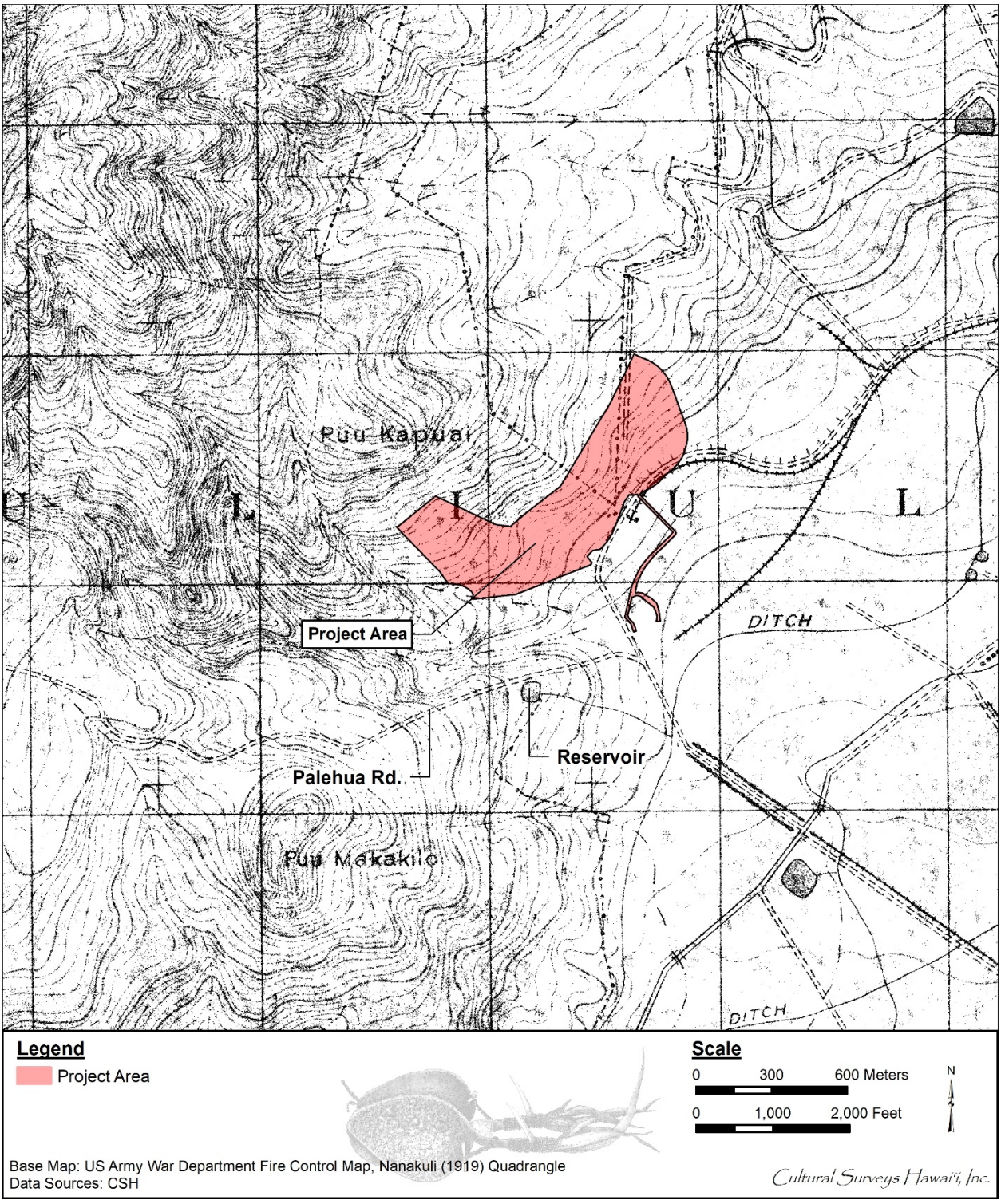

Figure 16. Portion of 1919 U.S. Army War Department fire control map, Nanakuli quadrangle showing the project area

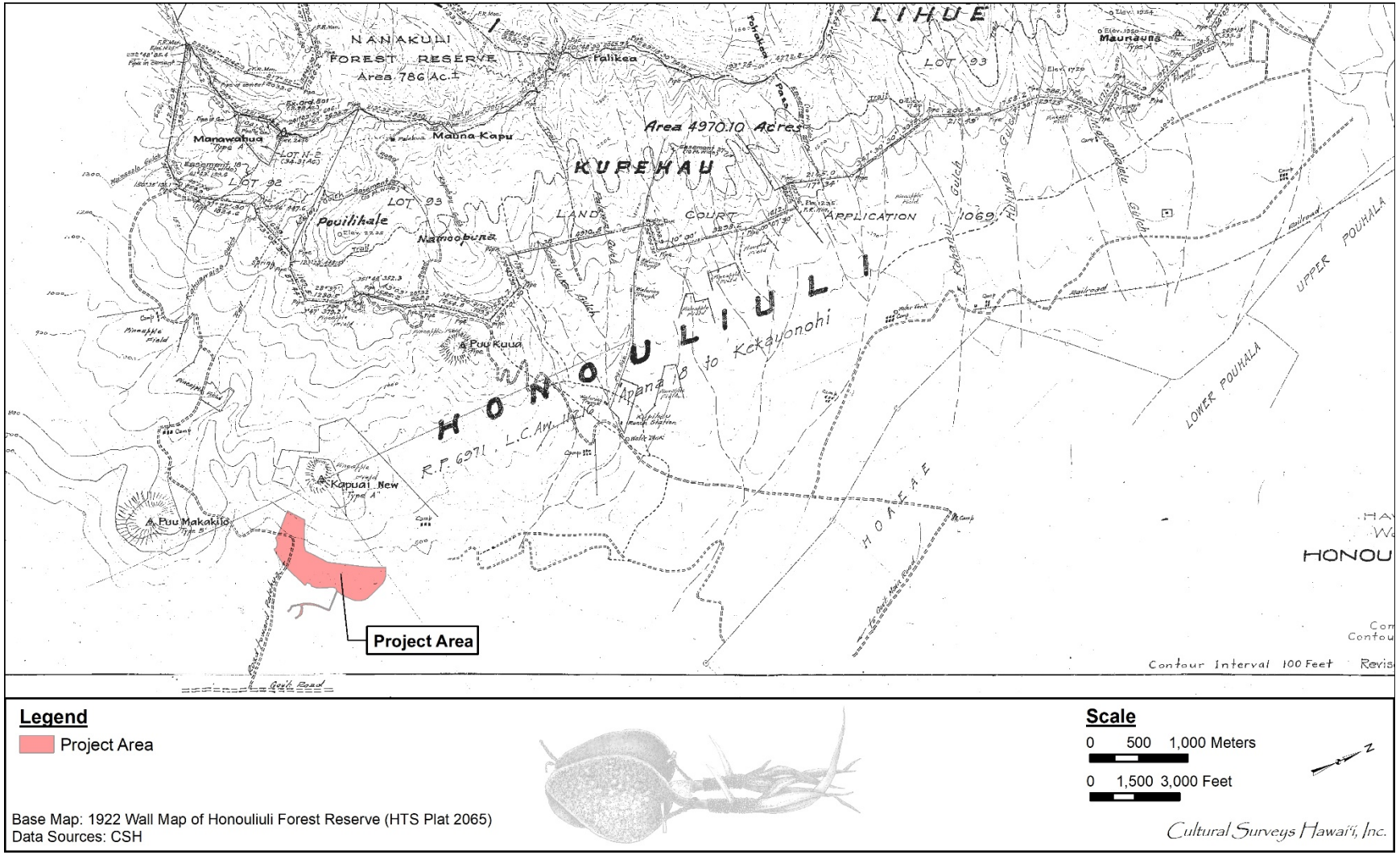

Figure 17. Portion of 1922 Wall map of Honouliuli Forest Reserve showing the location of the project area

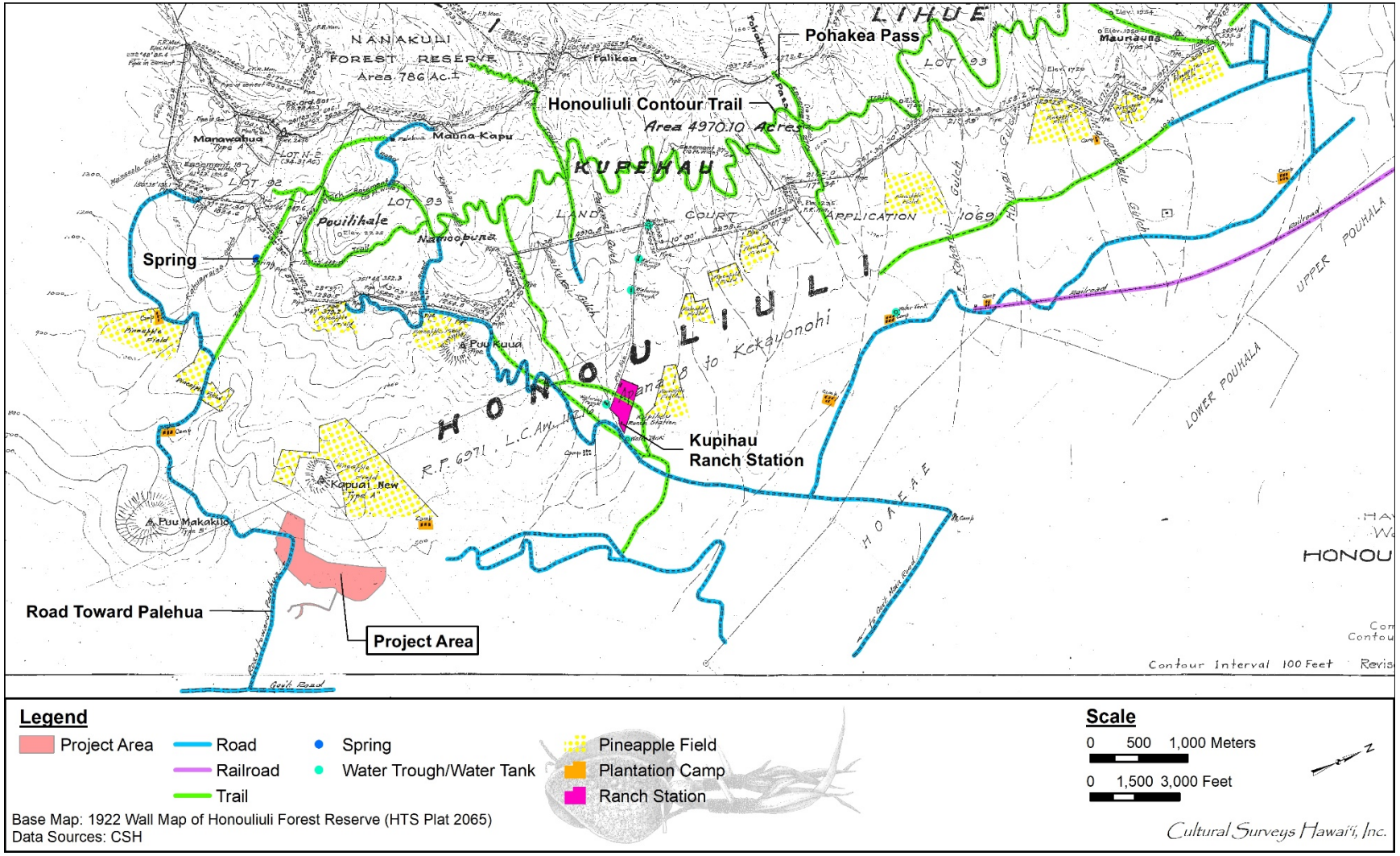

Figure 18. 1922 Wall map of Honouliuli Forest Reserve showing the location of the project area with annotations

By 1925 (Figure 19) most of the project area is depicted as within Oahu Sugar Company plantation Field 30. The extreme upslope end of the project area still appears to be outside the area of sugarcane cultivation, in keeping with the depiction on the 1906 Donn map (compare with Figure 15).

In the late 1920s, the main residential communities were at the northeast edge of the ‘Ewa Plain and the largest community was still located at Honouliuli Village. ‘Ewa was primarily a plantation town, focused around the sugar mill, with a public school as well as a Japanese school. Additional settlement, in Waipahu, centered around the Waipahu sugar mill operated by the Oahu Sugar Company. However, small plantation camps were scattered within the extensive sugarcane fields (as indicated in Figure 18).

By 1936, however, “Pump Camp 5” had been established on either side of a pipeline that bisected the present project area (Figure 20). The 1936 map indicates approximately seven houses on the northeast side of the pipeline and 17 houses on the southwest side of the pipeline within the present project area at that time. The central pipeline extended downslope from the Waiahole Ditch to a large pump house structure that still exits just southeast (outside) of the project area. The alignment of the Waiahole Ditch crossing the western portion of the project area, and a roughly parallel road just upslope, are clearly depicted. It appears that a spur plantation railroad serviced Pump Camp 5 connecting to the northeast and continued a short distance to the southeast.

The 1943 map (Figure 21) shows much the same scene, though the unimproved road crossing the west portion of the project area now wraps around Pu‘u Kapua‘i. Additional new, unimproved roads suggest the expansion of sugarcane fields. The extensive system of fences depicted upslope indicate cattle ranching was still a significant enterprise.

Historic maps of the Makakilo area indicate a lack of any other significant development in the area into the 1940s. Major land use changes came to western Honouliuli when the U.S. military began development in the area. Military installations were constructed near the coast as well as in the foothills and upland areas. Barbers Point Military Reservation (a.k.a. Battery Barbers Point from 1937–1944), located at Barbers Point Beach, was used beginning in 1921 as a training area for firing 155 mm guns (Payette 2003). Also in the vicinity were Camp Malakole Military Reservation (a.k.a. Honouliuli Military Reservation), used from 1939, and Gilbert Military Reservation, used from 1922–1944. Barbers Point Naval Air Station (NAS), in operation from 1942 into the 1990s, was the largest and most significant base built in the area. It housed numerous naval and defense organizations, including maritime surveillance and anti-submarine warfare aircraft squadrons, a U.S. Coast Guard Air Station, and components of the U.S. Pacific Fleet.

Fort Barrette (a.k.a. Kapolei Military Reservation and Battery Hatch), located atop Pu‘uokapolei to the southwest, was in use from 1931 to 1948 for housing four 3-inch anti-aircraft batteries (Payette 2003). In the 1950s, the site was used as a NIKE missile base. Palailai Military Reservation, located atop Pu‘u Pālailai in Makakilo to the west, was in service from 1921, housing Battery Palailai and Fire Control Station B (Payette 2003). Fire Control Station A was located atop Pu‘u Makakilo approximately 1.4 km to the southwest of the project area. From 1942 to 1945 the Pu‘u Makakilo Training Area, including lands in and around Pu‘u Makakilo, was used for military training during World War II (Environment Hawai‘i 1992).

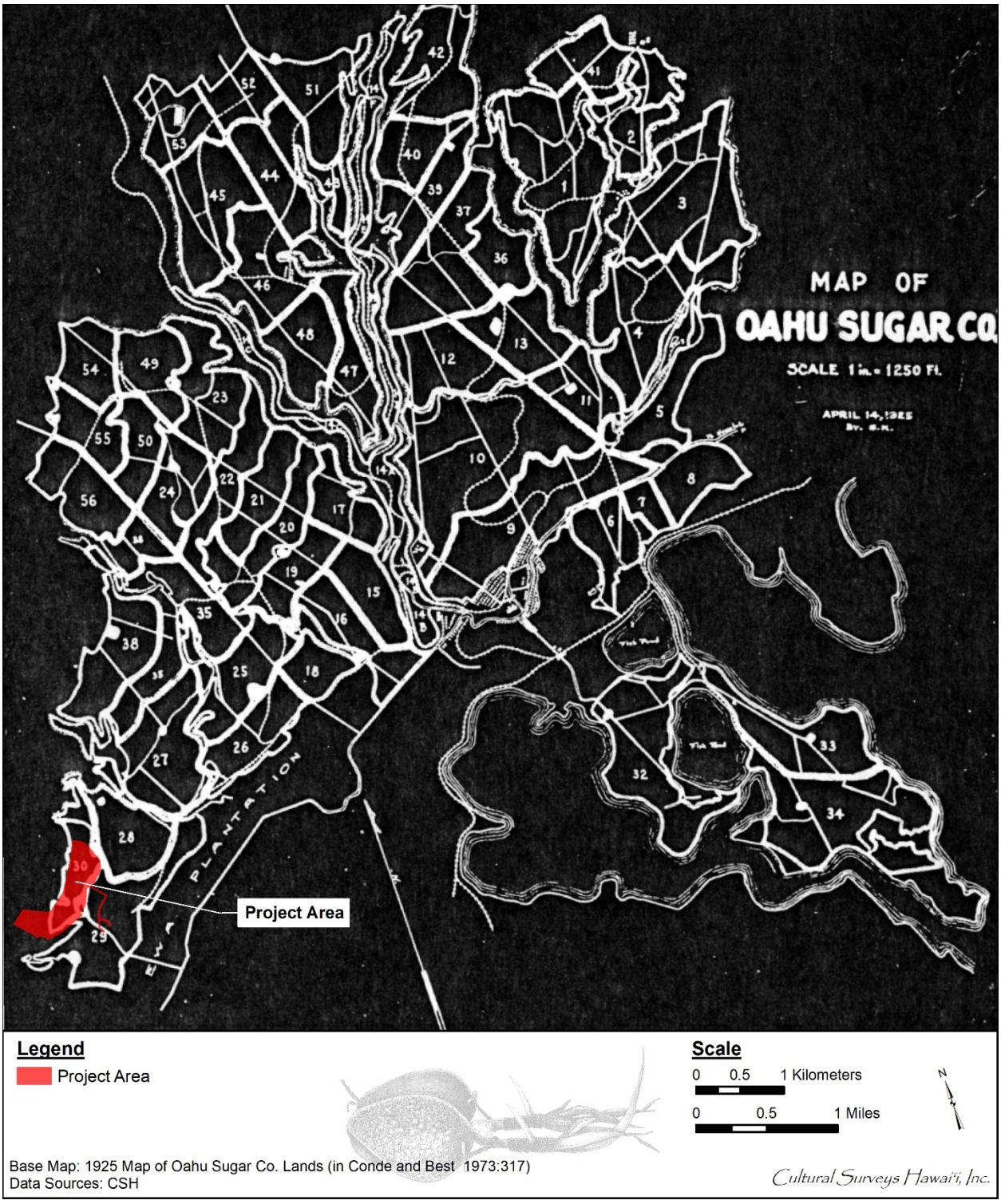

Figure 19. 1925 Oahu Sugar Company plantation map showing project area (red) as largely within former Field 30 (Condé and Best 1973:317)

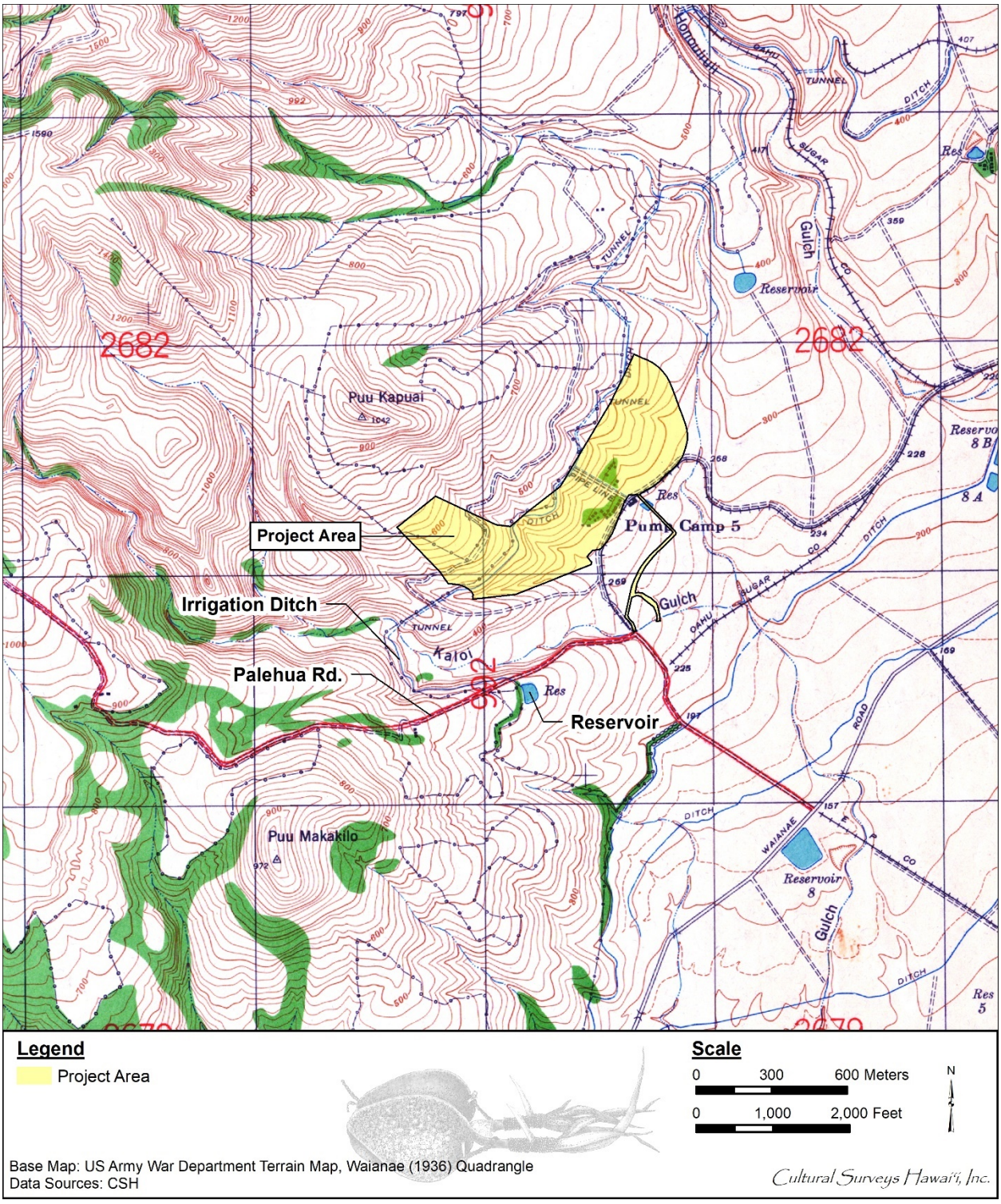

Figure 20. Portion of the 1936 U.S. Army War Department terrain map, Waianae quadrangle showing the location of the project area

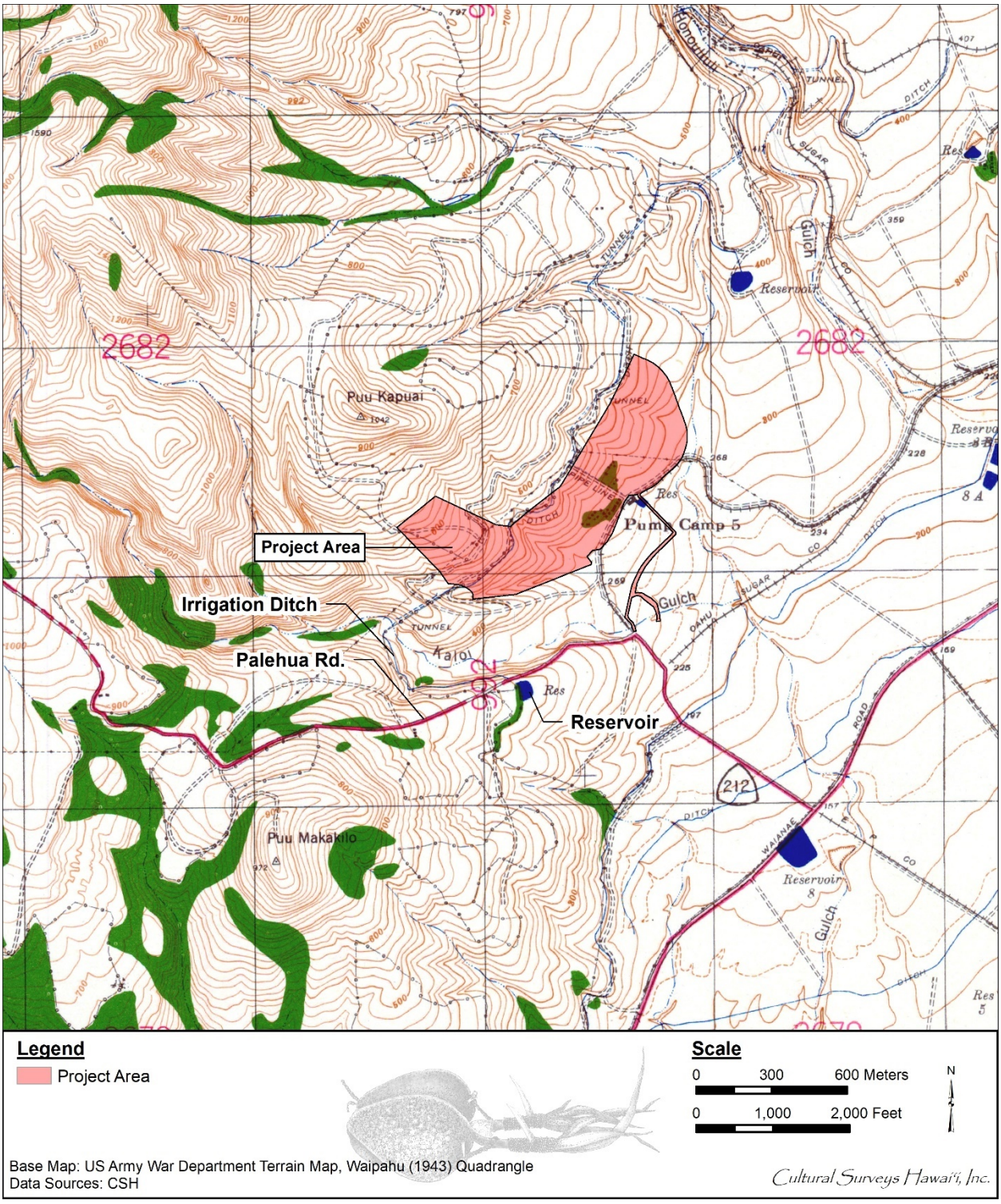

Figure 21. Portion of the 1943 U.S. Army War Department terrain map, Waipahu quadrangle showing the project area

The 1951 aerial photograph (Figure 22) clearly shows the two neighboring housing areas of Pump Camp 5 within the central portion of the project area (just northwest and southwest of the pump house building or pumping station which remains just outside the project area). While the majority of the project area was under sugarcane cultivation, it appears the southwest portion of the project area, west or upslope of the Waiahole Ditch, was not under cultivation at that time, instead used as grazing lands. The west portion of the project area appears to have been previously cultivated but appears fallow. Extensive areas north of Pu‘u Kapua‘i appear to be under pineapple cultivation.

The 1953 USGS map (Figure 23) shows much the same landscape as the 1943 map (see Figure 21) except the railroads have now all disappeared—quickly replaced by trucking after World War II. A naval reservation is shown on the southeast base of Pu‘u Makakilo. An access road is now depicted running up the mouth of Kalo‘i Gulch, parallel to and just north of the Kalo‘i Stream channel, understood to have been developed to service the present quarry. The initial date of construction of an industrial quarry within Kalo‘i Gulch—depicted to the south (outside) of the current project area—is uncertain, though historic maps indicate a construction window between 1943 and 1952. In 2004, CSH conducted an archaeological inventory survey whereby the quarry was documented and designated an historic property: SIHP # 50-80-12-6680.

The 1968/1969 USGS map (Figure 24) no longer shows Pump Camp 5, which had been prominent at least as early as 1936 (see Figure 20) and lasted until at least 1953 (see Figure 23). The “Pumping Station” immediately southeast of the project area is still labeled and in general the plantation infrastructure (other than the train lines) appears active. The road up Kalo‘i Gulch, depicted as improved in 1953, is now shown as unimproved suggesting abandonment of some quarrying operations.

4.5 Contemporary Land Use

Modern maps of the Makakilo area indicate vast changes to the project area and surrounding lands, including the retreat of the sugarcane fields, the construction of the H-1 Freeway, and the partial construction of the Pu‘u Makakilo Golf Course and Grace Pacific Makakilo Quarry.

The 1968 aerial photograph (Figure 25) shows virtually the entire project area still utilized for sugarcane, though there is no trace of the former Pump Camp 5 residential areas that appear to now be entirely covered with cane. Many of these plantation homes are understood to have been slightly raised on “tofu-block” foundations that allowed for relatively complete demolition leaving only the remnants of privies and trash pits. The 1968 USGS aerial photograph also shows new fields to the northwest (Figure 25).

In 1969 and 1970, Pacific Concrete and Rock Company, Ltd. began subsurface drilling on the southward facing slopes of Pu‘u Makakilo for a new quarry location. The company’s previous quarry in Pu‘u Pala‘ila‘i that had been in operation for the past 22 years was nearly exhausted. The newly proposed Makakilo Quarry would “encompass 72 acres of actual total quarry area and 188 acres of green belt buffer. Of the 72 acres of actual quarry area, only a maximum of 18 acres will be under active quarrying at any given time” (Cerny 1972:1).

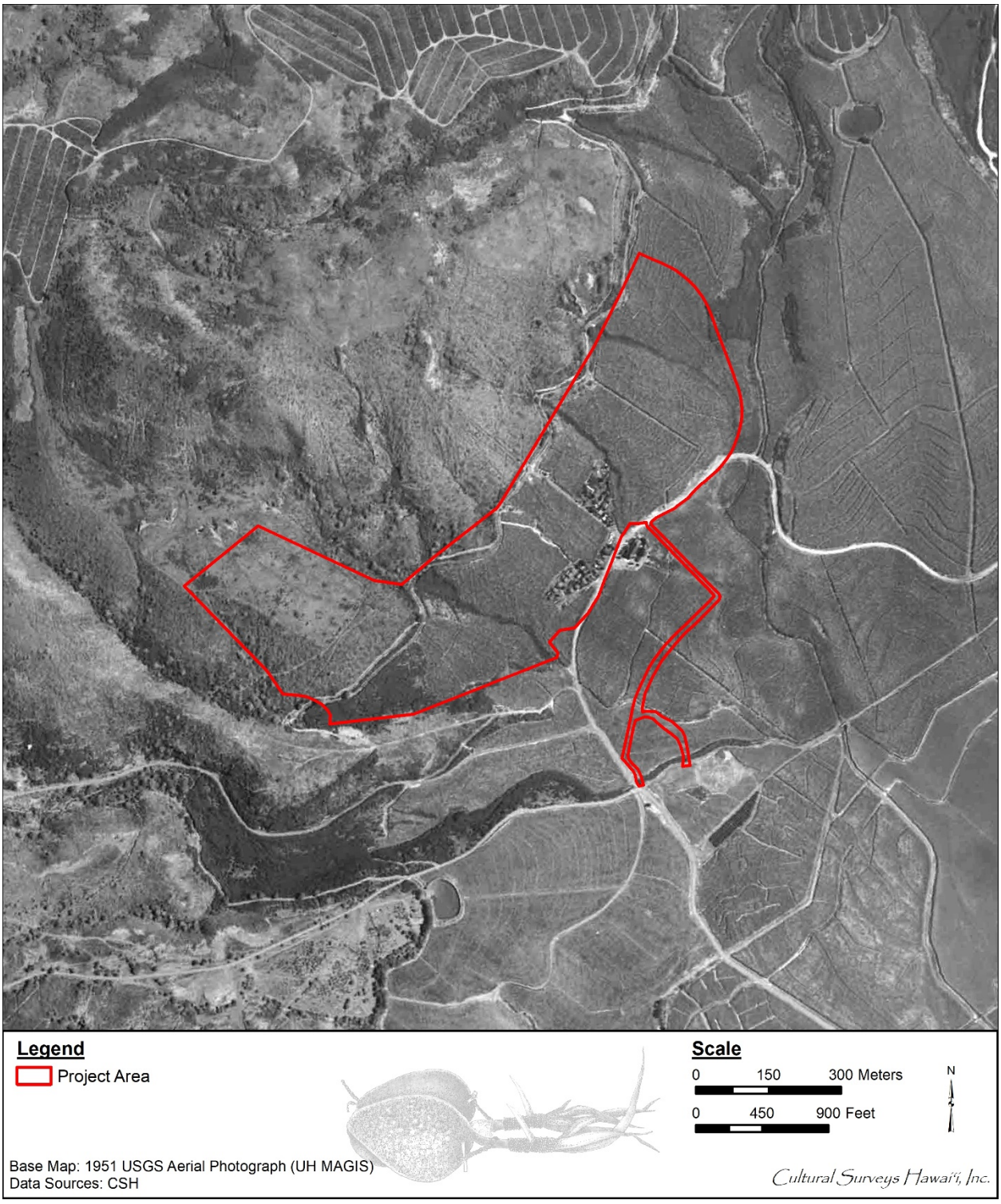

Figure 22. 1951 USGS aerial photograph (UH MAGIS) showing the project area

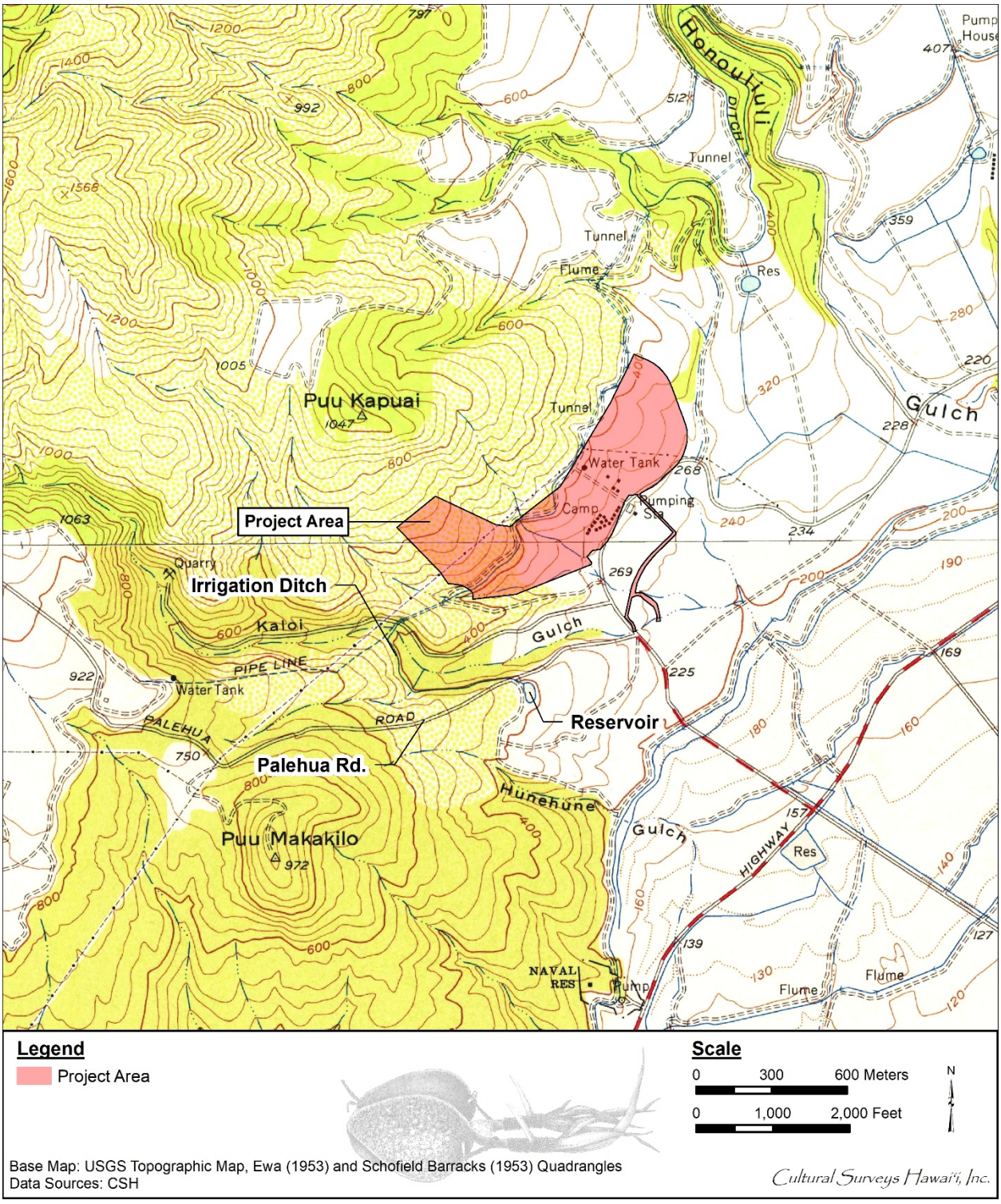

Figure 23. Portion of the 1953 Ewa and Schofield Barracks USGS topographic quadrangles showing the project area

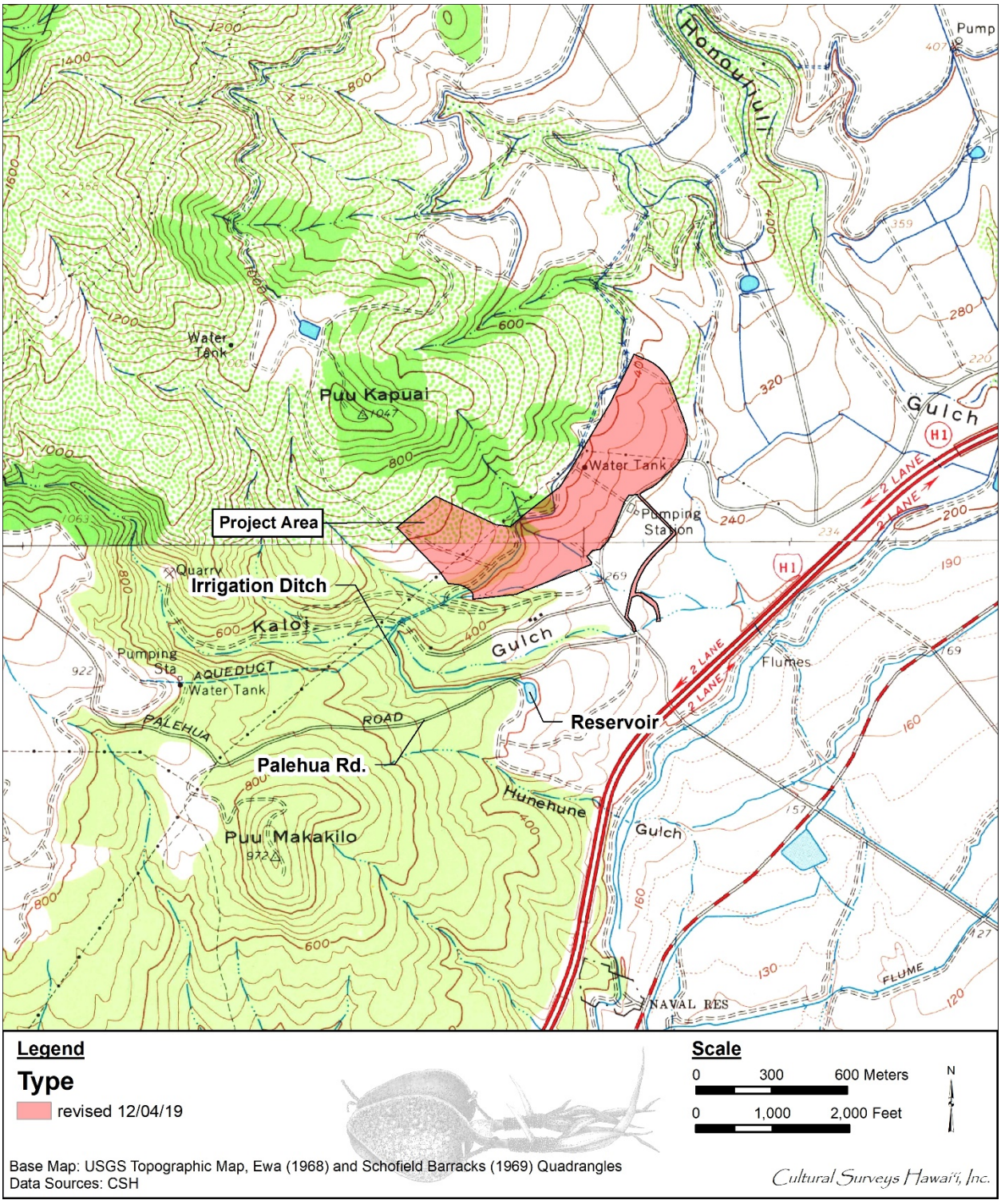

Figure 24. Portion of the 1968 Ewa and 1969 Schofield Barracks USGS topographic quadrangles showing the project area

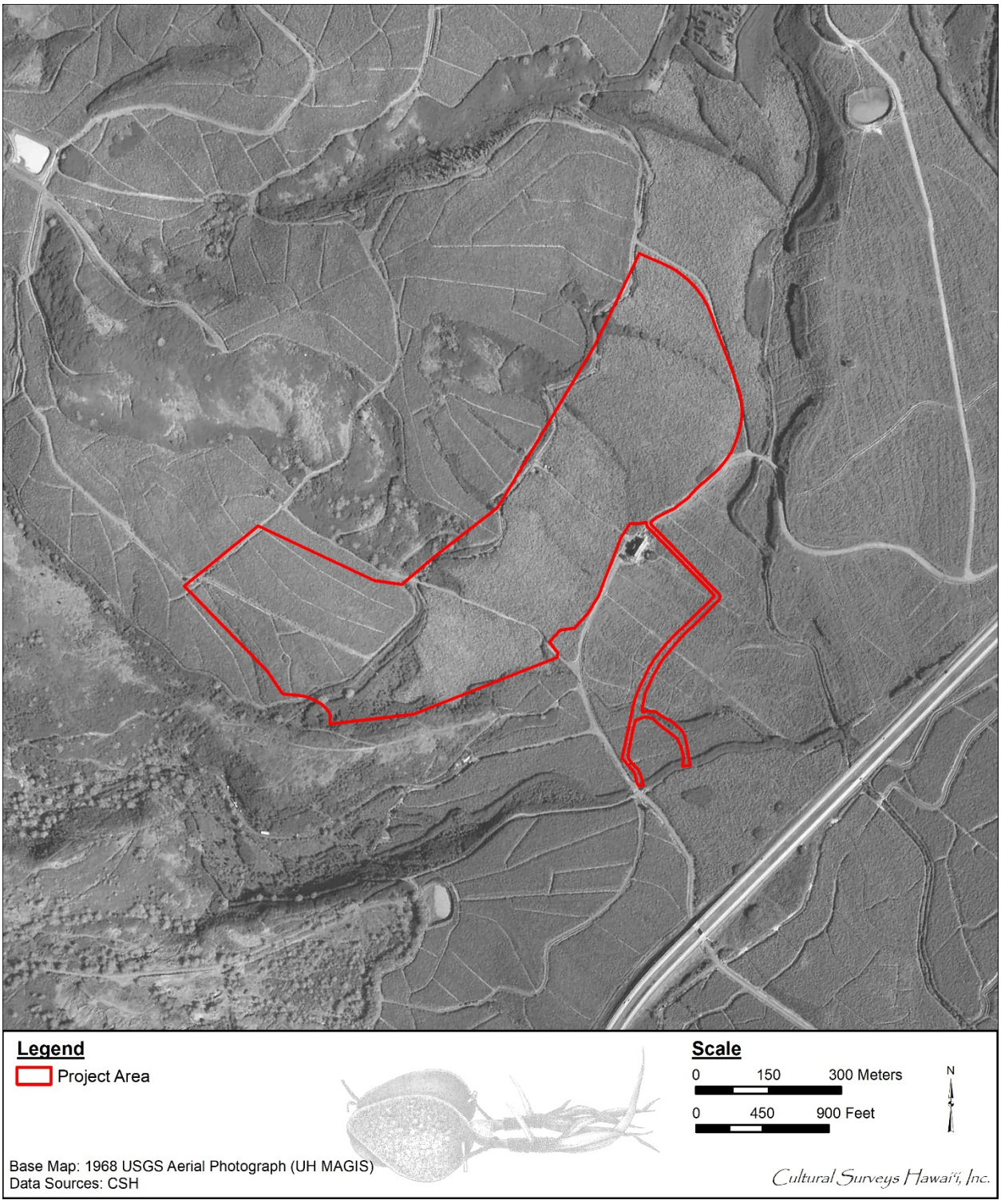

Figure 25. 1968 USGS aerial photograph (UH MAGIS) showing the project area

A 1977 USGS aerial photograph (Figure 26) appears to display decreased sugarcane cultivation in the Wai‘anae foothills. It is not clear if the project area is in active cultivation or not. Clearly by 1993 (Figure 27) sugarcane cultivation within the project area is finished, although it remains active immediately southeast of the project area.

Sometime in the early 1990s, a group of Japanese investors poured $70 million into the development of the Pu‘u Makakilo Golf Course. The golf course’s exact date of construction is unclear; however, the proposed area was surveyed by Sinoto in 1988 (Sinoto 1988). The golf course was situated on the slopes of Pu‘u Makakilo just north of the rock quarry. During a burst bubble in the Japanese investment market the project foundered, and the course and buildings were purchased by Grace Pacific in 1994 (*Honolulu Advertiser*, May 2004:31). Construction of the golf course resulted in grading and terracing of a large area just south of the present project area for fairway construction.

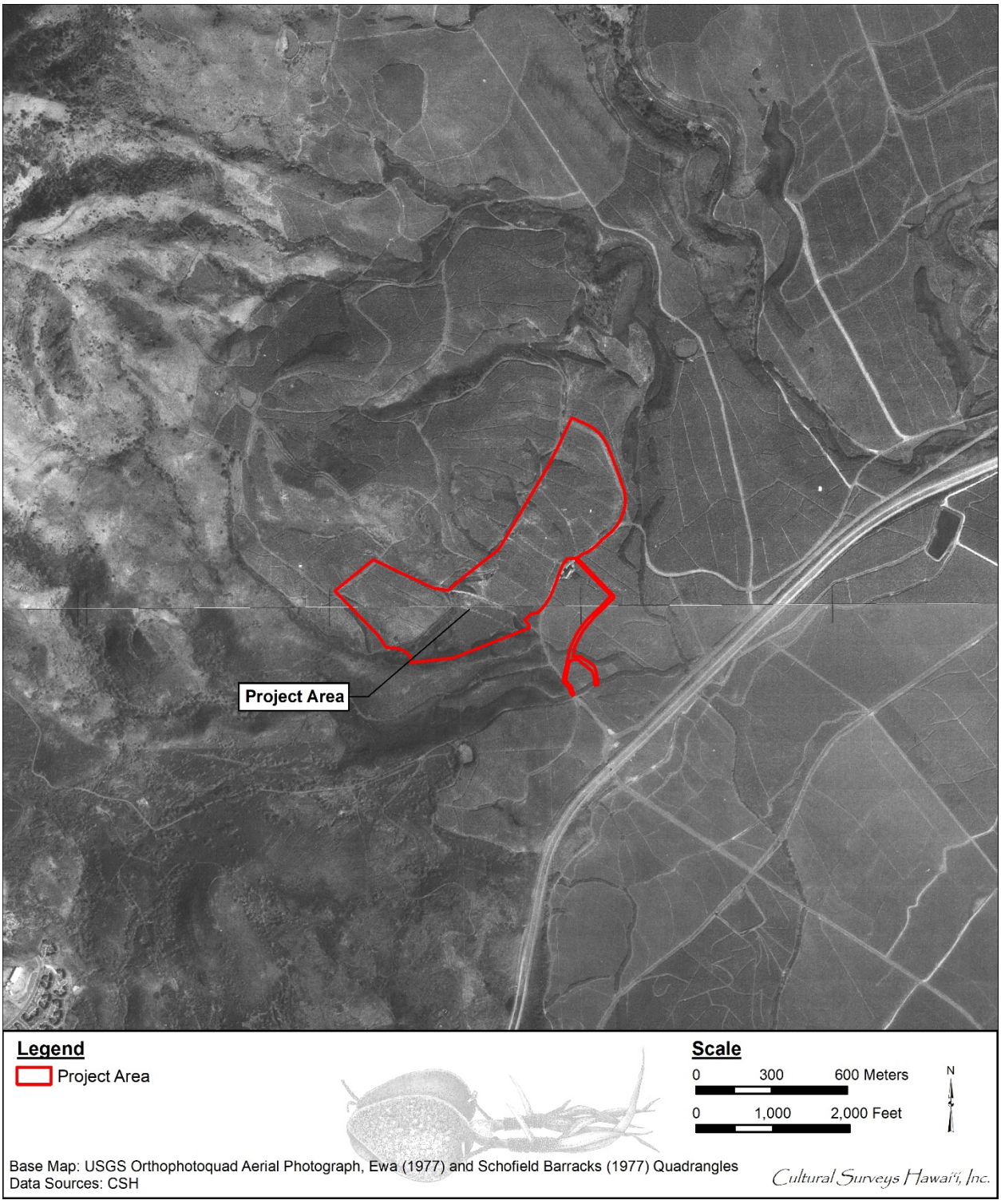

Figure 26. 1977 USGS Orthophotoquad aerial photograph, Ewa and Schofield Barracks quadrangles showing the project area

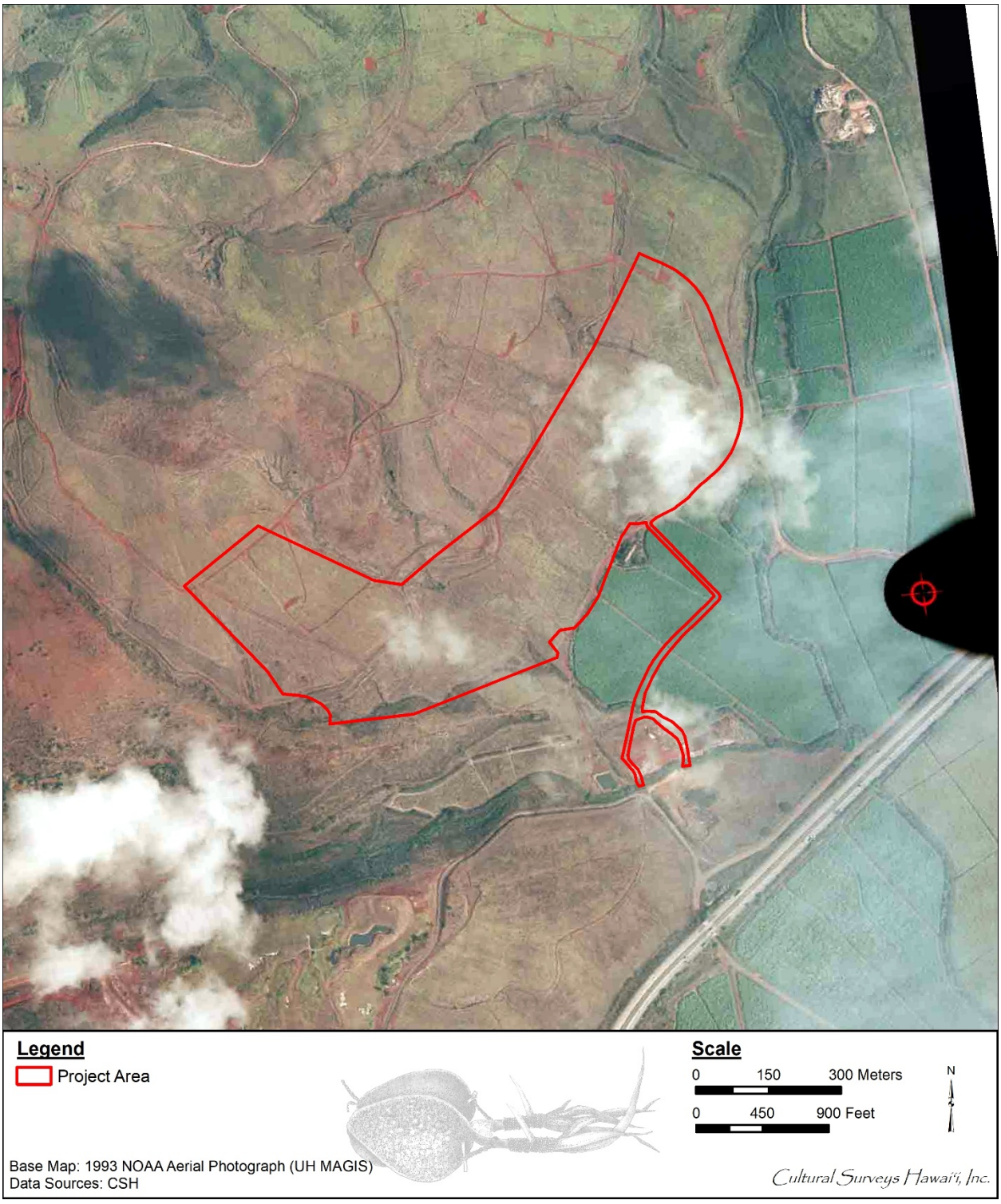

Figure 27. 1993 NOAA aerial photograph (UH MAGIS) showing the project area

Section 5 Previous Archaeological Research

Several archaeological studies have been conducted in the vicinity of the project area. This section discusses previous archaeological studies in the area (Figure 28 and Table 1) and identifies the types and locations of previously identified historic properties (Figure 29 and Table 2). There are no sites documented by McAllister (1933) in his early archaeological reconnaissance study of O‘ahu in the vicinity of the project area.

5.1 Archaeological Investigations in the Vicinity of the Project Area

5.1.1 Bordner 1977

In 1977, the Archaeological Research Center Hawaii, Inc. (Bordner 1977) conducted an archaeological reconnaissance survey of a then proposed Kalo‘i Gulch landfill location, 500 m west of the present project area. The study concluded the lower section of the gulch had been extensively modified through quarrying operations and cattle ranching. Foundations of both crushing and loading facilities were noted. In the upper reaches of the property, three walls of possible pre-Contact origin were documented between 1,250 and 1,300 ft elevation and were designated as SIHP #s 50-80-12-2600, -2601 and -2602. These three historic properties were in the extreme, upslope end of the large property more than 1.5 km from the present project area. SIHP # -2600 was a low (only 0.61 m or 2.0 ft high) wall of poorly stacked *pāhoehoe* (smooth, unbroken type of lava), approximately 7.62 m (25.00 ft) long set on top of a small knoll jutting out from the slope. SIHP # -2600 is described as a wall built on the stream terrace cut following the course of the stream, and constructed of stacked *pāhoehoe* with a total length of 67.70 m (222.1 ft), an average height of 0.91 m (3.0 ft) and incorporating in situ boulders into the wall. The wall appeared to have been constructed to protect a stream terrace from erosion. It also retained a terrace measuring approximately 12.0 m (39.4 ft) by 31.0 m (101.7 ft). SIHP # 50-80-12-2602 was a free-standing 18.2-m (59.7-ft) wall of stacked *pāhoehoe* that had the appearance of being a boundary wall. The historic properties were regarded as of “a marginal status” and no further archaeological work was recommended for the area covered in the reconnaissance survey.

5.1.2 Sinoto 1988

In 1988, the Bishop Museum Applied Research Group conducted a surface survey for a then proposed Makakilo Golf Course just southwest of the current project area (Sinoto 1988). The study concluded the majority of the project area had been damaged by severe erosion. No surface remains were documented within the project area and subsurface testing was deemed unnecessary. Just west (outside) of the golf course property, one deteriorated wall segment was documented on the northeast slope of Pu‘u Makakilo. The wall, designated SIHP # 50-80-12-1975, may have served as an “historic erosional control feature” (Sinoto 1988:1). Due to the deteriorated condition of the wall remnant, no further work was recommended.

5.1.3 Spear 1996

Scientific Consultant Services, Inc. conducted an archaeological reconnaissance survey of a large area extending from south of the H-1 freeway to the north side of Renton Road (Spear 1996). No historic properties were identified.

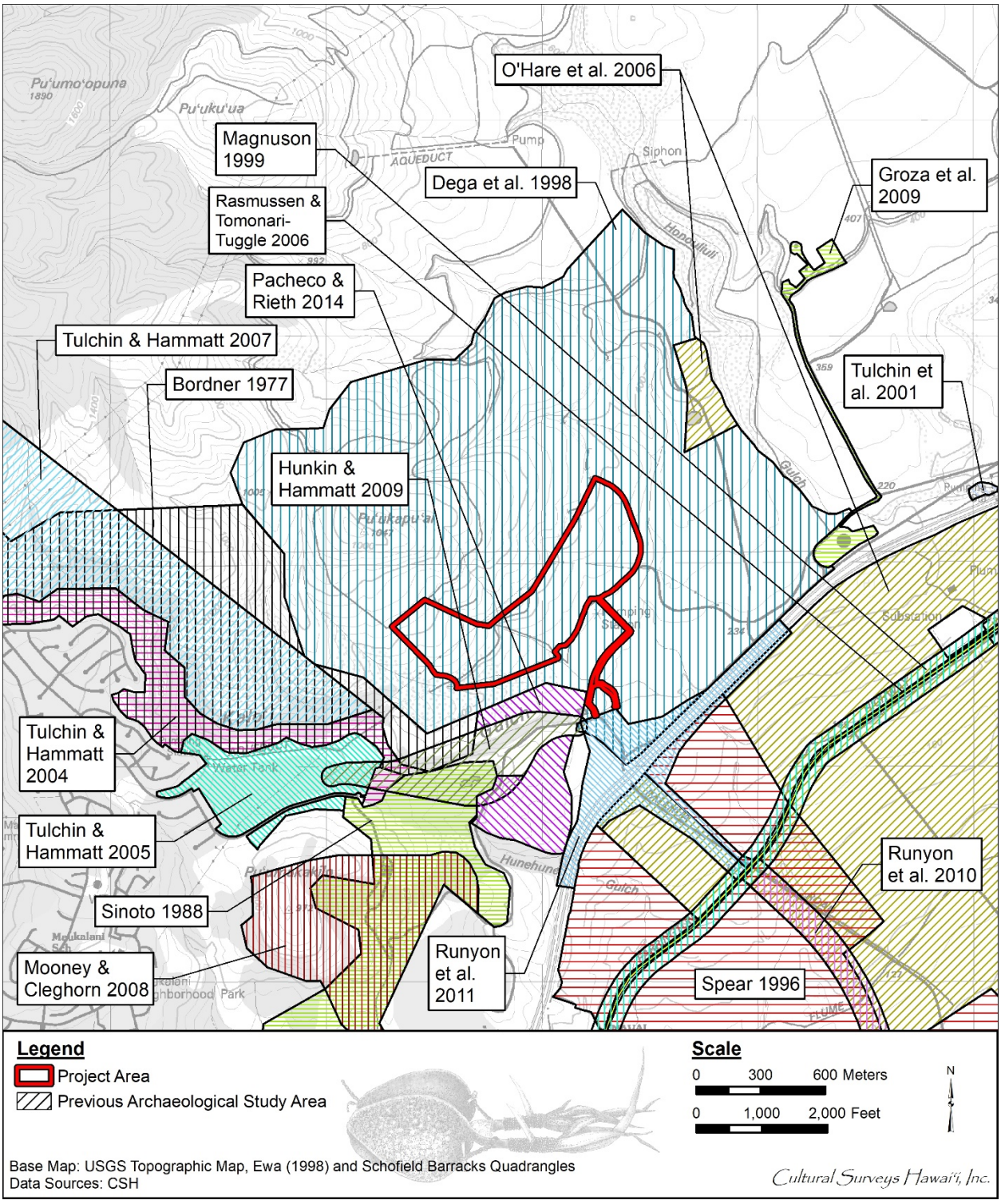

Figure 28. Portion of the 1998 Ewa and Schofield Barracks USGS topographic quadrangles showing the locations of previous archaeological studies in the vicinity (within approximately 1.5 km) of the project area

Table 1. Previous archaeological studies within the vicinity (within approximately 1.5 km) of the project area

Author	Type of Investigation	Location	Report Description and Results
Bordner 1977	Archaeological reconnaissance survey	Proposed Kalo‘i Gulch landfill location	Three walls designated as SIHP #s 50-80-12-2600, -2601 and -2602 in extreme west, upslope end of large project area, more than 1.5 km from present project area (and hence are not depicted in Figure 29)
Sinoto 1988	Archaeological reconnaissance survey	Makakilo Golf Course	Low stacked boulder wall, SIHP # 50-80-09-1975
Spear 1996	Archaeological reconnaissance survey	East Kapolei, TMK: [1] 9-1-016:017	No historic properties identified
Dega et al. 1998	Archaeological inventory survey	UH West O‘ahu, TMK: [1] 9-2-002:001	Two historic property complexes: historic irrigation and plantation infrastructure system (SIHP # 50-80-08-5593) and Waiahole Ditch System (SIHP # 50-80-09-2268)
Magnuson 1999	Archaeological reconnaissance survey	‘Ewa Plain	Identified six concrete bridges, a railroad track, and a set of unidentified concrete features; no SIHP #s assigned
Tulchin et al. 2001	Archaeological inventory survey	Proposed ‘Ewa Shaft Renovation project, Honouliuli Gulch, adjacent to west-bound lanes of H-1, TMK: [1] 9-2-001	SIHP # 50-80-08-6370, stone wall alignment; also documented large pumping station and shaft building
Tulchin and Hammatt 2004	Archaeological inventory survey	86-acre proposed Pālehua Community Association, TMKs: [1] 9-2-003:078 por. and 079	Four historic properties identified: a complex of concrete and iron structures associated with industrial rock quarry operations (SIHP # 50-80-12-6680); three boulder mounds believed to be related to land clearing or ditch construction by Oahu Sugar Co. (SIHP # 50-80-12-6681); a small terrace believed to function as a historic water diversion feature (SIHP # 50-80-12-6682); and a remnant portion of Waiahole Ditch (SIHP # 50-80-09-2268)

Author	Type of Investigation	Location	Report Description and Results
Tulchin and Hammatt 2005	Archaeological inventory survey	71-acre proposed Pālehua East B project, Makakilo, TMKs: [1] 9-2-003:076 and 078	Three historic properties identified: pre-Contact agricultural alignment and mound (SIHP # 50-80-12-6666), plantation-era stacked basalt boulder walls and a ditch (SIHP # 50-80-12-6667), and single alignment of upright basalt boulders and a small, low terrace (SIHP # 50-80-12-6668)
O'Hare et al. 2006	Archaeological inventory survey	Ho‘opili East Kapolei	Documented six previously identified historic properties: plantation infrastructure (SIHP # 50-80-12-4344); railroad berm (SIHP # 50-80-12-4345); northern pumping station (SIHP # 50-80-12-4346); central pumping station (SIHP # 50-80-12-4347); southern pumping station (SIHP # 50-80-12-4348); and documented four newly identified features of SIHP # 50-80-12-4344: a linear wall, stone-faced berm, concrete ditch, and concrete catchment
Rasmussen and Tomonari-Tuggle 2006	Archaeological monitoring	Waiau Fuel Pipeline corridor	No historic properties identified
Tulchin and Hammatt 2007	Archaeological literature review and field inspection	Approx. 790-acre parcel, TMKs: [1] 9-2-003:002 por. and 005 por.	Documented features interpreted as related to pre-Contact indigenous Hawaiian habitation (SIHP #s 50-80-08-2316 and 50-80-12-2602); historic ranching and related features (SIHP # 50-80-12-2601); and historic quarrying and related features (SIHP # 50-80-12-6680) and various pre- and post-Contact features (designated with temporary #s CSH1–CSH22)
Mooney and Cleghorn 2008	Archaeological reconnaissance survey	TMK: [1] 9-2-003:018	No historic properties identified
Groza et al. 2009	Archaeological inventory survey	TMKs: [1] 9-2-001:001 por., 004, 005, 006, 007 por.; 9-2-002:002	No historic properties identified

Author	Type of Investigation	Location	Report Description and Results
Hunkin and Hammatt 2009	Archaeological inventory survey	TMKs: [1] 9-2-002:006; 9-2-003:079	Documented two newly identified historic properties: irrigation ditches (SIHP #s 50-80-12-6950 and -6951); and one previously identified historic property, Waiahole Ditch (SIHP # 50-80-09-2268)
Runyon et al. 2010	Archaeological monitoring	TMKs: [1] 9-2-002:006; 9-2-003:079	No historic properties identified
Runyon et al. 2011	Archaeological monitoring	TMKs: [1] 9-1-018:001, 003, 004, 005; 9-2-002:001, 006	Documented two historic properties: a water diversion and a trash deposit (SIHP #s 50-80-12-4664 and -7128)
Pacheco and Rieth 2014	Archaeological inventory survey	East Kapolei Solar Farm, TMK: [1] 9-2-002:006 por.	Documented SIHP # 50-80-12-7433, an unpaved early twentieth century agricultural (ranching and/or sugarcane cultivation) road, understood as created between 1918 and 1928

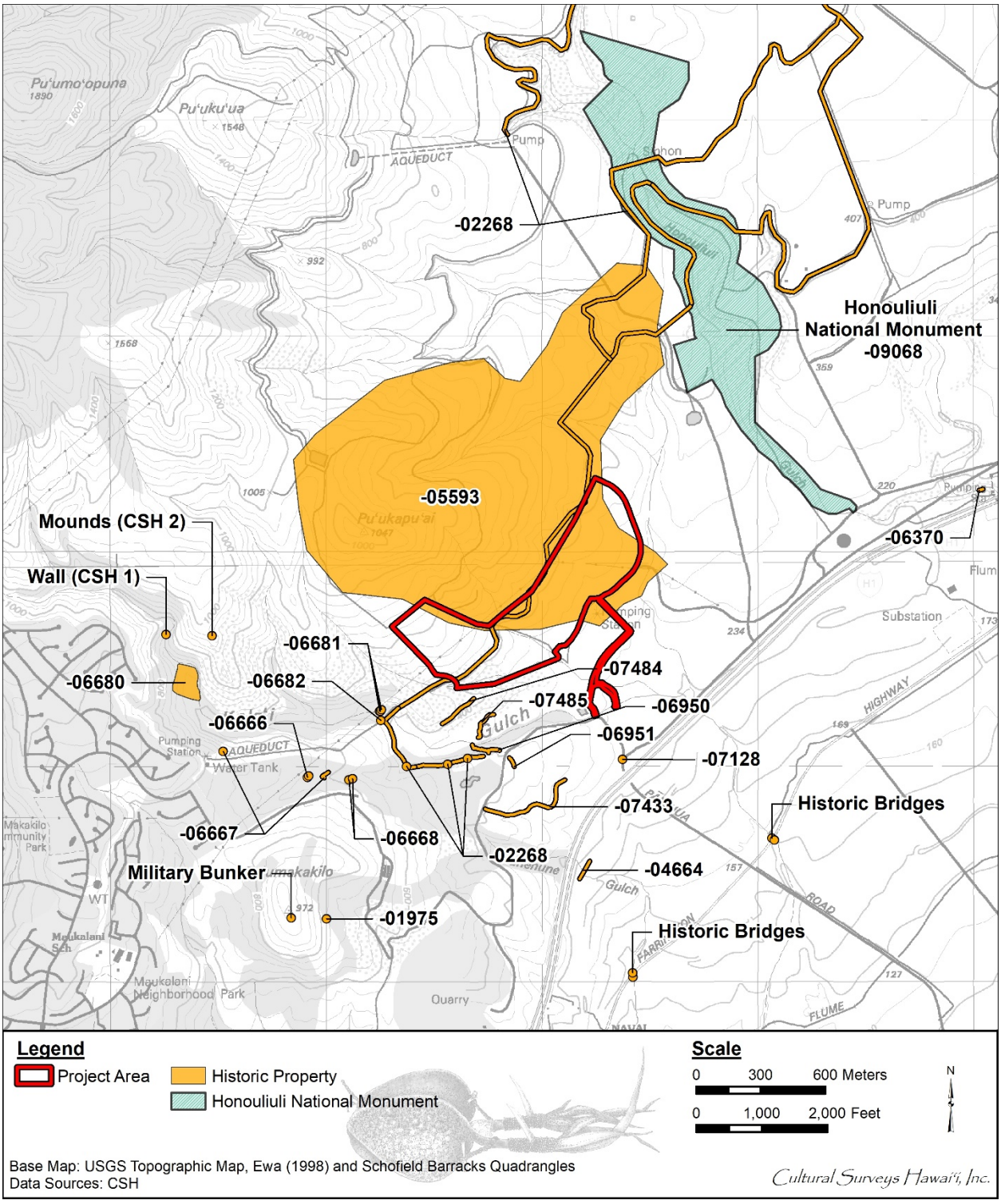

Figure 29. Portion of the 1998 Ewa and Schofield Barracks USGS topographic quadrangles showing the locations of previously identified historic properties in the immediate vicinity of the project area

Table 2. Previously identified historic properties in the vicinity of the project area

SIHP #	Description	Report Author(s)
50-80-08-5593	Plantation-era “flumes, aqueducts, ditches, pumps, and other irrigation features”	Dega et al. 1998
50-80-08-6370	Stone wall alignment, likely associated with cattle ranching or pumping station	Tulchin et al. 2001
50-80-09-2268	Waiahole Ditch System	Goodman and Nees 1991; Hammatt et al. 1996; Dega et al. 1998; Tulchin and Hammatt 2005; Hunkin and Hammatt 2009; Zapor et al. 2018; Shideler and Hammatt 2018
50-80-08-9068	Honouliuli National Monument (Internment Camp)	National Register
50-80-12-1975	Low-stacked boulder wall segment	Sinoto 1988
50-80-12-4664	Historic water diversion structure	Nakamura et al. 1993; Runyon et al. 2011
50-80-12-6666	Alignment and mound	Tulchin and Hammatt 2005
50-80-12-6667	Two walls	Tulchin and Hammatt 2005
50-80-12-6668	Alignment and terrace	Tulchin and Hammatt 2005
50-80-12-6680	Complex of concrete and iron structures associated with industrial rock quarry operations	Tulchin and Hammatt 2005
50-80-12-6681	Three boulder mounds believed to be related to land clearing or ditch construction by the Oahu Sugar Company	Tulchin and Hammatt 2005
50-80-12-6682	Terrace believed to function as an historic water diversion feature	Tulchin and Hammatt 2005
50-80-12-6950	Portion of a plantation-era irrigation ditch	Hunkin and Hammatt 2009
50-80-12-6951	Portion of a plantation-era irrigation ditch	Hunkin and Hammatt 2009
50-80-12-7128	Burned trash fill layer	Runyon et al. 2011

SIHP #	Description	Report Author(s)
50-80-12-7433	Unpaved early twentieth century agricultural (ranching and/or sugarcane cultivation) road, understood as created between 1918 and 1928	Pacheco and Rieth 2014
50-80-12-7484	Post-Contact irrigation ditch portion	Pacheco and Rieth 2014
50-80-12-7485	Post-Contact irrigation ditch portion	Pacheco and Rieth 2014
Historic Bridges	No SIHP #s assigned, no further documentation or mitigation recommended	Magnuson 1999
Military Bunker	WWII-era bunker	Mooney and Cleghorn 2008
CSH 1	Post-Contact wall related to historic ranching	Tulchin and Hammatt 2007
CSH 2 (Mounds)	Two basalt mounds interpreted as possible trail markers	Tulchin and Hammatt 2007

5.1.4 Dega et al. 1998

In 1998, Scientific Consultant Services, Inc. (SCS) conducted an archaeological inventory survey (AIS) for the University of Hawai‘i, West O‘ahu Campus project area (Dega et al. 1998). The project encompassed the entirety of the current project area. Several plantation-era “flumes, aqueducts, ditches, pumps, and other irrigation features occurring within the heavily modified landscape of the project area” were noted (Dega et al. 1998:i). The features represented an extensive complex of sugarcane irrigation features used from the 1920s through more recent times. The irrigation complex was designated SIHP # 50-80-08-5593. A portion of the Waiahole Ditch System (SIHP # 50-80-09-2268) (previously recorded by Goodman and Nees 1991) was also documented crossing through the northwest section of the subject parcel and continuing southwest through the lower agricultural fields. No artifacts were recovered from the project area. No further work was recommended for SIHP # 50-80-08-5593.

An overlay of the present project area on the Dega et al. (1998) plan map (Figure 30) indicates that it lies entirely within the south/central portion of that 1998 AIS project. While the Dega et al. (1998) plan map should probably be understood as a sketch, it does indicate certain remnants of plantation infrastructure (designated as SIHP # 50-80-08-5593) were present in the present project area in 1998.

5.1.5 Magnuson 1999

In 1999, an archaeological reconnaissance survey was completed by International Archaeological Research Institute, Inc. (IARII) for a Farrington Highway Expansion project extending along 5.3 km (3.3 miles) of Farrington Highway between Golf Course Road and Fort Weaver Road with a roughly 61-m (200-ft) wide corridor on each side (Magnuson 1999). The project identified six concrete bridges, one railroad track, and “a set of unidentified concrete features” (Magnuson 1999:17). The study concluded the following:

> The sites observed in the Farrington Highway Expansion project are neither exemplary sites of their kind nor unique. Therefore these sites have been adequately recorded during the investigations and no further work is necessary should preservation not be possible. [Magnuson 1999:25]

5.1.6 Tulchin et al. 2001

CSH archaeologists completed an AIS in support of a proposed ‘Ewa Shaft Renovation project. The ‘Ewa Shaft project is within Honouliuli Gulch, adjacent to the west-bound lanes of the H-1 Interstate Highway, approximately 1.7 km east of the present project area. That property included a pumping station enclosure and the surrounding area of approximately 1 acre. One historic property was documented, a stone wall alignment designated SIHP # 50-80-08-6370. Subsurface testing was conducted adjacent to the wall. The wall alignment was interpreted as constructed in association with cattle ranching or the pumping station. The study also documented a portion of the large pumping station and shaft building on the property.

5.1.7 Tulchin and Hammatt 2004

In 2004, CSH conducted an AIS to the west of the current project area for the Pālehua Community Association (PCA) in Makakilo (Tulchin and Hammatt 2004). Three overhang shelters were observed and tested, however, no cultural material was identified during excavation.

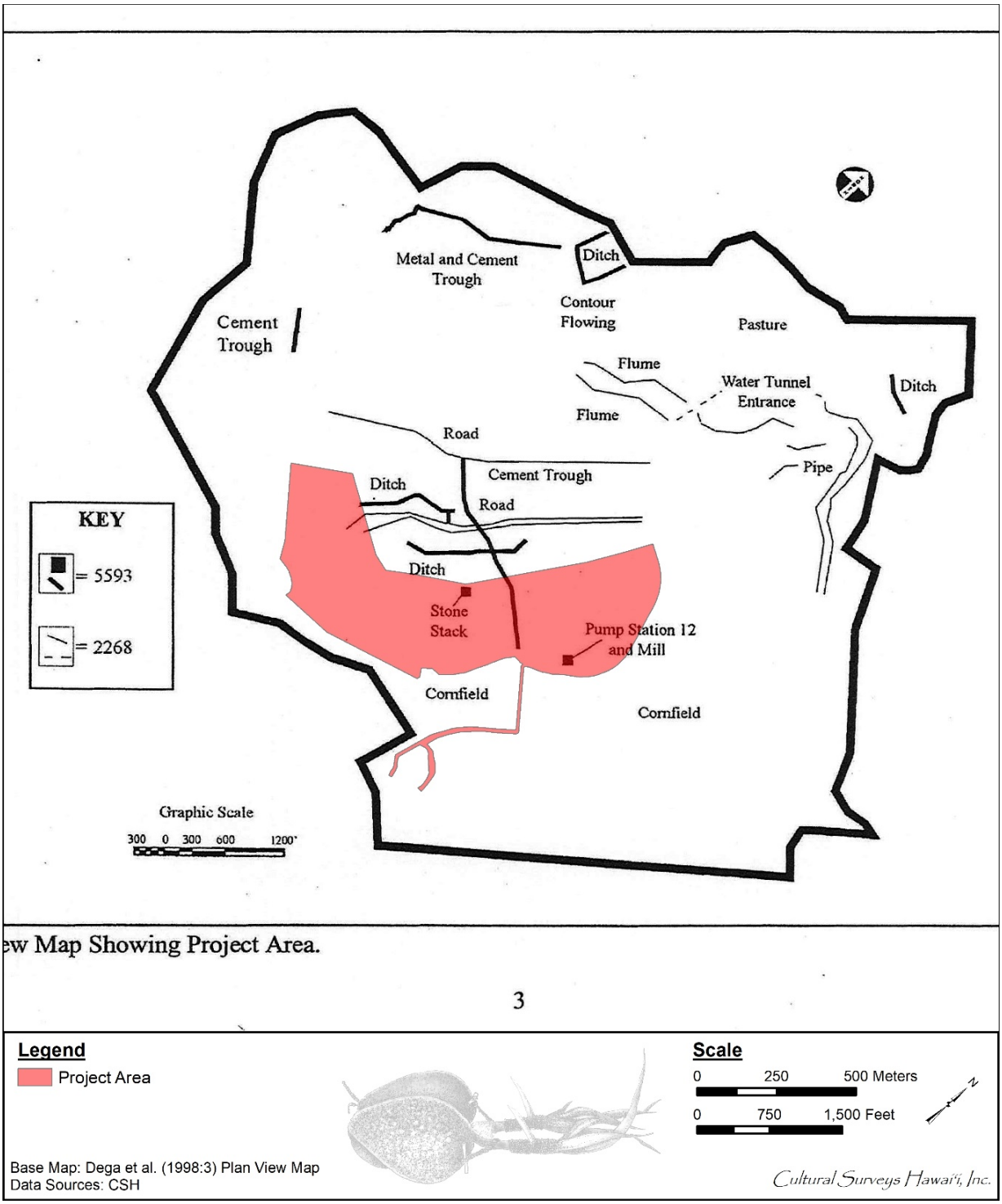

Figure 30. Plan map of the AIS for the University of Hawai‘i, West O‘ahu Campus project area showing historic properties (as of 1998) with an overlay of the current project area (adapted from Dega et al. 1998:3). This overlay suggests “Pump Station 12 and Mill” and a ditch were documented as within the present project area and another ditch and road and “Stone stack” were adjacent to the north side of the present project area.

The study documented several historic properties, including a complex of concrete and iron structures associated with industrial rock quarry operations (SIHP # 50-80-12-6680); three boulder mounds believed to be related to land clearing or ditch construction by the Oahu Sugar Company (SIHP # 50-80-12-6681); a small terrace believed to function as an historic water diversion feature (SIHP # 50-80-12-6682); and a remnant portion of the Waiahole Ditch (SIHP # 50-80-09-2268).

5.1.8 Tulchin and Hammatt 2005

In 2005, CSH conducted an AIS west of the current project area for the proposed Pālehua East B project in Makakilo (Tulchin and Hammatt 2005). The study identified three historic properties, including an alignment and a mound (SIHP #s 50-80-12-6666A and B), two walls (SIHP #s 50-80-12-6667A and B), and an alignment and terrace (SIHP #s 50-80-12-6668A and B). SIHP # 50-80-12-6667 is thought to contain remnants of plantation infrastructure. The historic properties were documented in an unnamed gully south of Kalo‘i Gulch.

5.1.9 O’Hare et al. 2006

In 2006, CSH conducted an AIS of approximately 1,600 acres for the East Kapolei project (subsequently known as the Ho‘opili project) (O’Hare et al. 2006) to the southeast of the present project area. The Ho‘opili project was bounded on the east by Fort Weaver Road, *makai* by Mango Tree Road, and *mauka* by the H-1 Freeway.

Several historic properties documented by the O’Hare et al. (2006) study were previously identified during an archaeological survey in 1990 (Hammatt and Shideler 1990). These previously identified historic properties included SIHP # 50-80-12-4344, plantation infrastructure; SIHP # 50-80-12-4345, railroad berm; SIHP # 50-80-12-4346, northern pumping station; SIHP # 50-80-12-4347, central pumping station; and SIHP # 50-80-12-4348, southern pumping station. Four additional archaeological features were documented by the O’Hare et al. (2006) study. These additional features, grouped under SIHP # 50-80-14-4344, include Feature D, a linear wall along the east bank of Honouliuli Stream; Feature E, a linear wall along the west bank of Honouliuli Stream; Feature F, a stone-faced berm constructed perpendicular to the orientation of the stream; and Feature G, a concrete ditch and concrete masonry catchment basement on the west bank of Honouliuli Gulch. None of the historic properties identified in the O’Hare et al. study (2006) were near the present project area.

5.1.10 Rasmussen and Tomonari-Tuggle 2006

In 2006, IARII conducted archaeological monitoring along the Waiau Fuel Pipeline corridor, extending from the Hawaiian Electric Company’s Barbers Point Tank Farm to the Waiau Generating Station (Rasmussen and Tomonari-Tuggle 2006). The Waiau Fuel Pipeline corridor follows Farrington Highway to Kunia Road, angles *makai* near Kunia Road, then continues east along the OR&L right-of-way near the Pearl Harbor coast. It appears no archaeological monitoring was conducted west of Waipi‘o Peninsula, as the corridor to the west had been determined to not be archaeologically sensitive. No historic properties were identified during archaeological monitoring.

5.1.11 Tulchin and Hammatt 2007

In 2007, an archaeological literature review and field inspection (Tulchin and Hammatt 2007) was done of an approximately 790-acre parcel at Pālehua, Makakilo. The inspection covered

portions of Makaīwa Gulch, Awanui Gulch, and Kalo‘i Gulch. Overall, 26 archaeological historic properties were identified during the field inspection. Four of these historic properties were identified during previous archaeological studies. SIHP # 50-80-08-2316 consists of a *ku‘ula* stone documented by the Bishop Museum (Kelly 1959). SIHP # 50-80-12-2601, a pre-Contact wall utilized as a water control feature, and SIHP # 50-80-12-2602, a pre-Contact wall possibly utilized for agriculture, were originally documented by Bordner in 1977 (Bordner 1977). SIHP # 50-80-12-6680, a complex of concrete and iron structures associated with industrial rock quarry operations was identified by CSH in 2004 (Tulchin and Hammatt 2004).

Newly identified historic features (designated with temporary CSH site #s) included CSH 1, wall; CSH 2, mounds; CSH 3, large enclosure; CSH 4, platform; CSH 5, mounds; CSH 6, adze; CSH 7, platform; CSH 8, terraces; CSH 9, enclosure and two small caves; CSH 10, enclosure; CSH 11, mound; CSH 12, platform; CSH 13, enclosure; CSH 14 terrace; CSH 15, wall remnant, hearth, and military “foxhole”; CSH 16, terrace and *hau* thicket; CSH 17, level soil along ridge; CSH 18, enclosure; CSH 19, trail; CSH 20 water tunnel; CSH 21, large boulder with petroglyphs; and CSH 22, enclosure with stone uprights. These potential historic properties were not assigned SIHP #s.

Other than the previously reported SIHP # -6680 complex of structures associated with industrial rock quarry operations, none of the identified historic properties were in the vicinity of the present project area.

5.1.12 Mooney and Cleghorn 2008

In 2008, Pacific Legacy, Inc. conducted an AIS (recorded as an archaeological assessment due to lack of finds) for the proposed Makakilo Quarry expansion (Mooney and Cleghorn 2008). No historic properties were identified; however, the remnants of a modern, abandoned golf course were noted.

5.1.13 Groza et al. 2009

In 2009, CSH conducted an AIS (recorded as an archaeological assessment) for the Ho‘opili project 440-Ft Elevation Reservoir and Water Line project (Groza et al. 2009). No historic properties were identified.

5.1.14 Hunkin and Hammatt 2009

In 2009, CSH completed an archaeological inventory survey for an approximately 62-acre Makakilo Drive extension project (Hunkin and Hammatt 2009). The project documented two newly identified historic properties (SIHP #s 50-80-12-6950 and -6951). Both historic properties are portions of plantation irrigation ditches. The ditches functioned to transport water for irrigation of the sugarcane fields.

In addition to the newly identified historic properties, a portion of the previously identified SIHP # 50-80-09-2268 alignment was documented. A meeting was held on site within the project area with CSH staff, SHPD staff, and Mr. Shad Kāne on 10 February 2009 to discuss the alignment within the project area. Mr. Kāne led the group along the graded alignment of SIHP # 50-80-09-2268, indicating the ditch had been constructed over the alignment of an ancient Hawaiian trail. SHPD staff observed the plantation irrigation ditch and associated infrastructure and concurred the alignment was a portion of the Waiahole Ditch System. SHPD staff also concluded the ditch was

most likely constructed over the alignment of a pre-Contact Hawaiian trail. SHPD staff expressed a concern that documentation make it clear the pre-Contact Hawaiian trail function was the dominant function of this designated site in the vicinity (which was then developed as the Waiahole Ditch in the early twentieth century).

Two new features (SIHP # 50-80-09-2268 Features B and C) associated with the main ditch were also documented. These features are drainage-related, with the function of preventing storm water and sediment from entering the main Waiahole Ditch.

5.1.15 Runyon et al. 2010

In 2010, CSH conducted archaeological monitoring for Phase 1B of the North-South Road project (Runyon et al. 2010). No historic properties were identified.

5.1.16 Runyon et al. 2011

In 2011, CSH completed archaeological monitoring for phase 1C of the North-South Road project (Runyon et al. 2011). Two historic properties were observed. A previously identified historic water diversion structure (SIHP # 50-80-12-4664), originally documented by Nakamura et al. (1993), was observed on the southwest edge of Ramp C. A newly identified burnt trash fill layer (SIHP # 50-80-12-7128) was documented directly under Pālehua Road on the west edge of Ramp A.

5.1.17 Pacheco and Rieth 2014

In 2014, IARII conducted an AIS (Pacheco and Rieth 2014) for an East Kapolei Solar Farm project (on approximately 19 acres of TMK: [1] 9-2-002:006).The study documented one historic property: SIHP # 50-80-12-7433, an unpaved early twentieth century road related to ranching and/or sugarcane cultivation in the area, understood as created between 1918 and 1928.

5.1.18 Zapor et al. 2018

CSH conducted a supplemental AIS for the Makakilo Drive Extension project. The survey identified two historic properties: portions of the Waiahole Ditch (SIHP # 50-80-09-2268) and irrigation ditches (SIHP # 50-80-12-6951). The project documented an additional feature of the Waiahole Ditch, an earthen mound and stacked stone wall, interpreted as likely remnants of a reservoir. SIHP # 50-80-12-6951 was observed as an irrigation ditch and associated retaining wall, pipe, valve, and sluice gate remnants.

Section 6 Community Consultation

6.1 Introduction

Throughout the course of this assessment, an effort was made to contact and consult with Native Hawaiian Organizations (NHO), agencies, and community members including descendants of the area, in order to identify individuals with cultural expertise and/or knowledge of the *ahupua‘a* of Honouliuli. CSH initiated its outreach effort in May 2019 through letters, email, telephone calls, and in-person contact.

6.2 Community Contact Letter

Letters (Figure 31 and Figure 32) along with a map and an aerial photograph of the project were mailed with the following text:

> On behalf of AES Distributed Energy, Inc. (AES), Cultural Surveys Hawai‘i Inc. (CSH) is conducting a cultural impact assessment (CIA) for the AES West O‘ahu Solar Plus Storage Project, Honouliuli Ahupua‘a, ‘Ewa District, O‘ahu Island. AES is proposing a solar photovoltaic (PV) and battery energy storage system (BESS) project to be located approximately 3 miles northeast of Kapolei in West O‘ahu. The project area includes approximately 80 acres and is within a portion of tax map key (TMK) 9-2-002:007, which is owned by the University of Hawai‘i (UH) in an area commonly referred to as the UH West O‘ahu Mauka property. The project area is depicted on a portion of the 2013 Ewa and Schofield Barracks U.S. Geological Survey (USGS) 7.5-minute topographic quadrangles, and 2018 Google Earth aerial photograph.
>
> The proposed project will involve construction and operation of an approximately 12.5-megawatt (MW) ground-mounted solar PV system, coupled with a 50 MW-hour BESS and related interconnection and ancillary facilities. The solar PV panels will be arranged in a series of evenly-spaced rows across the project area. The BESS will consist of containerized lithium-ion battery units and inverters distributed across the project area. This equipment will connect with a project substation via underground electrical conduit. The substation will be constructed adjacent to an existing Hawaiian Electric Company (HECO) 46kV transmission line that traverses the project area and will facilitate interconnection of the project to the HECO grid; an overhead electrical connection between the substation and existing transmission line may be required for interconnection. The project will be accessed via the existing gated entry off Kualakai Parkway and will utilize a network of existing and new onsite access roads. Some site grading will be needed to accommodate the project facilities and to comply with stormwater and civil engineering requirements and some of the existing access roads may need to be improved to support access to the project site. The project area will be secured for use by AES through a long-term lease (or similar agreement) with UH. The Project will be owned and operated by AES, and the power generated by the Project will be sold to HECO under a new 25-year power purchase agreement (PPA). It is anticipated that construction will

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Job code: HONOULIULI 172 ktanaka@culturalsurveys.com www.culturalsurveys.com

May 2019

Aloha,

On behalf of AES Distributed Energy, Inc. (AES), Cultural Surveys Hawai‘i Inc. (CSH) is conducting a cultural impact assessment (CIA) for the AES West O‘ahu Solar Plus Storage Project, Honouliuli Ahupua‘a, ‘Ewa District, O‘ahu Island. AES is proposing a solar photovoltaic (PV) and battery energy storage system (BESS) project to be located approximately 3 miles northeast of Kapolei in West O‘ahu. The project area includes approximately 80 acres and is within a portion of tax map key (TMK) 9-2-002:007, which is owned by the University of Hawai‘i (UH) in an area commonly referred to as the UH West O‘ahu Mauka property. The project area is depicted on a portion of the 2013 Ewa and Schofield Barracks U.S. Geological Survey (USGS) 7.5-minute topographic quadrangles, and 2018 Google Earth aerial photograph (Figure 1 and Figure 2).

The proposed project will involve construction and operation of an approximately 12.5-megawatt (MW) ground-mounted solar PV system, coupled with a 50 MW-hour BESS and related interconnection and ancillary facilities. The solar PV panels will be arranged in a series of evenly-spaced rows across the project area. The BESS will consist of containerized lithium-ion battery units and inverters distributed across the project area. This equipment will connect with a project substation via underground electrical conduit. The substation will be constructed adjacent to an existing Hawaiian Electric Company (HECO) 46kV transmission line that traverses the project area and will facilitate interconnection of the project to the HECO grid; an overhead electrical connection between the substation and existing transmission line may be required for interconnection. The project will be accessed via the existing gated entry off Kualakai Parkway and will utilize a network of existing and new onsite access roads. Some site grading will be needed to accommodate the project facilities and to comply with stormwater and civil engineering requirements and some of the existing access roads may need to be improved to support access to the project site. The project area will be secured for use by AES through a long-term lease (or similar agreement) with UH. The Project will be owned and operated by AES, and the power generated by the Project will be sold to HECO under a new 25-year power purchase agreement (PPA). It is anticipated that construction will require approximately 12-15 months, with commercial operations commencing in 2021 or 2022.

The purpose of this CIA is to gather information about the project area and the surrounding area through research and interviews with individuals that are knowledgeable about this area in order to assess potential impacts to cultural resources, cultural practices, and beliefs as a result of the proposed project. We are seeking your *kōkua* and guidance regarding the following aspects of our study:

Figure 31. Community consultation letter page one

- **General history as well as present and past land use of the project area**
- **Knowledge of cultural sites which may be impacted by future development of the project area—for example, historic and archaeological sites, as well as burials**
- **Knowledge of traditional gathering practices in the project area, both past and ongoing**
- **Cultural associations of the project area, such as *mo‘olelo* and traditional uses**
- **Referrals of *kūpuna* or elders and *kama‘āina* who might be willing to share their cultural knowledge of the project area and the surrounding *ahupua‘a* lands**
- **Any other cultural concerns the community might have related to Hawaiian cultural practices within or in the vicinity of the project area**

In advance, we appreciate your assistance in our research effort. If you are interested in participating in this study, please contact Kellen Tanaka at ktanaka@culturalsurveys.com. I am also available by phone at (808) 262-9972.

Mahalo nui loa,

Kellen Tanaka
Cultural Researcher

Figure 32. Community consultation letter page two

require approximately 12-15 months, with commercial operations commencing in 2021 or 2022.

The purpose of this CIA is to gather information about the project area and the surrounding area through research and interviews with individuals that are knowledgeable about this area in order to assess potential impacts to cultural resources, cultural practices, and beliefs as a result of the proposed project. We are seeking your *kōkua* and guidance regarding the following aspects of our study:

- **General history as well as present and past land use of the project area**
- **Knowledge of cultural sites which may be impacted by future development of the project area—for example, historic and archaeological sites, as well as burials**
- **Knowledge of traditional gathering practices in the project area, both past and ongoing**
- **Cultural associations of the project area, such as *mo‘olelo* and traditional uses**
- **Referrals of *kūpuna* or elders and *kama‘āina* who might be willing to share their cultural knowledge of the project area and the surrounding ahupua‘a lands**
- **Any other cultural concerns the community might have related to Hawaiian cultural practices within or in the vicinity of the project area**

In December 2019, CSH was notified of a slight modification to the project area to include additional areas along the perimeter of the project area, as well as maintenance of the existing roadways approaching the project area from the southeast. Revised letters (Figure 33 and Figure 34) along with a map and aerial photograph of the project area were mailed with the following revised text.

In May and June 2019, Cultural Surveys Hawai‘i (CSH), on behalf of AES Distributed Energy, Inc., reached out to the Honouliuli community regarding a cultural impact assessment (CIA) for the West O‘ahu Solar Project, Honouliuli Ahupua‘a, ‘Ewa District, O‘ahu Island TMK: [1] 9-002:007. As the project area has changed slightly, we are seeking additional input as part of the CIA consultation process.

As described in the previous consultation letter, the proposed West O‘ahu Solar project will involve construction and operation of an approximately 12.5-megawatt (MW) ground-mounted solar PV system, coupled with a 50 MW-hour BESS and related interconnection and ancillary facilities. The solar PV panels will be arranged in a series of evenly-spaced rows across the project area. The BESS will consist of containerized lithium-ion battery units and inverters distributed across the project area. This equipment will connect with a project substation via underground electrical conduit. The substation will be constructed adjacent to an existing Hawaiian Electric Company (HECO) 46kV transmission line that traverses the project area and will facilitate interconnection of the project to the HECO grid; an

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Job code: HONOULIULI 172 ktanaka@culturalsurveys.com www.culturalsurveys.com

January 2020

Aloha,

In May and June 2019, Cultural Surveys Hawai‘i (CSH), on behalf of AES Distributed Energy, Inc., reached out to the Honouliuli community regarding a cultural impact assessment (CIA) for the West O‘ahu Solar Project, Honouliuli Ahupua‘a, ‘Ewa District, O‘ahu Island TMK: [1] 9-002:007. As the project area has changed slightly, we are seeking additional input as part of the CIA consultation process.

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Recently, CSH was notified of a slight modification to the project area to include additional areas along the perimeter of the project area, as well as maintenance of the existing roadways approaching the project area from the southeast. Both the original project area and the revised project area are depicted in the attached figures (please refer to Figure 1 and Figure 2 noting “Original Project Area” and Figure 3 and Figure 4 noting “Revised Project Area”).

The purpose of this CIA is to gather information about the project area and the surrounding area through research and interviews with individuals that are knowledgeable about this area in order to assess potential impacts to cultural resources, cultural practices, and beliefs as a result of the proposed project. Specifically, the input sought through the CIA process includes the following aspects:

Figure 33. Revised community consultation letter page one

- **General history as well as present and past land use of the project area**
- **Knowledge of cultural sites which may be impacted by future development of the project area—for example, historic and archaeological sites, as well as burials**
- **Knowledge of traditional gathering practices in the project area, both past and ongoing**
- **Cultural associations of the project area, such as *mo‘olelo* and traditional uses**
- **Referrals of *kūpuna* or elders and *kama‘āina* who might be willing to share their cultural knowledge of the project area and the surrounding *ahupua‘a* lands**
- **Any other cultural concerns the community might have related to Hawaiian cultural practices within or in the vicinity of the project area**

In advance, we appreciate your assistance in our research effort. Please contact us by telephone or email if your *mana‘o* has changed or been affected by the changes to the project area. Please do not hesitate to contact Kellen Tanaka at ktanaka@culturalsurveys.com or by phone at (808) 262-9972 with any questions or additional *mana‘o*.

Mahalo nui loa,

Kellen Tanaka
Cultural Researcher

Figure 34. Revised community consultation letter page two

overhead electrical connection between the substation and existing transmission line may be required for interconnection. The project will be accessed via the existing gated entry off Kualaka‘i Parkway and will utilize a network of existing and new onsite access roads. Some site grading will be needed to accommodate the project facilities and to comply with stormwater and civil engineering requirements and some of the existing access roads may need to be improved to support access to the project site. The project area will be secured for use by AES through a long-term lease (or similar agreement) with UH. The Project will be owned and operated by AES, and the power generated by the Project will be sold to HECO under a new 25-year power purchase agreement (PPA). It is anticipated that construction will require approximately 12-15 months, with commercial operations commencing in 2021 or 2022.

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In most cases, two or three attempts were made to contact individuals, organizations, and agencies. Community outreach letters were sent to a total of 70 individuals or groups, 12 responded, one provided written testimony, and three of these *kama‘āina* and/or *kupuna* met with

CSH for more in-depth interviews. The results of the community consultation process are presented in Table 3.

6.3 Community Contact Table

Below in Table 3 are names, affiliations, dates of contact, and comments from NHOs, individuals, organizations, and agencies contacted for this project. Results are presented below in alphabetical order.

Table 3. Community contact table

Name	Affiliation	Comment
Alaka‘i, Robert	Cultural practitioner	Letter and Figures sent via USPS 14 May 2019 Letter and Figures sent via email 15 May 2019 Letter and Figures sent via email 28 June 2019 Revised Letter and Figures sent via email 3 January 2020
Barbieto, Leda	Raised in Ewa Plantation (Banana / Varona Camp)	Letter and Figures sent via USPS 14 May 2019 Letter and Figures sent via USPS 27 June 2019 Revised Letter and Figures sent via USPS 3 January 2020
Barbieto, Pio	Raised in Ewa Plantation (Banana / Varona Camp)	Letter and Figures sent via USPS 14 May 2019 Letter and Figures sent via USPS 27 June 2019 Revised Letter and Figures sent via USPS 3 January 2020
Basham, Leilani	Associate Professor of Hawaiian-Pacific Studies, University of Hawai‘i (UHWO)	Letter and Figures sent via email 15 May 2019 Letter and Figures sent via email 28 June 2019 Revised Letter and Figures sent via email 3 January 2020
Berg, Tom	Former Councilman, District 1	Mr. Berg contacted CSH via email 19 August 2019. His comments are provided below verbatim: *Please accept my comments for the Cultural Impact Assessment – AES West Oahu Solar and Storage Project-* *Please see attached* [Tom Berg’s letter is provided in full in Appendix A]. *In brief- I captured hundreds of sightings of pueo on camera- many are on youtubes- these pueo are along the Hunehune and Kaloi and Honouliuli Gulch Corridor which is served by the hill/slope where you favor the development.* *But with all this evidence of pueo right there on youtubes- to this day, UHWO / Attorney General / UH BOR / DLNR / USFWS / and OEQC claim in concert the videos are “fake” -*

Name	Affiliation	Comment
Berg, Tom (cont.)	Former Councilman, District 1	*How did they do that--come to the conclusion my videos of pueo are fake?* *The answer is- the proof- smoking gun if you will- whereby the Hawaii State Attorney General Claire Connors wrote a letter to State Representatives Bob McDermott and Rida Cabanilla on February 26, 2019 that reads- paraphrasing* [following bold text is in the original]*:* ***"No pueo use the property at UHWO- for no habitat is present on the property for the pueo to use- and thus, no pueo and their habitat existed or is on the property- per scientific research, surveys, and the Environmental Impact Statement done for the property."*** *Result? Entire pueo habitat destroyed. Pueo wrongfully extirpated from the property due to faulty protocol to inventory for these species from the onset.* *But alas- everyone can see with their own eyes two pueo engaged in courtship behavior at UHWO in these opening scenes* [following bold text is in the original] ***-see video link pasted below-*** *and it's a travesty our Attorney General would lie like this (and Chair DLNR Suzanne Case) and refute these scenes as rather being "fake and manufactured" and actually promote a faulty and deceptive representation of the property. The research/surveys that the Attorney General referenced in her letter covered up the fact the survey and research failed to include /physically go to the property for five months during the period/season when the pueo use and occupy UHWO:* [link to Chant for Pueo @ UHWO by Michael Kumukauoha Lee] *The pueo (and Hoary Bat) have been wrongfully extirpated from UHWO Makai Segment- and have henceforth, as can be proven, "transferred" their ecosystem/reliance from UHWO Makai Segment to the hill/UHWO Mauka Segment that you want to develop and place solar panels on.* *Remember now- DBEDT is bent on allowing what I have deduced to be possible illegal illumination of lighting on the Monsanto farm fields right next to your proposed solar project. The glare from these lights will most likely blind many avian species when reflected from your solar panels- at least contribute to their peril.* *Question is- are you going to adequately look for the bats and pueo or not at the solar project site before you blitz the area- what will be your protocol be to look for the endangered species on the property?*

Name	Affiliation	Comment
Berg, Tom (cont.)	Former Councilman, District 1	CSH replied via email 6 September 2019: *Mahalo for your response. We appreciate your input and acknowledge your concerns regarding the pueo and ‘ōpe‘ape‘a habitat within the project area and the importance of these species in Hawaiian culture. Your comments and concerns will be incorporated and addressed in the cultural impact assessment. Other due diligence studies that are being conducted for the project include an assessment of biological resources; your input regarding survey protocols for the two species will be shared with the biologists. The results of both the cultural and biological due diligence studies and impact analyses for the project will be included in an environmental assessment (EA) which will be published for public review.* Mr. Berg replied via email 6 September 2019: *With the assistance of Senator Mike Gabbard, we are now astute as to what the illumination of the night sky is all about near the proposed solar project @ Monsanto.* *Thank you for responding and please do include the lighting information- provided with and by Senator Gabbard’s Office/and DBEDT---Lights are used for soy bean growth and lighting are able to violate State Illumination Law as farmers were given waivers to blind migratory species.* *Please do inquire with Project Pueo Biologist Team- Dr. Melissa Price- and Dr. Javier Cotin and USFWS Jenny Hoskins- and DOFAW Biologist Afsheen Siddiqi- about pueo protocol.* *Mind you- this Pueo team approved of the FEIS (2005) for 500-acres of property known as UHWO - saying no pueo are there--* *I should say rather - these pueo experts had no objections to the FEIS protocol used at UHWO---------whereby in the biological survey for pueo at UHWO- get this---- the observer only looked for a few hours TOTAL over a period of two days within a week during the month of April when the pueo are not there.....and to cover 500-acres------and the DLNR stated in writing in the FEIS for UHWO--- “That was a thorough inventory process to search for pueo- satisfactory.”* *DLNR went on to state---* *“That’s good enough of a look for us- only 3-4 hours of observation need take place to determine on 500-acres if pueo are on the property or not.” ---And – in the FEIS for UHWO- they looked mid-morning hour- not before sunrise or at sunset when pueo are active----but mid morning when that bird ain’t to be seen.*

Name	Affiliation	Comment
Berg, Tom (cont.)	Former Councilman, District 1	*DLNR has proven they are corrupt and very dishonest indeed----* *These Project Pueo experts know that pueo do not have a defined breeding season- and are plot hoppers- and will deploy a foraging ecology- a breeding ecology- at different times of the seasons- and hence, these experts have stated that it is prudent to have the biological survey for pueo be conducted year round.* *These same pueo experts will also state the observation needs to take place at sunset and sunrise- if to be a proper protocol deployed.* *Can you answer if that will be done on this solar property? Year round observation?* *I have CC'd the Project Pueo experts in this email to have them confirm what a proper protocol of a duration of time should be deployed in which to observe a property / conduct the inventory/survey.* *I hope a three to four hour look on one day, then another couple of hours of a look on another day is not the protocol you will be using- and to do it while sitting in a car eating a burger and sipping on a milk shake. . . . like the protocol they used for UHWO.* CSH sent summary of written testimony to Mr. Berg for approval via email on 2 October 2019 Mr. Berg replied via email 3 October 2019: *Wow- it's beautiful- your work- my verbiage was a bit sloppy-* *So- I found two places where I made a mistake- and two areas I lacked the supporting documentation- four points total---* *1. On page 2- I stated it was the UHWO Mauka Segement- oops- I meant the* ***Makai*** *Segment-* *And - the date the FEIS was executed- accepted and signed by the Governor was in February of 2007, and not executed in 2005 or 2006 where referenced. Maybe the inventory exercise took place in 2005/2006- but it wasn't codified until 2007-* *2. Date was 2007- date it was accepted.* *3. I should have included the video links to justify the claim of Willful Indifference, Institutional Prejudice, Administrative Bias- - I am making a serious claim here- and this two-part video is my evidence to defend and substantiate my claim- it would be appreciated if you would attach it somehow--- :* [link to Mike Lee: The Willful Indifference /Pueo Habitat @ UHWO p.1; Mike Lee Willful Indifference @ UHWO p. 2] *This is relevant for the purpose that pueo extirpated from UHWO Hunehune and Kalio Gulches - headed mauka for*

Name	Affiliation	Comment
Berg, Tom (cont.)	Former Councilman, District 1	*refuge- they can't go east- can't go west- can't go south- so they went north up the gulches as this was their only option- and they need the slopes where these solar farm(s) are to be placed to have habitat for the pueo to forage- of course, only if the pueo has been determined as present via an adequate survey performed for the property ----* *4. And finally- the lights that blind the bats and owls- and others- these grow lights- may have been the cause of this barn owl to lose its eye- this owl was found dead one -half mile from the solar site- and this video is relevant as evidence - for I captured it flying back and forth under the grow lights- I have a youtube on it- not included below- and just a few weeks later- it died with this eye injury---DLNR refused to accept the carcass for a necropsy.* *I would appreciate if this evidence in the video- were too added- to support and substantiate my claim - for since no necropsy was performed, my claim in the video may be wrong- and the owl did not suffer from rat bait poison- but from the grow lights- so the evidence in the video is all we have to make a deduction- could be relevant if found to be a pattern latter on- best to include it even though my assessment may be pure conjecture- I can't prove what killed this owl--- your call:* [link to Brought to you by RAT Bait Poison/DEAD BARN OWL 7.22.19] *Mahalo! My sentence structure is not great- plenty of errors on my end- but that's fine - you captured my points- well done. Your work is appreciated.* Mr. Berg approved interview summary via email 3 October 2019: *There is one change--- DOFAW---- is: Division of Forestry and Wildlife- under DLNR.* *This concludes my review of the submission- however, omitted from it- is that nearby - is the Honouliuli Internment Camp US National Park Service development-* *"Who conducted the survey for pueo and bats for that project- if executed already?"* *I can't find status on that--- to then include that subject for comment-* Revised Letter and Figures sent via email 3 January 2020 Mr. Berg replied via email 3 January 2020: *Yes- I have issues on the changes - it appears the expansion to the south encroaches upon the gulch area- and or rather erodes any current foliage buffer of the gulch that is provided to wildlife-- this buffer appears to be taken /consumed by the project---*

Name	Affiliation	Comment
Berg, Tom (cont.)	Former Councilman, District 1	*How long do I have until the deadline to get you comments on this notice?* *Why is it necessary to encroach upon the gulch?* *Is there an explanation?* *Who did the biological survey for this project- or will there be one in the future before development?* CSH replied via email 7 January 2020: *The client has provided answers to your questions regarding the gulch area and the biological survey for the proposed project.* *AES does not intend to build any project facilities within the gulch along the southern boundary; however, the project area boundary has been adjusted to provide flexibility for natural features such as landscaping if warranted (either for visual screening purposes or in response to specific comments received as part of the cultural impact assessment). The preliminary project plans include maintenance of a natural vegetative buffer along the gulch.* *As part of the due diligence studies for the project, a general biological survey was conducted by Tetra Tech. In addition, surveys have been conducted specifically for pueo based on the protocol defined for The Pueo Project. Consistent with your previous input, the team has consulted with the State of Hawaii Department of Land and Natural Resources Division of Forestry and Wildlife (DOFAW) as well as researchers with The Pueo Project. This information will be detailed in the Draft Environmental Assessment, which is expected to be published in early 2020.* Mr Berg replied via email 8 January 2020: *I don't see any reference to any studies from Project Pueo being conducted on the property in question- do you?* *Please take a gander- see files attached* [Mr. Berg attached pdfs of The Pueo Project Final Report April 2017-March 2018; The Pueo Project Annual Report 2018; xcel file of UHWO pueo survey data] *if can- what do you conclude?* *Was there a separate commissioned exercise conducted for the solar area not in these reports- ?* CSH replied via email 10 January 2020: *Thank you for forwarding the attachments - we agree that the Pueo Project data do not appear to include surveys within the project area. The pueo surveys conducted within the project area, as referenced in our previous response, were not conducted by Pueo Project researchers as part of their research project. Rather, these were conducted as part of the due diligence efforts for the proposed solar project. These surveys were*

Name	Affiliation	Comment
Berg, Tom (cont.)	Former Councilman, District 1	*conducted by qualified biologists according to the protocol that was established for the Pueo Project (see Appendix 1 of the Final Report); DOFAW specifically references this protocol as the best methodology for pueo surveys. The results of these surveys will be included in the Draft Environmental Assessment, which is expected to be published in early 2020.* Mr. Berg replied via email 10 January 2020: *Ok- mahalo-*
Bond, John	Kanehili Cultural Hui	Letter and Figures sent via USPS 14 May 2019 Letter and Figures sent via USPS 27 June 2019 Mr. Bond replied via telephone on 28 June 2019 requesting letter and figures via email CSH followed up with Mr. Bond via email 6 August 2019 Revised Letter and Figures sent via USPS 3 January 2020
Caceras, Mana Kaleilani	OIBC Representative for ‘Ewa	Letter and Figures sent via email 15 May 2019 Letter and Figures sent via email 28 June 2019 Mr. Caceras replied via email on 13 August 2019: *E kala mai for not responding to your earlier request, been in the field quite a bit lately. I do not personally know of any mo‘olelo or cultural sites within the proposed project area but here is a short list of people who might. A few months ago I sat in a section 106 consultation for the Makakilo Drive Extension Project and these three gentlemen have so much knowledge of the area.* *Mr. Joseph Kūhiō Lewis, President, Kapolei Community Development Corporation* *Mr. Shad Kane, President, Kalaeloa Heritage and Legacy Foundation and Aha Moku Representative* *Mr. Douglas “McD” Philpotts, Hawaiian Cultural Practitioner* *Have a great evening.* CSH replied via email 14 August 2019 Revised Letter and Figures sent via email 3 January 2020 Mr. Caceras replied via email 15 January 2020: *Mahalo Kellen. Will look through the document and let you know if we have any information that could be useful to your CIA.* *Have a great weekend* CSH replied via email 23 January 2020
Cayan, Phyllis	Intake Specialist, SHPD	Letter and Figures sent via email 15 May 2019 DLNR.Intake.SHPD replied via email on 20 May 2019: *Aloha, your submittal is in the queue for review by the History & Culture Branch and is assigned log 2019.01148 for reference. Direct all inquiries on this matter to Regina Hilo and Hinano Rodrigues at their emails above.*

Name	Affiliation	Comment
		Revised Letter and Figures sent via email 3 January 2020
Cordy, Ross	Professor of Hawaiian-Pacific Studies, University of Hawai‘i (UHWO)	Letter and Figures sent via email 15 May 2019 Letter and Figures sent via email 28 June 2019 Revised Letter and Figures sent via email 3 January 2020
Cox, Malia	DHHL	CSH contacted Ms. Cox via email 16 September 2019: *My name is Kellen Tanaka. I am a cultural researcher with Cultural Surveys Hawaii (CSH) and have been assisting with the cultural impact assessment for the AES West O‘ahu Solar Plus Storage Project. We were forwarded DHHL’s comments for the pre-assessment for the Environmental Assessment for the AES West O‘ahu Solar Project. We would like to follow up with DHHL’s recommendations of consulting with Hawaiian Homestead community associations and Native Hawaiian Organizations. In the letter, it states there are six Hawaiian Homestead communities less than three miles from the proposed project. We have reached out to the Kanehili Hawaiian Homestead Association, Kapolei Community Development Corporation, Kaupea Homestead Association, and the Malu‘ohia Residents Association which were mentioned in the letter. Could you assist us in identifying the other two Hawaiian Homestead communities and contact information so we may reach out to them?* Ms. Cox replied via email 17 September 2019: *Kauluokahai Is the newest community. I don’t know that they have stood up a association at this time. KCDC might be able to help with identifying appropriate individuals in that community.* *Ill get back to you tomorrow on the remaining organization. I believe it is the undivided interests group, but will have to check my notes when I get back into the office tomorrow.* Ms. Cox replied via email 18 September 2019: *Attached, please find a copy of a portion of the latest lease report submitted to the HHC commission on 9/16/19. I’ve highlighted the communities identified on the report. Hoolimalima lessees are part of Maluohai resident community. If you need more information about the communities, please contact homestead services division (HSD)* Revised Letter and Figures sent via email 3 January 2020
Crabbe, Kamana‘o-pono	*Ka Pouhana* of OHA	Letter and Figures sent via USPS 14 May 2019 Letter and Figures sent via USPS 27 June 2019

Name	Affiliation	Comment
Cullen, Ty J.K.	Representative, House District 39	Letter and Figures sent via USPS 14 May 2019 Letter and Figures sent via email 15 May 2019 Letter and Figures sent via email 28 June 2019 Revised Letter and Figures sent via email 3 January 2020
DaMate, Leimana	Executive Director, DLNR-Aha Moku	Letter and Figures sent via USPS 14 May 2019 Letter and Figures sent via email 15 May 2019 Letter and Figures sent via email 28 June 2019 Revised Letter and Figures sent via email 3 January 2020 Ms. DaMate replied via email 8 January 2020: *Mahalo for contacting the Hawaii State Aha Moku and I would be happy to forward your request to our Aha Moku Representative Shad Kane, to whom I am encouraging a response to your email. Aside from being a historian of Ewa, and Honouliuli Ahupua'a, Shad is also in contact with generational cultural practitioners from the ahupua'a, including Kehaulani Lum (to whom I have also copied this email). I have also included Rocky Kaluhiwa, the Aha Moku Advisory Committee (AMAC) Chairperson for the State of Hawaii so she is aware of the activities on O'ahu. Rocky is also the AMAC rep for the Island of O'ahu. I am confident that between the three of these practitioners, you will be able to get answers and guidance for your project. Please feel free to contact me should you have any questions or concerns.* CSH replied via email 9 January 2020
De Santos, Kahulu	Cultural Advisor, Aulani, A Disney Resort and Spa	Letter and Figures sent via USPS 14 May 2019 Letter and Figures sent via USPS 27 June 2019 Revised Letter and Figures sent via USPS 3 January 2020
Eaton, Ku‘uwainani	Hoakalei Cultural Foundation	Letter and Figures sent via USPS 14 May 2019 Mail returned 17 May 2019
Farden, Hailama	President, Association of Hawaiian Civic Clubs	Letter and Figures sent via USPS 14 May 2019 Letter and Figures sent via email 15 May 2019 Letter and Figures sent via email 28 June 2019 Revised Letter and Figures sent via email 3 January 2020
Faulker, Kirsten	Executive Director, Historic Hawai‘i Foundation	Letter and Figures sent via USPS 28 May 2019 Letter and Figures sent via email 28 June 2019 Revised Letter and Figures sent via email 3 January 2020
Hanohano, Anolani	Kānehili Hawaiian Homestead	Letter and Figures sent via email 15 May 2019 Letter and Figures sent via email 28 June 2019 Revised Letter and Figures sent via email 3 January 2020

Name	Affiliation	Comment
Hilo, Regina	Burial Sites Specialist, SHPD	Letter and Figures sent via email 15 May 2019 Letter and Figures sent via email 28 June 2019 Ms. Hilo replied via email 28 June 2019: *Mahalo nui for sharing this. I'll forward to my colleagues*. CSH replied via email 28 June 2019 Revised Letter and Figures sent via email 3 January 2020
Holt Takamine, Victoria	Executive Director, PA‘I Foundation	Letter and Figures sent via USPS 14 May 2019 Letter and Figures sent via email 15 May 2019 Letter and Figures sent via email 28 June 2019 Revised Letter and Figures sent via email 3 January 2020
Gabbard, Mike	Senatorial District 20	Letter and Figures sent via USPS 14 May 2019 Letter and Figures sent via email 15 May 2019 Senator Gabbard replied via email 15 May 2019: *Mahalo for the information.* CSH replied via email 9 July 2019 Revised Letter and Figures sent via email 3 January 2020
Ito, Wallace K.	KUA Ewa Limu Project	Letter and Figures sent via email 22 May 2019 CSH followed up with Mr. Ito via email 6 August 2019 Mr. Ito replied via email 21 August 2019: *Sorry for not following through sooner. I just forwarded your request to other organizations doing malama ‘aina work in the Ewa Moku. You are cc'd on that so you should have received it a few minutes ago.* CSH replied via email 21 August 2019 Revised Letter and Figures sent via email 3 January 2020
Kai, G. Umi	President, ‘Aha Kāne	Letter and Figures sent via USPS 14 May 2019 Letter and Figures sent via email 15 May 2019 Letter and Figures sent via email 28 June 2019 Revised Letter and Figures sent via email 3 January 2020
Kaleikini, Ali‘ikaua	Cultural descendant	Letter and Figures sent via USPS 14 May 2019 Letter and Figures sent via USPS 27 June 2019 Revised Letter and Figures sent via USPS 3 January 2020
Kaleikini, Hāloa	Cultural descendant	Letter and Figures sent via USPS 14 May 2019 Letter and Figures sent via USPS 27 June 2019 Revised Letter and Figures sent via USPS 3 January 2020
Kaleikini, Kala	Cultural descendant	Letter and Figures sent via USPS 14 May 2019 Letter and Figures sent via USPS 27 June 2019 Revised Letter and Figures sent via USPS 3 January 2020
Kaleikini, Mahiamoku	Cultural descendant	Letter and Figures sent via USPS 14 May 2019 Letter and Figures sent via USPS 27 June 2019 Revised Letter and Figures sent via USPS 3 January 2020

Name	Affiliation	Comment
Kaleikini, Moehonua	Cultural descendant	Letter and Figures sent via USPS 14 May 2019 Letter and Figures sent via USPS 27 June 2019 Revised Letter and Figures sent via USPS 3 January 2020
Kaleikini, No‘eau	Cultural descendant	Letter and Figures sent via USPS 14 May 2019 Letter and Figures sent via USPS 27 June 2019 Revised Letter and Figures sent via USPS 3 January 2020
Kaleikini, Paulette Ka‘anohi	Cultural descendant	Letter and Figures sent via USPS 14 May 2019 Letter and Figures sent via email 15 May 2019 Letter and Figures sent via USPS 27 June 2019 Letter and Figures sent via email 28 June 2019 Revised Letter and Figures sent via USPS 3 January 2020 Revised Letter and Figures sent via email 3 January 2020
Kaleikini, Tuahine	Cultural descendant	Letter and Figures sent via USPS 14 May 2019 Letter and Figures sent via USPS 27 June 2019 Revised Letter and Figures sent via USPS 3 January 2020
Kane, Shad	‘Ewa Moku Representative, Aha Moku; Kalaeloa Heritage and Legacy Foundation	Letter and Figures sent via USPS 14 May 2019 Letter and Figures sent via email 15 May 2019 Letter and Figures sent via email 28 June 2019 CSH spoke with Mr. Kane via telephone 13 August 2019: *Mr. Kane stated that he is not in opposition to the proposed project. He noted the project area has been previously disturbed by sugar cane production.* Revised Letter and Figures sent via email 3 January 2020
Kanekoa, Mikiala	Hālau ‘o Kaululaua‘e	Letter and Figures sent via USPS 14 May 2019 Letter and Figures sent via email 15 May 2019 Letter and Figures sent via email 28 June 2019 Revised Letter and Figures sent via email 3 January 2020
Kauahi, R. Kaiulani Vincent	Culture and Arts Coordinator, Dept. Parks and Recreation	Letter and Figures sent via USPS 14 May 2019 Mail returned 17 May 2019
Keala, Jalna	Association of Hawaiian Civic Clubs	Letter and Figures sent via USPS 14 May 2019 Letter and Figures sent via email 15 May 2019 Letter and Figures sent via email 28 June 2019 Revised Letter and Figures sent via email 3 January 2020
Keaulana, Ha‘a	Cultural Advisor at Four Seasons Resort at Koolina	Letter and Figures sent via USPS 14 May 2019 Mail returned 17 May 2019
Keli‘inoi, Kalahikiola	Cultural descendant	Letter and Figures sent via USPS 14 May 2019 Letter and Figures sent via USPS 27 June 2019 Revised Letter and Figures sent via USPS 3 January 2020

Name	Affiliation	Comment
Keli‘inoi, Kilinahe	Cultural descendant	Letter and Figures sent via USPS 14 May 2019 Letter and Figures sent via USPS 27 June 2019 Revised Letter and Figures sent via USPS 3 January 2020
Kruse, Kehaulani	Outrigger Enterprises, Cultural Advisor	Letter and Figures sent via USPS 14 May 2019 Letter and Figures sent via email 15 May 2019 Letter and Figures sent via email 28 June 2019 Revised Letter and Figures sent via email 3 January 2020
Lee, Mike Kumukauoha	Kanehili Cultural Hui	Letter and Figures sent via USPS 14 May 2019 Letter and Figures sent via email 15 May 2019 Letter and Figures sent via email 28 June 2019
Legal, Jack	Chair, Makakilo/ Kapolei/Honokai Hale Neighborhood Board No. 34	Letter and Figures sent via USPS 14 May 2019 Letter and Figures sent via USPS 27 June 2019 Revised Letter and Figures sent via USPS 3 January 2020
Lewis, Joseph Kūhiō	President, Kapolei Community Development Corporation	Letter and Figures sent via USPS 14 May 2019 Letter and Figures sent via email 15 May 2019 Letter and Figures sent via email 28 June 2019 Revised Letter and Figures sent via email 3 January 2020
Lidstone, Miki‘ala	Executive Director, Ulu A‘e Learning Center	Letter and Figures sent via USPS 14 May 2019 Letter and Figures sent via email 15 May 2019 Letter and Figures sent via email 28 June 2019 Revised Letter and Figures sent via email 3 January 2020
Lilomaiava-Doktor, Sa‘iliemanu	Associate Professor of Hawaiian-Pacific Studies, University of Hawai‘i (UHWO)	Letter and Figures sent via email 15 May 2019 Letter and Figures sent via email 28 June 2019 Revised Letter and Figures sent via email 3 January 2020
Lopez, Kealii	Imua Hawaii	Letter and Figures sent via USPS 14 May 2019 Letter and Figures sent via email 15 May 2019 Letter and Figures sent via email 28 June 2019 Revised Letter and Figures sent via email 3 January 2020

Name	Affiliation	Comment
Luthy, Tamara	Ethnographer, DLNR	Letter and Figures sent via email 28 June 2019 Ms. Luthy responded via email 1 July 2019: *Good to hear from you! Thank you for letting me know about the project. I am cc'ing Kaahiki Solis and Hinano Rodrigues on this email. We request that when you finish your CIA that we may receive a copy as a professional courtesy so that we can keep it for our records in case any other archaeological, architectural, or ethnographic work in the same or adjourning regions comes through our office for review. I have also attached a few reports which may be of interest from the Ewa/Honouliouli area, though I didn't see anything from the exact TMK your project is in.* *SHPD policy dictates that we can only recommend ways to find research participants rather than pointing you to specific individuals. I would recommend putting out a notice in the Honolulu Star Advertiser, notifying OHA as well to see if anyone there can send out the information to relevant parties. It would be useful to follow up with any Hawaiian civic clubs in the area. It may be worthwhile to contact folks involved with the Ewa Limu Project, as they may know local resource users both mauka and makai. There is also an interview with Julia Powell and also one with Louis Aila Junior through the UH Oral History Project which discuss life in Ewa in the past, including some information on gathering plants. If you want to know more about ongoing gathering practices in the area, it would be worthwhile to reach out to local hula halaus and lā'au lapa'au practitioners. Hawaiian Studies and/or professors at UH Manoa and Leeward Community College may be good resources as well.* CSH replied via email 3 July 2019: *Mahalo for your quick response and all the information you provided. Those pdfs are very helpful. We will continue our outreach with those mentioned below. . .* Revised Letter and Figures sent via email 3 January 2020 Ms. Luthy replied via email 3 January 2020: *Hi there Kellen, I just got your email. I will look into it on Monday and get back to you soon.* CSH replied via email 6 January 2020
Lyman, Melissa	Kalaeloa Heritage and Legacy Foundation, President	Letter and Figures sent via USPS 14 May 2019 Letter and Figures sent via email 15 May 2019 Letter and Figures sent via email 28 June 2019 Revised Letter and Figures sent via email 3 January 2020

Name	Affiliation	Comment
Malama, Tesha	‘Ewa Villages Association	Letter and Figures sent via USPS 14 May 2019 Letter and Figures sent via USPS 27 June 2019 Revised Letter and Figures sent via USPS 3 January 2020
McKeague, Kawika	Cultural practitioner, Honouliuli historian and longtime resident	Letter and Figures sent via USPS 9 August 2019 Revised Letter and Figures sent via email 3 January 2020
Medeiros, Pōhai	PIKO Program Advisor, University of Hawai‘i West O‘ahu	Letter and Figures sent via USPS 9 August 2019 Revised Letter and Figures sent via email 3 January 2020
Nahulu-Mahelona, Moani	Hawaiian Studies Department, Kapolei HS	Letter and Figures sent via USPS 14 May 2019 Letter and Figures sent via USPS 27 June 2019 Revised Letter and Figures sent via USPS 3 January 2020
National Park Service Honouliuli National Monument		Letter and Figures sent via USPS 14 May 2019 Letter and Figures sent via email 15 May 2019 CSH reached out the Ms. Jacqueline Ashwell via email 30 July 2019 Ms. Ashwell replied via email 30 July 2019: *I am away on detail to another agency, returning to the NPS in November of 2019.* *While I am away, please direct all matters related to Pearl Harbor National Memorial and Honouliuli National Monuments to Steve Mietz . . .* CSH reached out to Mr. Steven Mietz via email 30 July 2019 Revised Letter and Figures sent via email 3 January 2020 Hanako Wakatsuki-Chong replied on behalf of the PWR Honouliuli on 14 January 2020: *Thank you for reaching out to us about the cultural impact assessment for the West O‘ahu solar panel project. I have cc’d Katie Bojakowski, the Chief of Cultural and Natural Resources; Jacqueline Ashwell, Superintendent; and Melia Lane-Kamahele, NPS Regional Office Manager. When do you need comments by?* CSH replied via email 14 January 2020: *Mahalo for your response and for forwarding our request to those mentioned below. We look forward to hearing from them. We kindly ask for your response by February 3, 2020. Feel free to contact me if you any questions.*

Name	Affiliation	Comment
Paglinawan, Lynette	Cultural practitioner; Educator, teaches a course on Native Hawaiian Healing at University of Hawai‘i West O‘ahu	CSH met with Ms. Palignawan 14 October 2019 Interview summary sent to Ms. Palignawan via USPS 22 October 2019 Revised summary sent for review and approval via USPS 19 November 2019 CSH followed up with Ms. Paglinawan via email 27 December 2019 Revised Letter and Figures sent via USPS 3 January 2020 Revised summary sent for review and approval 14 January 2020 Ms. Paglinawan approved summary 15 January 2020
Paik, Linda Kaleo	Cultural practitioner/ Secretary/Treasurer for Koa Ike Cultural Specialist; Former History and Culture, SHPD ‘Aha Wahine Aha Moku Committee, Kona District, Oahu	Letter and Figures sent via USPS 14 May 2019 Letter and Figures sent via email 15 May 2019 Letter and Figures sent via email 28 June 2019 Revised Letter and Figures sent via email 3 January 2020
Paishon, Jr., Frank	Raised in Tenney Village	Letter and Figures sent via USPS 14 May 2019 Letter and Figures sent via USPS 27 June 2019 Revised Letter and Figures sent via USPS 3 January 2020
Patterson, Kaleo	Native Hawaiian Church; Pacific Justice & Reconciliation Center	Letter and Figures sent via USPS 14 May 2019 Letter and Figures sent via email 15 May 2019 Letter and Figures sent via email 28 June 2019 Revised Letter and Figures sent via email 3 January 2020
Puahala, Roth	President, Ke One O Kakuhihewa	Letter and Figures sent via USPS 14 May 2019 Letter and Figures sent via email 15 May 2019 Letter and Figures sent via email 28 June 2019 Revised Letter and Figures sent via email 3 January 2020
Ramos, Rodolfo	President, Ewa Villages Community Association; Chair of ‘Ewa Task Force	Letter and Figures sent via USPS 14 May 2019 Letter and Figures sent via USPS 27 June 2019 Revised Letter and Figures sent via USPS 3 January 2020

Name	Affiliation	Comment
Rodenhurst, Roda	President, ‘Ahahui Siwila Hawai‘i o Kapolei Hawai‘i O Kapolei (Kapolei Hawaiian Civic Club)	Letter and Figures sent via USPS 14 May 2019 Letter and Figures sent via email 15 May 2019 Letter and Figures sent via email 28 June 2019 Revised Letter and Figures sent via email 3 January 2020
Rodrigues, Hinano	SHPD, Interim History and Cultural Branch Chief (O‘ahu and Maui)	Mr. Rodrigues forwarded email to Ms. Regina Hilo 14 June 2019 Revised Letter and Figures sent via email 3 January 2020
Saul, Melissa	Associate Specialist, Title III PIKO Project Director, University of Hawai‘i West O‘ahu	Letter and Figures sent via USPS 9 August 2019 Revised Letter and Figures sent via email 3 January 2020
Schaedel, Homelani	President, Malu‘ōhai Residents Association	Letter and Figures sent via email 17 September 2019 Revised Letter and Figures sent via email 3 January 2020
Serrao, Marleen Kau‘i	Pelekikena, ‘Ewa-Pu‘uloa Hawaiian Civic Club	Letter and Figures sent via USPS 14 May 2019 Letter and Figures sent via email 15 May 2019 Letter and Figures sent via email 28 June 2019 Revised Letter and Figures sent via email 3 January 2020
Shibuya, Barbara	*Kama‘āina* of ‘Ewa, member of the Shibuya Dayanan Family	Letter and Figures sent via email 15 May 2019 Letter and Figures sent via email 28 June 2019 Revised Letter and Figures sent via email 3 January 2020
Silva, Adrian Nakea	Chariman, Hui Huliau Inc.	Letter and Figures sent via USPS 14 May 2019 Letter and Figures sent via email 15 May 2019 Letter and Figures sent via email 28 June 2019 Revised Letter and Figures sent via email 3 January 2020
Solis, Ka‘āhiki	SHPD, Cultural Historian (O‘ahu)	Letter and Figures sent via email 15 May 2019 Letter and Figures sent via email 28 June 2019 Revised Letter and Figures sent via email 3 January 2020 Ms. Solis replied via email 6 January 2020: *Mahalo and good luck with your project.* CSH replied via email 9 January 2020

Name	Affiliation	Comment
Suganuma, La‘akea	President, Royal Hawaiian Academy of Traditional Arts and Nā Lei Ali‘i Kawananakoa	Letter and Figures sent via USPS 14 May 2019 Letter and Figures sent via email 15 May 2019 Letter and Figures sent via email 28 June 2019 Revised Letter and Figures sent via email 3 January 2020
Swinney, Shirley S.	Vice President, Kapolei Community Development Corporation; Hawaii Community Development Authority	Letter and Figures sent via USPS 14 May 2019 Letter and Figures sent via USPS 27 June 2019 Revised Letter and Figures sent via USPS 3 January 2020
Uyeoka, Kelly	Nohopapa	Letter and Figures sent via email 22 August 2019 Revised Letter and Figures sent via email 3 January 2020
Ward, Sandy	Executive Director, Mālama Pu‘uloa	Ms. Ward was forwarded letter and figures by Mr. Wally Ito on 21 August 2019 Ms. Ward replied via email 21 August 2019: *did you follow up on the Nohopapa `Ewa Inventory I suggested? - that is the best research on cultural significance and wahi pana I have seen -. . . It‘s organized by ahupua`a so it‘s easy to find information and I suggest you contact them directly to assist you if you don‘t find the information you are looking for in their publication.* CSH replied via email 22 August 2019 Revised Letter and Figures sent via email 3 January 2020
Wong-Kalu, Hinaleimoana	OIBC Chair	Letter and Figures sent via USPS 14 May 2019 Letter and Figures sent via email 15 May 2019 Letter and Figures sent via email 28 June 2019 Revised Letter and Figures sent via email 3 January 2020
Woode Jr., Lawrence A.	Pelekikena, Hawaiian Civic Club of ‘Ewa-Pu‘uloa	Letter and Figures sent via USPS 14 May 2019 Letter and Figures sent via USPS 27 June 2019 Revised Letter and Figures sent via USPS 3 January 2020
Woode, Napali	Native Hawaiian Economic Alliance	Letter and Figures sent via USPS 14 May 2019 Letter and Figures sent via email 15 May 2019 Letter and Figures sent via email 28 June 2019 Revised Letter and Figures sent via email 3 January 2020

Name	Affiliation	Comment
Wond, Kanani	Vice President, Kaupe‘a Homestead Association	Letter and Figures sent via USPS 14 May 2019 Letter and Figures sent via email 15 May 2019 Letter and Figures sent via email 28 June 2019 Revised Letter and Figures sent via email 3 January 2020
Yee, Christian	*Kama‘āina*, familiar with *wahi pana* and *mo‘olelo*	Letter and Figures sent via USPS 14 May 2019 Letter and Figures sent via email 15 May 2019 CSH spoke with Mr. Yee briefly on 18 May 2019: Mr. Yee expressed interest in visiting the Honouliuli Internment Camp. Letter and Figures sent via email 28 June 2019 CSH followed up with Mr. Yee via telephone on 9 August 2019 CSH met with Mr. Yee on 9 August 2019 CSH sent summary for approval 24 September 2019 Mr. Yee approved summary 3 October 2019 Revised Letter and Figures sent via email 3 January 2020

6.4 Written Testimony from Tom Berg

Tom Berg, former City Councilman, provided CSH with written testimony on 19 August 2019 regarding the AES West O‘ahu Solar Plus Storage Project. Mr. Berg’s entire testimony is included in Appendix A.

Mr. Berg stated that the project has been “proposed on a pueo (owl) foraging and breeding ecosystem.” The *pueo* (Hawaiian short-eared owl, *Asio flammeus sandwichensis*) are found on all of the main Hawaiian islands and are listed by the State of Hawai‘i as endangered on the island of O‘ahu (DLNR 2005). The Department of Land and Natural Resources (DLNR) states that *pueo* are most commonly found in “open habitats such as grasslands, shrublands, and montane parklands, including urban areas and those actively managed for conservation” (DLNR 2005).

Mr. Berg noted that records indicate that per earliest colonial contact, the *pueo* is most abundant on the slopes from Pu‘ukapuai to West Loch, in the area where the project is slated. He added that “Hunehune Gulch, Kaloi Gulch, and Honouliuli Gulch are migratory routes used by the pueo to go from mountain to sea to court, mate, forage, and raise their brood.” He noted tat *pueo* are not forest dwellers, preferring “scrub, open fields/dirt landscapes with some grass.” He stated that the proposed project will “encroach on prime pueo habitat-considered to be graded A+—“a ten (10)”—when it comes to the degree of pueo habitat in use on this project site.”

Mr. Berg added that the *pueo* has “a direct connection to Native Hawaiian family lineage in Ewa Beach;” the *pueo* is the *‘aumakua* for the Michael Lee family and their accounts, which go back over seven generations, are documented at the State Archives Building in Honolulu.

Mr. Berg also stated that the project site is “inhabited by the ōpe‘ape‘a [Hawaiian hoary bat, *Lasiurus cinereus semotus*] at various times of the seasons,” noting that in 1910, the State of Hawai‘i documented *‘ōpe‘ape‘a* within a half-mile of the project area. *‘Ōpe‘ape‘a* is “the only land mammal native to the Hawaiian archipelago” and is found on all of the main Hawaiian islands except for Ni‘ihau (DLNR 2005:3-13). DLNR states *‘ōpe‘ape‘a* have been “found roosting in

‘ōhi‘a (*Metrosideros polymorpha*), pu hala (*Pandanus tectorius*), coconut palms (*Cocos nucifera*), kukui (*Aleurites moluccana*), kiawe (*Proscopis pallida*), avocado (*Persea americana*), shower trees (*Cassie javanica*), pūkiawe (*Styphelia tameiameiae*), and fern clumps; they are suspected to roost in Eucalyptus (*Eucalyptus* spp.) and Sugi pine (*Cyrptomeria japonica*) stands" (DLNR 2005).

Mr. Berg stated his concern that the "property in question will not receive the proper protocol to conclude no endangered species inhabit the area." He asked "what protocol will be deployed to determine if the population of both the pueo and ‘ōpe‘ape‘a are served by habitat on the property?" He discussed five points which he felt need to be addressed:

1. Who will look for the *pueo* and *‘ōpe‘ape‘a* on the land? What is their expertise and qualifications as observers?
2. Did the observation to inventory for the species transpire before sunrise and after the sunset periods when the *‘ōpe‘ape‘a* and *pueo* are most active and can be recorded?
3. Did the observer conduct the biological survey whereby the inventory for the species was repeated year-round over the wet and dry seasons?
4. What tools were used—visual aids in the field—techniques to identify the species while observing/conducting the inventory?
5. Was the inventory to assess and survey for *pueo* and *‘ōpe‘ape‘a* done completely on foot or was a vehicle used?

Mr. Berg stated that to properly account for the *pueo* and *‘ōpe‘ape‘a*, the DLNR and United States Fish and Wildlife Service (USFWS) have developed a protocol which states inventory surveys should "be executed over the changing seasons year-round." However, Mr. Berg noted that "this practice, to deploy the protocol year-round, is not being done in either the EA [Environmental Assessment] and or EIS [Environmental Impact Statement] review processes." He added his opinion that surveys must be "undertaken after sunset and before the sunrise periods."

Mr. Berg discussed the recent population distribution survey for *pueo* on the island of O‘ahu that included the University of Hawai‘i West O‘ahu (UHWO) Makai Segment. The survey, conducted between 31 December 2017 and early August 2018, concluded no *pueo* or its habitat existed on the UHWO property, however, Mr. Berg notes that *pueo* inhabit the property "throughout the months of late August, through September, October, November, and vacate late December." He added that had the survey been conducted year-round, the survey would have "reported a pueo ecosystem thriving on the property and many Native Hawaiians' ‘aumakua would be protected rather than purged from the property."

In his statement, Mr. Berg provided links to videos of *pueo* observed on the UHWO property. He noted that despite these videos, UHWO, University of Hawai‘i (UH) Board of Regents, DLNR, and the Attorney General have stated the *pueo* "did not and have not ever existed there." He stated that this claim is "a violation of the law- HRS [Hawai‘i Revised Statutes] Ch. 343 that protects endangered species and their habitat."

He added that Governor Ige's Administration's claim that "absolutely no pueo used UHWO property," is in his opinion, "not only patently false–but a deliberate act of Administrative Bias, Institutional Prejudice—and a willful act of Malice—to cause direct harm to an endangered specie- a 100% violation of Article XII, Section VII of Hawaii's State Constitution that protects Native Hawaiian Religious and Cultural Practices and their ‘aumakua." To justify his claims, Mr. Berg

provided the links to the following videos hosted on YouTube: Mike Lee: The Willful Indifference / Pueo Habitat @ UHWO p.1 [https://www.youtube.com/watch?v=7z8-7u3Q0Bo] and Mike Lee: Willful Indifference @ UHWO p.2 [https://www.youtube.com/watch?v=Db46xPfazVQ]. He added that "pueo extirpated from UHWO Hunehune and Kaloi Gulches – headed mauka for refuge – they can't go east- can't go west- can't go south- so they went north up the gulches as this was their only option- and they need the slopes where these solar farm(s) are to be placed to have habitat for the pueo to forage- of course, only of the pueo has been determined as present via an adequate survey performed for the property ----."

Mr. Berg also expressed his concern for the possible negative aspects of light at an adjacent parcel. He expressed concern that a solar panel may reflect neighboring lighting operations into "the flight patterns of migrating birds and the *ʻōpeʻapeʻa* and *pueo* in particular need to be addressed."

On 6 September 2019, a corresponding email was sent by Mr. Berg. He noted that information provided by Senator Mike Gabbard and the Department of Business, Economic Development, & Tourism (DBEDT) indicates the lighting at the nearby property are used for soy bean growth. Mr. Berg asserted his opinion that the lighting violates State Illumination Law. Mr. Berg expressed his opinion that "farmers were given waivers to blind migratory species." To support his claim, Mr. Berg provided a link to a video (https://www.youtube.com/watch?v=rmVw04oWr6E&t=26s) he filmed of the carcass of a barn owl which was "found dead one -half mile from the solar site-." He believes the owl may have died from eating vermin laced with rat bait poison. The owl was also missing an eye. Mr. Berg stated his opinion that the "grow lights- may have been the cause of this barn owl to lose its eye." He stated that "DLNR refused to accept the carcass for a necropsy." He also acknowledged that he "can't prove what killed this owl," noting that "since no necropsy was performed, my claim in the video may be wrong- and the owl did not suffer from rat bait poison- but from the grow lights- the evidence in the video is all we have to make a deduction- could be relevant if found to be a pattern later on-."

Mr. Berg also recommended inquiring with Dr. Melissa Price and Dr. Javier Cotin of the Project Pueo Biologist Team and DLNR's Division of Forestry and Wildlife (DOFAW) Biologist Afsheen Siddiqi regarding *pueo* protocol. He made note that "this Pueo team approved of the FEIS [Final Environmental Impact Statement] (2007) for 500-acres of property known as UHWO – saying no pueo are there—." He added that "these pueo experts had no objections to the FEIS protocol used at UHWO" in which, according to Mr. Berg, the "observer only looked for a few hours TOTAL over a period of two days within a week during the month of April when the pueo are not here……and to cover 500-acres------."

He noted that in the FEIS for UHWO (PBR Hawaii 2006), DLNR stated in writing "that was a thorough inventory process to search for pueo- satisfactory." He also characterized the DLNR evaluation as, "That's good enough of a look for us- only 3-4 hours of observation need take place to determine on 500-acres if pueo are on the property or not."

Mr. Berg added that surveyors for the FEIS "looked mid-morning hour- not before sunrise or at sunset when pueo are active----but mid morning when that bird ain't to be seen." He noted,

> These Project Pueo experts know that pueo do not have a defined breeding season- and are plot hoppers- and will deploy a foraging ecology-a breeding ecology- at different times of the seasons- and hence, these experts have stated that it is prudent

> to have the biological survey for pueo be conducted year round. […] These same pueo experts will also state observation needs to take place at sunset and sunrise- if to be a proper protocol deployed.

Mr. Berg questions "if that will be done on this solar property? Year round observation?" He recommends that "a thorough and complete protocol is adopted to repeat the inventory exercise for pueo and ‘ōpe‘ape‘a over the course of a calendar year would be in order so the project does not inadvertently contribute to more endangered species habitat loss."

6.5 *Kama‘āina* Interviews

The authors and researchers of this report extend our deep appreciation to everyone who took the time to speak and share their *mana‘o* and *‘ike* with CSH whether in interviews or brief consultations. We request that if these interviews are used in future documents, the words of contributors are reproduced accurately and in no way altered, and that if large excerpts from interviews are used, report preparers obtain the express written consent of the interviewee/s.

6.5.1 Shad Kāne

CSH spoke with Mr. Shad Kāne, member of the Kapolei Hawaiian Civic Club, Chair of the O‘ahu Council of Hawaiian Civic Clubs Committee on the Preservation of Historic Sites and Cultural Properties, Ali‘i Ai Moku of the Kapuāiwa Chapter of the Royal Order of Kamehameha Ekahi, President of Kalaeloa Heritage and Legacy Foundation, and ‘Ewa Moku Representative on the State Aha Moku Advisory Committee, via telephone on 13 August 2019. Mr. Kane stated that he is not in opposition to the proposed project. He noted the project area has been previously disturbed by sugarcane production.

6.5.2 Christian Kaimanu Yee

On 9 August 2019, CSH met with Mr. Christian Kaimanu Yee at Keaīwa Heiau State Recreation Area to discuss the AES West O‘ahu Solar Plus Storage project and to share his *‘ike* regarding *mo‘olelo* and *wahi pana* associated with the *ahupua‘a* of Honouliuli.

Mr. Yee was "made in ‘Ewa Beach, [but] born in England." His father was a fireman for the United States Air Force and was stationed at Lakenheath Air Force Base (AFB) in England when Mr. Yee was born in 1980. His mother is a second-generation Filipina from ‘Ewa Beach. Mr. Yee lived in England until 1983 when his father got stationed at Nelles AFB in Las Vegas. In 1985, his family returned to Hawai‘i and moved to ‘Ewa Beach where he lived until 1986, when his parents "separated for a little while" and his father moved to Waimalu in ‘Aiea. After being honorably discharged from the military, Mr. Yee's father worked for a trucking company. His father would take him on "drives" where they would visit cultural sites including *heiau* and Kūkaniloko, the sacred birthstones where the highest ranking *ali‘i* were born (Sterling and Summers 1978:139).

> Kukaniloko is considered to be the very center of the Hawaiian culture. As a person and a nation, one can come here and directly be in contact with the past, present, and future of Hawaii. Only royalty were allowed in the area of Lihue. High ranking Ali‘i were born here, and the privileged were brought here to learn aspects of Hawaiian culture such as navigation. [Yee 2013]

Mr. Yee's father continued to share numerous *mo‘olelo* regarding the mythical and ancient past of O‘ahu. Mr. Yee began studying Hawaiian history and culture and in 2013, equipped with the

knowledge that he had inherited from his father and his *kumu* (teacher) Kaipo‘i, Mr. Yee began a blog, *Pohukaina Cave*. In this blog he shares, “Hawaiian history and places from a bicycle”:

> I am a resident of Waimalu in the moku [district] of Ewa with a fascination of history, and being a Hawaiian it’s gotta be Hawaiian history for now! […] I just want to share something that might appeal to you and hopefully things from the past will not be lost and covered by the fast present day life style! [Yee 2013]

Mr. Yee began the interview by discussing the importance of trails to the *ahupua‘a* of Honouliuli noting that trails leading to Wai‘anae and the North Shore pass through Honouliuli. He pointed out that the “north shore trail” traverses a portion of the eastern boundary of the *ahupua‘a* between Honouliuli and Hō‘ae‘ae Ahupua‘a before branching off and leading to Pōhākea Pass and traversing through the Wai‘anae Mountain Range to Lualualei Ahupua‘a in the *moku* of Wai‘anae.

Mr. Yee added that Pōhākea Pass is associated with the goddess Hi‘iakaikapoliopele, sister of volcano goddess Pele, and her epic journey across the Hawaiian Islands. Mr. Yee noted that from Pōhākea Pass, Hi‘iaka could see the entire *moku* of ‘Ewa.

> Hi‘iaka actually stands there and sees the whole *moku* of ‘Ewa and pointed it out cause she stood there and seen Leilono from there. She stands at Pōhākea Pass and defines the entire *moku* of ‘Ewa at that moment.

He also stated that from Pōhākea Pass, Hi‘iaka could see her traveling companions, Lohi‘au and Wahine‘ōma‘o, as they traveled by canoe to the harbor of Kou (Honolulu) (Ho‘oulumahiehie 2008b:260): “I think Hi‘iaka went this way and the guy’s in the canoe went this way, Lohi‘au and Wahine‘ōma‘o, that’s when they first started falling for each other. She’s like ‘eh, no talk to my husband […] No talking over there,’ from the mountains, eh.”

Pōhākea Pass is also the location where Hi‘iaka chanted as she “gazed toward Hawai‘i, and saw that her aikāne [friend], Hōpoe, had died in the fires of her elder sister Pele” (Ho‘oulumahiehie 2008b:262).

Mr. Yee also noted that Pōhākea Pass is associated with the famous warrior, Palila. Mr. Yee referred to Palila as the “Hawaiian Thor,” due to his supernatural war club which he could throw a long distance and fly along the club’s path as he held on to the end of it. According to *mo‘olelo*, Palila used his supernatural war club to carry himself from Ka‘ena Point at Wai‘anae, east across the *moku* of ‘Ewa, landing in a number of places in Honouliuli including Pōhākea Pass, the peaks of Manuauna and Kānehoa, and the plain of Keahumoa (Fornander 1918:5[1]:142–143).

Mr. Yee stated the *‘ili* of Līhue which is located in the northern region of Honouliuli Ahupua‘a was associated with a class of chiefs known as the *lo ali‘i*. Mr. Yee noted, “The *lo ali‘i* were the highest ranking chiefs but then they were hidden so they were like the poorest at the same time. In the rain, eating ferns and stuff cause they were so sacred. It’s a curse, blessing and a curse at the same time.”

Samuel Kamakau discussed the *lo ali‘i*:

> The chiefs of Lihue, Wahiawa, and Halemano on Oahu were called *Lo* chiefs, *po‘e Lo Ali‘i* [“people from whom to obtain a chief”], because they preserved their chiefly kapus. The men had kapus, and the women had kapus, and when they joined their kapus and children were born, the children preserved their kapus. They lived

> in the mountains (*i kuahiu‘i*)*;* and if the kingdom was without a chief, there in the mountains could be found a high chief (*ali‘i nui*) for the kingdom. Or if a chief was without a wife, there one could be found-one from chiefly ancestors. [Kamakau 1991a:6]

He also discussed the *mo‘olelo* of Kelea, a chiefess of Maui, who was kidnapped and brought to O‘ahu to marry Lō Lale, a *lo ali‘i* from Līhue in Honouliuli (Kamakau 1991b:46).

> There’s a story about that one Maui chiefess, the one who got kidnapped by the canoe guys and took to live over there. But she ends up being the female progenitor of most chiefs, like in Hawai‘i, cause they had like the highest *mana* [spiritual power], cause she mated with the *lo ali‘i* and the *ali‘i nui* [high chief] of Waikīkī […] She was like a surfer, but she lived up in the mountains, that’s why they kidnapped her. […] She wanted to go surf again, she asked him if she could go but then he knew that she was gonna leave forever cause she was gonna be out of his watch. And it says something like, ‘she washes the red dirt of Līhue off’ when she enters Waikīkī.

A version of the *mo‘olelo*, which appears in Samuel Kamakau’s *Tales & Traditions of the People of Old*, states that Kelea lived with Lō Lale for ten years in the uplands of Līhue. They had three children, Kaholi-a-Lale, Luli-wahine, and Luli-kāne, who were among “the ancestral chiefs of O‘ahu” (Kamakau 1991b:46–47). Kelea was unhappy living in Līhue, longing for the ocean and her favorite pastime of surfing (Kamakau 1991b:47). She left Līhue to “go down to the seashore of ‘Ewa to go sightseeing,” traveling through the plain of Keahumoa, to Waipahu, ‘Ewa-uli, and Hālawa before reaching Waikīkī.

When Kelea and her companions reached the coconut grove of Kawehewehe in Waikīkī, they were welcomed by the *kama‘āina* of Waikīkī who stated “this is a place for enjoyment. Over there is the *kou* [Cordian subcordata] grove of Kahaloa where one may view the surfing of the chiefs and the *ali‘i nui* Kalamakua” (Kamakau 1991b:48). Kamakau describes Kalamakua:

> KALAMAKUA-A-KAIPŪHŌLUA was a good chief. He was noted for cultivating, and it was he who constructed the large pond fields Ke‘okea, Kualulua, Kalamanamana, and the other *lo‘i* [irrigated terrace] in Waikīkī. He traveled about his chiefdom with his chiefs and household companions to cultivate the land and gave the produce to the commoners, the *maka‘ainana.* They loved him. [Kamakau 1991b:45]

Kelea proceeded to borrow a surfboard and before entering the ocean she “rubbed the red dirt of ‘Ewa from her feet so as to look fresh” (Kamakau 1991b:48). She jumped on her board and paddled out past the “place where the surf broke” and waited for a wave to rise.

> When Kelea reached the place where the surf broke, she left that place to the *kama‘āina* and paddled on out to wait for a wave to rise. As she floated there, the first wave rose up but she did not take it, nor did she take the second or third wave, but when the fourth wave swelled up, she caught it and rode it to shore. As she caught the wave, she showed herself unsurpassed in skill and grace. The chiefs and people who were watching burst out in cheering the cheering rising and falling, rising and falling. [Kamakau 1991b:48–49]

Kalamakua was working in his fields when he was startled by loud shouts coming from the shoreline. He asked his men, “What is that shouting reverberating from the seashore?” They replied, “It is probably because of a skilled woman surfer.” Kalamakua realized that the “skilled woman surfer” was Kelea, a chiefess of Maui, and left his work to stand on the shore and watch. When Kelea came ashore, Kalamakua wrapped his *kīhei* (cape) around her and made her his wife (Kamakau 1991b:49).

> As Kelea rode in on a wave, the *mōʻī* ran to the edge of the sea and stood there. When the chiefess reached the sand, he took hold of her board and asked, ‘Are you Kelea?’ ‘Yes,’ she answered. She stood up, naked. The *mōʻī* removed his *kihei* shoulder covering and wrapped it around her as a *pāʻū* [skirt] and took her to a *kapu* place. That was the beginning of her life as the *aliʻi wahine moʻi* [queen] and she married (*hoʻiio mal-e*) the *mōʻī* Kalamakua. [Kamakau 1991b:49]

In another version of the *moʻolelo*, which appears in David Kalākaua’s *The Legends and Myths of Hawaii*, Kalamakua is described as “Lo-Lale’s cousin […] a noble of high rank whose lands were on the coast of the Ewa district” (Kalākaua 1990:233). In this version, Kalamakua is sent on the mission to find Lō Lale a wife. On the voyage returning to Oʻahu, Kalamakua had “become very much interested in Kelea” (Kalākaua 1990:240). Kelea lived with Lō Lale for a while, however, she longed for Kalamakua. When Kelea decided to leave Lō Lale, he voiced no “spoken bitterness;” however, after she left, he sang this lament:

> Farewell, my partner of the lowland plains,
>
> On the waters of Pohakeo, above Kanehoa,
>
> On the dark mountain spur of Mauna-una!
>
> O, Lihue, she is gone!
>
> Sniff the sweet scent of the grass,
>
> The sweet scent of the wild vines
>
> That are twisted by Waikoloa,
>
> By the winds of Waiopua,
>
> My flower!
>
> As if a mote were in my eye.
>
> The pupil of my eye is troubled.
>
> Dimness covers my eyes. Woe is me!
>
> [Kalākaua 1990:224–245]

When Kelea left Līhue, she traveled to ‘Ewa where she “found a large number of nobles and retainers of Kalamakua, the high chief of the district, amusing themselves in the surf” (Kalākaua 1990:245). Kelea borrowed a surfboard and “joined the party of surf-riders beyond the breakers” (Kalākaua 1990:245). Upon hearing that “a beautiful woman from Lihue had beaten all the chiefs at surf-riding,” Kalamakua realizes that the woman is Kelea and proceeds to the beach, greeting Kelea by placing his *kihei* over her shoulders (Kalakaua 1990:245). Kalakaua notes that Kelea and

Kalamakua “lived happily together, and were blessed with a daughter Laielohelohe, who inherited her mother’s beauty, and became the wife of her cousin Piilani, son and successor of Kawao, moi of Maui […]” (Kalākaua 1990:246).

Mr. Yee also discussed Kūali‘i, a “celebrated chief […] noted for his strength and bravery” who defeated the chiefs of Ko‘olauloa on the plains of Keahumoa (Fornander 1917b:4[2]:364). When the chiefs of Ko‘olauloa and their army of twelve hundred arrived in Honouliuli, they were outnumbered by Kūali‘i’s army of twelve thousand, however, the battle was averted when a *mele* in honor of Kūali‘i was chanted and the chief of Ko‘olauloa ceded the districts of Ko‘olauloa, Ko‘olaupoko, Waialua and Wai‘anae to Kūali‘i (Fornander 1917b:4[2]:400).

Mr. Yee stressed the importance of two brothers, Kapa‘ahulani and Kamaka‘aulani, who were on opposing sides of the battle. According to the *mo‘olelo*, Kapa‘ahulani and Kamaka‘aulani composed the *mele* in honor of Kūali‘i and devised a plan in which Kapa‘ahulani would go to Waialua where the chief of Ko‘olauloa was residing and urge him to make war on Kūali‘i, and Kamaka‘aulani would take Kūali‘i and “conceal yourselves in the bushes” at the place where the battle is to be fought (Fornander 1917b:4[2]:366). When the forces of Ko‘olauloa arrived in Honouliuli at the location which the brothers have agreed upon, Kapa‘ahulani tells the chief of Ko‘olauloa that their army is surrounded, and states that “I will chant my prayer, and if it should be acceptable this morning, we will be saved” (Fornander 1917b:4[2]:368). As Kapa‘ahulani chanted the *mele* which he had composed in honor of Kūali‘i, Kamaka‘aulani convinces Kūali‘i to delay the battle (Fornander 1917b:4[2]:380). When the chant was finished the “two armies came together and the battle was declared off” (Fornander 1917b:4[2]:400).

Mr. Yee also pointed out Mauna Kapu, a peak located in the Wai‘anae Mountain Range bordering the *ahupua‘a* of Nānākuli. The name Mauna Kapu translates to “sacred mountain” (Pukui et al. 1974:148). He believes “Mauna Kapus” were “meeting places, or something like that, for the chiefs,” noting that another Mauna Kapu is located in the *ahupua‘a* of Moanalua. Sterling and Summers describe Pu‘u Kapu (sacred hill) in Moanalua Ahupua‘a, noting that “this was where the chiefs and commoners met to discuss matters of importance” (Sterling and Summers 1978:334). There is also a hill named Mauna Kapu located in Līhue on the island of Kaua‘i (Pukui et al. 1974:148).

Mr. Yee discussed the hill of Pu‘uokapolei, stating that during the summer solstice, the sun sets over Pu‘uokapolei. He noted that the pathway of the sun aligns a *heiau* located on Pu‘uokapolei with Papa‘ena‘ena Heiau located in the *ahupua‘a* of Waikīkī.

> Pu‘uokapolei. Supposedly, that has an alignment with a *heiau* where, is it Papa‘ena‘ena Heiau, I think it lines up with that, or if there was another *heiau*. […] ‘Ōlelo Hawai‘i class […] they go there, that class goes there on one of the solstices or something like that and they chant for the sunset because the sun sets on Pu‘uokapolei at a certain time, as viewed from Papa‘ena‘ena Heiau […]

Sterling and Summers also stated that Pu‘uokapolei was used by ancient Hawaiians as an astronomical marker to designate the seasons, noting that the annual season of Kau which is marked by a high-sun period and corresponds with warmer temperatures and steady trade winds begins when the sun sets over Pu‘uokapolei.

> […] the people of Oahu reckoned from the time when the sun set over Pu‘uokapolei until it set in the hollow of Mahinaona and called this period Kau, and when it moved south again from Pu‘uokapolei and·it grew cold and the time came when young sprouts started, the season was called from their germination (oilo) the season of Ho-‘oilo. [Sterling and Summers 1978:34]

Mr. Yee also noted the possibility of a burial cave located on Pu‘uokapolei which contained a canoe inside of it: “Supposedly, what the guy told me is that there’s a burial cave in Pu‘uokapolei that has a canoe inside of it. But that’s probably long gone cause if you look at it, it’s all leveled already, on the *makai* side.”

Mr. Yee also noted the area where the ‘Ewa by Gentry subdivision is located was once the site of the largest grove of *wiliwili* trees on the island of O‘ahu.

> My most beloved thing ever, the *wiliwili* tree. There was a *wiliwili* grove over there cause that’s ‘Ewa […] there was a *wiliwili* grove there, where ‘Ewa by Gentry is now. The biggest one on the island, and that’s why all the birds. The land birds lived over there. The extinct ones, the flightless birds.

Traditional accounts (Kamakau 1991a:47–49) associate the *ao kuewa* with a grove of *wiliwili* trees on the plains of Kaupe‘a in Honouliuli.

> When a man who had no rightful place in the *‘aumakua* [family or personal gods] realm (*kanaka kuleana ‘ole*) died, his soul would wander about and stray amongst the underbrush on the plain of Kama‘oma‘o on Maui, or in the *wiliwili* grove of Kaupe‘a on Oahu.
>
> On the plain of Kaupe‘a beside Pu‘uloa [Pearl Harbor], wandering souls could go to catch moths (*pulelehua*) and spiders (*nanana*). However, wandering souls could not go far in the places mentioned earlier before they would be found catching spiders by *‘aumakua* souls, and be helped to escape […] [Kamakau 1991a:47–49]

Mr. Yee also stated “there was those two ladies who were down by the archery, that’s two *pōhaku*, the lizards in the Hi‘iaka story.” According to the *mo‘olelo*, as Hi‘iaka traveled toward the ‘Ewa coast, two women, who were also *mo‘o* (lizard or water spirit), saw Hi‘aka coming. Fearing that Hi‘iaka would kill them, the women changed into their lizard form and hid from her. One of the lizards hid in a little space on a stone along the coastal trail, and the other hid nearby. (*Ka Hōkū o Hawai‘i*, 15 February 1927, translated in Maly 1997:19). This stone is known as Pe‘ekāua which translates to “we two hidden.” Hi‘iaka greeted the two women and passed on without hurting them.

Mr. Yee discussed visiting Kalaeloa Heritage Park which is located in the coastal region of Honouliuli. He described observing a *heiau* that was partially underground and built using upright coral stones. He noted that Shad Kāne, *kahu* (caretaker) of Kalaeloa Heritage Park, believes the *heiau* is of Tahitian descent. He also noted the presence of a trail marked by upright coral slabs that “supposedly led all the way to another *heiau* that was by Laulaunui Island” near the West Loch of Pu‘uloa (Pearl Harbor).

He also noted that Ko‘olina is the site of one of the oldest fishing encampments on the island of O‘ahu.

> At Ko‘olina is one of the oldest fishing encampments, or even oldest carbon dates, on Oahu. Cause there’s like some fishing cave near Ko‘olina or those cliffs by Tracks [Beach Park] before this side of the island was inhabited, people from the Ko‘olau were going on fishing expeditions and coming all the way over here. Camping out.

In *The Rise and Fall of the O‘ahu Kingdom*, Ross Cordy discussed evidence of early settlement at “sites on the arid western fringe of the ‘Ewa Plain in today’s Ko Olina Resort” (Cordy 2002:13–14).

> Apparent human manipulation of the inland marsh’s (site 3357) flora dates to at least A.D. 225-565. Backhoe trenches uncovered a buried habitation deposit (site 1446-1) at the base of the low limestone escarpment next to the marsh. This site has complex stratigraphy with overlapping firepits, midden deposits, and intervening non-cultural alluvium. Fishbone, shellfish, bird bone (flightless goose, etc.), early types of one-piece bone and pearlshell fishhooks, and basalt adze blanks of unusual and often early forms were found. This site yielded an initial use date of A.D. 145-600. Rockshelters (site 3355) in the escarpment across the marsh were also excavated, and deposits dated back to the A.D. 600s-1000s. Also, the coastal dune had subsurface deposits (site 1438-1) with one date of A.D. 410-660, but most post-1200s. The dune deposits contained food remains (fish, molluscs, sea birds and extinct geese), postholes, firepits and fishhooks of early type. The researchers concluded that these three sites reflected ‘very dispersed’ ‘temporary encampments utilized by fishermen and bird collectors’. [Cordy 2002:13–14]

Mr. Yee stated that as a child his favorite beach, which he referred to as “Hamburgers,” was located at Ko‘olina. He believes the beach was “annihilated” during the development of Ko‘olina.

> I get my own *mo‘olelo*, brah, here we go, so my favorite beach as a child, try find out where this place is, it’s this place called Hamburgers. I think the whole Ko‘olina development or the harbor that they made, the fake harbor, just totally annihilated it. I didn’t even know what road we took off, which led us there, but it was a beach that we could play as a kid cause the water would come around this rock, you couldn’t jump off of it cause the rock was huge, brah, like two stories, as a child, I believe. And it looked like a hamburger, like of sand, sandstone, and the waves would hit it and come around and it would have this little pond. Kind of felt like Magic Island, but it was smaller than that, but you couldn’t jump in cause it’s like six inches deep, like and it’s like super high.

The *wahi pana* and *mo‘olelo* associated with Honouliuli which were shared by Mr. Yee demonstrate the importance of Honouliuli in traditional Hawaiian times. Honouliuli was the largest *ahupua‘a* on O‘ahu. *Kama‘āina* travelling from the *moku* of Kona to the *moku* of Wai‘anae and Waialua crossed through the *ahupua‘a* of Honouliuli through a network of trails. Numerous *mo‘olelo* and *wahi pana* associate Honouliuli with the *akua* including Hi‘iaka and Pālila, as well as the *ali‘i,* including a class of chiefs known as the *lo ali‘i* who lived in the *‘ili* of Līhue located in the northern region of Honouliuli and the *ali‘i* Kūali‘i who defeated the chiefs of Ko‘olauloa on the plains of Keahuamoa when a *mele* honoring Kū‘ali‘i was chanted.

6.5.3 Lynette Paglinawan

On 14 October 2019, CSH met with Ms. Lynette K. Kaopuiki Paglinawan at her home to discuss the West Oahu Solar Project and to share her *‘ike* of the traditional cultural practice of *ho‘oponopono* (to correct) and the *ao kuewa* in the *ahupua‘a* of Honouliuli.

Ms. Paglinawan is a social worker. For about eight years, she was on the Historic Sites Review Board. She is also an educator, teaching a class at the University of Hawai‘i West O‘ahu (UHWO) about Native Hawaiian healing which includes the traditional cultural practices of *ho‘oponopono*, *lomilomi* (massage), and *lā‘au lapa‘au* (herbal medicines). She discussed *ho‘oponopono* which is the process of setting things right within the context of a family. She explained:

> In *ho‘oponopono*, which is what I practice, if you do transgressions and if I broke the glass pane in a picture window of a house, my going up to them and just apologizing and saying I’m sorry is not going to make them happy, I have to replace it or give them monetary value to have it replaced. When I do that, then the relationship becomes harmonious.

Since Ms. Paglinawan began working at UHWO, she has “come to learn about the area and the cultural impact that has happened in the *moku* of ‘Ewa and [*ahupua‘a* of] Honouliuli […]” Through her research of the works of Mary Kawena Pukui, she has learned that “the area from Waimānalo Gulch over to Kapolei to the location of UHWO was known by very early residents there to be the place where “*ao kuewa*,” wandering spirits, congregated from *makai* to *mauka* up Pālehua and especially near the cluster of *wiliwili* trees in Kaupe‘a.” She noted that “families in the Hawaiian definition includes the souls of these families.” She added:

> The souls of deceased individuals have three areas to go to, one to *pō* [the realm of the gods] which is like heaven, to be with ancestors, one to *milu* [underworld] which is like hell, the other one is to designated areas within a district and it happens to be in the area of Waimānalo Gulch on over as you go *mauka*.

Ms. Paglinawan’s great-great-grandparents were “born and reared in Honouliuli.” She added:

> If my great-grandparents were born and reared there and my great-grandfather had inherited land and was reared in the area, I can surmise that my *‘ohana* [family], my relatives, the big branch of relatives, some of them when they died, they went to heaven, some of them when they died might have gone to hell, but possibly there were some who just were not good enough to go to heaven so they were relegated to roam in this area […]

She stated that she has heard numerous stories of “strange happenings” which are “due to the presence of spirits.” She noted that “this is their territory.” She mentioned that “there are stories of them being known to go down to the oceanside and cause havoc with the living” and “even going up into the mountain of Pālehua beyond Makakilo,” noting “the families who live there talk about ghosts and strange happenings […]” She stated:

> I’ve had discussions with some people who live up Makakilo and they finally had to leave because things happened and when I talk about it with my students, some of them are residents in the Hawaiian Homes subdivision, they have given me examples of their kids screaming because they see things in the house.

She also recalled an experience Mary Kawena Pukui had when she was a teenager walking on the beach in ‘Ewa with her dog. As she walked to visit her relatives in Kalaeloa, Ms. Pukui’s dog was attacked by an *‘uhane* (spirit) who wanted to eat the animal.

> Tutu Pukui said, she was about a teenager, went to visit the relatives, they were walking on the beach, ‘Ewa Beach, going to Kalaeloa, they had the dog with them, the dog suddenly started growling and jumped up and the next thing they saw was the dog fell down, frothing and the heart pounding. Her aunty said to her, “Take this, go get salt water, bring it back.” The aunty sprinkled the salt water on the dog. She talked to the spirits and scolded the spirits, “This animal is not ready to die, you folks leave him alone, you go look for something else, he needs to live yet.” And then she prayed. By the time she got finished, he could bring his body upright, but they had to walk slowly. Because this was an animal and in the old days, Hawaiians ate dog. So they used to what they ate in real life, but because her aunty lives that area, she knows how to deal with it. After that she asked the aunty, “Why the dog was like that?” The aunty explained to her about the *ao kuewa*.

Ms. Paglinawan expressed her concerns regarding the effects that the proposed project will have on the *ao kuewa*, noting her belief that ghosts are attracted at night to lights and to energy. She stated that “the building that has the most energy, electrical energy is our library, it is temperature and humidity controlled, it has all the electronic equipment for media and dispersal of information.” She recalled speaking with staff at the UHWO library:

> So, the stories that have been told to me is staff turned off the lights and everything in the library [when] they leave. When the guard make their round again, even before midnight, the huge monitor is lit up. Who turned it on? They have constant problems with the elevators on campus and the newest building on campus that was just completed about a year ago has had electrical difficulties “left and right.”

She added that, “on top of the library we have this huge art piece that is highlighted at night and our chancellor says, “It’s a beacon for the people, Nānākuli, Wai‘anae,” but hell, it’s a beacon for the ghosts, too. Because they’re energy, they seek the thrill of electricity.”

She also noted that “we’ve had documentation of the double pane picture windows in the library for humidity control and temperature control, they had an incident where somebody from the inside was trying to break their way out. The inner panel was broken, they hadn’t gotten to the outer panel. So, it was from the inside going out, and yet, staff will swear nobody was in the building.”

She also stated that people “have seen lights coming from the second floor ground, lights from the carpet shining up and they’re wondering, “What the hell is that?” They go down, there is nothing underneath.”

She noted that these “strange happenings” are not limited to the library. She stated that:

> […] every single building, the workers, they work late, they feel it and we have in the back of [UH] West O‘ahu towards this end, we have the housing of the electrical unit. The ones who work there during the day say it is spooky, so you know what they have, Hawaiian salt, if they feel a presence, they eat some Hawaiian salt and they sprinkle, so they have to contend with that.

She also expressed her concerns of the effect of the *‘uhane* on the solar panels, noting “that’s high energy. It will be like going to the game room.” She also noted her concerns regarding the Honolulu Rail Transit System, stating that:

> I hate to think what it’s going to be like when the rail comes on. This thing lit up at night going zoom, zoom. They gonna be on it, but there’s going to be a lot electrical outage cause the more power the faster the excitement.

She also stated that she expects to “see a lot of repair and maintenance on electrical parts.” She stated that following exam periods when there is a “high utilization of night classes, night classrooms and study areas,” they experience “things breaking down or burning out.” She added that “in the long run, the cost for electrical repair and maintenance is a heavy burden for the contractor, but once that contract has finished the problem still remains […]”

Ms. Paglinawan stated that “spirits travel on ancient trails” noting that “they go from *mauka* going down to *makai*” and that, “ancient trails were there to go up and down, and so, *lōlō* [crazy] for them [ghosts] to just stay one place when they don’t have to.” She added that these “ancient trails are still in use,” stating that:

> The people who have residence in Kapolei area tell me the stories about somebody trying to enter the house and break the door down. And when they swear, and they go to the front door, they going fight with them, they open the door, no more nothing. And I asked them, “How often does this happen?” They said, “Not that often, once in a while.” But that’s the ghost who walked the trails on certain nights.

She also discussed an old home on Hawaiian Home Lands in the *ahupua‘a* of Waimānalo, Ko‘olaupoko. She noted that this house has “never ever been completed” because the residents built the home on the ancient pathway to the beach and they were getting “bothered all the time.”

> […] you know down Waimānalo [Ahupua‘a], […] across from the beach is Hawaiian Home Lands, there’s one old house that has never ever been completed. It’s because the residents built that house right on the beach pathway and they get bothered all the time, so they’ve given it up.

She also recalled that while her husband, the late Richard K. Paglinawan, was a student at the University of Hawai‘i, he heard spirits travelling on the ancient pathways “coming from the ocean going up Waiāhole Road into the mountains.”

> My husband lived in Waiāhole and when he studied for the University it would be like 2-3 o’clock in the morning, as soon as he hears the drums, he turn off all the lights, he put his head under the pillow and he will himself to go sleep because he can hear it coming from the oceanside going up Waiāhole Road into the mountains.

She added that “this area where the University [of Hawai‘i West O‘ahu] is located has a lot of trails that go from *mauka-makai*, come from Honolulu going towards Nānākuli.” She asked, “Is this going to be built on ancient trails?” She added that the project proponents should be “mindful of the ancient trails because when the ghosts march, they begin from the mountain, but they also begin from the oceanside and they go into the valley.”

Ms. Paglinawan stated that the development of the *moku* of ‘Ewa including the *ahupua‘a* of Honouliuli resulted in the displacement of the *ao kuewa*. She noted that “we destroyed the habitat

of the *ao kuewa* which is the *wiliwili* trees." She added that "if we destroy the habitat of the ghosts, they have no place to go but into the facilities."

> […] if we recognize we destroyed their habitat, we are making restitution cause we know we did that. It is reciprocal *aloha* [love]. So we do this with the right intentions, righting the wrong that we have done and they will respond in right ways. We have the saying, "When *aloha* is given unconditionally, you never know when, but it comes back to you." So, I really believe in that and because I believe that these may be the spirits of my ancestors, I lay my genealogy on the line to reach out to them. That with *aloha* we want to rectify our sins, our transgressions.

To illustrate reciprocal *aloha*, Ms. Paglinawan shared a *mo‘olelo* of the goddess Hi‘iakaikapoliopele who passed through the ‘Ewa District. She stated:

> […] Hi‘iakaikapoliopele, who traveled through from Ka‘ena Point across the west side and then from Pu‘u Kapu and descended down into the ‘Ewa District. She as a goddess can see if you're human or you're a ghost. She saw in the distance, two women, they were stringing *leis* [garlands]. She thought in her mind, "I wonder if they still remember *aloha*?" Now for a Hawaiian, *aloha* is your behavior that is hospitable, it is welcome. And the practices during that time, if you were a stranger coming through that desolate area, you're invited to partake in whatever water you have and whatever limited food you have. So she said, "I wonder if they still remember *aloha*?" So she did an *oli* [chant], *oli aloha*, and as soon as they heard it, they looked up and they saw that's a *malihini* [stranger] and the smile just graced their faces. Hi‘iaka said, "they still know *aloha*." They stopped everything, the *leis* that they had, they rushed to her and said, "Welcome," and bedecked her with the *leis*. So, the lesson for us, the living, if our intentions is good, if it is *pono* [proper], it increases the opportunity for *aloha* to be reciprocal.

Ms. Paglinawan recommended planting "a wall of trees" surrounding the proposed project area which would provide a home for the displaced spirits. She asked, "Can we entice them to go there?" She went on to state that:

> I'm also very mindful that any kind of tree that we put there, that produces food, not just for the living but for the ghosts cause you know if you get *‘ulu* [breadfruit, *Artocarpus altilis*], you get coconut, not everybody picks up everything, some go on the ground. Coconut leaves, if you leave it on the ground, it begins to be a cover that bugs begin to cluster, the bugs are also the things the ghosts ate. They also ate whatever foods fell down, but they were Hawaiian so they went *makai* and they go catch crab and they eat crab, they eat the seaweed.

She added that:

> I'm thinking we're gonna have a conference in January and Kūkaniloko, the birthing stones, were promised a donation of 10,000 Hawaiian plants. They've offered as many of the *wiliwili* trees as I want, so I want to start a campaign that, like Hawaiian Home Lands, they allow their residents to plant a tree and maybe it might be a border of the road, plant a whole row of trees and that way they have their own houses, man have their own houses. And Hawaiian's have rituals that can

> clear them [ghosts] out of the house and prevent them from entering again with bamboo.

She added that, “I’d like to see us repair the habitat, so in our rituals and in our belief in the gods listening to our plea, our needs, they would consider that these souls want to live with *aloha*, with man, the living man, cause for me it’s family. I want them to live with *aloha*, so if they sacrifice and having to move outside so that man is comfortable in his area, let’s set aside a wall of trees.”

Ms. Paglinawan discussed the types of plants that were previously found in the area which include *noni* (Indian mulberry, *Morinda citrifolia*) plants, coconut trees, *lauhala* (*Pandanus tectorius*) trees, and *‘ulu* trees. She noted that these plants were “very plentiful but sparse not like a big grove where it’s like a park of trees, it was interspersed throughout.” She also noted that the destruction of the foliage has also “affected the number of Hawaiian birds who no longer come around.” She noted:

> There used to be *noni* trees in the area and it was known that the birds sought the nectar from the *noni* flower, now they don’t have this around. As a result, the count of the Hawaiian birds has really diminished.

Ms. Paglinawan stated that she would like to “reverse the negative impact and do restitution.” She noted that “if you have a border of trees that’s long, it meets the needs for life, you have physical food, you have supplies that you use for making crafts and getting along, and you create habitat, not just for the *ao kuewa*, but for birds, as well, who used to be a larger number of them there like the *pueo* (Hawaiian short-eared owl; *Asio flammeus sandwichensis*) and *‘i‘iwi* (Scarlet Hawaiian honey creeper; *Vestiaria coccinea*).”

She also mentioned that she wanted to do plantings in the gulch which is located near the UHWO campus, noting that “we wanted to do plantings, keep the ravine clear, but on the sides we do the plantings, so that they [ghosts] leave [UH] West O‘ahu and they go to the plants […]”

She also noted that planting of “a wall of trees” around the proposed project area would have other benefits including the production of oxygen. She stated that “we need to create this area to have an opportunity to equalize the airspace that’s going to reduce carbon dioxide but can we replace it with oxygen.” She noted that,

> [Solar] Energy is a replacement of carbon dioxide emission but what are we promoting to occupy the space carbon dioxide had because trees produce oxygen, we need oxygen for living.

Ms. Paglinawan also noted that,

> For me, it’s *ho‘oponopono*. If you destroy a part of an ecosystem, how do you bring it back to retain balance? Otherwise it will always be uneven, you remove the oxygen from fossil fuel emission, what are you gonna replace with it? Other chemicals, well, what about oxygen that we need to live and survive on.

Ms. Paglinawan also expressed her concerns about the psychological impacts on the people who encounter these spirits, asking, “What kind of psychological impact is being created when we occupy certain space and then the spirits have to cluster?” She noted her belief that “children who are more pure and more innocent, they see many more things than we do.” She added that:

> Mary Kawena Pukui says, “if you talk to the ghosts and they know what’s happening, if they know they’re not wanted there cause they’re making people scared. You ask them to go back where they belong, they will go.” But, that is an act of *aloha* because they making life good for the living. The children not going get scared.

Ms. Paglinawan also noted that each island has areas which are home to the *ao kuewa*. She stated:

> […] like on Maui, you know where the sand dunes are, lot of bones yeah, Hawaiian Home Lands had land right at the edge of the sand dunes, they built a subdivision, the grandchildren see ghosts. Kaua‘i has Manā (sands of Manā) by Polihale, the cliffs of Polihale. That is where the good spirits are judged to leap off and to join their ancestors and they go, but there’s also some that never make that jump. So, it happens over there. So, Hawaiians have the leaping off place to get to *pō*, so that area means there are pathways that you shouldn’t build houses on because it’s gonna happen with Hawaiian deaths.

Ms. Paglinawan would like to use the traditional cultural practice of *ho‘oponopono* to make things right with the *‘uhane* who have been displaced by the development of the *moku* of ‘Ewa and in the *ahupua‘a* of Honouliuli. She recommends planting “a wall of trees” around the proposed project area as restitution to the *‘uhane* who may be displaced by the proposed project. She expressed concerns regarding the effects that the *‘uhane* will have on the solar panels, noting the numerous electrical problems experienced by the UHWO due to the presence of the *‘uhane*. She stated that planting of “a wall of trees” around the proposed project area would provide a home for the *‘uhane* who may be attracted to the energy being generated by the proposed solar farm, as well as, providing a habitat for Native Hawaiian birds and producing oxygen.

She would also like the project proponents to be mindful of the locations of ancient trails which she noted are still in use by the *‘uhane* to travel from *mauka* to *makai* in Honouliuli Ahupua‘a with less worry about money.

Ms. Paglinawan also expressed her concerns for the people that encounter the *‘uhane*. She noted the psychological trauma on workers at the UHWO, as well as, families who live in the area. She was particularly concerned for the children who encounter these spirits, noting her belief that children “see many more things than adults do.”

6.6 Summary of *Kama‘āina* Interviews

Based on reviewed and approved interview summaries of Tom Berg, Shad Kāne, Christian Kaimanu Yee, and Lynette Paglinawan, the following is a synthesis of findings within Honouliuli Ahupua‘a.

CSH met with Mr. Christian Kaimanu Yee on 9 August 2019 to share his extensive *‘ike* of *wahi pana* and *mo‘olelo* associated with the *ahupua‘a* of Honouliuli. Mr. Yee discussed several *wahi pana* in the *ahupua‘a* of Honouliuli including Pōhakea Pass, Mauna Kapu, Pu‘uokapolei, a *wiliwili* grove and a *pōhaku* known as Pe‘ekāua on the plains of Kaupe‘a, and a *heiau* and trail located at Kalaeloa Heritage Park. He also noted that one of the oldest fishing encampments on the island of O‘ahu was found at Ko‘olina.

Mr. Yee noted the importance of trails to the *ahupua‘a* of Honouliuli pointing out that trails leading to Wai‘anae and the North Shore pass through Honouliuli. He stated that the “north shore trail” travels along the boundary between Honouliuli and Hō‘ae‘ae Ahupua‘a before branching off and leading to Pōhākea Pass where it continues through the Wai‘anae Mountain Range to Lualualei Ahupua‘a in the *moku* of Wai‘anae. Mr. Yee added that Pōhākea Pass is associated with the goddess Hi‘iakaikapoliopele and her epic journey across the Hawaiian Islands, as well as the famous warrior, Palila, who Mr. Yee referred to as the “Hawaiian Thor.”

Mr. Yee also discussed the *‘ili* of Līhue which was associated with a class of chiefs known as the *lo ali‘i*. He shared the *mo‘olelo* of Kelea, a chiefess of Maui, who was kidnapped and brought to O‘ahu to marry Lō Lale, a *lo ali‘i* from Līhue in Honouliuli (Kamakau 1991b:46).

He also discussed Kūali‘i, a chief who defeated the chiefs of Ko‘olauloa on the plains of Keahumoa (Fornander 1917:364) when a *mele* in honor of Kūali‘i was chanted and the chief of Ko‘olauloa ceded the districts of Ko‘olauloa, Ko‘olaupoko, Waialua, and Wai‘anae to Kūali‘i (Fornander 1917:400). He noted that the *mele* in honor of Kūali‘i was composed by Kapa‘ahulani and Kamaka‘aulani, two brothers who were on opposing sides of the battle.

On 13 August 2019, CSH spoke with Mr. Shad Kāne via telephone. Mr. Kane stated he is not in opposition to the proposed project, noting that the project area has been previously disturbed by sugarcane production.

In written testimony provided to CSH on 19 August 2019, Mr. Berg stated that the project has been “proposed on a pueo (owl) foraging and breeding ecosystem.” He noted that records indicate that per earliest colonial contact, the *pueo* is most abundant on the slopes from Pu‘u Kapua‘i to West Loch, adding that “Hunehune Gulch, Kaloi Gulch, and Honouliuli Gulch are migratory routes used by the pueo to go from mountain to sea to court, mate, forage, and raise their brood.” He stated the proposed project will “encroach on prime pueo habitat-considered to be graded A+—“a ten (10)”—when it comes to the degree of pueo habitat in use on this project site.” Mr. Berg also stated the project site is also “inhabited by the ōpe‘ape‘a at various times of the seasons,” noting that in 1910, the State of Hawai‘i documented ‘*ōpe‘ape‘a* within a half-mile of the project area.

Mr. Berg also stated that the *pueo* has “a direct connection to Native Hawaiian family lineage in Ewa Beach,” noting the *pueo* is the *‘aumakua* for the Michael Lee family and their accounts, which go back over seven generations, are documented at the State Archives Building in Honolulu.

Mr. Berg stated his concern that the “property in question will not receive the proper protocol to conclude no endangered species inhabit the area.” He recommended that “a thorough and complete protocol is adopted to repeat the inventory exercise for pueo and ‘ōpe‘ape‘a over the course of a calendar year would be in order so the project does not inadvertently contribute to more endangered species habitat loss.” He added that “this practice, to deploy the protocol year-round, is not being done in either the EA and or EIS review processes.” Mr. Berg also recommended consulting with Dr. Melissa Price and Dr. Javier Cotin of the Project Pueo Biologist Team and DOFAW Biologist Afsheen Siddiqi regarding *pueo* protocol.

Mr. Berg also expressed his concern for the possible negative aspects of neighboring lighting operations at an adjacent parcel which may reflect off a solar panel into “the flight patterns of migrating birds and the *‘ōpe‘ape‘a* and *pueo* in particular need to be addressed.”

Ms. Lynette Paglinawan stated that “whole area in Honouliuli going *mauka* is the space that was occupied by the *ao kuewa*” which she defined as the “ghosts or spirits of the deceased relatives that belong in a family.” She expressed her concerns regarding the effects that the proposed project will have on the *ao kuewa*, which she believes are attracted to energy. She also expressed her concerns of the effect of the spirits on the solar panels, noting “that’s high energy. It will be like going to the game room.” She also noted that UHWO experiences numerous electrical problems due to the presence of these spirits.

Ms. Paglinawan noted that “this area where the University [of Hawai‘i West O‘ahu] is located has a lot of trails that come from *mauka-makai*, come from Honolulu going towards Nānākuli.” She stated that project proponents should be mindful of the locations of ancient trails, noting that the ancient trails are still used by spirits to travel from *mauka* to *makai* within Honuliuli Ahupua‘a.

Ms. Paglinawan recommended planting “a wall of trees” surrounding the proposed project area as restitution to the spirits who may be displaced by the proposed project. She also noted that planting of “a wall of trees” around the proposed project area would have other benefits including the production of oxygen and providing a habitat for Native Hawaiian birds.

Ms. Paglinawan also expressed her concerns regarding the psychological impacts for the people that encounter the spirits, noting trauma on workers at the UHWO, as well as, families who live in the area. She was particularly concerned for the children who encounter these spirits, noting her belief that children “see many more things than we do.”

Section 7 Traditional Cultural Practices

Timothy R. Pauketat succinctly describes the importance of traditions, especially in regards to the active manifestation of one's culture or aspects thereof. According to Pauketat,

> People have always had traditions, practiced traditions, resisted traditions, or created traditions […] Power, plurality, and human agency are all a part of how traditions come about. Traditions do not simply exist without people and their struggles involved every step of the way. [Pauketat 2001:1]

It is understood that traditional practices are developed within the group, in this case, within the Hawaiian culture. These traditions are meant to mark or represent aspects of Hawaiian culture that have been practiced since ancient times. As with most human constructs, traditions are evolving and prone to change resulting from multiple influences, including modernization as well as other cultures. It is well known that within Hawai‘i, a "broader 'local' multicultural perspective exists" (Kawelu 2015:3). While this "local" multicultural culture is deservedly celebrated, it must be noted that it has often come into contact with "traditional Hawaiian culture." This contact between cultures and traditions has undoubtedly resulted in numerous cultural entanglements. These cultural entanglements have prompted questions regarding the legitimacy of newly evolved traditional practices. The influences of "local" culture are well noted throughout this section and understood to represent survivance or "the active sense of presence, the continuance of native stories, not a mere reaction, or a survivable name. Native survivance stories are renunciations of dominance, tragedy and victimry" (Vizenor 1999:vii). Acknowledgement of these "local" influences help to inform nuanced understandings of entanglement and of a "living [Hawaiian] contemporary culture" (Kawelu 2015:3). This section strives to articulate traditional Hawaiian cultural practices as were practiced within the *ahupua‘a* in ancient times, and the aspects of these traditional practices that continue to be practiced today; however, this section also challenges "tropes of authenticity," (Cipolla 2013) and acknowledges the multicultural influences and entanglements that may "change" or "create" a tradition.

This section integrates information from Sections 3–6 in examining cultural resources and practices identified within or in proximity of the project area in the broader context of the encompassing Honouliuli landscape. Excerpts from interviews are incorporated throughout this section where applicable.

7.1 Gathering of Plant and Aquatic Resources

Lying in the lee of the Wai‘anae Mountain Range, Honouliuli is one of the driest areas of O‘ahu with most of the area averaging about 550 mm (22 inches) of rain on the coastal and inland region of the *ahupua‘a* and about 1,200 mm (39 inches) in the northern region up into the Wai‘anae Mountain Range (Giambelluca 2013). Despite the relative lack of rainfall in this area, there exists a traditional rain name associated with the *ahupua‘a* of Honouliuli. This rain, known as the Nāulu, is described as a sudden shower and is more commonly associated with other notoriously dry locations, such as Kawaihae, Hawai‘i and Ni‘ihau (Akana and Gonzalez 2015:187). The general lack of distinctive, traditional rain names is indicative of historic environmental conditions within the *ahupua‘a*. Due to these conditions, *maka‘āinana* living within the *ahupua‘a* were forced to modify or utilize freshwater resources in innovative ways.

No natural streams are located in the vicinity of the project area. However, fresh water remains available below the surface of Honouliuli. Dissolution “pit caves” (Mylroie and Carew 1995) or “sink holes” would accumulate water within them via a subterranean water or karst system; this water also contained nutrient-rich sediment that allowed for the cultivation of significant plant resources such as *kalo, kī*, and *noni*. McAllister (1933) documented examples of traditional agricultural activity in Honouliuli, writing that the *kama‘āina* of the *ahupua‘a* utilized the soil on the floor of caves for cultivation. At the time of his survey in 1930 both *mai‘a* (bananas) and *kō* (sugarcane) were still being cultivated within these pits.

The lowlands fronting the west loch of Pearl Harbor (Kaihuopala‘ai) were suitable for the cultivation of the traditional Hawaiian staple crop, *kalo*. The production (and consumption) of *kalo* was vitally important to many communities of Native Hawaiians living in ‘Ewa. Captain James King, visiting Hawai‘i in 1779, noted that “the natives of these islands are, in general, above the middle size and well made; they walk very gracefully, run nimbly and are capable of bearing great fatigue” (Shintani 1993:10). Accordingly, the high level of physical activity and physical fitness described by Captain King was a normal part of Hawaiian life and was largely attributable to the availability of plant and food resources such as *kalo*, *‘uala* (sweet potato; *Ipomoea batatas*), *niu*, *mai‘a*, *limu* (seaweed), and *i‘a* (fish). Besides the observed contributions to stamina and health, *kalo* was also a revered staple food, believed to have derived from the first-born son of Wakea and Papa.

> […] the supreme god Kane ‘in the form of Wakea (a form associated with the earth) produced two sequential offspring: the first became kalo (taro) plant, the second became Hāloa, the ancestor of man […] thus, in kinship terms, the taro is the elder brother and the senior branch of the family tree, mankind belongs to the junior branch, stemming from the younger brother.’ [Trask 2012:75]

‘Ewa was also famous for a rare taro called the “*kāī o ‘Ewa*,” which was grown in mounds in marshy locations (Handy and Handy 1972:471). The cultivation of this prized and delicious taro led to the saying, “*Ua ‘ai i ke kāī-koi o ‘Ewa*, He has eaten the Kāī-koi taro of ‘Ewa” (Pukui 1983:305).

Traditional Hawaiian diets were also supplemented with ocean-based proteins. Native Hawaiians historically fished the reefs, farmed fishponds, and utilized the freshwater springs in the *ahupua‘a* of Honouliuli. The lochs of Pearl Harbor were ideal for the construction of fishponds and fish traps. References to the abundance of ocean resources can be found within *mo‘olelo*, *wahi pana*, and *‘ōlelo no‘eau* associated with Honouliuli Ahupua‘a.

The *mo‘olelo* “Legend of the Children” describes the coastal area of Kūalaka‘i as being plentiful in fish. Clark (1977:74) and Pukui et al. (1974:119) describe Kūalaka‘i as a type of sea cucumber (*Tethys*) that squirts purple fluid when squeezed. The *‘ōlelo no‘eau,* “*Kai a hali a ka makani*,” translates to “the fish fetched by the wind” which describes the migration of the *‘anae* that travels from the leeward coast to the windward coast of O‘ahu.

Interviewee Christian Kaimanu Yee noted that the site of one of the oldest fishing encampments on the island of O‘ahu was discovered at Ko‘olina. Ross Cordy (2002:13–14) discussed evidence of early settlement at “sites on the arid western fringe of the ‘Ewa Plain in today’s Ko Olina Resort,” which included “fishbone, shellfish, bird bone (flightless goose, etc.), early types of one-piece bone and pearlshell fishhooks, and basalt adze blanks” which date back to AD 145-600.

7.2 Faunal Resources

The *pueo (Asio flammeus sandwichensis* or short-eared owl), which is endemic to Hawai‘i, are found on all of the main Hawaiian islands and are listed by the State of Hawai‘i as endangered on the island of O‘ahu (DLNR 2005). The DLNR states that *pueo* are most commonly found in “open habitats such as grasslands, shrublands, and montane parklands, including urban areas and those actively managed for conservation” (DLNR 2005).

In written testimony provided to CSH via email on 19 August 2019, Mr. Tom Berg stated that the project has been “proposed on a pueo (owl) foraging and breeding ecosystem.” He noted that historic records indicate the *pueo* is most abundant on the slopes from Pu‘u Kapua‘i to West Loch. He added that “Hunehune Gulch, Kaloi Gulch, and Honouliuli Gulch are migratory routes used by the pueo to go from mountain to sea to court, mate, forage, and raise their brood.” He also stated the proposed project will “encroach on prime pueo habitat-considered to be graded A+—“a ten (10)”—when it comes to the degree of pueo habitat in use on this project site.”

The *pueo* is one of the most important *‘aumākua* gods and ancestral deities of the family (Valeri 1985:19, 21). Mr. Berg noted the *pueo* has “a direct connection to Native Hawaiian family lineage in Ewa Beach,” noting that the *pueo* is the *‘aumakua* for the Michael Lee family and their accounts, which go back over seven generations, are documented at the State Archives Building in Honolulu.

Mr. Berg also stated that the project site is “inhabited by the ōpe‘ape‘a [Hawaiian hoary bat, *Lasiurus cinereus semotus*] at various times of the seasons,” noting that in 1910, the State of Hawai‘i documented ‘*ōpe‘ape‘a* within a half-mile of the project area. “The only land mammal native to the Hawaiian archipelago,” *‘ōpe‘ape‘a* are found on all of the main Hawaiian islands except for Ni‘ihau (DLNR 2005:3-13) and have been “found roosting in ‘ōhi‘a (*Metrosideros polymorpha*), pu hala (*Pandanus tectorius*), coconut palms (*Cocos nucifera*), kukui (*Aleurites moluccana*), kiawe (*Proscopis pallida*), avocado (*Persea americana*), shower trees (*Cassie javanica*), pūkiawe (*Styphelia tameiameiae*), and fern clumps; they are suspected to roost in Eucalyptus (*Eucalyptus* spp.) and Sugi pine (*Cyrptomeria japonica*) stands” (DLNR 2005). The *‘ōpe‘ape‘a* was listed as an endangered species under the Endangered Species Conservation Act of 1969.

7.3 Wahi Pana

There exist a myriad of cultural sites or *wahi pana* for ‘Ewa Moku, however, for the *ahupua‘a* of Honouliuli trails, plains, and temples were of particular importance.

Trails were and continue to be valuable resources for Native Hawaiian culture and life ways. In the past, trails were well used for travel within the *ahupua‘a,* between *mauka* and *makai* and laterally between *ahupua‘a*. A historical trail system existed in O‘ahu extending from Honolulu to Wai‘anae. A cross-*ahupua‘a* (east-west) trail that bordered Pearl Harbor passed through Honouliuli north of Pu‘uokapolei and continued along the coast to Wai‘anae. Mr. Yee pointed out that the “north shore trail,” which branches off the cross-*ahupua‘a* trail, traverses a portion of the eastern boundary of the *ahupua‘a* between Honouliuli and Hō‘ae‘ae Ahupua‘a before branching off and leading to Pōhākea Pass and traversing through the Wai‘anae Mountain Range to Lualualei Ahupua‘a in the *moku* of Wai‘anae.

Mr. Yee noted that Pōhākea Pass is associated with the goddess Hi‘iakaikapoliopele, sister of volcano goddess Pele, and her epic journey across the Hawaiian Islands. He noted that from Pōhākea Pass, Hi‘iaka could see the entire *moku* of ‘Ewa. From Pōhākea Pass, Hi‘iaka also saw her traveling companions, Lohi‘au and Wahine‘ōma‘o, as they traveled by canoe to the harbor of Kou (Honolulu) (Ho‘oulumahiehie 2008b:260). She also saw that her *aikāne*, Hōpoe, had “died in the fires of her elder sister Pele” as she “gazed towards Hawai‘i” from Pōhākea Pass (Ho‘oulumahiehie 2008b:260).

Mr. Yee also noted that Pōhākea Pass is associated with the famous warrior, Palila, who could throw his supernatural war club a long distance and fly along the club’s path as he held on to the end of it. According to the *mo‘olelo*, Palila used his supernatural war club to carry himself from Ka‘ena Point at Wai‘anae, before landing at Pōhākea Pass and continuing east across the *moku* of ‘Ewa.

Ms. Paglinawan stated that “this area where the University [of Hawai‘i West O‘ahu] is located has a lot of trails that go from *mauka-makai*, come from Honolulu going towards Nānākuli.” She noted that the ancient trails are still used by spirits to travel from *mauka* to *makai* within Honuliuli Ahupua‘a. She mentioned that “there are stories of them being known to go down to the oceanside and cause havoc with the living” and “even going up into the mountain of Pālehua beyond Makakilo,” noting “the families who live there talk about ghosts and strange happenings […]” Ms. Paglinawan asked, “Is this going to be built on ancient trails?” She stated that the project proponents should be “mindful of the ancient trails because when the ghosts march, they begin from the mountain, but they also begin from the oceanside and they go into the valley.”

Mr. Yee stated the *‘ili* of Līhue, which is located in the northern region of Honouliuli Ahupua‘a, was associated with a class of chiefs known as the *lo ali‘i*. Mr. Yee noted the “*lo ali‘i* were the highest ranking chiefs but then they were hidden so they were like the poorest at the same time.” He also discussed the *mo‘olelo* of Kelea, a chiefess of Maui, who was kidnapped and brought to O‘ahu to marry Lō Lale, a *lo ali‘i* from Līhue in Honouliuli (Kamakau 1991b:46).

Mr. Yee pointed out Mauna Kapu, a peak located in the Wai‘anae Mountain Range bordering the *ahupua‘a* of Nānākuli. He noted the existence of another Mauna Kapu in the *ahupua‘a* of Moanalua, adding that he believes that Mauna Kapu were “meeting places, or something like that, for the chiefs.”

The ‘Ewa coastal plain was also a place of spiritual significance as it was associated with the *ao kuewa*, the realm of the homeless souls. According to Samuel Kamakau, there existed three spirit realms, the *ao kuewa*, *ao ‘aumakua*, and *ke ao o milu*. Upon death, the spirit of the recently deceased was said to leave the body and then proceed toward a *leina* where they would leap into Pō, the world of the unseen (Handy and Pukui 1972:146). The spirit was guided to and over the *leina* and into Pō by their *‘aumakua* (Handy and Pukui 1972:146), however, if the soul of the deceased had no place in the *‘aumakua* realm, or was abandoned by an *‘aumakua*, they were destined to wander the *wiliwili* grove of Kaupe‘a until such time that they were rescued by their *‘aumakua*. Mr. Yee also noted largest grove of *wiliwili* trees on the island of O‘ahu was once located in the area where the ‘Ewa by Gentry subdivision is now. Fornander (1919a:6[2]:292) states that Pu‘uokapolei may have been a *leina,* jumping off point associated with the wandering souls who roamed the plains of Kaupe‘a and Kānehili, *makai* of the hill.

Pu‘uokapolei was also known to be the home of Kamapua‘a’s grandmother, Kamaunuaniho, (Nakuina 1904:50). After conquering the majority of O‘ahu, he established his grandmother as queen (Pukui 1974:203). There was once a large rock shelter on the *makai* side said to have been the residence of Kamapua‘a and his grandmother (McAllister 1933:108). Another account (*Ka Loea Kālai‘āina*, 13 January 1900 in Sterling and Summers 1978:34) stated that Kekele‘aikū, the older brother of Kamapua‘a, also lived on Pu‘uokapolei.

The plain of Pukaua is also located near Pu‘uokapolei, northwest of the project area. Two distinct *mo‘olelo* are connected with this cultural site. The first of these two stories was presented within a 13 January 1900 edition of *Ka Loea Kālai‘āina* which states that two old women with supernatural powers were heading to their home to Pukaua following an evening of fishing at the village of Kualaka‘i. As the sun began to rise, the women hid to avoid being seen and their bodies turned to stone. The second *mo‘olelo* involves Hi‘iaka, and was spread across several daily editions of *Ka Hōkū o Hawai‘i* from February 1927. According to the *mo‘olelo*, the two women were *mo‘o*. The women saw Hi‘iaka as she journeyed toward the ‘Ewa coast. They were afraid that Hi‘iaka would kill them, so they transformed into their lizard form and hid from Hi‘iaka (*Ka Hōkū o Hawai‘i*, 15 February 1927, translated in Maly 1997:19). This stone was known as “Pe‘e-kāua,” which translates to “we two hidden.” Mr. Yee also discussed the plain of Pukaua, mentioning that “there was those two ladies who were down by the archery, that’s two *pōhaku*, the lizards in the Hi‘iaka story.”

Mr. Yee also discussed Kūali‘i, a “celebrated chief […] noted for his strength and bravery” who defeated the chiefs of Ko‘olauloa on the plains of Keahumoa (Fornander 1917b:4[2]:364). Mr. Yee stressed the importance of two brothers, Kapa‘ahulani and Kamaka‘aulani, who were on opposing sides of the battle. According to the *mo‘olelo*, Kapa‘ahulani and Kamaka‘aulani composed the *mele* in honor of Kūali‘i and devised a plan in which Kapa‘ahulani would urge the chief of Ko‘olauloa to make war on Kūali‘i, and Kamaka‘aulani would take Kūali‘i and “conceal yourselves in the bushes” at the place where the battle is to be fought (Fornander 1917b:4[2]:366). When the forces of Ko‘olauloa arrived in Honouliuli, their army of twelve hundred were outnumbered by Kūali‘i’s army of twelve thousand, however, the battle was averted when the *mele*, which was composed by Kapa‘ahulani and Kamaka‘aulani in honor of Kūali‘i was chanted and the chief of Ko‘olauloa surrendered, ceding the districts of Ko‘olauloa, Ko‘olaupoko, Waialua and Wai‘anae to Kūali‘i (Fornander 1917b:4[2]:400).

Kūalaka‘i is the name of an ancient fishing village located on the southwestern side of Honouliuli Ahupua‘a, southwest of the project area. Kūalaka‘i is mentioned in the “Legend of the Children” which foretells the breaking of the eating *kapu* by the *ali‘i* (*Ka Loea Kālai‘āina*, 22 July 1899:15; translation in Sterling and Summers 1978:7). This area was also once the site of a spring called Hoaka-lei (“lei reflection”), where according to *mo‘olelo*, Hi‘iaka picked *lehua* and saw her reflection in the water (Pukui et al. 1974:119).

Kalaeloa is an area located at the southwestern point of O‘ahu. Kalaeloa Point was the home of Uhu Makaikai, a *kupua* who could take the form of a man or a giant parrotfish (*uhu).* He is mentioned in several legends concerning the hero Kawelo and with Kawelo’s struggles with ‘Aikanaka, the ruling chief of Kaua‘i (Hawaiian Ethnological Notes, Bishop Museum Vol. II:114, translation in Sterling and Summers 1978:41).

Cultural practices within Honouliuli of late have been inspired by traditional understandings of caring for natural and cultural resources. The Kalaeloa Heritage and Legacy Foundation has adopted practices wherein the community can *mālama* (care for) cultural sites, and in turn benefit from the knowledge inherent in such sites. Previously documented cultural sites within the Kalaeloa Heritage Park are actively cared for while also the subject of numerous university-level studies. These sites have been established as important centers for an *‘āina*-based education. Mr. Yee recalled visiting Kalaeloa Heritage Park where he observed a *heiau* which was partially underground and built using upright coral stones. He also observed a trail marked by upright coral slabs which “supposedly led all the way to another *heiau* that was by Laulaunui Island” near the West Loch of Pu‘uloa (Pearl Harbor).

7.4 Religious Practice

Several *heiau* stood in Honouliuli Ahupua‘a including Pu‘uokapolei Heiau, Pu‘u Ku‘ua Heiau, and two unidentified *heiau* located at the foot of Pu‘u Kanehoa and Pu‘u Kuina, respectively. Each year, a ceremony commemorating the changing of the seasons is still observed in the beginning of May at Waikīkī and Honouliuli. Sam ‘Ohukani‘ōhi‘a Gon III, Na Wa‘a Lalani Kahuna O Pu‘u Koholā, and the late Kumu Hula John Keola Lake’s *hula hālau* perform *oli* and *hula* during the ceremony (Genz et al. 2012). The ceremony occurs at Pu‘uokapolei Heiau which is oriented so that it views the setting of the sun behind Pu‘ula‘ila‘i farther west, and maintains a line of sight extending eastward from Pu‘ula‘ila‘i toward Papa‘ena‘ena Heiau located in Waikīkī. Mr. Yee also noted that during the summer solstice, the sun sets over Pu‘uokapolei, adding that the pathway of the sun aligns a *heiau* located on Pu‘uokapolei with Papa‘ena‘ena Heiau.

Interviewee Lynette Paglinawan stated that “the area from Waimānalo Gulch over to Kapolei to the location of UHWO was known by very early residents there to be the place where “*ao kuewa*,” wandering spirits, congregated from *makai* to *mauka* up Pālehua and especially near the cluster of *wiliwili* trees in Kaupe‘a.” Ms. Paglinawan stated that the development of the *moku* of ‘Ewa including the *ahupua‘a* of Honouliuli resulted in the displacement of the *ao kuewa*. She noted that “we destroyed the habitat of the *ao kuewa* which is the *wiliwili* trees.” She added that “if we destroy the habitat of the ghosts, they have no place to go but into the facilities.” She would like to use the traditional cultural practice of *ho‘oponopono* to make things right with the spirits who have been displaced. Ms. Paglinawan suggests planting “a wall of trees” surrounding the proposed project area which would provide a home for the displaced spirits.

7.5 Burials

‘Ewa was famous for the many limestone caves formed in the uplifted coral, called the “Ewa Karst.” In traditional Hawaiian times, the areas of exposed coral outcrop were undoubtedly more extensive. Where not covered by alluvium or stockpiled material, this Pleistocene limestone outcrop has characteristic dissolution “pit caves” (Mylroie and Carew 1995). The caves of Pu‘uloa were sometimes also used as burial caves. Following the death of Keali‘iahonui, son of Kaua‘i’s last king, Kaumuali‘i, in 1849, his body was buried in Pu‘uloa (Alexander 1907:27). Burials have been encountered in the coastal areas of the *ahupua‘a*, however, no burials have been encountered within the project area nor within the vicinity of the project area.

Mr. Yee noted the possibility of a burial cave located on Pu‘uokapolei which contained a canoe inside of it, however, he added that it’s “probably long gone cause if you look at it, it’s all leveled already, on the *makai* side.”

Section 8 Results and Analysis

CSH undertook this CIA at the request of Tetra Tech, Inc., and on behalf of AES Distributed Energy. The research broadly covered the entire *ahupua‘a* of Honouliuli, including the current project area.

8.1 Results of Background Research

Background research for this study yielded the following results, presented in approximate chronological order:

1. Honouliuli is the largest *ahupua‘a* in the *moku* of ‘Ewa. Honouliuli translates literally as “dark water,” “dark bay,” or “blue harbor,” and thus is named for the waters of Pearl Harbor which marks the eastern boundary of the *ahupua‘a* (Jarrett 1930:22). Another source translates Honouliuli as “The blue bays or inlets” (*Saturday Press*, 11 August 1883). Honouliuli appears in the “Mo‘olelo of Lepeamoa,” the chicken-girl of Pālama, where Honouliuli is the name of the husband of the chiefess Kapālama, and grandfather of Lepeamoa (Westervelt 1923:164–184).
2. Generally, Honouliuli was described as very hot and dry. Evidence for drought-like conditions are further supported by the relative lack of traditional rain names associated with Honouliuli Ahupua‘a. The Nāulu rain is the only known associated rain name for Honouliuli. Due to the lack of rainwater, freshwater resources were accessed via a karstic system.
3. In traditional Hawaiian times, the areas of exposed coral (Pleistocene limestone) outcrop were undoubtedly more extensive. According to McAllister (1933), holes and pits in the coral were generally accessed for water while larger pits, often containing soil, were used for cultivation. McAllister additionally remarked that at the time of his 1930s survey *mai‘a* (banana; *Musaceae*) and *kō* (sugarcane; *Saccharum officinarum*) were being cultivated within the pit caves (sinkholes) (McAllister 1933:109).
4. The traditional *ka‘ao* associated with the area speak of the *akua* brothers, Kāne and Kanaloa. It was their supernatural feat of hurling *pōhaku* across the island that determined the boundaries of land divisions (Sterling and Summers 1987:1). Additional *mo‘olelo* speak of Hi‘iaka and her travels across the plains of ‘Ewa. In particular, the *wahi pana* of Kaupe‘a (located south of the current project area) is described. Kamakau describes Kaupe‘a as a wide plain where a grove of *wiliwili* (*Erythrina sandwicensis*) stands (Kamakau 1991a:47). This plain is an *ao kuewa*, a realm belonging to homeless souls. In general, the *kama‘āina* of both Honouliuli Ahupua‘a and ‘Ewa District made a point to avoid this place.
5. Pu‘uokapolei is a prominent hill located on the ‘Ewa coastal plain that was the primary landmark for travelers on the trail running from Pearl Harbor to Wai‘anae. A *heiau* was once on the summit of the hill, however, by the time of McAllister’s survey of O‘ahu it had been destroyed (McAllister 1933:108). The hill was also used as a point of solar

reference or as a place for celestial observations of the winter and summer solstice. A ceremony at a *heiau* on Pu‘uokapolei provides a vantage point to capture the sun setting directly behind Pu‘ula‘ila‘i, a peak farther west in the Wai‘anae Range. A coinciding ceremony at Kūpalaha Heiau in Waikīkī captures the same essence as the sun sets behind Pu‘uokapolei.

6. Additional *heiau* located within Honouliuli included Pu‘u Ku‘ua located at Palikea, in addition to two unidentified *heiau*. These two unidentified *heiau* are located at the foot of Pu‘u Kanehoa and Pu‘u Kuina, respectively.
7. In later historic times, a network of trails encircled and crossed the Wai‘anae Range, allowing passage from West Loch to the Honouliuli lowlands, past Pu‘uokapolei and Waimānalo Gulch to the Wai‘anae coast and onward circumscribing the shoreline of O‘ahu (‘Ī‘ī 1959:96–98). The main trail along the south shore of O‘ahu would have been approximately 1.5 km to the southeast. A main trail extending up the central valley of O‘ahu would have been approximately 3 km to the east. The 1825 Malden map shows a trail extending from the main trail along the south shore of O‘ahu into the uplands in the Pālehua area as passing just a couple hundred meters to the southwest of the project area.
8. The rich resources of Pu‘uloa—the fisheries in the lochs, the shoreline fishponds, the numerous springs, and the irrigated lands along the streams—made ‘Ewa a prize for competing chiefs. ‘Ewa Moku was also a political center and home to many chiefs in its day. Oral accounts of *ali‘i* recorded by Hawaiian historian Samuel Kamakau date back to at least the twelfth century. *Ali‘i* associated with Honouliuli and greater ‘Ewa Moku included Kākuhihewa, Keaunui, Lakona, Mā‘ilikūkahi, and Kahahana.
9. In early historic times, the population of Honouliuli was concentrated at the western edge of West Loch in the vicinity of Kapapapuhi Point in the “Honouliuli Taro Lands.” This area was clearly a major focus of population due to the abundance of fish and shellfish resources in close proximity to a wide expanse of well-irrigated bottomland suitable for wetland taro cultivation.
10. Early foreign accounts describe the southwest coast of O‘ahu, including Honouliuli Ahupua‘a, as an area “a little distance from the sea, the soil is rich and all the necessaries of life are abundantly produced” (Vancouver 1798:215). A sailor among Vancouver’s crew observed, however, that “from the number of houses within the harbour it should seem to be very populous; but the very few inhabitants who made their appearance were an indication of the contrary” (Vancouver 1798:216).
11. Following the Māhele of 1848, 99 individual land claims in the *ahupua‘a* of Honouliuli were registered and awarded by King Kamehameha III. No *kuleana* land claims were made for land within the current project area or vicinity. The vast majority of the LCA parcels were located in Honouliuli near the taro lands of the *‘ili* of Pu‘uloa and the Pu‘uloa Salt Works. The largest award (Royal Patent 6071, LCA 11216, *‘Āpana* 8) in Honouliuli Ahupua‘a was granted to Miriam Ke‘ahi-Kuni Kekau‘onohi on January 1848 (Native Register 1848) who acquired a deed to all unclaimed land within the *ahupua‘a*, including the present project area.

12. Beginning with the time of Western Contact, however, Hawaiian populations were introduced to many virulent western diseases which began to decimate the native populations. Thus, four years following the 1832 census, the ‘Ewa population had dropped to 3,423 (Schmitt 1973:9, 36), “a decrease of 592 in 4 years” (Ewa Station Reports 1836). Between 1848 and 1853, there was a series of epidemics of measles, influenza, and whooping cough that often wiped out whole villages.
13. With the increasing foreign interests on O‘ahu Island during the last half of the nineteenth century, an array of agricultural enterprises were attempted. In 1871, John Coney rented the lands of Honouliuli to James Dowsett and John Meek, who used the land for cattle grazing. In 1877, James Campbell purchased most of Honouliuli Ahupua‘a for a total of $95,000.
14. By 1889, the Ewa Plantation Company was established and lands throughout Honouliuli were designated for sugarcane cultivation. Sugar production exploded with the successful drilling of an artesian well by James Campbell on the ‘Ewa Plain. Campbell’s first well was named Waianiani (“crystal waters”) by the *kama‘āina* of Honouliuli (Nellist 1925). By 1930, Ewa Plantation had drilled 70 artesian wells to irrigate cane lands; artesian wells provided fresh water to Honouliuli for nearly 60 years (Ho‘okuleana 2014).
15. In 1897, B.F. Dillingham established the Oahu Sugar Company (OSC) on 12,000 acres leased from the estates of John Papa ‘Ī‘ī, Bishop, and Robinson. The Oahu Sugar Company had over 900 field workers, composed of 44 Hawaiians, 473 Japanese, 399 Chinese, and 57 Portuguese. The first sugar crop was harvested in 1899, ushering in the sugar plantation era in Waipahu (Ohira 1997). Prior to commercial sugar cultivation, these lands were described as being “of near desert proportion until water was supplied from drilled artesian wells and the Waiahole Water project” (Condé and Best 1973:313).
16. The Waiahole Water Company was formally incorporated in 1913 and was originally a subsidiary of the Oahu Sugar Company. The Waiahole Ditch was designed by engineer Jorgen Jorgensen, with recommendations by engineer J.B. Lippencott and assisted by W.A. Wall. Upon its completion in 1916, the Waiahole Ditch was 35 km (21.9 miles) long and cost $2.3 million. The 32 million gallons of daily water enabled the O‘ahu Sugar Company to grow to “some 20 square miles […] ranging in elevation from 10 ft at the Waipio Peninsula […] to 700 ft at the Waiahole Ditch” (Condé and Best 1973:313). The ditch system is included on the state inventory of archaeological sites as SIHP # 50-80-09-2268. The Waiahole Ditch System crossed through the western portion of the present project area.
17. The early twentieth century saw the lands of Honouliuli heavily utilized by both civilians and the U.S. military for transportation. The U.S. Government began acquiring the coastal lands of ‘Ewa for development of a naval base at Pearl Harbor. In 1901, the U.S. Congress formally ratified annexation of the Territory of Hawaii, and the first 1,356.01 acres of Pearl Harbor land were transferred to U.S. ownership.

18. In 1937, 18 miles of roads were built in the coastal Honouliuli area, and in 1939-1940 the U.S. bought 3,500 acres of land in this area (Landrum et al. 1997:62–67), to build several other military camps and installations, including Barbers Point Naval Air Station.
19. Following the Japanese Navy’s attack on Pearl Harbor on 7 December 1941, the Territory of Hawaii was declared under martial law and the writ of *habeas corpus* (the requirement for a person under arrest to be brought before a judge or into court) was suspended (U.S. Department of the Interior 2014:6–7). Persons of Japanese and European ancestry in Hawai‘i suspected of disloyalty to the United States were rounded up and imprisoned by the U.S. military and the FBI (U.S. Department of the Interior 2014:xii). In 1943, the Honouliuli Internment Camp was constructed to intern citizens, resident aliens, and prisoners of war. Located in Honouliuli Gulch, east of the project area, the camp was the “last, largest, and longest-used World War II confinement site in Hawai‘i,” holding approximately 320 internees and nearly 4,000 prisoners of war (U.S. Department of the Interior 2014:xiv).

8.2 Results of Community Consultations

CSH attempted to contact Hawaiian organizations, agencies, and community members as well as cultural and lineal descendants in order to identify individuals with cultural expertise and/or knowledge of the project area and vicinity. Community outreach letters were sent to a total of 70 individuals or groups; 12 responded, one provided written testimony, and three of these *kama‘āina* and/or *kūpuna* met with CSH for more in-depth interview. Consultation was received from community members as follows:

1. Christian Kaimanu Yee, *kama‘āina* and knowledgeable of *mo‘olelo* and *wahi pana*
2. Shad Kāne, member of Kapolei Hawaiian Civic Club, Chair of the O‘ahu Council of Hawaiian Civic Clubs Committee on the Preservation of Historic Sites and Cultural Properties, Ali‘i Ai Moku of the Kapuāiwa Chapter of the Royal Order of Kamehameha Ekahi, and ‘Ewa Moku Representative on the State Aha Moku Advisory Committee.
3. Tom Berg, former Councilman, District 1
4. Lynette Paglinawan, cultural practitioner; educator, teaches a course on Native Hawaiian Healing at University of Hawai‘i West O‘ahu

On 24 January 2020, an *In-Progress Draft Cultural Impact Assessment for the West O‘ahu Solar Project* was provided via email to two parties representing the Aha Moku Council, two parties at Nā Ala Hele, two parties at the SHPD History and Culture Branch, and OHA. The parties were invited to review and comment, or provide notification of their intent to comment, prior to the reports inclusion in the Draft Environmental Assessment. CSH followed up with the seven parties via email on 25 February 2020, and has not received any comments or notification of an intent to comment to date.

8.3 Impacts and Recommendations

Based on information gathered from the community consultation, participants voiced and framed their concerns in a cultural context.

1. Mr. Shad Kāne stated he is not in opposition to the proposed project. He noted the project area has been previously disturbed by sugarcane production.
2. Mr. Tom Berg stated that the project has been "proposed on a pueo (owl) foraging and breeding ecosystem." He noted records indicate that per earliest colonial contact, the *pueo* is most abundant on the slopes from Pu‘u Kapua‘i to West Loch, in the area where the project is slated. He added that "Hunehune Gulch, Kaloi Gulch, and Honouliuli Gulch are migratory routes used by the pueo to go from mountain to sea to court, mate, forage, and raise their brood." He stated the proposed project will "encroach on prime pueo habitat-considered to be graded A+—"a ten (10)"—when it comes to the degree of pueo habitat in use on this project site."
3. Mr. Berg added that the *pueo* has "a direct connection to Native Hawaiian family lineage in Ewa Beach," noting the *pueo* is the *‘aumakua* for the Michael Lee family and their accounts, which go back over seven generations, are documented at the State Archives Building in Honolulu.
4. Mr. Berg also stated that the project site is "inhabited by the ōpe‘ape‘a at various times of the seasons," noting that in 1910, the State of Hawai‘i documented *‘ōpe‘ape‘a* within a half-mile of the project area.
5. Mr. Berg stated his concern that the "property in question will not receive the proper protocol to conclude no endangered species inhabit the area." He recommended that "a thorough and complete protocol is adopted to repeat the inventory exercise for pueo and ‘ōpe‘ape‘a over the course of a calendar year would be in order so the project does not inadvertently contribute to more endangered species habitat loss." He also recommended consulting with Dr. Melissa Price and Dr. Javier Cotin of the Project Pueo Biologist Team and DLNR's Division of Forestry and Wildlife (DOFAW) Biologist Afsheen Siddiqi regarding pueo protocol.
6. Mr. Berg also expressed his concern over the possible negative aspects of light at an adjacent parcel. He expressed concern that a solar panel may be reflecting neighboring lighting operations into "the flight patterns of migrating birds and the ‘ōpe‘ape‘a and pueo in particular need to be addressed."
7. Ms. Lynette Paglinawan stated that "the area from Waimānalo Gulch over to Kapolei to the location of UHWO was known by very early residents there to be the place where "*ao kuewa*," wandering spirits, congregated from *makai* to *mauka* up Pālehua and especially near the cluster of *wiliwili* trees in Kaupe‘a." She expressed her concerns regarding the effects that the proposed project will have on the *ao kuewa*, which she believes are attracted to energy. She also expressed her concerns of the effect of the spirits on the solar panels, noting "that's high energy. It will be like going to the game room." She also noted that UHWO experiences numerous electrical problems due to the presence of these spirits.
8. Ms. Paglinawan noted that "this area where the University [of Hawai‘i West O‘ahu] is located has a lot of trails that go from *mauka-makai*, come from Honolulu going towards Nānākuli." She stated that project proponents should be mindful of the locations of ancient

trails, noting that the ancient trails are still used by spirits to travel from *mauka* to *makai* within Honuliuli Ahupua‘a.

9. Ms. Paglinawan recommended planting “a wall of trees” surrounding the proposed project area as restitution to the spirits who may be displaced by the proposed project. She also noted that planting of “a wall of trees” around the proposed project area would have other benefits including the production of oxygen and providing a habitat for Native Hawaiian birds.
10. Ms. Paglinawan also expressed her concerns regarding the psychological impacts for the people that encounter the spirits, noting trauma on workers at the UHWO, as well as, families who live in the area. She was particularly concerned for the children who encounter these spirits, noting her belief that children “see many more things than adults do.”
11. Project construction workers and all other personnel involved in the construction and related activities of the project should be informed of the possibility of inadvertent cultural finds, including human remains. In the event that any potential historic properties are identified during construction activities, all activities will cease and the SHPD will be notified pursuant to HAR §13-280-3. In the event that *iwi kūpuna* are identified, all earth moving activities in the area will stop, the area will be cordoned off, and the SHPD and Police Department will be notified pursuant to HAR §13-300-40. In addition, in the event of an inadvertent discovery of human remains, the completion of a burial treatment plan, in compliance with HAR §13-300 and HRS §6E-43, is recommended.
12. In the event that *iwi kūpuna* and/or cultural finds are encountered during construction, project proponents should consult with cultural and lineal descendants of the area to develop a reinterment plan and cultural preservation plan for proper cultural protocol, curation, and long-term maintenance

8.4 *Ka Pa‘akai* Analysis

In Ka Pa‘akai vs Land Use Commission, 94 Hawai‘i (2000) the Court held the following analysis also be conducted:

1. The identity and scope of valued cultural, historical, or natural resources in the project area, including the extent to which traditional and customary native Hawaiian rights are exercised in the project area;
2. The extent to which those resources—including traditional and customary native Hawaiian rights—will be affected or impaired by the proposed action; and
3. The feasible action, if any, to be taken by the LUC to reasonably protect native Hawaiian Rights if they are found to exist.

Based on information gathered from the cultural and historical background, and community consultation of the CIA for this project, no culturally significant resources were identified within the project area. At present, there is no documentation or testimony indicating traditional or customary Native Hawaiian rights are currently being exercised “for subsistence, cultural and religious purposes and possessed by *ahupua‘a* tenants who are descendants of native Hawaiians who inhabited the Hawaiian Islands prior to 1778” (Hawai‘i State Constitution, Article XII, Section 7) within the project area. While no cultural resources, practices, or beliefs were identified as currently existing within the project area, Honouliuli Ahupua‘a maintains a rich cultural history in the exercise of traditional or customary Native Hawaiian rights within the project *ahupua‘a*.

Honouliuli Ahupua‘a is the largest *ahupua‘a* in the *moku* of ‘Ewa (and on the island of O‘ahu). The environment of Honouliuli is very hot and dry. These environmental limitations forced ingenuity and innovation. *Kama‘āina* of Honouliuli used agricultural sinkholes that accumulated water within them via a subterranean water or karst system; this water also contained nutrient-rich sediment allowing plants such as *kalo, kī*, and *noni* to survive.

The post-Contact period brought numerous changes to the *ahupua‘a* of Honouliuli. Traditional agricultural was rapidly replaced by large-scale commercial ventures. The discovery of artesian water beneath the ‘Ewa plains by James Campbell in 1879 led to the establishment of sugarcane plantations in Honouliuli including the Oahu Sugar Company. Extensive *mauka* lands in northern Honouliuli, including ridges and deep gulches, were unsuitable for commercial sugar cultivation and remained pasture land for grazing livestock. The Donn 1906 map suggests the present project area was at the *mauka* edge of sugarcane cultivation at that time (see Figure 15). By 1920, however, commercial sugarcane cultivation had expanded into the uplands including the present project area (Frierson 1972:18).

The project area is situated between Pu‘u Kapua‘i which is located 0.5 km to the northwest and Pu‘u Makakilo located 1.2 km to the southwest. These are understood as “very late cones [of the Wai‘anae volcano] […] composed of a varied mixture of cinder, spatter and lava flows” (Macdonald et al. 1983:429). Pukui et al. (1974:199) translate “Pu‘u Kapua‘i” as “footprint hill,” however, the association with that name is unknown. “Pu‘u Makakilo” is translated as “observing eyes” (Pukui et al. 1974:201). The association of this name is also unknown.

The project area is also located between two deeply dissected gulches, Kalo‘i Gulch which is located 300 m to the southwest and Honouliuli Gulch located 700 m to the northeast. These gulches are at a comparable elevation and are believed to rarely run with water. The name “Ka-lo‘i”

translates to “the taro patch” (Pukui et al. 1974:77). Sterling and Summers (1978:35) associates Kalo‘i Gulch with a number of vignettes regarding the “Waihuna” or “Punahuna” hidden spring. It was also noted that the hidden spring “had been one of the principal sources of water for all that country, which was quite heavily populated before the smallpox epidemic of 1840” (Ida E.K. von Holt in Sterling and Summers 1978:35).

8.4.1 A Summary of Cultural, Historical, or Natural Resources in the Project Area

8.4.1.1 Archaeological Resources

An AIS conducted for the University of Hawai‘i West O‘ahu Campus which encompassed the entirety of the project area (Dega et al. 1998) identified no surface Hawaiian features. Dega et al. (1998:i) noted several plantation-era “flumes, aqueducts, ditches, pumps, and other irrigation features occurring within the heavily modified landscape of the project area.” The features represented an irrigation complex (SIHP # 50-80-08-5593) which was used for sugarcane cultivation from the 1920s through more recent times. A portion of the Waiahole Ditch System (SIHP # 50-80-09-2268) was also documented crossing through the northwest section of the project area and continuing southwest through the lower agricultural fields.

A companion *Archaeological Inventory Survey Report for the AES West O‘ahu Solar Project* (Welser et al. 2019 draft) only identified the same two twentieth century historic properties associated with commercial sugarcane cultivation as were identified in the Dega et al. (1998) study. The historic properties previously identified in the general vicinity are virtually all post-Contact (Welser et al. 2019:42–44). Two basalt cobble and boulder mounds identified 800 m to the west of the project area (CSH2 described in Tulchin and Hammatt 2007) were thought to be possible trail markers but their age is unclear. The reader is referred to that archaeological study for further details of the archaeological resources in the vicinity.

8.4.1.2 Burials

The “Ewa Karst,” which consists of limestone caves formed in the uplifted coral, was undoubtedly more extensive during traditional Hawaiian times than present exposures suggest. Where not covered by alluvium or stockpiled material, this Pleistocene limestone outcrop has characteristic dissolution “pit caves” (Mylroie and Carew 1995) which were sometimes also used as burial caves. Burials have been encountered frequently in coastal areas of Honouliuli Ahupua‘a, however, previous archaeological studies (Dega et al. 1998) within the project area have not documented any burials within the project area nor within the vicinity of the project area. No *iwi kūpuna* have been identified within the project area or within a kilometer of the project area (Welser et al. 2019:42–44). No burials are believed to be present.

8.4.1.3 Faunal Resources

In written testimony provided to CSH via email on 19 August 2019, Mr. Tom Berg, former City Councilman, expressed concern for two *‘aumākua* and celebrated species (*pueo* and *‘ōpe‘ape‘a*). Mr. Berg stated the project has been “proposed on a pueo (owl) foraging and breeding ecosystem.” The *pueo,* which are found on all of the main Hawaiian islands, are listed by the State of Hawai‘i as endangered on the island of O‘ahu (DLNR 2005). The DLNR states that *pueo* are most commonly found in “open habitats such as grasslands, shrublands, and montane parklands, including urban areas and those actively managed for conservation” (DLNR 2005).

Mr. Berg also noted records indicate that per earliest colonial contact, the *pueo* is most abundant on the slopes from Pu‘u Kapua‘i to West Loch, adding that “Hunehune Gulch, Kaloi Gulch, and Honouliuli Gulch are migratory routes used by the pueo to go from mountain to sea to court, mate, forage, and raise their brood.” He also noted *pueo* are not forest dwellers, preferring “scrub, open fields/dirt landscapes with some grass.” He stated that the proposed project will “encroach on prime pueo habitat-considered to be graded A+—“a ten (10)”—when it comes to the degree of pueo habitat in use on this project site.”

Mr. Berg also stated that the project site is “inhabited by the ōpe‘ape‘a at various times of the seasons.” The *‘ōpe‘ape‘a* or Hawaiian hoary bat was listed as an endangered species under the Endangered Species Conservation Act of 1969. Mr. Berg noted that in 1910, the State of Hawai‘i documented *‘ōpe‘ape‘a* within a half-mile of the project area. *‘Ōpe‘ape‘a* is “the only land mammal native to the Hawaiian archipelago” and is found on all of the main Hawaiian islands except for Ni‘ihau (DLNR 2005:3-13).

Mr. Berg stated his concern that the “property in question will not receive the proper protocol to conclude no endangered species inhabit the area.” He recommended that “a thorough and complete protocol is adopted to repeat the inventory exercise for pueo and ‘ōpe‘ape‘a over the course of a calendar year would be in order so the project does not inadvertently contribute to more endangered species habitat loss.” He also recommended consulting with Dr. Melissa Price and Dr. Javier Cotin of the Project Pueo Biologist Team and DOFAW Biologist Afsheen Siddiqi regarding *pueo* protocol.

Mr. Berg also expressed his concern for the possible negative aspects of lighting operations at an adjacent parcel which may reflect off of a solar panel into “the flight patterns of migrating birds and the *‘ōpe‘ape‘a* and *pueo* in particular need to be addressed.”

The cultural impact assessment acknowledges the role of *pueo* as one of the most important *‘aumākua* gods and ancestral deities of the family (Valeri 1985:19, 21). While *‘ōpe‘ape‘a* are rarely documented as *‘aumakua,* they fit the intersection of classes of animals (mammal and bird) and intersection of two domains (air and land) that would make them an appropriate manifestation of the *‘aumakua*. (Valeri 1985:23). Without question both *pueo and ‘ōpe‘ape‘a* are greatly celebrated in the *mo‘olelo* of Hawai’i’s past.

No accounts of hunting have been identified in association with this project area.

8.4.1.4 Earth Resources

No traditional use of the stones (or soft sediments) within the project area has been documented.

8.4.1.5 Plant Resources

Vegetation composition within the project area has been significantly impacted by human activities with the result that the overwhelming majority of the vegetation is exotic. Today the project area is largely covered with *haole koa* (*Leucaena leucocephala*) and exotic grasses. *Wiliwili* (*Erythrina sandwicensis*), sweet acacia or *klu* (*Acacia farnesiana*), and *kiawe* (*Prosopis pallida*) were also observed within the project area. No evidence of traditional gathering practices in the project area or vicinity was encountered.

Ms. Paglinawan stated that as a result of the development of the *moku* of ‘Ewa including the *ahupua‘a* of Honouliuli, “we destroyed the habitat of the *ao kuewa* which is the *wiliwili* trees.”

She recommended planting “a wall of trees” surrounding the proposed project area which would provide a home for the displaced spirits. She also discussed the types of plants that were previously found in the area which include *noni* plants, coconut trees, *lauhala* trees, and *‘ulu* trees. She noted that these plants were “very plentiful but sparse not like a big grove where it’s like a park of trees, it was interspersed throughout.”

8.4.1.6 Trails

In traditional times, trails were well used for travel within the *ahupua‘a* between *mauka* and *makai* and laterally between *ahupua‘a*. A historical trail system existed on O‘ahu extending from Honolulu to Wai‘anae. A cross-*ahupua‘a* (east-west) trail passed through Honouliuli north of Pu‘uokapolei, and continued along the coast to Wai‘anae following the route of the modern Farrington Highway. Early historic maps depict a trail that branches off the cross-*ahupua‘a* trail into the uplands in the Pālehua area. The 1825 Malden map (see Figure 7) shows a trail extending into the Pālehua area a couple hundred meters to the southwest of the project area. A 1919 map (see Figure 16) shows an unimproved road alignment just south of the project area, understood as the Pālehua Road, approximating a traditional Hawaiian footpath into the uplands, on the north slope of Pu‘u Makakilo and a less formal trail into the uplands skirting the west side of Pu‘u Kapua‘i to the west of the project area. However, a 1922 map (see Figure 17 and Figure 18 showing annotations), shows the Pālehua trail as arcing through the western portion of the project area before arcing north of Pu‘u Makakilo. This trail may have always been somewhat braided. The trail appears to only be depicted on the 1922 map (see Figure 17 and Figure 18) and appears to have been largely under Sugar Cane Field 30 in the 1925 map (Figure 19). This trail was not identified on the ground in either of the AIS studies of this area (Dega et al. 1998 and Welser et al. 2019). Access into the southeastern Wai‘anae Range today is facilitated by Makakilo Drive. Development of the present project area is suggested to have no adverse impact to traditional Hawaiian trails or access to upland resources.

Interviewee Lynette Paglinawan stated that “this area where the University [of Hawai‘i West O‘ahu] is located has a lot of trails that go from *mauka-makai*, come from Honolulu going towards Nānākuli.” She noted that “spirits travel on ancient trails” which they use to “go from *mauka* going down to *makai*.” She added that these “ancient trails are still in use,” noting that people who live in homes that have been built on or near these ancient pathways have experienced “strange happenings” which she believes are due to the *‘uhane* that still use these ancient trails to travel from *mauka* to *makai*.

8.4.1.7 Wahi Pana

While Pu‘u Kapua‘i (located 0.5 km to the northwest) and Pu‘u Makakilo (located 1.2 km to the southwest) are certainly prominent, they are not particularly “storied” places. They are some distance away.

Kalo‘i Gulch is arguably a more renowned *wahi pana* with a number of vignettes regarding a “Waihuna” or “Punahuna” hidden spring. It was also noted that the hidden spring “had been one of the principal sources of water for all that country, which was quite heavily populated […]” Historic maps indicate a spring located approximately 2.2 km to the north. It is believed that a significant spring may have been identified during an inventory survey for a neighboring Pālehua East B project (Tulchin and Hammatt 2005). The project area per se would not appear to merit consideration as a *wahi pana*.

8.4.2 The Extent to which Traditional and Customary Native Hawaiian Resources will be Affected by the Proposed Action

While acknowledging Mr. Berg's concern for *ʻōpeʻapeʻa* and *pueo* as a cultural concern, in addition to a concern for endangered species, the impact of the project on these natural populations, if any, is suggested as appropriately a matter for zoological analysis.

8.4.3 Feasible Action, if any, to be Taken by the LUC to Reasonably Protect Native Hawaiian Rights

In order to evaluate any possible adverse impact to cultural resources it is recommended that consideration of review of the biological study pertaining to populations of *ʻōpeʻapeʻa* and *pueo* be undertaken. With that possible exception, no adverse impact on cultural resources or practices is anticipated. No other customary resource has come to light in the historic background research or in the consultation outreach to 70+ individuals and NHOs and Mr. Berg was the only party to express concern for the *ʻōpeʻapeʻa* and *pueo.*

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Appendix A Written Testimony from Tom Berg

August 19, 2019

TO: Mr. Kellen Tanaka
Cultural Researcher
Cultural Surveys Hawaii, Inc.
41-1537 Kalanianaole Hwy., Suite 204
Waimanalo, Hawaii 96795

FROM: Tom Berg
91-203 Hanapouli Circle
Ewa Beach, Hawaii 96706
Phone: 808-685-1932
Email: tomberg00@yahoo.com

RE: CULTURAL IMPACT ASSESSMENT (CIA) FOR THE AES WEST O'AHU SOLAR PLUS STORAGE PROJECT, APPROXIMATELY 80-ACRES

AREA: TAX MAP KEY (TMK) 9-2-002:007, OWNED BY THE UNIVERSITY OF HAWAI'I (UH)

Aloha Mr. Kellen Tanaka,

My name is Tom Berg, and I am aware that a solar farm has been proposed on a pueo foraging and breeding ecosystem and how that solar farm may have potential impacts to cultural resources, cultural practices, and beliefs as a result of the proposed project (AES West O'ahu Solar Plus Storage). This project site is also inhabited by the ʻŌpeʻapeʻa at various times of the seasons.

I have two areas of concern that I would appreciate you taking into consideration for the Cultural Impact Assessment (CIA)- they are:

The State of Hawaii Department of Land and Natural Resources (DLNR) and the United States Department of Fish and Wildlife Service (USFWS) have developed a protocol to conduct biological surveys to inventory for endangered species that are considered sacred- of great spiritual value, and these relations are known as ʻaumakua- and of them, are the pueo (Hawaiian owl) and the ʻŌpeʻapeʻa (Hoary bat) that are being systematically extirpated due to poor, inadequate, faulty, Environmental Assessments (EA) and or Environmental Impact Statements (EIS) that lack proper protocol.

A protocol is defined as the methodology an observer undertakes when performing the biological survey for the property to be developed. This protocol is to be deployed on the site to ensure that prior to development, it can be concluded the property did not serve endangered species- or if found, mitigated as the law requires.

My concern is this property in question will not receive the proper protocol to conclude no endangered species inhabit the area- when they are indeed there- 'you just have to know when and where to look.' For instance, what protocol will be deployed to determine if the population of both the pueo and ʻŌpeʻapeʻa are served by habitat on the property? Five points to address are:

1. Who will look for the pueo and ʻŌpeʻapeʻa on the land? What is their expertise and qualifications as observers?
2. Did the observation to inventory for the species transpire before sunrise and after the sunset periods when the ʻŌpeʻapeʻa and pueo are most active and can be recorded?

Page 1

3. Did the observer conduct the biological survey whereby the inventory for the species was repeated year-round over the wet and dry seasons?

4. What tools were used- visual aids in the field – techniques to identify the species while observing/conducting the inventory?

5. Was the inventory to assess and survey for pueo and ʻŌpeʻapeʻa done completely on foot- or was a vehicle used?

The State of Hawaii has documented ʻŌpeʻapeʻa (1910) sighted within a half-mile of the project (State Office of Planning) which begs the question: When was the last population survey for ʻŌpeʻapeʻa in the proposed project area done?

Records illustrate the pueo being most abundant on the very slopes where this project is slated (Puʻukapuai to West Loch) per earliest colonial contact. Hunehune Gulch, Kaloi Gulch, and Honouliuli Gulch are migratory routes used by the pueo to go from mountain to sea to court, mate, forage, and raise their brood. This solar project- is slated in the heart, direct line of the pueo and use of these gulches.

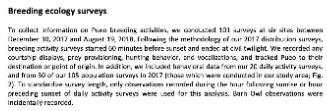
Pueo love scrub, open fields/dirt landscapes with some grass- and as such, they are not forest dwellers. This project site is to encroach upon prime pueo habitat-considered to be graded A+ - "a ten (10)" - when it comes to the degree of pueo habitat in use on this project site.

The pueo has a direct connection to Native Hawaiian family lineage in Ewa Beach-- with the Michael Lee family – and the pueo is their ʻaumakua and these accounts with the pueo are documented at the State Archives Building in Honolulu going back over seven generations for the Lee family. https://www.youtube.com/watch?v=sfW8FGI1XiI

To elaborate on my first concern, the DLNR and USFWS developed a protocol to properly account for ʻŌpeʻapeʻa and pueo and stated that a survey to inventory for them should be executed over the changing seasons year-round. This practice, to deploy the protocol, year-round, is not being done in either the EA and or EIS review processes. Furthermore, the inventory exercise conducted by the observer is to be undertaken after sunset and before the sunrise periods, otherwise:

> "The observer is more apt to miss the species since the pueo and ʻŌpeʻapeʻa are migratory- transient in nature and rotate plots with the changing seasons." (Wildlife Biologist Jenny Hoskins, USFWS; August 18, 2016, UHWO Town Hall Meeting on Pueo.). https://www.youtube.com/watch?v=i1Tm98qpmcQ

A population distribution survey for pueo was completed recently for the island of Oahu that included the area of UHWO (University of Hawaii West Oahu Mauka Segment) where I and Mike Lee have relations with the pueo. The observer began their inventory exercise December 31, 2017, and terminated it early August of 2018. The pueo that inhabited UHWO per my experience came to the property throughout the months of late August through September, October, November, and vacate late December. However, the survey didn't include those months for observation.
https://docs.wixstatic.com/ugd/35ff1d_864845984aec47e58618e97ca46e578f.pdf



Breeding ecology surveys

To collect information on Pueo breeding activities, we conducted 101 surveys at six sites between December 30, 2017 and August 19, 2018, following the methodology of our 2017 distribution surveys. Breeding activity surveys started 60 minutes before sunset and ended at civil twilight. We recorded any courtship displays, prey provisioning, hunting behavior, and vocalizations, and tracked Pueo to their destination or point of origin. In addition, we included behavioral data from our 20 daily activity surveys, and from 30 of our 105 population surveys in 2017 (those which were conducted in our study area; Fig. 2). To standardize survey length, only observations recorded during the hour following sunrise or hour preceding sunset of daily activity surveys were used for this analysis. Barn Owl observations were incidentally recorded.

Therefore, the survey mistakenly concluded no pueo or its habitat existed on the property at UHWO- *because the observer simply avoided conducting the inventory exercise on the property during the months when the pueo were historically and traditionally known to be most prevalent.*

Page 2

I have stipulated, that had the survey exercise at UHWO been conducted year-round as recommended as the proper protocol to inventory for pueo, the results of the survey would have reported a pueo ecosystem thriving on the property and many Native Hawaiians' ʻaumakua would be protected rather than purged from the property.

Your assurances a thorough and complete protocol is adopted to repeat the inventory exercise for pueo and ʻŌpeʻapeʻa over the course of a calendar year would be in order so the project does not inadvertently contribute to more endangered species habitat loss.

Here is a video of Mike Lee performing a chant to the pueo on January 1, 2018 at UHWO- note:

> UHWO / UH Board of Regents / DLNR / Attorney General, have stated that the pueo you see in the video- all taken at UHWO- "DID NOT and HAVE NOT EVER EXISTED THERE"- meaning, that I and Mike Lee fabricated the pueo recordings. https://www.youtube.com/watch?v=d9yoxlGeNCA
>
> This claim by government entities, that pueo never used the property at UHWO and no habitat ever existed there to serve pueo, is not only an affront to our State, its people, but also a violation of the law- HRS Ch. 343 that protects endangered species and their habitat.

Again, this claim by Hawaii's governor- the Ige Administration, that absolutely no pueo used UHWO property, is not only patently false- but a deliberate act of Administrative Bias, Institutional Prejudice- and a willful act of Malice- to cause direct harm to an endangered specie- a 100% violation of Article XII, Section VII of Hawaii's State Constitution that protects Native Hawaiian Religious and Cultural Practices and their ʻaumakua ---- https://www.youtube.com/watch?v=d9yoxlGeNCA --

This is significant, in that UH to this day, denies the pueo had any habitat on the UHWO Mauka Segment property when the evidence depicts otherwise. Will you too- be orchestrating another fake EIS or EA for this solar farm project that falsifies true characteristics of the property and misrepresents it's significance to sustain endangered species?

My other concern has to do with the illumination of property owned nearby by Monsanto that the AES West Oahu Solar Project may interface with. The lights when activated by Monsanto on its fields may have a negative effect on many avian species. How a solar panel may be reflecting Monsanto's lighting operations into the flight patterns of migrating birds and the ʻŌpeʻapeʻa and pueo in particular needs to be addressed.

Please reference the lights in operation next to your proposed solar farm operations: https://www.youtube.com/watch?v=S8Ba0zpSBI0

Your favorable review of my concerns in the CIA and any answers to my inquiries that you can provide are greatly appreciated.

Mahalo Nui,

Tom Berg

Page 3

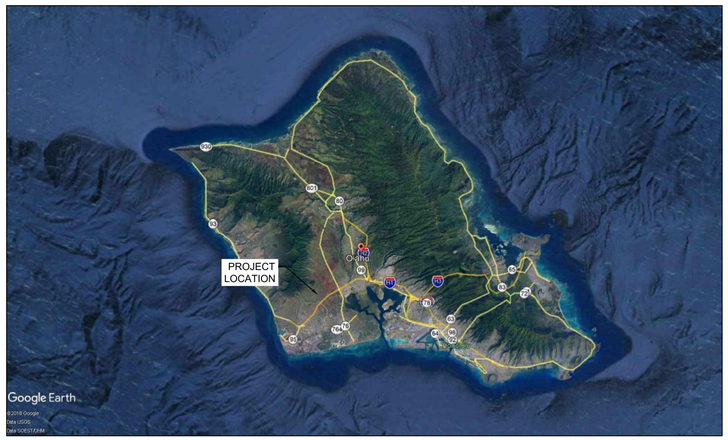
Attachment H
Site Plan and Drawings

WEST OAHU SOLAR PLUS STORAGE
12.5 MW AC COMBINED PV AND 50 MWh BESS

KAPOLEI, WEST OAHU, HAWAII

PREPARED FOR

CITY AND COUNTY OF HONOLULU DEPARTMENT OF PLANNING AND PERMITTING



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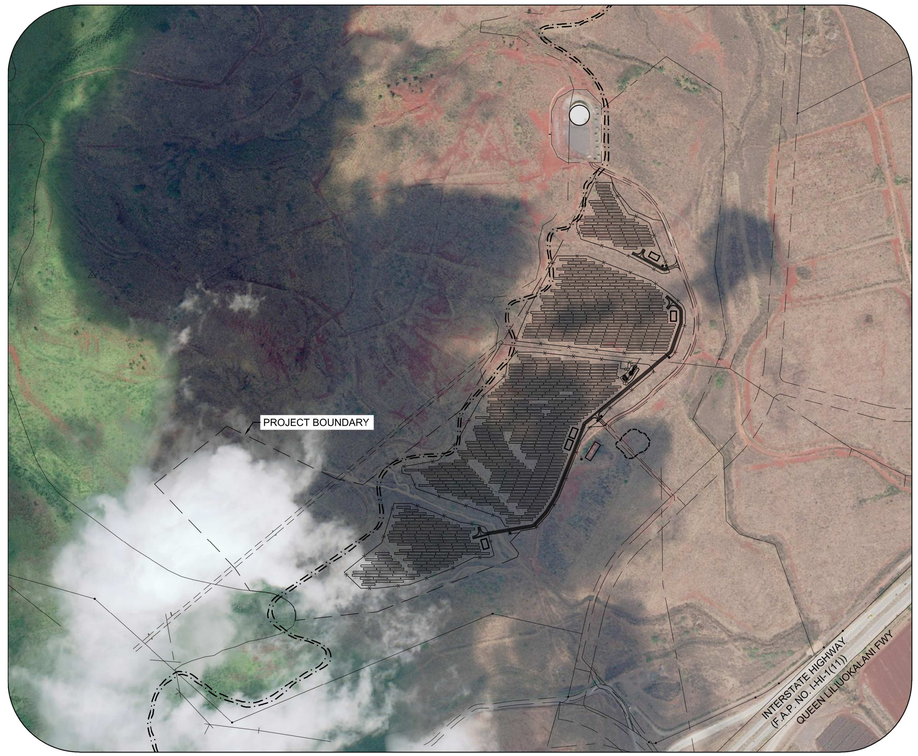

SITE MAP

1" = 500'

SCOPE OF WORK

THIS PACKAGE PROVIDES DRAWINGS FOR THE INSTALLATION OF 17.42 MW DC, 12.5 MW AC AT POI COMBINED PHOTOVOLTAIC AND BATTERY ENERGY STORAGE SYSTEM NEAR KAPOLEI, WEST OAHU, HAWAII.

PROJECT DEVELOPER

AES WEST OAHU SOLAR
282 CENTURY PL, SUITE 2000
LOUISVILLE, CO 80027

NICK MOLINARI
BUSINESS DEVELOPMENT
(303) 524-4368

CAMERON HAUGHEY
PROJECT MANAGER
(720) 450-4360

CIVIL ENGINEER

AARON MURPHY
3J CONSULTING
9600 SW NIMBUS AVE
BEAVERTON, OR 97008

HI LICENSE - 18696-C
EXP. DATE - 04/30/22

STRUCTURAL ENGINEER

THOMAS HAMLIN
HDR, INC.
3200 EAST CAMELBACK ROAD
PHOENIX, AZ 85018
(602) 522-7737

HI LICENSE - 16088 - S
EXP. DATE - 04/30/20

ELECTRICAL ENGINEER

JAMES TRAN
HDR, INC.
1670 BROADWAY, SUITE 3400
DENVER, CO 80202
(303) 323-9796

HI LICENSE - 18163 - E
EXP. DATE - 04/30/2022

SHEET INDEX

THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION

A. Murphy

4/30/2022

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AES Distributed Energy

AES Distributed Energy
282 Century Pl. Suite 2000
Louisville, CO 80027 USA

HDR / 3J CONSULTING
CIVIL ENGINEERING
WATER RESOURCES
COMMUNITY PLANNING
9600 SW NIMBUS AVE, SUITE 100, BEAVERTON, OR 97008

SYSTEM DESCRIPTION

REVISIONS

REV	BY	DATE	DESCRIPTION

PE STAMP

AARON J MURPHY
LICENSED PROFESSIONAL ENGINEER
No. 18696-C
HAWAII U.S.A.

AES WEST OAHU SOLAR
OAHU, HI

PROJECT NUMBER
19537
PHASE
LAND USE
MILESTONE
60% DESIGN

ELECTRICAL DESIGNER

STRUCTURAL DESIGNER

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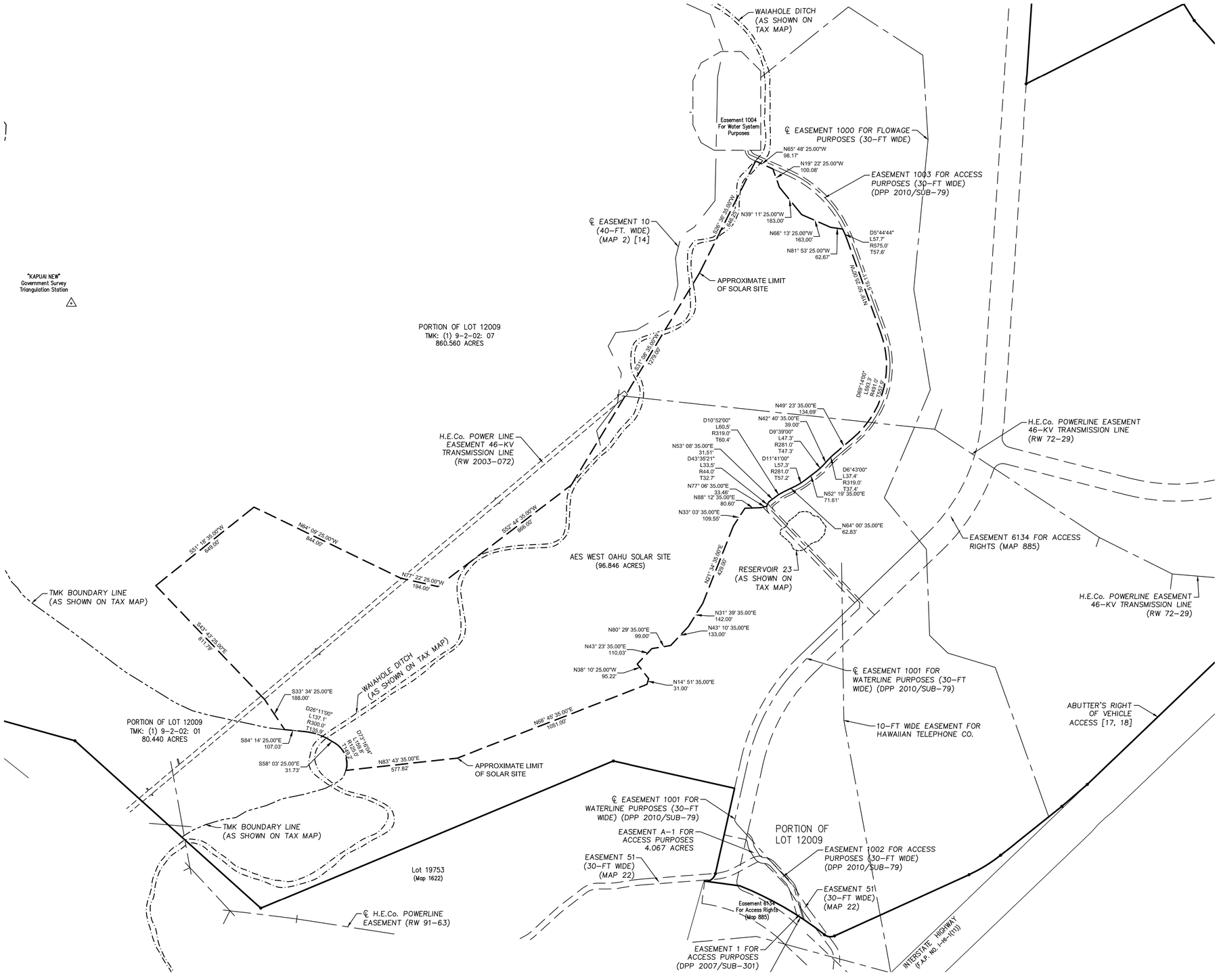

LEGEND

- BOUNDARY FOR LOT 12009
- TMK BOUNDARY
- WAIAHOLE DITCH (PER TAX MAP)
- RESERVOIR (PER TAX MAP)
- EXISTING ROW LINE
- EXISTING EASEMENT LINE
- EXISTING EASEMENT CENTER LINE
- APPROXIMATE LIMIT OF SOLAR SITE

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SCALE: 1" = 250'

0 250 500 FT

THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION

A. Murphy

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4/30/2022

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AES Distributed Energy

AES Distributed Energy
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Louisville, CO 80027 USA

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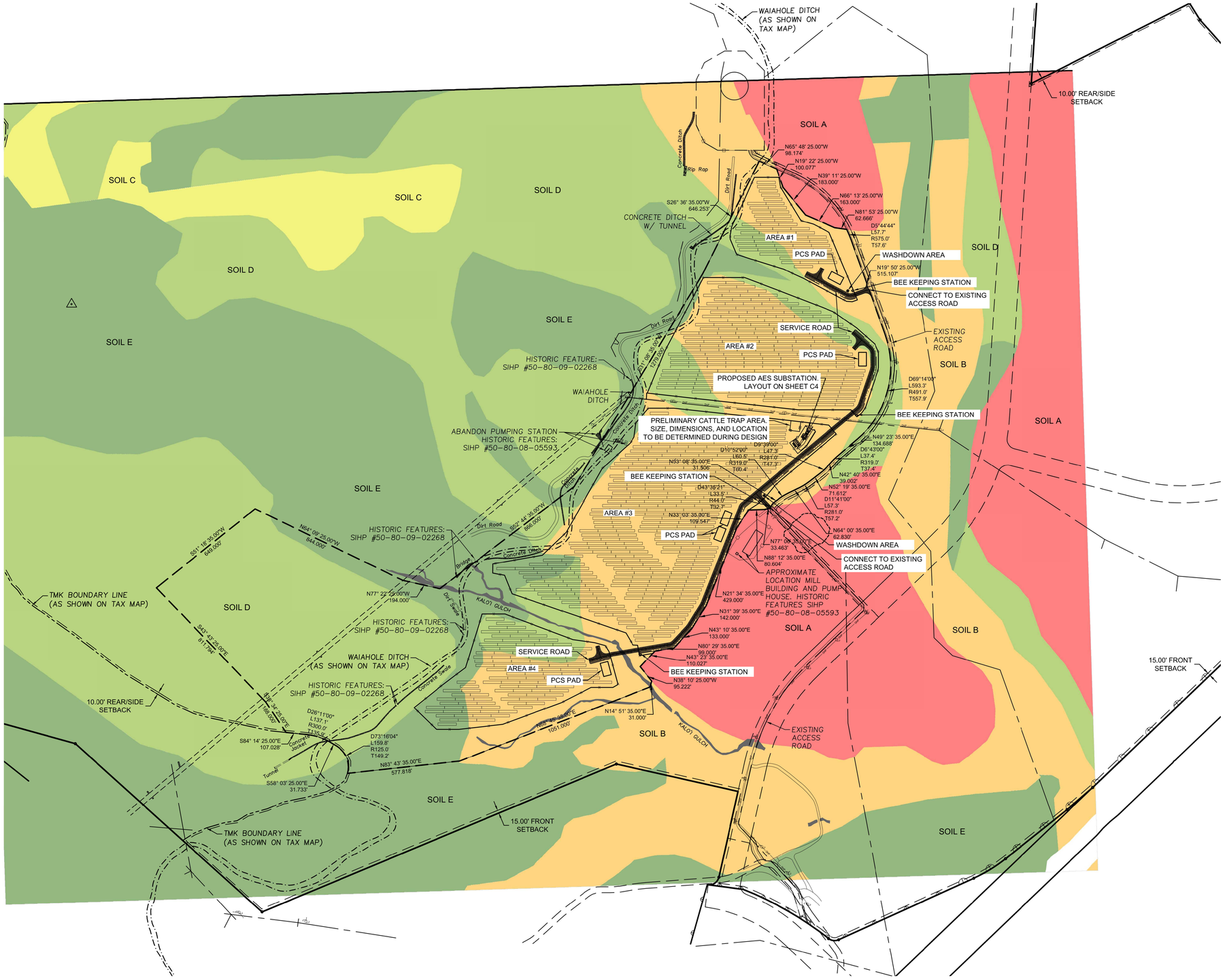

LAND STUDY BUREAU (LSB) SOIL CLASSES

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- LSB CLASS B
- LSB CLASS C
- LSB CLASS D
- LSB CLASS E

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THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION

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AES
Distributed Energy

AES Distributed Energy
282 Century Pl, Suite 2000
Louisville, CO 80027 USA

HDR 3J CONSULTING
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SYSTEM DESCRIPTION

REVISIONS

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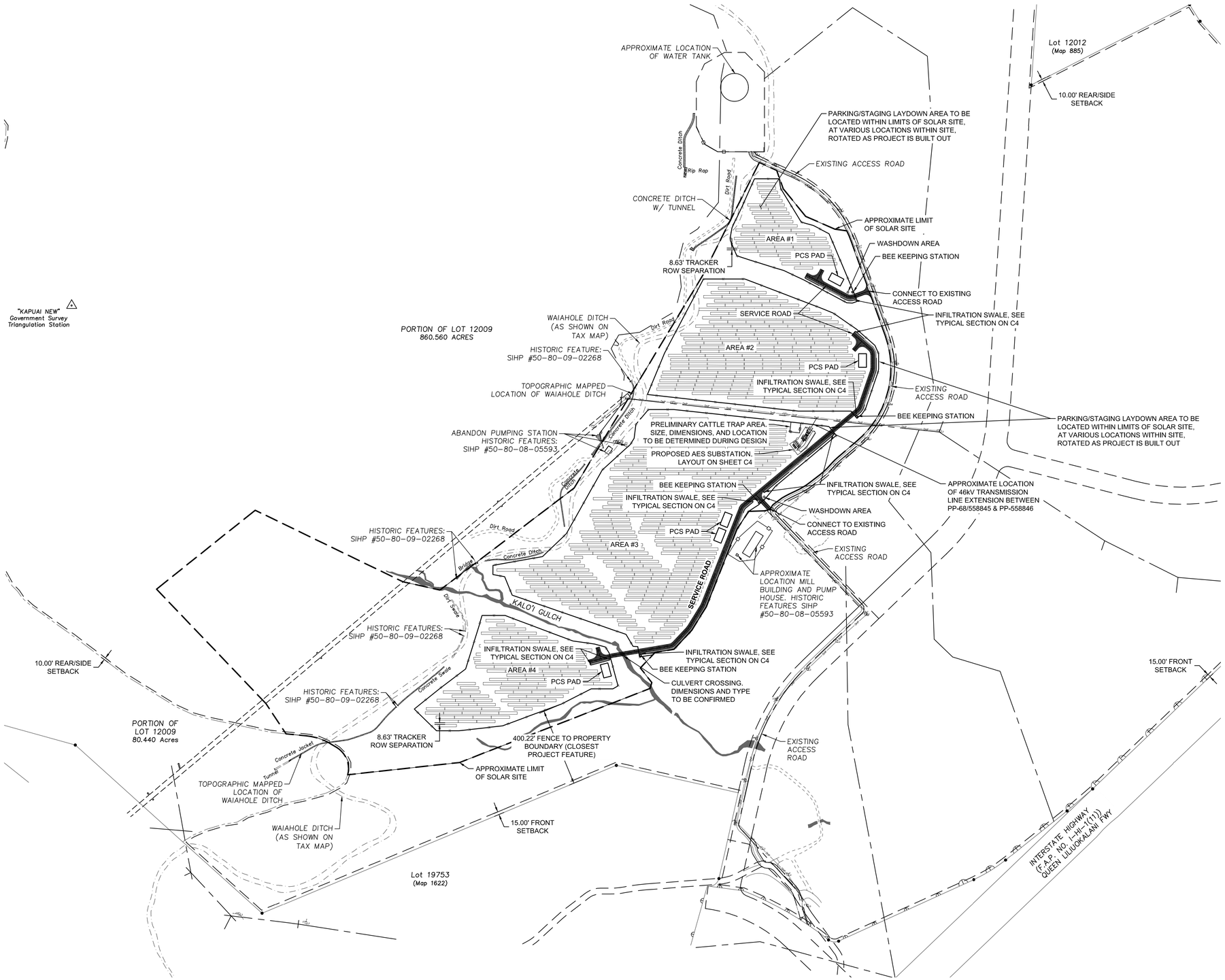

LEGEND

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- RESERVOIR (PER TAX MAP)
- EXISTING ROW LINE
- EXISTING EASEMENT CENTER LINE
- EXISTING EASEMENT LINE
- EXISTING ASPHALT
- EXISTING DIRT ROAD
- EXISTING CONCRETE DITCH
- EXISTING FENCE
- OHP — EXISTING OVERHEAD POWER
- EXISTING TRANSMISSION LINE POLE
- PROPOSED ACCESS ROAD, SEE TYPICAL SECTION ON SHEET C4
- PROPOSED PROPERTY BOUNDARY SETBACK
- PROPOSED 7' TALL STEEL FABRIC MESH SECURITY FENCE. SEE DETAIL ON SHEET C9.1
- PROPOSED PCS (POWER CONVERSION STATION) FOUNDATION AND EQUIPMENT PAD. SEE SCHEMATIC ON C4
- PROPOSED WASHDOWN AREA
- APPROXIMATE LIMIT OF SOLAR SITE

N
W E
S

SCALE: 1" = 250'
0 250 500 FT

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AES Distributed Energy

AES Distributed Energy
282 Century Pl, Suite 2000
Louisville, CO 80027 USA

HDR 3J CONSULTING
CIVIL ENGINEERING
WATER RESOURCES
COMMUNITY PLANNING
9600 SW NIMBUS AVE, SUITE 100, BEAVERTON, OR 97008

SYSTEM DESCRIPTION

REVISIONS

REV	BY	DATE	DESCRIPTION

PE STAMP

AARON J MURPHY
LICENSED PROFESSIONAL ENGINEER
No. 18696-C
HAWAII U.S.A.

AES WEST OAHU SOLAR

OAHU, HI

PROJECT NUMBER
19537
PHASE
LAND USE
MILESTONE
60% DESIGN

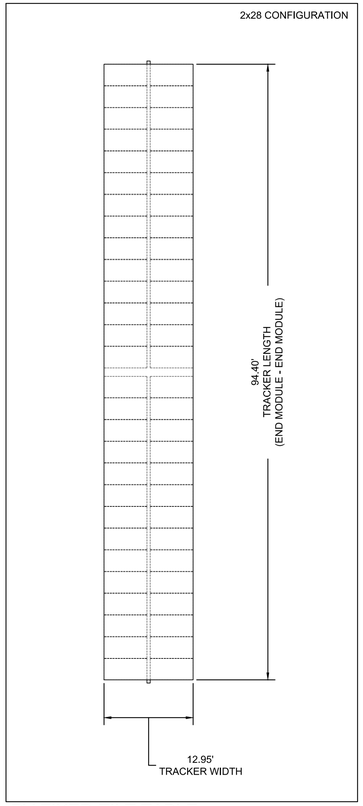
ELECTRICAL DESIGNER

STRUCTURAL DESIGNER

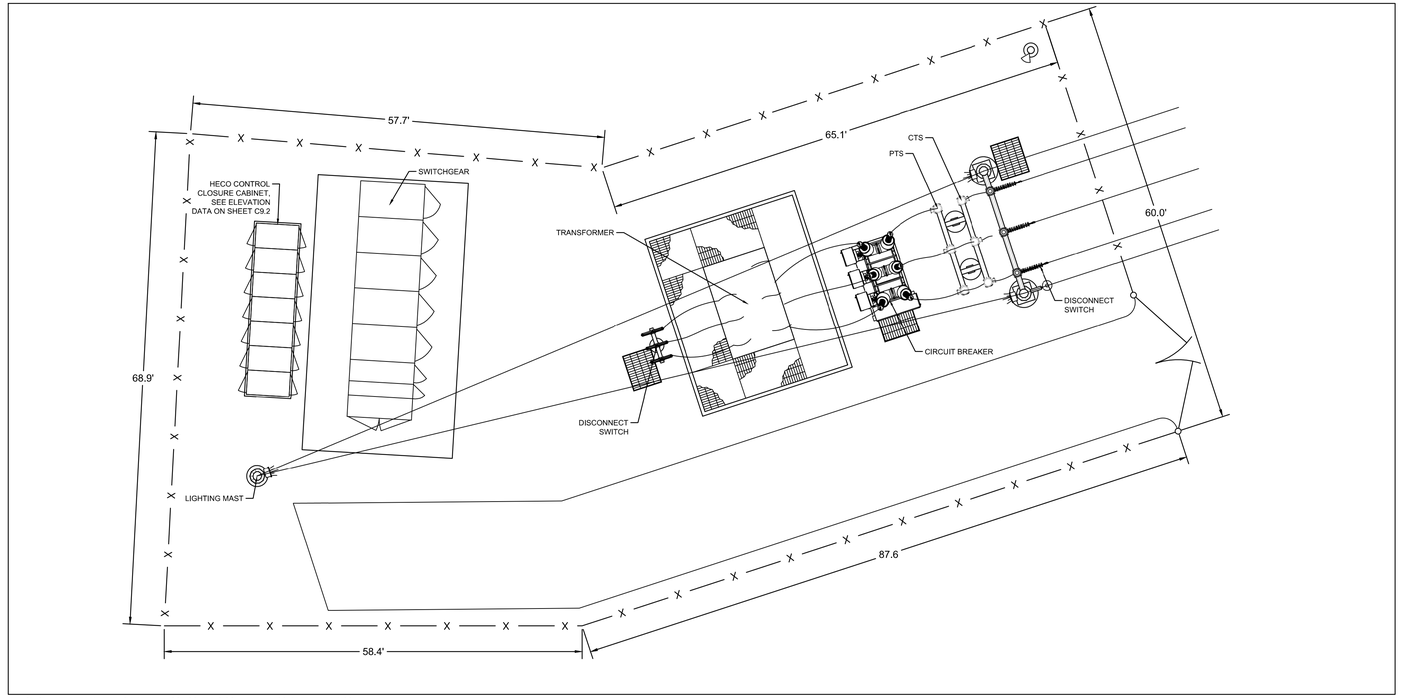
DATE 08-26-2020
SCALE 1" = 250'

TITLE
OVERALL SITE PLAN

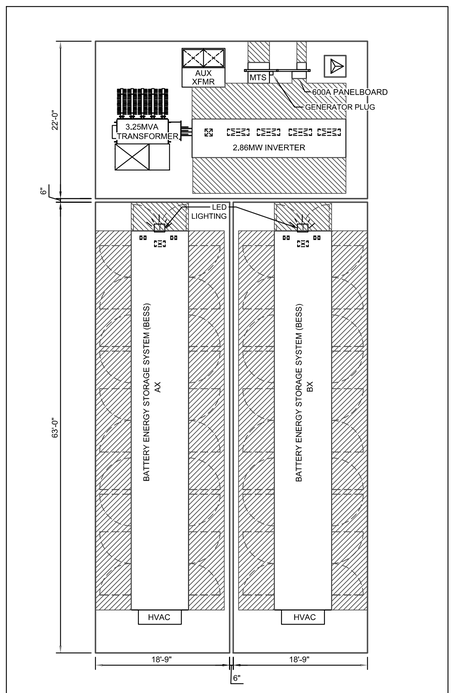
DRAWING
C3



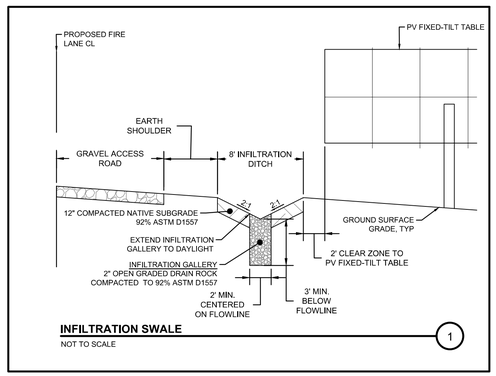
PV FIXED-TILT TABLE -
SEE ELEVATION DATA ON SHEET C9.2



PRELIMINARY AES SUBSTATION LAYOUT -
SEE ELEVATION DATA ON SHEET C9.2



POWER CONVERSION STATION (PCS) PAD LAYOUT -
SEE ELEVATION DATA ON SHEET C9.2



INFILTRATION SWALE 1
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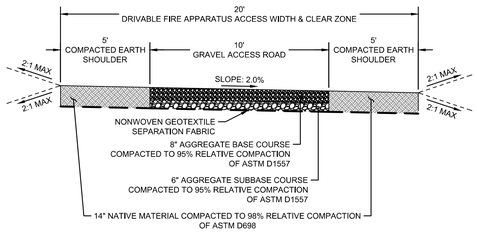

TYPICAL SECTION
GRAVEL SERVICE ROAD 1
NOT TO SCALE

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Distributed Energy
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HDR
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SYSTEM DESCRIPTION

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AARON J MURPHY
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OAHU, HI

PROJECT NUMBER
19537
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MILESTONE
60% DESIGN

ELECTRICAL DESIGNER

STRUCTURAL DESIGNER

DATE 08-26-2020
SCALE N/A

TITLE
SITE PLAN SCHEMATICS

N
W E
S

SCALE: 1" = 250'
0 250 500 FT

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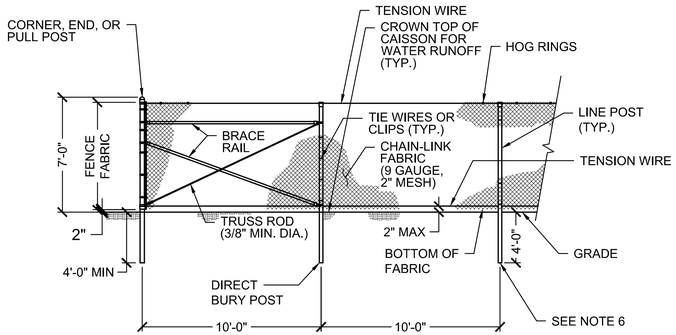
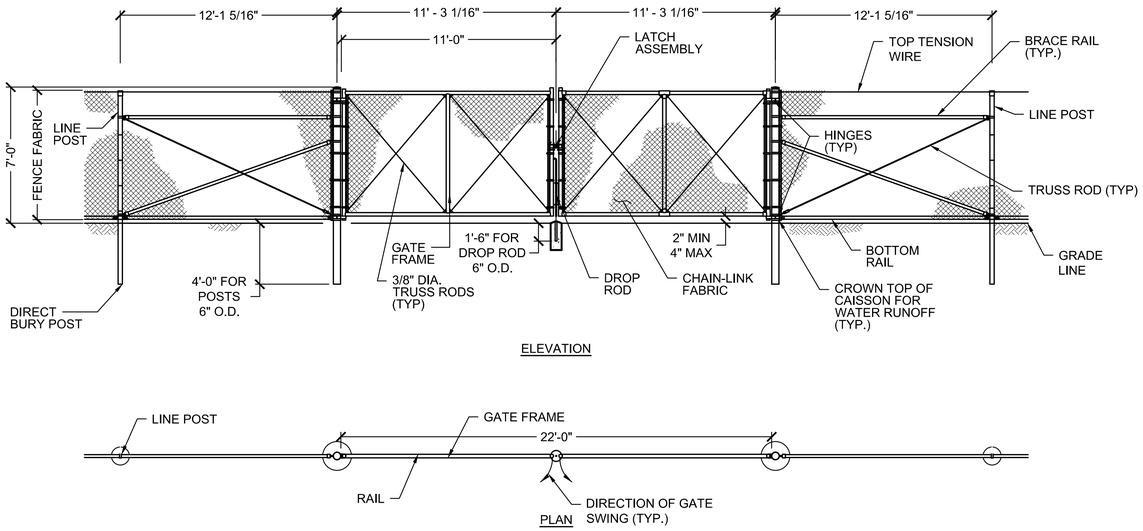
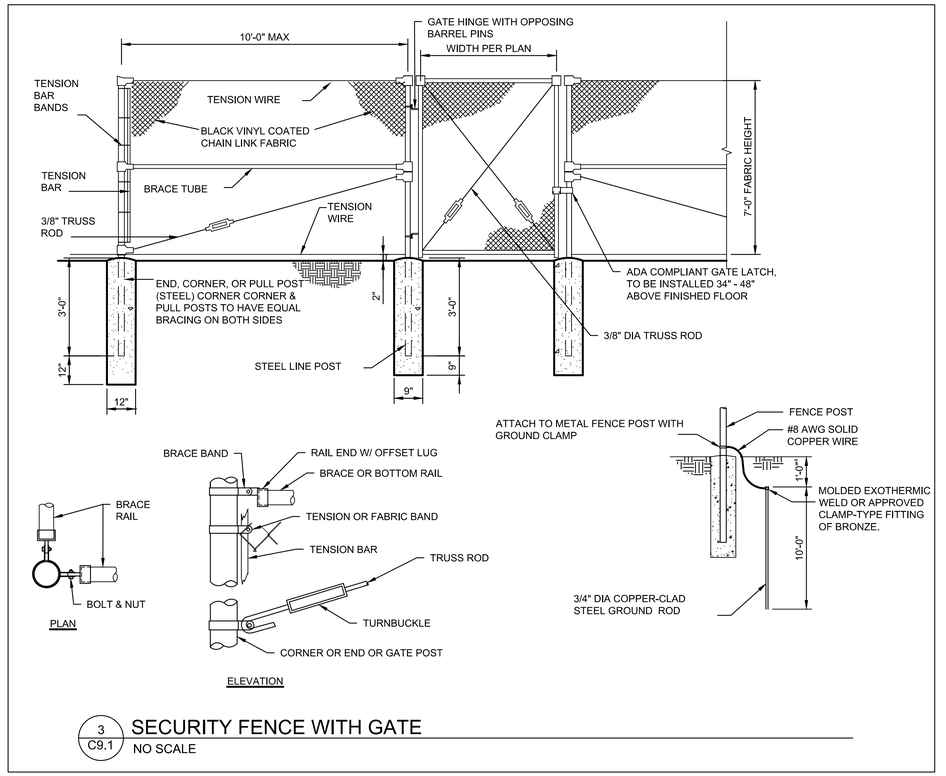
DRAWING
C4



1 C9.1 PERIMETER FENCE ELEVATION



2 C9.1 TYPICAL ACCESS GATE



3 C9.1 SECURITY FENCE WITH GATE
NO SCALE

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A. Murphy

4/30/2022

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60% DESIGN

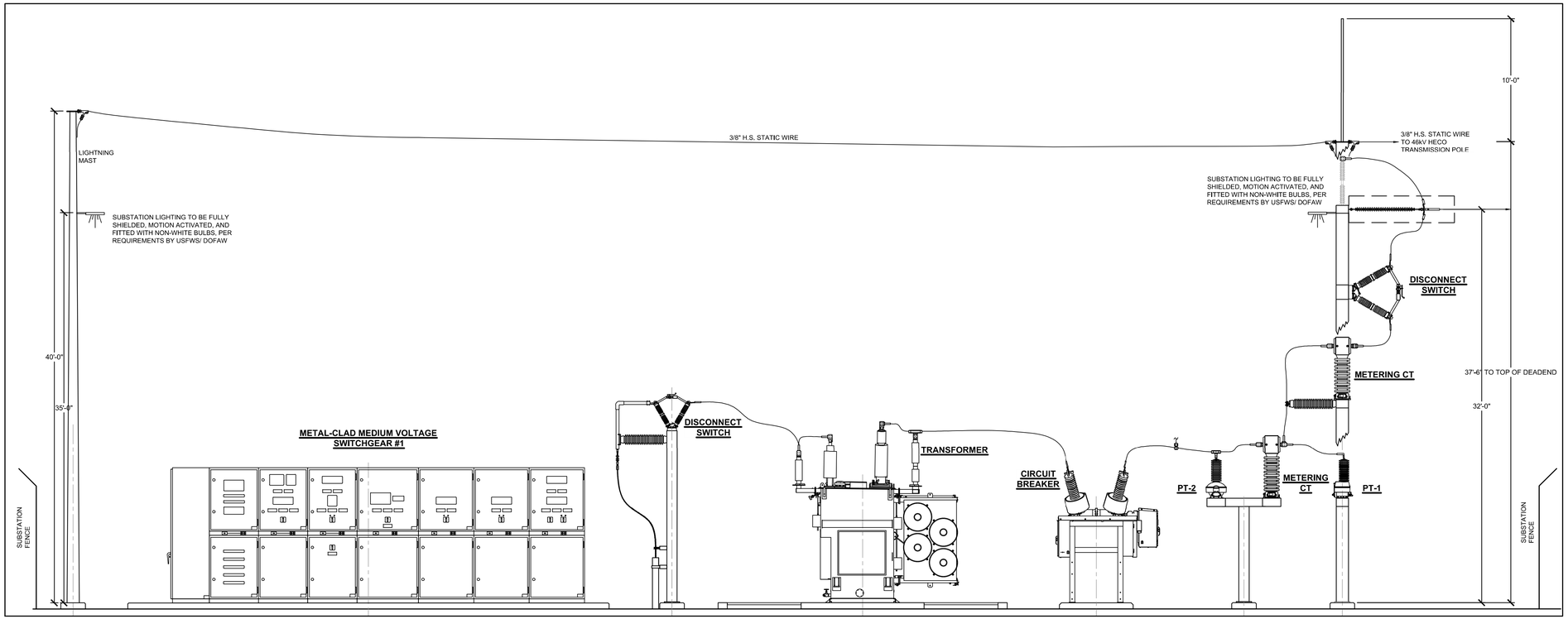
ELECTRICAL DESIGNER

STRUCTURAL DESIGNER

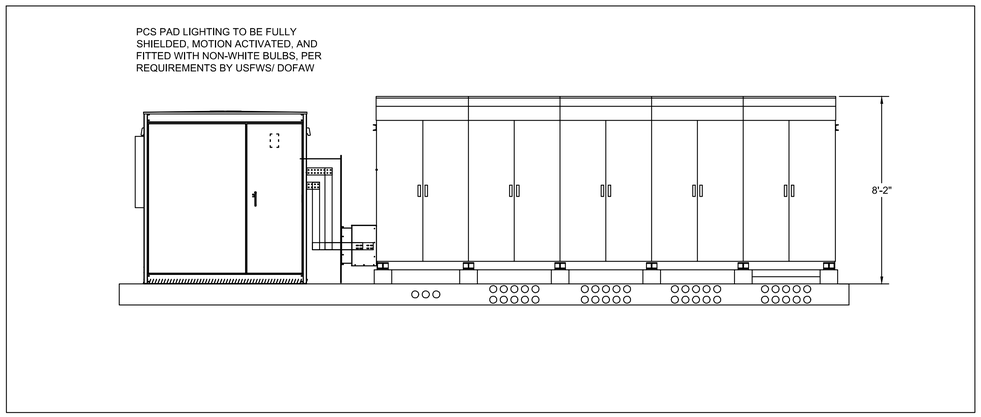
DATE 08-26-2020
SCALE N/A

TITLE
CIVIL DETAIL 1

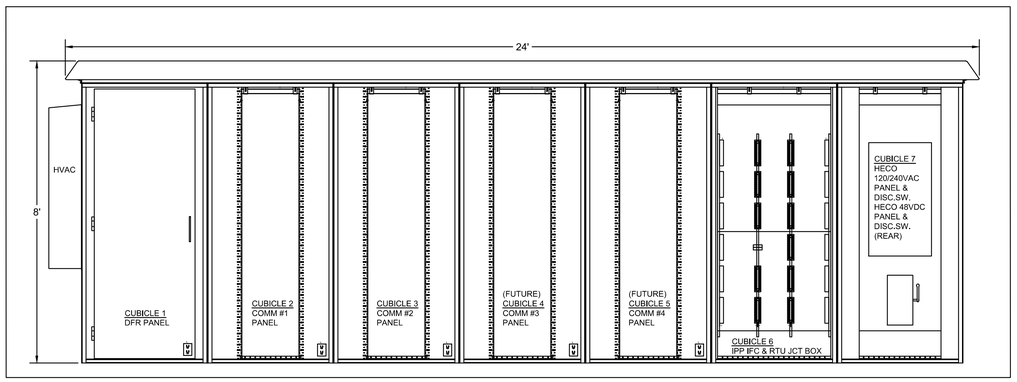
DRAWING
C9.1



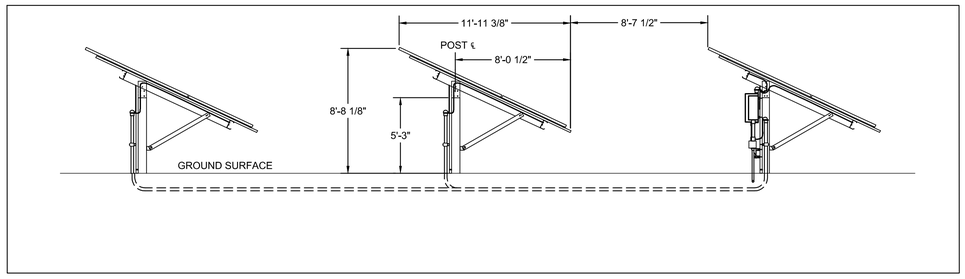
1 C9.2 PRELIMINARY SUBSTATION ELEVATION
N.T.S.



2 C9.2 POWER CONVERSION STATION (PCS) PAD INVERTER AND TRANSFORMER FRONT ELEVATION
N.T.S.



3 C9.2 HECO CONTROL CLOSURE CABINET ELEVATION
N.T.S.



4 C9.2 PV FIXED-TILT TABLE ELEVATION
N.T.S.

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CIVIL ENGINEERING
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9600 SW NIMBUS AVE, SUITE 100, BEAVERTON, OR 97008

SYSTEM DESCRIPTION

REVISIONS

REV	BY	DATE	DESCRIPTION

PE STAMP

AARON J MURPHY
LICENSED PROFESSIONAL ENGINEER
No. 18696-C
HAWAII U.S.A.

AES WEST OAHU SOLAR
OAHU, HI

PROJECT NUMBER
19537
PHASE
LAND USE
MILESTONE
60% DESIGN

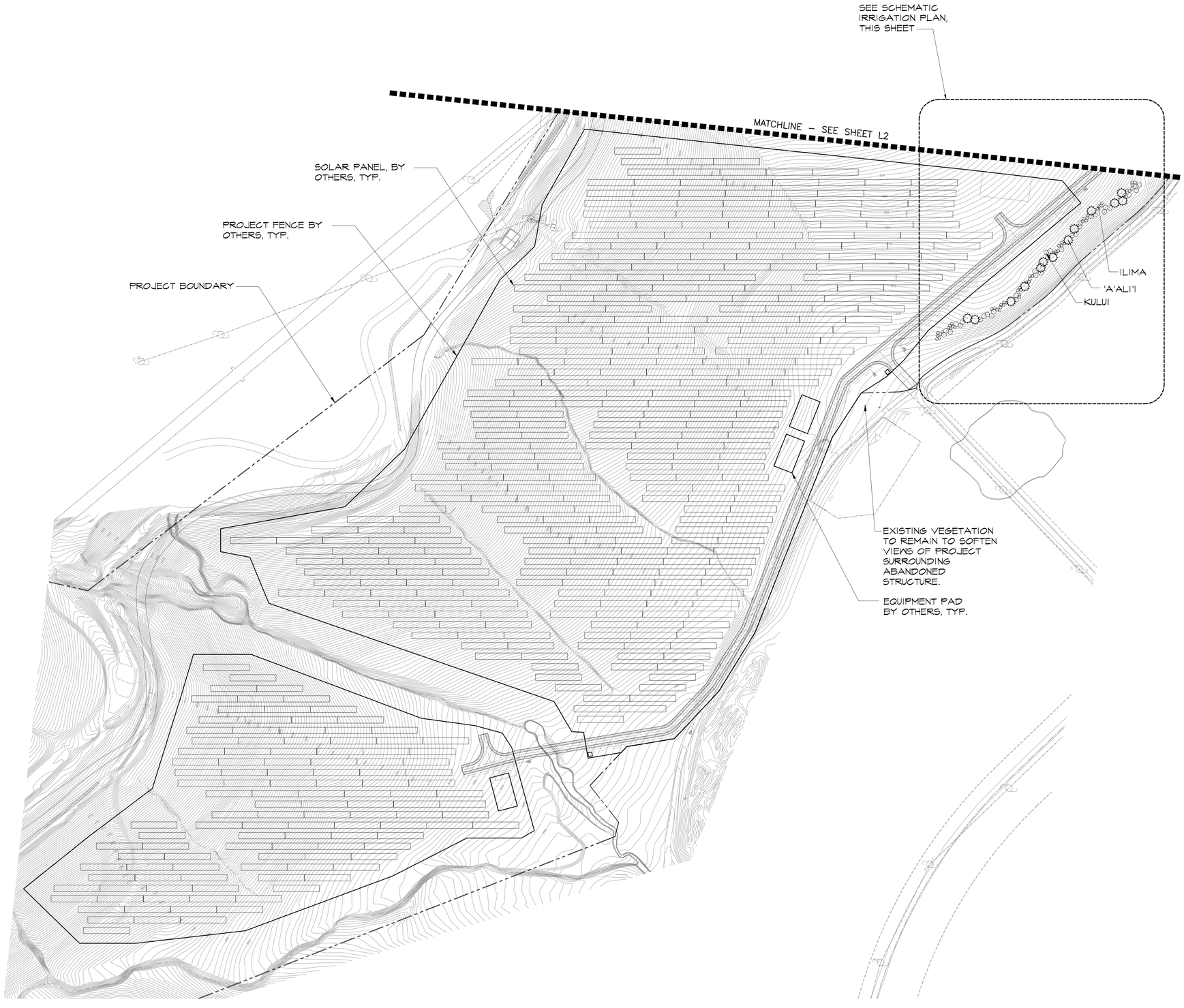
ELECTRICAL DESIGNER

STRUCTURAL DESIGNER

DATE 08-26-2020
SCALE N/A

TITLE
CIVIL DETAIL 2

DRAWING
C9.2



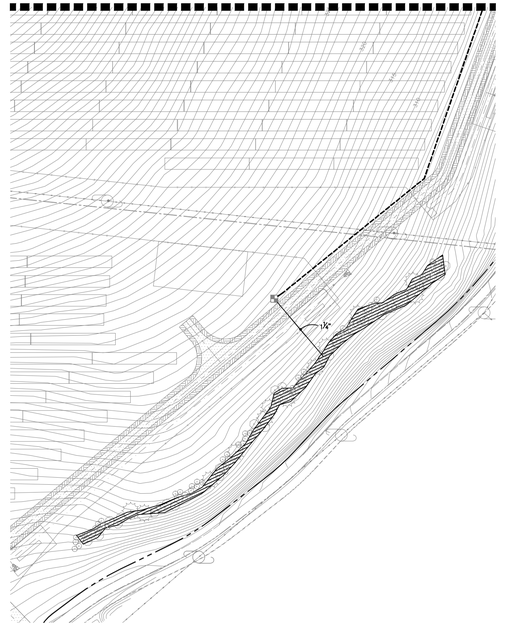
NORTH

LANDSCAPE PLAN

SCALE: 1" = 100'-0"

100' 0 100'

NOTE: SEE PLANT LEGEND ON SHEET L3 FOR PLANT NAMES, SIZES, QUANTITIES AND OTHER INFORMATION.



NOTE: SEE IRRIGATION EQUIPMENT LIST ON SHEET L3 FOR MORE INFORMATION.

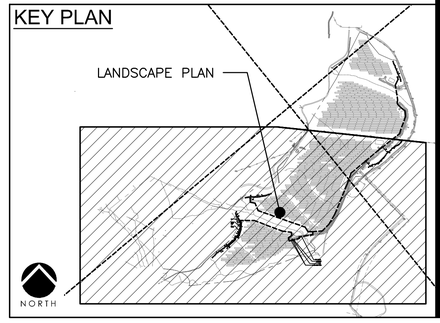
NORTH

SCHEMATIC IRRIGATION PLAN

SCALE: 1" = 80'-0"

80' 0 80'

KEY PLAN



REVISION	DATE	BY
REVISION 1		
REVISION 2		
REVISION 3		
REVISION 4		
REVISION 5		
REVISION 6		

1241 ALA AMOAMO ST
HONOLULU, HI 96819

VIVIAN L. ARITA
LICENSED PROFESSIONAL LANDSCAPE ARCHITECT
No. 18181
HAWAII, U.S.A.

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SIGNATURE 04/30/22 EXPIRATION DATE

AES WEST O'AHU SOLAR PLUS STORAGE PROJECT

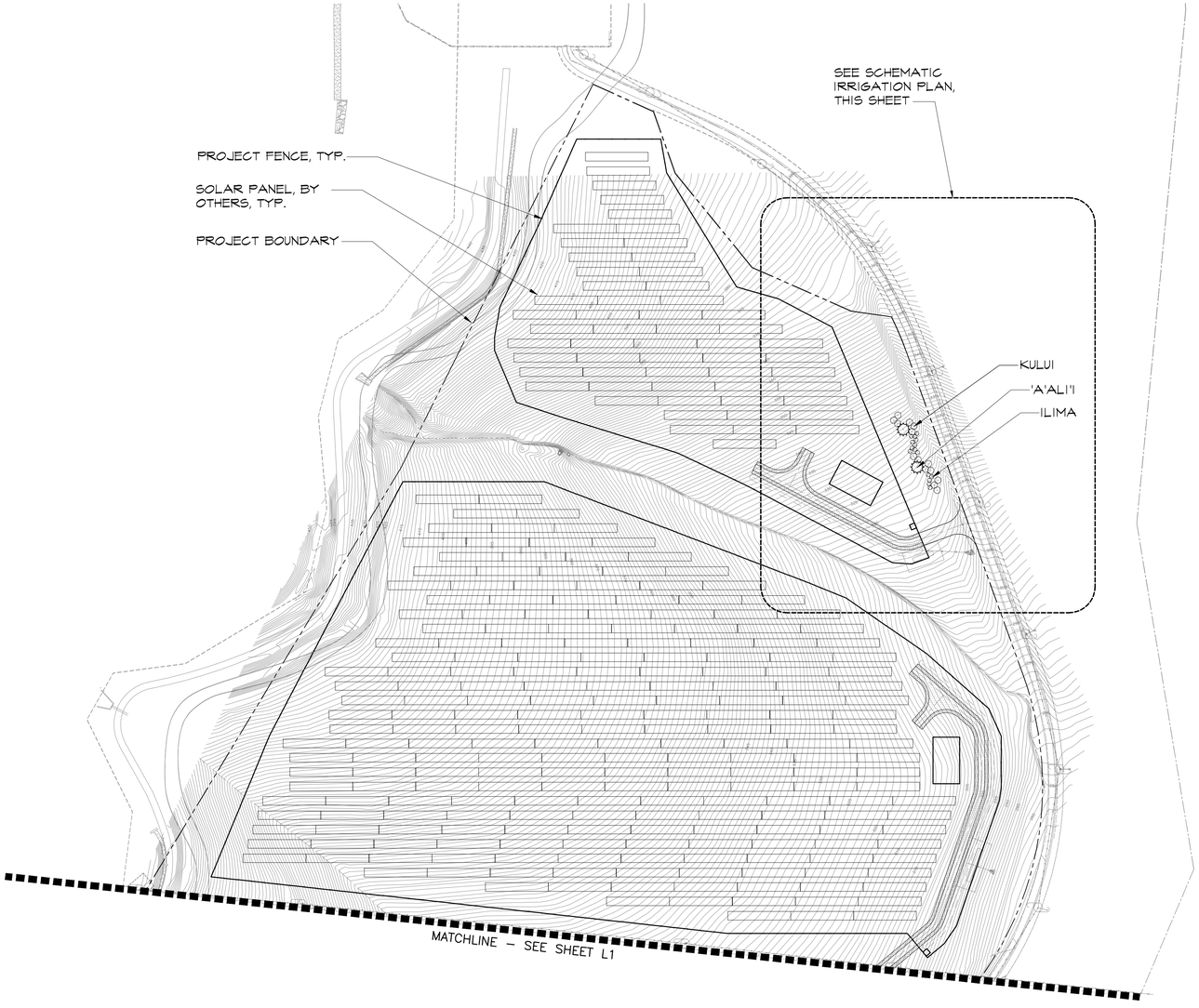
TMK: 9-2-002:007, Hono'uli'uli, 'Ewa, O'ahu, Hawai'i

LANDSCAPE PLAN AND SCHEMATIC IRRIGATION PLAN

DATE:	JUNE 2019
SCALE:	AS NOTED
DRAWN BY:	VA
MD JOB NO.:	2007

L1

1 OF 3 SHEETS

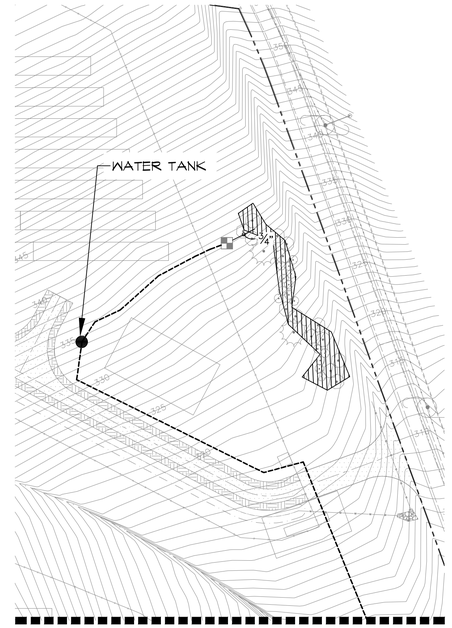


LANDSCAPE PLAN

NORTH SCALE: 1" = 100'-0"

100' 0 100'

NOTE: SEE PLANT LEGEND ON SHEET L3 FOR PLANT NAMES, SIZES, QUANTITIES AND OTHER INFORMATION.



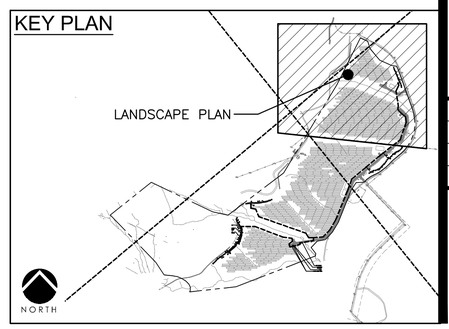
NOTE: SEE IRRIGATION EQUIPMENT LIST ON SHEET L3 FOR MORE INFORMATION.

SCHEMATIC IRRIGATION PLAN

NORTH SCALE: 1" = 50'-0"

50' 0 50'

KEY PLAN



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REVISION 6		

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SIGNATURE 4/30/22 EXPIRATION DATE

AES WEST O'AHU SOLAR PLUS STORAGE PROJECT

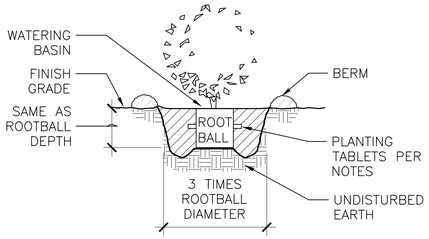
TMK: 9-2-002:007, Hono'uli'uli, 'Ewa, O'ahu, Hawai'i

LANDSCAPE PLAN AND SCHEMATIC IRRIGATION PLAN

DATE:	JUNE 2019
SCALE:	AS NOTED
DRAWN BY:	VA
MD JOB NO.:	2007

L2

2 OF 3 SHEETS



1 SHRUB PLANTING DETAIL

NOT TO SCALE

PLANTING NOTES:

1. THE LANDSCAPE CONTRACTOR SHALL VERIFY ALL EXISTING UTILITY LOCATIONS WITHIN THE PROJECT SITE PRIOR TO BEGINNING LANDSCAPE CONSTRUCTION ACTIVITIES.
2. PRIOR TO THE INSTALLATION OF ALL NEW SHRUBS, THE CONTRACTOR SHALL CLEAR AND GRUB EXISTING VEGETATION WITHIN A 10' DIAMETER FOR EACH NEW PLANTING.
3. ANY DAMAGE DONE TO UTILITIES BY THE LANDSCAPE CONTRACTOR DURING LANDSCAPE INSTALLATION ACTIVITIES SHALL BE REPAIRED/RESTORED TO ORIGINAL CONDITION AT NO EXPENSE TO THE OWNER
4. REFER TO "LANDSCAPE SPECIFICATIONS" SECTION 02480 PRIOR TO THE START OF WORK. CONTRACTOR SHALL BE HELD RESPONSIBLE FOR ALL MATERIALS, SCHEDULING, PRODUCTS, WARRANTIES AND METHODS FOR EXECUTION OF WORK WHICH MAY NOT BE INDICATED WITHIN THE DRAWINGS.
5. BACKFILL MIX SHALL CONSIST OF THREE (3) PARTS AMENDED IMPORTED PLANTING SOIL TO ONE (1) PART ORGANIC SOIL CONDITIONER (SEE SPECIFICATIONS). ADD ONE (1) POUND OF 10-30-10 FERTILIZER TO ONE (1) CUBIC YARD OF BACKFILL MIX. MIX THOROUGHLY ON PROJECT SITE PRIOR TO ANY PLANTING OPERATIONS.
6. PLANTING TABLETS FOR SHRUBS SHALL BE AS FOLLOWS:

   A) 5 GALLON 3 TABLETS
   B) 3 GALLON 2 TABLETS

   USE SLOW RELEASE FERTILIZER TABLETS 20-10-5, 21 GRAM SIZE.
7. QUANTITIES SHOWN ON PLANT SCHEDULE ARE FOR REFERENCE ONLY. VERIFY ACTUAL QUANTITIES AS SHOWN ON PLAN TO PROVIDE FULL AND EVEN COVERAGE OF PLANTING AREAS.

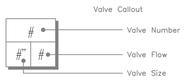
PLANT SCHEDULE

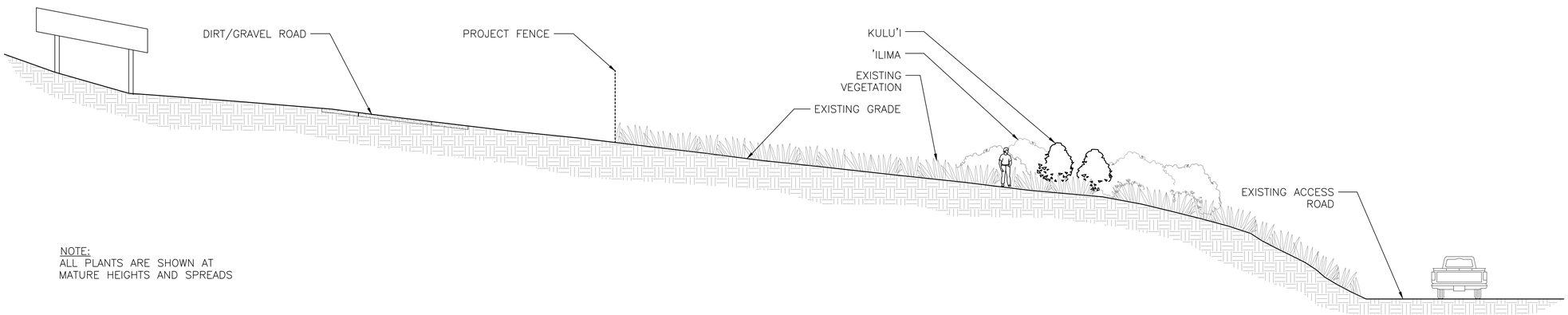
SHRUBS	QTY	COMMON NAME	BOTANICAL NAME	SIZE	HEIGHT	SPREAD	REMARKS
	48	KULU'I	NOTOTRICHIUM SANDWICENSE	5 GAL	3'-4'	2'-3'	MATURE HT: 6'
	15	'A'ALI'I	DODONAEA VISCOSA	5 GAL	3'-4'	2'-3'	MATURE HT: 20'
	69	'ILIMA	SIDA FALLAX	3 GAL	2'-3'	1'-2'	MATURE HT: 6'-8'

IRRIGATION SCHEDULE

SYMBOL	MANUFACTURER/MODEL/DESCRIPTION
	HUNTER ICZ-101-25 DRIP CONTROL ZONE KIT. 1" ICV GLOBE VALVE WITH 1" HY100 FILTER SYSTEM. PRESSURE REGULATION: 25PSI. FLOW RANGE: 2 GPM TO 20 GPM. 150 MESH STAINLESS STEEL SCREEN. CONTROLLERS SHALL HAVE SOLAR TIMERS.
	AREA TO RECEIVE DRIPLINE NETAFIM TLCV-04-18 TECHLINE PRESSURE COMPENSATING LANDSCAPE DRIPLINE WITH CHECK VALVE. 0.4 GPH EMITTERS AT 18" O.C. DRIPLINE LATERALS SPACED AT 18" APART, WITH EMITTERS OFFSET FOR TRIANGULAR PATTERN. 17MM.
	1000 GALLON ABOVE GROUND VERTICAL WATER STORAGE TANK. FDA APPROVED HIGH DENSITY LINEAR POLYETHYLENE, IMPACT, UV AND CORROSION RESISTANT.

SYMBOL	MANUFACTURER/MODEL/DESCRIPTION
	IRRIGATION LATERAL LINE: PVC SCHEDULE 40-NP
	IRRIGATION MAINLINE: HDPE PE3408 DR 11-NP





NOTE:
ALL PLANTS ARE SHOWN AT MATURE HEIGHTS AND SPREADS

2 SECTION THROUGH EAST SLOPE, SHRUBS AND EXISTING ACCESS ROAD

NOT TO SCALE

REVISION	DATE	BY
REVISION 1		
REVISION 2		
REVISION 3		
REVISION 4		
REVISION 5		
REVISION 6		

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SIGNATURE 04/30/22 EXPIRATION DATE

AES WEST O'AHU SOLAR PLUS STORAGE PROJECT
TMK: 9-2-002:007, Hono'uli'uli, 'Ewa, O'ahu, Hawai'i

LANDSCAPE DETAIL, SECTION, PLANT LIST, NOTES AND IRRIGATION EQUIPMENT LIST

DATE:	JUNE 2019
SCALE:	AS NOTED
DRAWN BY:	VA
MD JOB NO.:	2007

L3

3 OF 3 SHEETS

Attachment I
Representative Photographs of Similar Solar and Storage Project Components

Photograph 1. View of typical solar photovoltaic modules on a fixed-tilt racking system (*O‘ahu, Hawai‘i*)

Photograph 2. View of typical solar photovoltaic modules on a fixed-tilt racking system (*O‘ahu, Hawai‘i*)

Photograph 3. View of typical battery units and associated equipment on concrete equipment pad (*Kaua‘i, Hawai‘i*)

Photograph 4. View of typical substation and associated electrical equipment (*Kaua‘i, Hawai‘i*)

Attachment J
Correspondence Regarding Water Availability

BOARD OF WATER SUPPLY

CITY AND COUNTY OF HONOLULU
630 SOUTH BERETANIA STREET
HONOLULU, HI 96843
www.boardofwatersupply.com

May 11, 2020

MAY 18 2020

Mr. Nick Molinari
AES Distributed Energy
282 Century Place
Louisville, Colorado 80027

Dear Mr. Molinari:

Subject: Your Email Dated March 13, 2020 Requesting Water Availability to the Proposed AES West Oahu Solar and Storage Project
Tax Map Key: 9-2-002: 007

Thank you for your letter regarding the proposed solar power storage facility and the compatible agricultural activities.

The existing water system is adequate to accommodate the proposed solar and storage facility. However, please be advised that this information is based upon current data, and therefore, the Board of Water Supply (BWS) reserves the right to change any position or information stated herein up until the final approval of the building permit application. The final decision on the availability of water will be confirmed when the building permit application is submitted for approval.

Proposed water connection designs for the solar storage facility shall be submitted for our review and approval. Construction schedule shall be coordinated with the BWS to minimize impacts to our water system.

Water service cannot be made to the proposed compatible agricultural activities. The existing BWS water system has limited capacity and cannot accommodate the additional agricultural demands.

The developer should investigate the feasibility of developing its own private source water or using nonpotable water sources, such as the Waiahole Ditch, for irrigation of the proposed agricultural activities. The parcel is located above the potable aquifer, within the BWS No-Pass Zone and close to the Department of Health's capture zone delineation of a major BWS water source. Therefore, the developer will be required to submit and implement a soil and water conservation plan with best management practices to prevent contamination of the underlying aquifer.

If water is made available for the proposed solar and storage project, the applicant will be required to pay our Water System Facilities Charges for resource development and transmission.

The developer will be required to obtain a water allocation letter from the University of Hawaii West Oahu for use of their East Kapolei 440' reservoir storage.

Water conservation measures are required for the proposed development. These measures include utilization of nonpotable water for irrigation using rain catchment, drought tolerant plants, xeriscape landscaping, efficient irrigation systems, such as a drip system and moisture sensors, and the use of Water Sense labeled ultra-low flow water fixtures and toilets.

The on-site fire protection requirements should be coordinated with the Fire Prevention Bureau of the Honolulu Fire Department.

If you have any questions, please contact Robert Chun, Project Review Branch of our Water Resources Division at (808) 748-5443.

Very truly yours,

ERNEST Y. W. LAU, P.E.
Manager and Chief Engineer

UNIVERSITY of HAWAI'I SYSTEM

Jan S. Gouveia
Vice President for Administration

June 2, 2020

AES West Oahu Solar, LLC
282 Century Place, #2000
Louisville, CO 80027
Attn: Mr. Nick Molinari
nick.molinari@aes.com

RE: Water Assessment - University of Hawai'i West Oahu Solar + Storage Project

Dear Mr. Molinari

The University of Hawai'i has received your request to review potential water resources for the proposed West Oahu Solar + Storage project. We understand there are three proposed water uses for the project.

1) Crop Cultivation or Honey Production and Cattle Grazing: Unfortunately, the University of Hawai'i West Oahu (UHWO) cannot make water available for crop cultivation due to the significant water demands required for this use. We do, however, support the compatible agricultural uses already proposed for the project (i.e., honey bees and cattle grazing) and are willing to work with AES and the Board of Water Supply (BWS) to provide water for these uses. These aforementioned compatible agricultural activities would provide meaningful agricultural output but would not require the extremely large quantity of water that would be needed for crop cultivation.

2) Landscaping: UHWO does have capacity to meet potential water demands for landscape irrigation, if needed. It is our understanding that the water demands for this use are significantly lower than that of crop cultivation and would be required only for a limited time until landscaping plants are established and reach sufficient maturity to survive without irrigation.

3) Construction-Related Dust Control: UHWO does have capacity to meet potential water demands for temporary dust control during the construction and decommissioning phases of the project, if needed. It is our understanding that the water demands for this activity are very low and only required for a limited time until the completion of project construction.

Requests for potable water allocations will need to be coordinated with the University of Hawai'i. The water uses and availability identified above are subject to approval by the University and BWS and may require closing of abandoned wells. UHWO is committed to working with both AES and BWS on this matter.

Sincerely,

Jan Gouveia
Vice President for Administration

2444 Dole Street, Bachman Hall 109H
Honolulu, Hawai'i 96822
Telephone: (808) 956-6405 • Fax: (808) 956-9701

August 28, 2020

Mr. Ernest Lau
Board of Water Supply
630 S. Beretania Street
Honolulu, HI 96843

Subject: Your Letter Dated May 11, 2020 Regarding Water Availability for the Proposed AES West Oahu Solar and Storage Project

Dear Mr. Lau,

Our apologies for the delayed follow up. This email is in response to a comment within your letter dated May 11, 2020: "The developer should investigate the feasibility of developing its own private source water or using non-potable water sources, such as the Waiahole Ditch, for irrigation of the proposed agricultural activities."

After conducting preliminary due diligence, AES has determined that development of its own private water source such as a groundwater well or reservoir **would not be needed to meet the water demands of compatible agricultural activities such as grazing and honey production. Further, the maintenance and ownership** of a private water source does not align with the temporary nature of this project. AES only has a 25-year term for use of the land and as a result, the long-term maintenance and ownership of a private water system would be problematic. The use agreement with the University of Hawaii (landowner) and the power purchase agreement require the project to be decommissioned and removed, and the land returned to the owner. Further, it was determined that the timing to develop and construct a private water source would not comport with the project schedule as mandated by the PUC. Lastly, the portion of the Waiahole Ditch that runs through the project area is in poor condition and is not functional to carry water.

As noted in your letter, it is acknowledged that water service cannot be made available for high-demand crop cultivation agricultural activities. **For the reasons described in the previous paragraph, AES did not further investigate the development of a private water source.** It is also acknowledged that if water is made available for the lower water demands of the proposed

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solar and storage project, the applicant will be required to pay the Water System Facilities Charges for resource development and transmission. Further, the developer will be required to obtain a water allocation letter from the University of Hawaii West Oahu if use of their East Kapolei 440' reservoir storage is required for the project. In conjunction with that approach, proposed water connection designs for the solar storage facility shall be submitted to BWS for review and approval, and the final decision on the availability of water will be confirmed when the building permit application is submitted for approval.

Regards,

Nick Molinari

Project Development Manager
AES Distributed Energy
282 Century Place, Suite 2000
Louisville, CO 80027
Tel: 1 303 524 4368
Email: nick.molinari@aes.com

Cc:
Robert Chun (BWS)
Barry Usagawa (BWS)
Kirstin Punu (AESDE)

Attachment K
Landscape Plan Narrative

MAILELANI
DESIGN

AES West O'ahu Solar Project
Landscape Plan
July 2020

Introduction

The proposed AES West O‘ahu Solar Plus Storage Project, located within the upper slopes of Makakilo, Ewa, O‘ahu will sit on a parcel of land, owned by the State of Hawai‘i (University of Hawai‘i [UH] West O‘ahu), commonly referred to as the UH West O‘ahu Mauka Lands property. The project area will encompass up to 97 acres within an approximately 861-acre parcel. It is projected to provide 12.5 MW of solar energy and 50 MWh of battery storage with the intent to assist the State of Hawaii in achieving its energy goals of generating 100% from renewable sources. The 25-year lifespan of this Project will conclude with the decommissioning of the system and restoring the site to pre-Project conditions.

Landscape Design Intent

As part of the development of the Project, a landscape plan was sought to be included as part of a SUP (Special Use Permit) and CUP (Conditional Use Permit) application based on certain requirements stated in the LUO (Land Use Ordinance). The landscape plan must show proposed visual buffering from adjacent streets and major roadways, a supporting irrigation system and maintenance requirements. The plan identified and evaluated areas around the perimeter of the Project area that could potentially provide effective visual screening and/or buffering. The areas that were identified that had the most potential were along the South West (SW)/West (W) portion of the Project area facing the nearby Makakilo neighborhood, as well as the Eastern (E) boundary facing the H-1 freeway.

Prior to developing the landscape plan, climactic, geographic, cultural and biological information was collected and researched to assist and guide the landscape design intent, and to assure the proposed plant palette was sensitive and appropriate to the specific location. Considering all of the above factors, all facets of the Project's perimeter were considered and explored, to determine the most effective, practical and feasible approach to the landscape design.

Existing Site Conditions

The majority of the Project site sits on steep terrain ranging from 290' to 425' above sea level with slopes from 16% to 70% throughout, split by the Kalo'i Gulch and former Waiahole Ditch. The annual rainfall average is 30” a year, resulting in a dry, semi-arid, grassland environment. Biologically, the flora and fauna are varied but largely populated by non-native plant species such as Haole Koa (Leucaena leucocephala), Guinea grass (Urochloa maxima) and Buffel Grass (Cenchrus ciliaris). Of the 29 plant species identified on site, only 3 are native Hawaiian. These include ‘Ilima papa (Sida fallax), 'Uhaloa (Waltheria indica) and Wiliwili (Erythrina sandwicensis).

Limitations

Landowner considerations: The University of Hawai‘i has a long-term responsibility for the maintenance and stewardship of the UH West O‘ahu Mauka Lands Property, and expressed a strong desire to avoid the planting of trees or shrubs that may pose long-term maintenance and liability challenges due to fallen branches, aggressive root systems, etc. particularly within close proximity to roadways. Furthermore, planting of trees or other large vegetation may encourage undesirable activities on the property and as such, were requested to be avoided.[1]

[1] Enclosure A: Letter to AES West Oahu Solar, LLC from University of Hawaii dated June 23, 2020

Resources – The Project area does not currently have infrastructure for water or power to irrigate landscaping. As described above, the site is in a dry, semi-arid environment such that even a drought-resistant plant palette would require an irrigation system during the initial stages of establishment (see further discussion in "Temporary Irrigation System" section below.) The Project site is void of any water transmission infrastructure and irrigation water will need to be transported by truck and stored on-site in water tanks. As water tanks will be filled by truck, they must be located adjacent to service roads, limited to the South (S) and East (E) portion of the Project's fenced area (further discussed below). As the suitable water tank locations are in the lower elevation areas of the Project area, any plant materials placed up-slope of the tanks would require a booster pumping system to deliver water up-slope to the plants.

Vehicular Access – The Project site plan proposes various access points and internal service roads within the S and E portion of the Project's fenced area. However, due to the steep, rocky terrain construction of new service roads providing access to the Western Project area boundary is infeasible. Without vehicle access to the SW/W side of the site, installation of any plant material and supporting irrigation as well as ongoing maintenance would be unsafe and cost prohibitive.

Plant height and shading: Access to sunlight is essential to the production of renewable energy. The presence of any shadows upon the proposed solar panels significantly reduces their effectiveness. Therefore, consideration of the mature height of new plant materials and existing topography was considered in the placement of plants.

Landscape Plant Palette

Numerous factors were considered in selecting the most appropriate plant species for the Project requirements. In addition to being effective as a visual buffer, other considerations included annual rainfall, range of temperature, wind patterns, soil type, topography and elevation, existing vegetation types and sun exposure.

The consideration and study of the above factors resulted in the selection of the following plants.

'A'ali'i (see image below)	Shrub	Dodonaea viscosa
Kulu'i (see image below)	Shrub	Nototrichium sandwicense
ʻIlima	Shrub	Sida fallax

Figure 1 (Plant Palette)

'A'ali'i (Dodonaea viscosa)

'Ilima (Sida fallax)

Kulu'i (Nototrichium sandwicense)

Landscape Plan

The proposed landscape plan takes into consideration the various limitations outlined above, feasibility of installation, irrigation required through establishment, safety, cost and maintenance relative to the potential of providing a visual buffer from adjacent streets and major roadways. This palette was selected based on feedback received during community outreach, and is in keeping with AES' desire to support the reintroduction of species indigenous to the region. The plan proposes clustering of primarily native plant material along the E boundary of the Project area facing the H-1 freeway, optimizing the natural terrain, and relying on a gravity-fed irrigation system,

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eliminating the need for a pump or generator to supply water to the plants. Because these areas slope downward, the potential for shading at mature heights is greatly reduced. Further, 'Ilima was specifically identified and incorporated into the plan to provide an important food source for honeybees and would support the compatible agricultural activities through honey production. Although the landscaping would not completely screen the Project facilities, it would yield additional environmental and agricultural benefits to further support the community's vision and statewide goals related to agriculture and energy.

As discussed in further detail below, it was determined that planting along the SW/W portion of the Project area facing the nearby Makakilo neighborhood, as well as the NE boundary facing the H-1 freeway, with the intent to provide an effective visual screen between the project site and the upper residential area of Makakilo, and from vehicles traveling on Farrington Highway, required large and medium trees and shrubs with mature heights of 40' – 50'. Due to the considerations outlined above, and further discussed in the "Feasibility Studies" section below, the plan proposes preserving much of the existing vegetation along the West ridge, and the East side of the project site, outside the project fence line. While not anticipated to be effective in completely screening the view of the panels, it is expected to provide a visual buffer between the project site and upper residential areas as well as soften the view of the Project from major roadways below.

Temporary Irrigation System

The use of drought tolerant, site appropriate plants has great potential in the long run to reduce the amount of water needed to sustain the average plant. However, in the initial stages, regular watering is critical in the plants' establishment, assuring adequate root growth, canopy growth and overall health. Once established, these selected native plants, that are inherently drought-tolerant, are anticipated to survive on their own, relying only on rainfall within the area.

As the Project site is void of any water transmission infrastructure, irrigation water will need to be transported and/or stored on site. The proposed temporary irrigation system includes some or all of those listed below with the assumption that water will be delivered via a water truck to fill/refill the water storage tanks:

- One (1) 1000-gallon water storage tank
- Remote controlled valves with solar powered timers
- HDPE mainline pipe
- PVC laterals
- In-line drip tubing

The anticipated water demand for the proposed landscape plan is 6,100 gallons/year with a water truck refilling the tank 6-7 times.

Maintenance

The proposed plant palette was created with minimal maintenance requirements. Once established on-site the proposed plants are intended to survive on their own with little intervention. However, during the suggested 365-day maintenance period, the landscape contractor shall provide the following:

Landscape:

- First 6 months (weekly): Inspection of all plants, checking tree stakes, tree guys, observation of pests, successful plant establishment, replacement of dead plants, applying fertilizer, etc.
- Next 6 months (bi-monthly): same as above

Irrigation:

- First 6 months (weekly): Inspection that all irrigation equipment is in working order. Replace broken heads/drip tubing, fix leaks, overspray, fix gullies as needed, adjust timers as needed.
- Next 6 months (bi-monthly): same as above

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Feasibility Studies
Several options were considered as part of an initial feasibility study and are further discussed below.

Planting along the SW/W portion of the Project area facing the nearby Makakilo neighborhood, as well as the NE boundary facing the H-1 freeway with the intent to provide an effective visual buffer between the Project site and the upper residential area of Makakilo and vehicles traveling on Farrington Highway below was considered and was determined to have required large and medium trees and shrubs with mature heights of 40' – 50'. As stated above, it is the University's strong desire to avoid the planting of large trees or shrubs that may pose long-term maintenance and liability challenges.

In addition, the Project site plan proposes various access points and internal service roads within the S and E portion of the Project's fenced area. However, due to the steep, rocky terrain, construction of new service roads providing access to the Western Project area boundary is infeasible. Without vehicle access to the SW/W side of the site, installation of any plant material and supporting irrigation as well as ongoing maintenance would be unsafe and cost prohibitive.

Similarly, the installation of temporary irrigation for plant materials on the SW/W side of the site would involve substantial effort and cost, requiring a booster pump, (2) 2000-gallon water tanks and a solar powered generator to pump water up hill to the plants from the access road 130' below. The anticipated water demand for this scenario was 20,600 gallons/year with a water truck refilling the tanks 5-6 times.

Warranty
All plant materials furnished under this project shall be warranted in writing, for a period of 1 year from the date of the start of the maintenance period against defective, unsound, or diseased conditions that may appear. Replacement of these plants shall be of the same species as originally planted and shall be of a size closely approximating the size of the plant if normal growth had occurred since the original planting.

Summary
The proposed landscape plan began by identifying and evaluating areas around the perimeter of the Project area that could potentially provide effective visual screening and/or buffering of views of the Project from various vantage points. Areas identified as having most potential for location of plant materials that could provide screening and/or buffering were along the SW/W portion of the Project area facing the nearby Makakilo neighborhood, as well as the NE boundary facing the H-1 freeway.

Feasibility studies were conducted, and various limitations were identified which make installation of plant materials on the SW/W and higher-elevation portions of the NE side of the site infeasible.

The resulting landscape plan proposes clustering of primarily native plant material along the E boundary of the Project area facing the H-1 freeway, optimizing the natural terrain, and relying on a gravity-fed irrigation system, eliminating the need for a pump or generator to supply water to the plants. The pallete was selected based on feedback received during community outreach and is in keeping with AES' desire to support the reintroduction of species indigenous to the region. In addition, 'ilima was specifically identified and incorporated into the plan as an important food source for honeybees and would support the compatible agricultural activities through honey production. Although the landscaping would not completely screen the Project facilities, it would yield additional environmental and agricultural benefits to further support the community's vision and statewide goals related to agriculture and energy.

The plan proposes preserving much of the existing vegetation along the West ridge, and the East side of the project site, outside the Project fence line, providing a visual buffer and softening the view of the Project from various vantage points.

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Jan S. Gouveia
Vice President for Administration

UNIVERSITY of HAWAI'I® SYSTEM

June 23, 2020

AES West Oahu Solar, LLC
282 Century Place, #2000
Louisville, CO 80027
Attn: Mr. Nick Molinari
nick.molinari@aes.com

RE: Landscape Plan - University of Hawai'i West Oahu Solar + Storage Project

Dear Mr. Molinari

The University of Hawai'i understands that AES West Oahu Solar will be preparing a landscape plan as required under the permitting process for the University of Hawai'i West Oahu Solar + Storage Project and as described in the Project's Draft EA.

The University of Hawai'i has a long-term responsibility for the maintenance and stewardship of these lands. As such, it is our strong desire that AES avoid the planting of trees or shrubs that may pose long-term maintenance and liability challenges for the University due to fallen branches, aggressive root systems, etc. particularly within close proximity to roadways.

Furthermore, the planting of trees or other large vegetation may encourage undesirable activities on the property and should be avoided.

Sincerely,

Jan Gouveia
Vice President for Administration

2444 Dole Street, Bachman Hall 109H
Honolulu, Hawai'i 96822
Telephone: (808) 956-6405 • Fax: (808) 956-9701

Attachment L
Decommissioning Plan

Decommissioning Plan

AES Distributed Energy

West Oahu Solar Project

March 2020

Prepared for:
AES Distributed Energy
282 Century Pl, Suite 2000
Louisville, CO 80027

Contents

1 Introduction

AES Distributed Energy (AES) engaged HDR Engineering, Inc. (HDR) to provide a physical plan to complete decommissioning of the West Oahu Solar project (Project). The Project consists of a solar photovoltaic (PV) system plus battery energy storage system (BESS) and project substation. The decommissioning plan (Plan) describes the general measures and procedures that should be developed and implemented to decommission and restore the site, and safely dispose of or recycle project materials.

1.1 Decommissioning Requirements

This Plan outlines a typical program for decommissioning the Project at the end of the project life cycle that satisfies Hawaii state law requiring decommissioning per the "Permissible uses within the agricultural districts" as part of the Special Use Permit requirements, specifically the following requirements per Section 205-4.5, Item 21[1]:

> *"(B) Proof of financial security to decommission the facility is provided to the satisfaction of the appropriate county planning commission prior to date of commencement of commercial generation; and*
> *(C) Solar energy facilities shall be decommissioned at the owner's expense according to the following requirements:*
> *(i) Removal of all equipment related to the solar energy facility within twelve months of the conclusion of operation or useful life; and*
> *(ii) Restoration of the disturbed earth to substantially the same physical condition as existed prior to the development of the solar energy facility."*

Prior to commencing decommissioning, the Owner would need to verify with the local, state or federal agencies any additional requirements and submit a revised plan as required.

1.2 Project Description

The Project is located on the Hawaiian island of Oahu, North of the intersection of Interstate H1 and Kualakai Parkway (see Figure 1) on approximately 80 acres of agricultural zoned property. The undeveloped site consists primarily of shrub brush on Land Study Bureau (LSB) Soil Classification B, D and E. The Project consists of 17.4 MWdc (12.5 MWac at POI) of fixed tilt solar PV with 20 DC-coupled 650 kW BESS containers. The project will interconnect via a new project substation to an existing overhead 46 kV transmission line owned by Hawaii Electric Company (HECO) that bisects the site.

[1] Hawaii State Legislature, §205-4.5 Permissible uses within the agricultural districts, https://www.capitol.hawaii.gov/hrscurrent/Vol04_Ch0201-0257/HRS0205/HRS_0205-0004_0005.htm

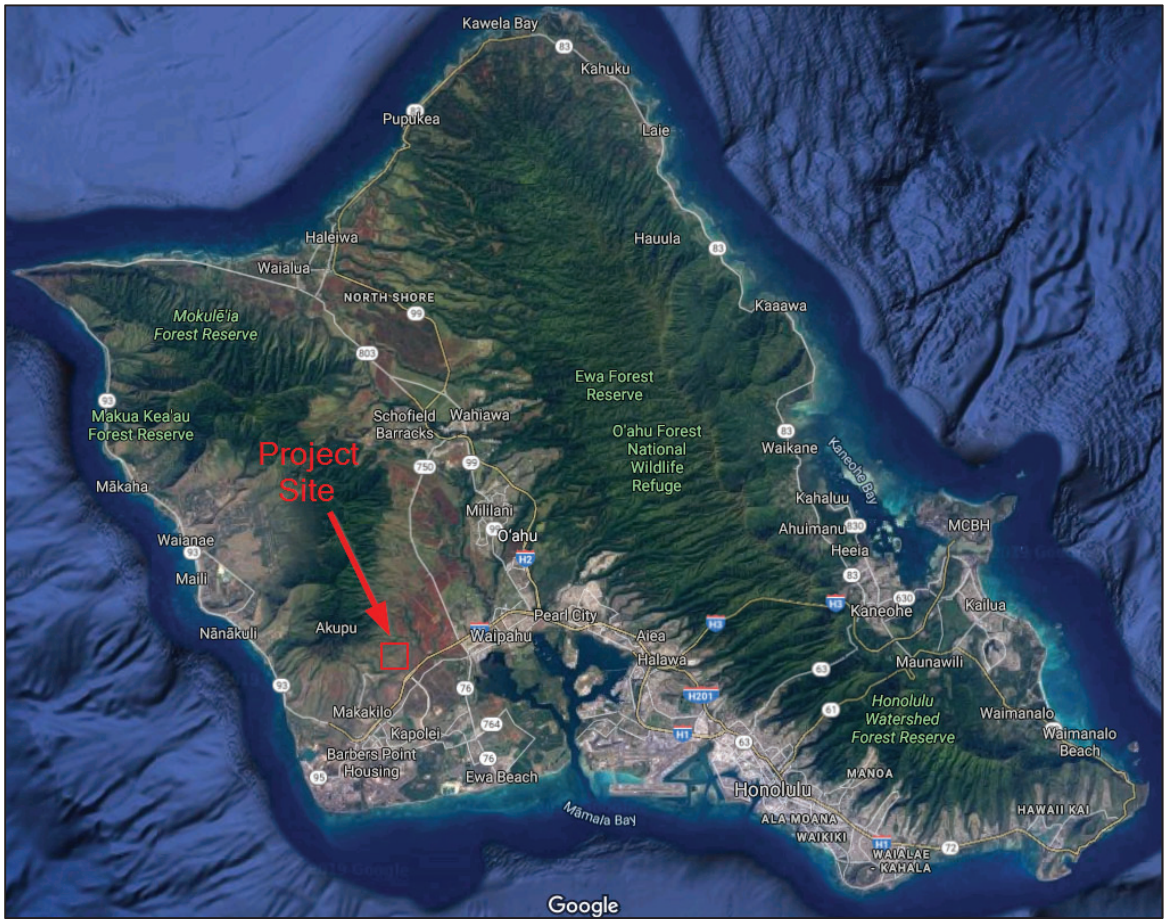


Figure 1 – Project Site Location (Source: Google Earth)

For preliminary site layout, see Appendix A. Major features of the Project are outlined below:

- 405 Watt (nominal) output, Monocrystalline, bifacial PV panels
- Fixed axis steel racks in a double portrait layout to support the PV panels
- Steel pile foundation to support panels/racks and miscellaneous equipment
- Five (5) 2.8 MWac central inverters on pads along with five (5) 3000 kVA medium voltage step up transformers, and associated data collection equipment for metering and monitoring.
- Twenty (20) 650 kWdc BESS storage containers co-located on electrical equipment pads
- On-site 100 ft by 200 ft project substation with GSU transformer
- 20 ft wide gravel site access roads
- Perimeter security fencing
- Bee hives and cattle grazing throughout the project area

1.3 Decommissioning Plan Description

This Plan has been developed to outline typical procedures and considerations for decommissioning the Project. Decommissioning may occur because the project has fulfilled its intended purpose and term, or because it has been abandoned.

2 Decommissioning Procedures

2.1 Overview

After project end of life or conclusion of operation, the site would be restored within 6-12 months to substantially the same physical condition as existed prior to the development of the Project. This decommissioning includes removal of project equipment and all site restoration activities noted below. All site activities described below will commence after the site has been de-energized and secured. Because decommissioning activities are not expected to occur for many years, and regulatory requirements may change, any applicable permitting or regulatory requirements would be reviewed with appropriate local and state agencies prior to decommissioning activities to ensure compliance.

2.2 General Environmental Protections

During decommissioning activities, general environmental protection measures would be implemented as required. Many activities during decommissioning would be comparable to the construction phase, including the use of heavy equipment on site, preparing staging areas, dust and erosion control procedures, and restoring disturbed areas around all project infrastructure. The project decommissioning activities shall meet all environmental, stormwater, dust control, erosion control and permitting requirements per local, state and federal regulations.

2.3 Pre-decommissioning Activities

Prior to engaging in decommissioning activities, the Owner would update this decommissioning plan in accordance with appropriate requirements at the time of decommissioning. Decommissioning and restoration activities will be performed in accordance with all relevant ordinances and requirements in place at the time of decommissioning and in accordance with the Project's other environmental permits. At the end of the Project's useful life, it will first be de-energized and isolated from all external electrical lines prior to initiating dismantling or ground-disturbing decommissioning work. This includes coordination and advanced communication with the interconnection utility (HECO).

2.4 Decommissioning and Restoration Activities

The major components of the Project are PV modules, steel racking and support piles, electrical cabling, inverters, transformers, BESS containers, and project substation equipment. All electrical equipment, both above ground and underground (where practicable and as noted herein), will be removed from the project property upon decommissioning.

PV Module and Racking Removal

All modules will be disconnected, removed from the racking, packaged and transported to a designated location for recycling or resale. Recycling will be done in accordance with applicable laws and requirements. Whether recycling or disposal occurs on the island or off the island may depend on current regulations at the time. The connecting cables and the combiner boxes will be de-energized, disconnected, and removed. The steel racking system supporting the PV modules will be unbolted and disassembled by laborers using standard hand tools, possibly assisted by small portable crane. All steel support structures will be completely removed and transported off site for salvage or reuse. Any demolition debris that is not salvageable will be transported to an approved disposal area. Other salvageable equipment and/or material will be removed for the site for resale, scrap value or disposal.

The modules and racking systems will likely be supported via driven steel piles or screws. Other miscellaneous equipment may be supported via steel piles. All piles will be removed and salvaged.

Electrical Equipment Removal

All decommissioning of electrical devices, equipment, and wiring/cabling will be in accordance with local, state and federal laws. Any electrical decommissioning will include obtaining required permits, and following applicable safety procedures before de-energizing, isolating, and disconnecting electrical devices, equipment and cabling. Decommissioning will require dismantling and removal of the electrical equipment, including inverters, transformers and underground/aboveground cables. All electrical equipment will be removed from the project property upon decommissioning. The equipment will be disconnected and transported off site.

Any concrete foundations and support pads will be broken up by mechanical equipment (e.g. backhoe-hydraulic hammer/shovel, jackhammer), loaded in to dump trucks and removed from the site. All concrete foundations will be removed, including any deep pier foundations (if required). Smaller pre-cast concrete support pads will be removed intact by cranes and loaded onto trucks for reuse, or will be broken up and hauled away by dump trucks. Prior to removal of any transformers, any oil will be pumped out into a separate industry approved disposal container and sealed to prevent any spillage during storage and/or transportation. Salvaged oil from transformers will be transported to the nearest oil recycling or disposal center. Equipment and material may be salvaged for resale or scrap value depending on the market conditions.

BESS Removal

The BESS containers will be co-located with project inverters and electrical equipment. They will be comprised of containerized modules consisting of lithium-ion batteries and an air conditioning / HVAC system to provide cooling and heating. Lithium-ion batteries will require routine continuous maintenance and care in their use and handling. Batteries reaching end of life will be recycled and disposed of in accordance with the relevant local, state or federal regulations. Replacements will be made with new or appropriately refurbished batteries. This periodic replacement would have no effect on decommissioning processes.

The following steps are required for BESS removal:

- Disconnect BESS from sectionalizing equipment, inverters, transformers and auxiliary power

- Remove battery racks for recycling as well as other easily non-secured components. Containers to be removed and remaining components disassembled at appropriate recycling facilities.
- Remove foundation pad and/or pile supports as previously noted.
- Re-grade surfaces, add topsoil and seed according to “Site Restoration” below.

Project Substation Removal

All project substation equipment and buildings shall be removed, including the underground cabling, grounding grid, and foundations. The Project does not anticipate a gen-tie line to connect to the utility transmission line outside of the single connecting overhead span, but regardless all equipment, structures and foundations required for removal shall be done according to this Plan. Decommissioning activities would require coordination with the local utility on the interconnecting transmission line including the assets at the point of interconnection. Owner shall not be responsible for decommissioning anything on the utility transmission line unless otherwise agreed upon.

The following steps are required for Project substation removal:

- De-energize transformers and other energized equipment and disconnect from the project substation
- Disconnect and remove medium voltage switchgear
- Disconnect and remove sectionalizing equipment and transformers
- Disconnect and remove electrical and communications equipment in the control building
- Demolish control building and remove foundation
- Remove equipment foundation pads and pile supports for remaining equipment
- Remove grounding grid, fence and cables
- Remove and recycle aggregate surfaces
- Re-grade surfaces, add topsoil and seed according to “Site Restoration” below

Road Rehabilitation

At the time of decommissioning, the Owner will coordinate with the property owners and easement holders (if applicable) to determine if any site access roads should remain. If any of the other roads serve no future purpose, they will be decommissioned and restored to preconstruction conditions. The decommissioning will involve the removal of the aggregate and filling the remaining voids with on-site surface materials by grading. Removed materials will be taken to an appropriate recycling area (possibly on site) where the gravel or aggregate materials can be processed for salvage value or future use. Remaining ground surfaces will be rough graded to merge with the surrounding elevations and returned to near preconstruction conditions by means of grading and disking, using a tractor and disc attachment to restore the soil structure and to aerate the soil.

Site Restoration

Following decommissioning, the Project site will be stabilized to ensure that there are no ongoing adverse environmental effects. The site will be restored to a clean, safe and environmentally stable state, and substantially to preconstruction conditions according to state regulations. Site restoration activities in the various project areas will immediately follow the removal of above ground and below ground structures to ensure there are no adverse environmental impacts due to rain events. Site restoration will consist of re-seeding of disturbed areas with native grass mixture as required.

Fences and Gates

The security fence will be dismantled, removed and recycled offsite only after all other ground-disturbing decommissioning and site restoration work has been completed. The fencing protecting the perimeter of the site typically consists of steel fence attached to line posts. Posts will typically extend to depths of 4 ft to 6 ft below grade and will either be encased in concrete footings or directly embedded. All posts shall be removed intact. The Project will be accessed through manually operated swing gates located at multiple permanent access points and personnel gates. It is anticipated that the fence, gates, wire and hardware would be removed and recycled at decommissioning.

2.5 Waste Management Procedures

During decommissioning, debris and waste generated will be recycled to the extent feasible and as required by local, state and federal regulations. The contractor will facilitate recycling of all construction waste through coordination with licensed sub-contractors, local waste haulers, and/or other facilities that recycle construction/demolition wastes. The contractor will also be responsible for ensuring that wastes requiring special disposal (e.g., transformers) are handled according to regulations that are in effect at the time of disposal. Although hazardous waste is not anticipated on the site, any hazardous waste would be removed and disposed of in accordance with applicable laws and regulations.

2.6 Emergency Response and Communications Plans

During decommissioning, the Owner and Contractor will coordinate with local authorities, the public, and others as required to provide information about the ongoing activities. Besides regular direct/indirect communication, signs will be posted at the Project facility to inform the local public and visitors. The Owner and Contractor’s project representatives contact information (e.g. telephone number) will be made public for those seeking more information about the decommissioning activities and/or for reporting emergencies and complaints. All inquiries will be directed to the project representatives.

In the event of an emergency, the Owner will mobilize its resources to the site to respond to the event. Personnel involved in decommissioning will be trained in the emergency response and communications procedures. Emergency response procedures will be prepared prior to decommissioning.

3 Material and Salvage Plan

This section identifies major material and equipment quantities on the Project based off of preliminary designs. Any bids from decommissioning contractors will be responsible for verification of quantities (per final drawings), construction costs and salvage rates.

Salvage value of recyclable material is derived from the makeup of the materials of the racking system, piles, inverters, transformers, cabling, aggregate, BESS and potentially PV panels (see bullets below) removed from the project at end of life.

The following may be assumed for salvage recovery rates and values:

- Depending on the component, equipment, and anticipated decommissioning activity, various material recovery percentages ranging from 75% to 100% are assumed. Salvage rate accounts for inefficiencies in removal of salvageable material, damage during removal or transport, and inability to cost effectively separate components to recoverable materials. To be on the conservative side, a salvage rate less than 100% is typical to thereby reduce the salvage value recovered.
- The future market is not clear on the usability or value of recently deployed solar panels after the approximate component lifecycle of 25 years. Panels are recyclable (the majority of components) and disposing of panels in a landfill should be avoided.
    - Panels may be recycled by a panel recycler at a cost of $25 per panel (about $0.50/lb) as reported by Recycle PV Solar, LLC[2]. This can be impacted by transportation costs for the recycler.
    - Alternatively, the panels could also be offered to a panel refurbishment company at no cost to the project or possibly at a salvage rate. The Owner would dismantle, package and turn over the panels at no cost; therefore, no panel recycling fee.
    - Panel salvage/reuse is likely to remain dynamic; alternatives should be evaluated for and reassessed periodically.
- All excess material that is not salvageable is anticipated to be removed off-site and transported to approved disposal facilities.

3.1 Major Equipment Quantities

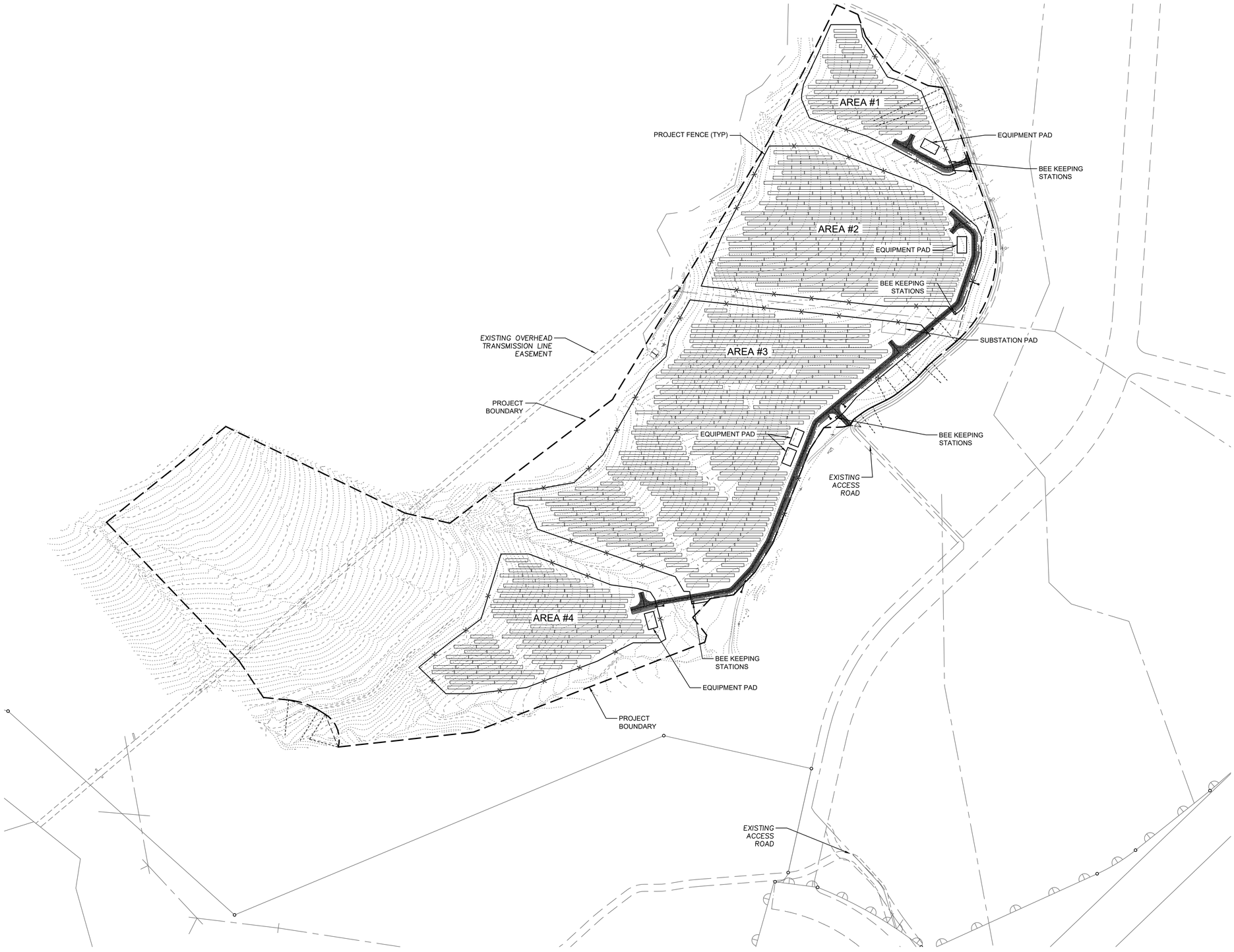
Major equipment quantities on the Project are listed in the table below based off preliminary design documents. Quantities listed below may not reflect final installed quantities and should be updated to reflect final designs.

Major Equipment Quantity Summary				
Item	**Description/Details**	**Unit**	**Quantity**	**Notes**
PV Modules	Jinko Eagle Bifacial HC 72M G2	Each	42,980	
ISU Transformers	3000 kVA	Each	5	GE Prolec
Inverters	2.8 MW Central Inverters	Each	5	GPTECH Inverters
BESS	650 kW BESS	Each	20	40 x 8 Containerized. Manufacturer not identified at this stage

[2] Recycle PV Solar. www.recyclepv.solar; accessed November 5, 2019.

Major Equipment Quantity Summary				
Item	**Description/Details**	**Unit**	**Quantity**	**Notes**
GSU Substation Transformer	10/13.3/16.6 MVA, 46kV-12.47kV Transformer	Each	1	Siemens
Substation Steel Structures	TBD	Lbs	TBD	
Breaker	46 kV Breaker	Each	1	TBD
15 kV Switchgear	Switchgear with (3) breakers and communication section	Each	1	TBD
Racking	Steel PV Racking Structure	Lbs	TBD	RBI Solar
Fence	PV Perimeter Fence	LF	TBD	
Roads	20 ft Gravel Access Roads	LF	TBD	Confirm Road Details

Appendix A:
Preliminary Site Layout



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Louisville, CO 80027 USA

HDR
3J CONSULTING
CIVIL ENGINEERING
WATER RESOURCES
COMMUNITY PLANNING
9600 SW NIMBUS AVE, SUITE 100, BEAVERTON, OR 97008

SYSTEM DESCRIPTION

REVISIONS

REV	BY	DATE	DESCRIPTION

PE STAMP

AES WEST OAHU SOLAR
OAHU, HI

PROJECT NUMBER
19537
PHASE
ISSUED FOR REVIEW
MILESTONE
60% DESIGN

ELECTRICAL DESIGNER

STRUCTURAL DESIGNER

DATE
03-13-2020
SCALE
1"=200'

TITLE
OVERALL SITE PLAN

DRAWING
FIGURE 1

Attachment M
Community Meeting and Outreach Summary Report and August 26, 2020 Meeting Agenda for the Makakilo/ Kapolei/Honokai Hale Neighborhood Board No. 34

MAKAKILO/ KAPOLEI/ HONOKAI HALE NEIGHBORHOOD BOARD NO. 34

c/o NEIGHBORHOOD COMMISSION • 925 DILLINGHAM BOULEVARD, SUITE 160 • HONOLULU, HAWAII 96817
TEL: (808) 768-3710 • FAX: (808) 768-3711 • INTERNET: http://www.honolulu.gov/nco

REGULAR MEETING AGENDA
WEDNESDAY, AUGUST 26, 2020
KAPOLEI HALE- CONFERENCE ROOM
1000 Uluohia St, Kapolei
7:00 P.M. – 9:45 P.M.
Meeting number: 146 187 5524
Password: fXRuUsM7C73 (39788767 from phones and video systems)
https://cchnl.webex.com/cchnl/j.php?MTID=md9b77dcdbe7af7c904a5676ded64b0ae
Join by phone: 1-408-418-9388 United States Toll

MEETING POLICIES

RULES OF SPEAKING: Makakilo/Kapolei/Honokai Hale Neighborhood Board No. 34 asks if anyone wishing to speak is asked to raise their hand, and when recognized by the Chair to address comments to the Chair. §2-14-117 Order and decorum. (a) All board members shall promote and preserve the order and decorum of the commission's proceedings. Time allowances will prevail at the noted limits and anyone wanting to comment on multiple items will be allowed to do so with the same time limit allowed per issue/item when the issue/item is called. All speakers are asked to be first recognized by the Chair, and address comments through the Chair. Speakers (community and Board), must keep their comments under one (1) minute (adopted December 5, 2005), and those giving **reports are urged to keep their reports under three (3) minutes unless otherwise noted. Written reports, flyers, information pertinent to reports are to be handed out PRIOR to presentation/discussion. Please silence all electronic devices. Please adhere to time limits.**

NOTE: The Board may take action on any agenda item. As required by the State Sunshine Law (HRS 92), specific issues not noted on this agenda cannot be voted on unless added to the agenda.

ORDER AND DECORUM: Our meetings are intended to act with fairness and order, and according to the 2008 Neighborhood Plan. Everyone is asked to treat each speaker with respect and keep their comments on **agenda subjects** within the time allowed. Your kokua is appreciated to avoid delays or timely adjournment of the meeting. Rules of decorum will be strictly enforced.

WELCOME

I. CALL TO ORDER

II. ROLL CALL – Neighborhood Board Assistant

III. ELECTION OF OFFICERS TO SERVE FROM JULY 1, 2020 to JUNE 30, 2021 [NP §2-14-120(b)]. The officers to be elected are the Chair, one or more Vice Chairs, a Secretary, a Treasurer, and any other officer(s) determined to be needed to conduct the board's business.

IV. CITY MONTHLY REPORTS

1. Honolulu Fire Department (HFD) – Duty Officer
2. Honolulu Police Department (HPD) – Duty Officer
3. Mayor Kirk's Caldwell Representative- Tim Hiu
4. Councilmember Kymberly Pine and/or Louis Galdeira
5. Board of Water Supply (BWS) – Rian Adachi
6. Honolulu Authority for Rapid Transportation (HART)- Johnny Reid
7. Oahu Metropolitan Planning Organization Report- Frank Genadio

V. MEETING DETERMINATION-DATE/TIME/LOCATION (AUGUST 2020 to JUNE 2021)

VI. DETERMINATION OF BOARD RECESS SCHEDULE (AUGUST 2020 to JUNE 2021)

VII. REQUEST TO PARTICIPATE IN THE OLELO BROADCAST PROGRAM

VIII. ADOPTION OF ORAL TESTIMONY RULES

IX. MOTION TO RETAIN COMMITTEES, SUBCOMMITTEES, & THEIR MEMBERSHIP

X. APPROVAL OF MINUTES FROM THE FEBRUARY 26, 2020 BOARD MEETING

XI. COMMUNITY/BOARD CONCERNS & ANNOUNCEMENTS (Limited to one (1) minute each per person in totality. Issues concerning and/or needing elected official's or agency input/comments and related issues are to be discussed at the relative portion of the agenda. Issues and concerns not listed elsewhere on the Board's agenda may be raised, but HRS Chapter 92 ("Sunshine Law") prohibits Board action from being taken during this meeting.)

XII. STATE MONTHLY REPORTS – (Limited to two (2) minutes each, unless otherwise requested) *If there are any printed reports and/or flyers that need to be disseminated, please do so before start of meeting (or as early as possible) so Board members have adequate time to brief themselves with your material and information.*

1. Governor David Ige's Representative – Robert Yu, Department of Budget and Finance
2. Highways Division, DOT- Karen Chun, Acting Design Branch Head
3. State Senator Mike Gabbard or designated office representative
4. State Senator Maile Shimabukuro or designated office representative
5. State Representative Sharon Har or designated office representative
6. State Representative Ty Cullen or designated office representative
7. State Representative Stacelynn K.M. Eli or designated office representative
8. Hawaii Community Development Authority (HCDA)- Tesha Malama

XIII. BOARD BUSINESS (10 minutes limit unless otherwise noted) Discussion and Action

1. 2020 Census- Sharlette Poe, Chair Waianae Neighborhood Board No. 24
2. P3 Memorial Update- Carl Vincenti
3. Environmental Services, Refuse Division- Lori Kahikina, Director of Environmental Services
4. Makai Apartments Parking Lot Improvements Project- Michael Iosua, Imanaka Asato LLC (on behalf of Greystar)
5. Farrington Highway Improvements Project- Jeff Overton (Principal with G70)
6. Resolution for Community Gardens Expansion to Leeward Coast- Hannah Azouz
7. Develop Utility-Scale Solar + Battery Storage on University of Hawai'i West Oahu's Mauka Land- Shane H Peters (On Behalf of AES Distributed Energy)
8. An Introduction to the Barbers Point Solar Project- Jody Allione

XIV. TREASURER'S REPORT

XV. COMMITTEE REPORTS – (Limited to two (2) minutes each)

XVI. ANNOUNCEMENTS

- Next Scheduled Meeting – The Makakilo/Kapolei/Honokai Hale Neighborhood Board No.34's next scheduled meeting will be held on Wednesday, September 23, 2020 at Kapolei Hale.

XVII. ADJOURNMENT

'Olelo Community Television Cablecast of Board Meetings: The Makakilo/Kapolei/Honokai Hale Neighborhood Board regular meetings are video recorded and later on `Olelo Community Television Channel 49 at 9:00 p.m. on the second Friday of the month and on Channel 49 with a schedule of the 1st and 3rd Saturday of the month at 12:00 p.m. determined by 'Olelo. There may be a week or two (2) delay after a meeting date before the first cablecast of that meeting's video. The 'Olelo program schedule is posted at http://www.olelo.org/programming/default.html

A mailing list is maintained for interested persons and agencies to receive this board's agenda and minutes. Additions, corrections, and deletions to the mailing list may be directed to the Neighborhood Commission Office (NCO) at Kapalama Hale, 925 Dillingham Boulevard, Suite 160 Honolulu, Hawaii 96817; Telephone (808) 768-3710 Fax (808) 768-3711. Agendas and minutes are also available on the internet at www.honolulu.gov/nco.

All written testimony must be received in the Neighborhood Commission Office 48 hours prior to the meeting. If within 48 hours, written and/or oral testimony may be submitted directly to the board at the meeting. If submitting written testimony, please note the board and agenda item(s) your testimony concerns. Send to: Neighborhood Commission Office, 925 Dillingham Boulevard, Suite 160 Honolulu, Hawaii 96817. Fax: (808) 768-3711. Email: nbtestimony@honolulu.gov.

If you require special assistance, auxiliary aid and/or service to participate in this event (i.e. sign language interpreter; interpreter for language other than English, or wheelchair accessibility), please contact the NCO at (808) 768-3710 or email your request to nco@honolulu.gov at least three (3) business days prior to the meeting.

West Oahu Solar-Plus-Storage Project
COMMUNITY MEETING AND OUTREACH
SUMMARY REPORT

Prepared For:
AES Distributed Energy

March 31, 2019

Background

AES Distributed Energy was recently selected by The Hawaiian Electric Companies (HECO) to develop a solar-plus-storage project on Oahu on the leeward portion of the island near Makakilo.

As an initial step in the process, HECO has directed AES Distributed Energy to conduct a community meeting to describe the proposed project in further detail and gather community input. AES Distributed Energy retained the services of Peters Communications to assist with this initiative.

This report is a preliminary summary of the outreach activities conducted to date along with the community's feedback and questions received thus far. A community meeting was conducted on Tuesday, February 26, 2019 from 5:30 p.m. to 7:30 p.m. at Kapolei High School.

Community Outreach

Prior to the scheduled community meeting, the AES project team conducted a strategic outreach effort to engage and inform key elected officials and community leaders.

- *Council Member Kymberly Pine* – CM Pine was reached early in the process to discuss project details and to introduce principals of AES Distributed Energy. Her preliminary comments cited visual impacts as the probable primary source of concern from community members. She also asserted that the community is growing increasingly concerned that the process for renewable energy projects is being rushed without meaningful opportunities for the community to consider and comment. Her suggestions:
    - Proactively offer solutions/mitigation measures for visual impacts including landscaping. She also suggested that AES consider using native plants and potentially partner with the Malama Learning Center. She urged AES to show visualizations of the project with landscaping to indicate to the community that AES is mindful of their concerns.
    - CM Pine recommended that AES respectfully inform the community that there will be ample opportunity to participate in the approval process for the project. She also recommended AES explain that the project is not approved until it goes through the land use and entitlement process which will be months down the road.

Community Outreach (Cont'd)

- *Rep. Ty Cullen* – Preliminary outreach was conducted with Rep. Cullen's office on Monday, February 11, 2019 to provide a project factsheet along with the community meeting notice. A follow up meeting with Rep. Cullen was conducted on Tuesday, February 19, 2019. He thought the project seemed fine but was mindful that visual impacts would probably be an issue of concern.
- *Rep. Sharon Har* – Preliminary outreach was conducted with Rep. Har's office on Monday, February 11, 2019 to provide a project factsheet along with the community meeting notice. A follow up meeting with Rep. Har was conducted on Thursday, February 21, 2019. Rep. Har was very supportive. She was familiar with the coal plant in Kalaeloa and thought that AES had a good reputation. She did not anticipate significant opposition.
- *Sen. Mike Gabbard* – Preliminary outreach was conducted with Sen. Gabbard's office on Monday, February 11, 2019 to provide a project factsheet along with the community meeting notice. A follow up meeting with Sen. Gabbard was conducted on Thursday, February 21, 2019. Sen. Gabbard shared his support for the project. He further suggested partnering with Gary Maunakea-Forth of Ma'o Farms to explore agricultural opportunities as a component of the project. Mr. Maunakea-Forth provides work and education opportunities at his farm for disadvantaged youth from the leeward area. He also suggested UH West Oahu's agriculture program might be a good partner.
- *Maeda Timson* – An AES project consultant conducted early outreach with well-known community leader Maeda Timson (former neighborhood board chair and member of the Hawaii Community Development Authority Kalaeloa board). Based on project information she was provided, Ms. Timson thought AES was being thorough and careful with its initial community outreach efforts and meeting. She did not think the project would be as controversial as other renewable energy projects being proposed in West Oahu given its location and the partnership with landowner University of Hawaii.
- *Dr. Kioni Dudley* – Preliminary outreach was conducted with Dr. Dudley, former neighborhood board chair and community activist. The project team is awaiting a response to a request for a follow up in-person meeting to discuss the project in further detail.
- *Jack Legal* – Preliminary outreach was conducted with Mr. Legal, current neighborhood board chair. The project team is awaiting a response to a request for a follow up in-person meeting to discuss the project in further detail.

Community Meeting Notification

In addition to strategic community outreach, the AES project team issued a community meeting notice via first class mail through the US Postal Service to approximately 2,264 addresses in east Makakilo. See 'Appendix A' for a copy of the meeting notice. See 'Appendix B' for a map of the area targeted for direct mail.

Community Meeting Details

Date: Tuesday, February 26, 2019
Time: 5:30 – 7:30 p.m.
Location: Kapolei High School Cafeteria
91-5007 Kapolei Parkway
Kapolei, HI 96707
Presenters: Rob Cooper – Business Development Director, AES
Sam Ley – Senior Energy Systems Engineer, AES

ATTENDEES
19 individuals attended the community meeting. Notable attendees included West Oahu community member and former Kapolei/Makakilo neighborhood Board Chair Maeda Timson as well as staff from Sen. Gabbard's office.

COMMUNITY QUESTIONS/COMMENTS
Following the presentation by AES project representatives Cooper and Ley, meeting participants posed a number of questions in the following categories:

- **Subject: Vandalism and Safety**
  Questions/Comments
  - We have vandalism problems around here. How do you propose to address that?

  Responses
  - Safety is our main concern. If someone breaks a panel, we'll be a little disappointed but we're more concerned about the broken glass hurting someone.
  - We will have fencing and surveillance cameras to help prevent this. We'll also have operators on site to help deter people from entering the property to damage equipment.
  - During construction, we'll also have 24-hour security to prevent theft and damage.
  - It is also important to know that the primary access to the site is currently secured with through a gate and roadway that is maintained by Grace Pacific. They have onsite security at that gate so it would be another layer of safety and security to deter vandalism.

Community Meeting Details (Cont'd)

- **Subject: Agricultural Land**

  Questions/Comments:

  - You mentioned agriculture lands B, D and E for the property. Can you explain how good the agricultural lands are? Not just for grazing animals because we graze cows there now. Is this area good to plant?

  Responses:

  - The State categorizes lands in order from A through E. A represents the prime ag lands that are currently being used for agricultural use. B lands are just below that tier but are typically not used for active farming. We have some B lands and as you mentioned this are currently used for grazing. In the past, it was used for sugarcane production.
  - The good news is that we're sensitive to this and our operations are design to be completely removed so that the land can be restored to previous conditions and return to agricultural use.
  - D and E lands are generally considered poor conditions for growing crops. They're typically very rocky or very steep and are generally considered unproductive.
  - It should be noted that UH West Oahu has A lands below that they intend to continue to use for agricultural purposes. They set aside the less productive B, D and E lands for renewable energy production.
  - Another thing we want to be sure everyone is aware of is that our intention here is to find compatible agriculture uses on the B lands. The good thing about solar is that it is not an exclusive use of the land. We want to be able to do both agricultural production as well as solar energy. There are multiple benefits here. The community receives renewable energy and reduces carbon footprint, the University receives revenue, and we can still generate agricultural production.

  Questions/Comments:

  - Just to be clear, the B lands here were only categorized as such because they were inaccessible. Now that there will be access, I would urge you to consider partnering with others like Malama Learning Center to do some planting; just something to think about.

- **Subject: Traffic and Access**

  Questions/Comments:

  - How do you intend to access the site? Is it through Makakilo Drive or through the quarry road? This is important because using Makakilo Drive will add to traffic and damage the road with heavy trucks.

  Responses:

  - AES has already reached out to Grace Pacific. We will be accessing the property through their quarry road and security gate. We're very sensitive to the traffic concerns. By utilizing the quarry road, we'll have direct access to the freeway and will be able to minimize area traffic.

Community Meeting Details (Cont'd)

- **Subject: Decommissioning**

  Questions/Comments:

  - With regard to your comment about decommissioning, is that part of a written agreement or is that something you're just saying? I ask because we've been burned before by developers who've said one thing but done another.

  Responses:

  - Yes, it will be in writing. We will have an agreement with UH West Oahu. In addition, we will float a bond to cover the cost of decommissioning and the removal of all equipment, which will be disposed and recycled as appropriate. In doing so, we will be restoring the property to the same condition in which we started.
  - We should also note, this isn't just a promise or agreement. This is also a requirement under state law. Under the rules for use of agricultural lands for renewable energy projects, we will be required by the Land Use Commission and Public Utilities Commission to decommission our property as described and issue a bond at the start to cover those costs.

Email Comments

AES has also established a dedicated email address to capture additional comments and feedback from the community. AESWestOahuSolar@aes.com has been shared with members of the community, area leaders and elected officials to raise awareness of the continuing opportunity for the community to weigh in on the project. The email address has been active from February 12 and will remain active until March 28, 2019 (30 days after the public meeting).

As of March 28, 2019, AES received only one email from an individual indicating their regrets for not being able to attend the meeting in person.

Conclusion

The AES project team recognizes we are still in the preliminary phases of the project and that significant outreach activities must be undertaken as we proceed. If the project receives preliminary approval from the Public Utilities Commission, AES has indicated a strong commitment to continuing outreach efforts to address potential concerns and raise awareness about the benefits of the project.

If you have any questions or concerns regarding this preliminary summary and report, please don't hesitate to contact Shane Peters at shane@peters-comm.com or (808) 421-9879.

APPENDIX A

AES Distributed Energy, Inc.
West Oahu Solar-Plus-Storage Project
Invitation to Community Meeting – Feb 26th

Purpose:

The AES Distributed Energy, Inc. (AES) team would like to invite you to a community meeting for a proposed solar + energy storage project in the West Oahu region. The project is in its initial stages and AES hopes to share information, solicit feedback and questions, and engage the community.

Community Meeting Location & Time:

DATE: Tuesday, February 26
TIME: 5:30 p.m. to 7:30 p.m.
LOCATION: Kapolei High School - Cafeteria
91-5007 Kapolei Parkway
Kapolei, HI 96707

About AES:

AES Distributed Energy was recently selected by the Hawaiian Electric Companies for three of its eight solar-plus-storage projects in Hawai'i, representing the largest addition of renewable energy in the state's history. One of AES Distributed Energy's projects is on the island of Oahu with Hawaiian Electric Company and the other two projects are on Hawai'i Island and Maui.

AES Distributed Energy is a wholly owned subsidiary of The AES Corporation (NYSE: AES).
With a presence in Hawai'i for more than 25 years, AES shares the state's commitment to a greener energy future and is helping the state realize its goal of reaching 100% renewable energy by 2045.

Project Location:

The proposed AES West Oahu project is located on a portion of land owned by the University of Hawaii located mauka of the University of Hawaii West Oahu campus and the H-1 freeway near Kualakai Parkway.

AES West Oahu Project Details:

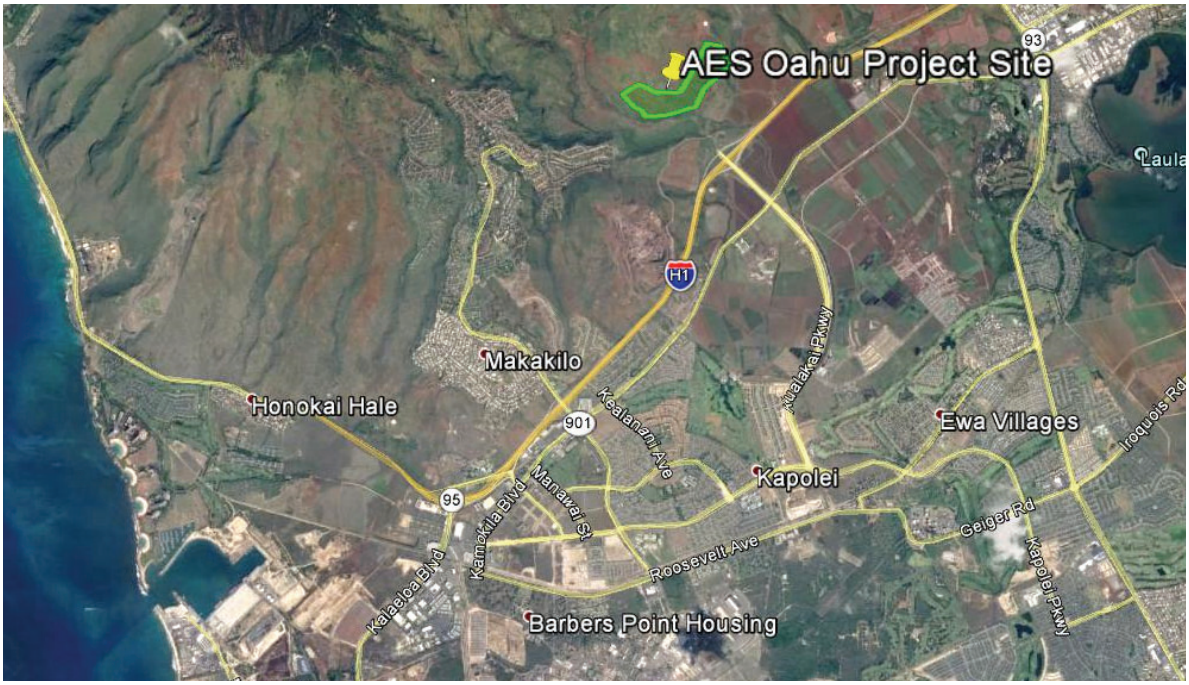
- 12.5 MW of solar PV plus 50 MWh battery energy storage system
- Enough energy to offset ~2,335 homes electricity use per year

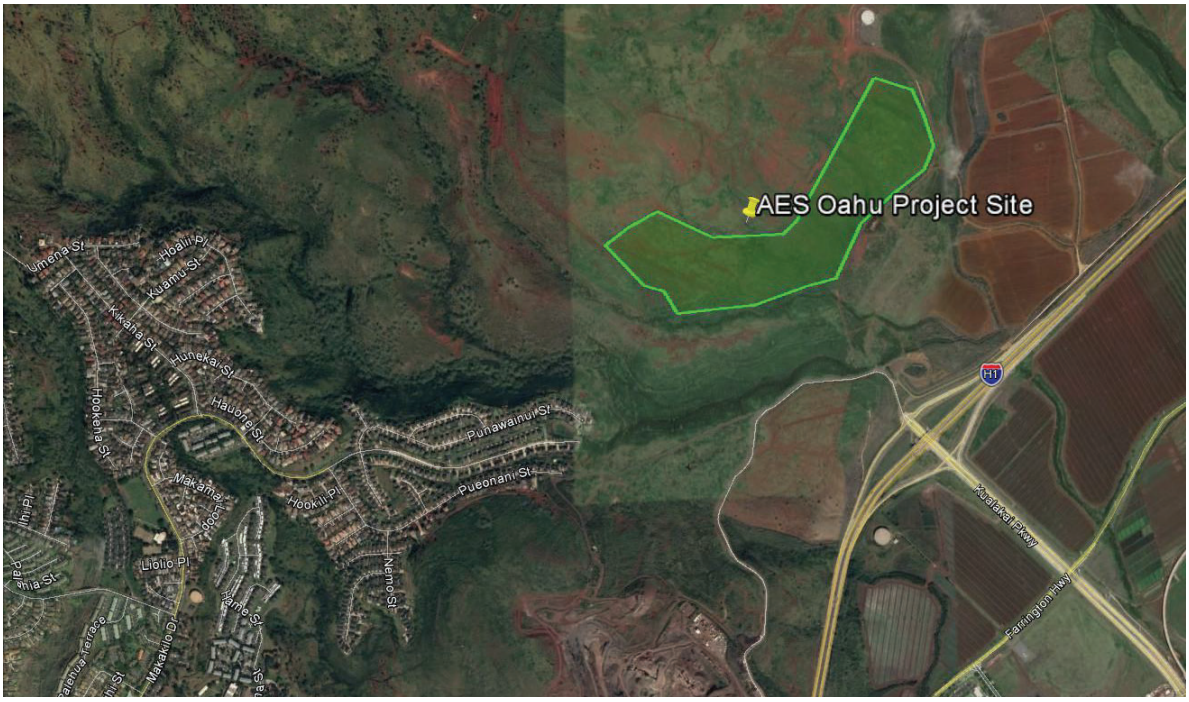
Questions/Comments:

AES welcomes questions and comments by email at AESWestOahuSolar@aes.com.

AES Distributed Energy
4875 Pearl East Circle, Suite 200
Boulder, CO 80301
aesdistributedenergy.com

Project Location Map:





AES Distributed Energy
4875 Pearl East Circle, Suite 200
Boulder, CO 80301
aesdistributedenergy.com

APPENDIX B


COMPACT
INFORMATION SYSTEMS
MAKAKILO
HEIGHTS
MAKAKILO
CITY
EAST
KAPOLEI
Makakilo Drive
Makakilo Drive
Kualakai Parkway
Kualakai Parkway
Kapolei Parkway
Kapolei Parkway
Kapolei Parkway
Kapolei Parkway
Fort Barrette Road
93
93
93
93
0.5 mi.
Map Dimensions: 2.86 mi x 4.3 mi
Map data © OpenStreetMap contributors, CC BY-SA

Attachment N
Stormwater Management Design Memo

3J CONSULTING
9600 SW NIMBUS AVENUE, STE 100
BEAVERTON, OREGON 97008
PH: (503) 946.9365
WWW.3J-CONSULTING.COM

TECHNICAL MEMORANDUM

To: Dave Phillips, PLS
Power Delivery Renewable Lead
HDR Engineering, Inc.
412 E Parkcenter Blvd, Suite 100
Boise, ID 834706-6659

From: Phillip Patague, PE
Water Resources Engineer

Kathleen Freeman, PE
Water Resources Project Manager

CC: Aaron Murphy, PE
Senior *Project Manager*

Date: January 30, 2020

Project Name: **AES Solar Oahu – West Oahu**
Project No: **19537**
Subject: **60% Stormwater Management Plan**

The project site is located just off Pueonani Street near latitude 21°22'24.39"N and longitude 158°03'56.28"W approximately 0.5 miles north of Queen Liliuokalani Freeway on the island of Oahu. The project proposes five solar array systems, with a total project area of approximately 96.81 ac. Onsite drainage will largely remain unchanged since the solar arrays will be elevated above the undeveloped ground surface. Gravel access roads and concrete equipment pads are proposed which are expected to increase stormwater runoff. Furthermore, the project is expected to disturb more than one acre, requiring the implementation of water quality treatment facilities. Natural drainage patterns divide the project site into smaller drainage management areas (DMA). 35.65 ac of the project site consist of DMAs containing the proposed impervious areas, which will drain to proposed stormwater management best management practices (BMP). The remaining onsite area will contain proposed solar modules but not impervious area; therefore, these areas should not experience altered stormwater runoff quantity and quality. It is important to note that onsite wetlands flow through the project site; however, runoff to the wetland areas generated by onsite impervious areas will be mitigated through design.

This memorandum will discuss the methodologies used in (1) quantifying stormwater runoff for the affected areas and (2) sizing the required stormwater management BMPs.

The design and analysis of onsite BMPs are based on the County of Honolulu's "Rules Relating to Storm Drainage Standards", "Post-Construction Water Quality Requirements" and "Storm Water BMP Guide for New and Redevelopment". The memo will refer to all of these guidance documents collectively as "the Standards".

Existing Conditions

The existing site is undeveloped and sparsely covered with vegetation. Onsite drainage patterns will remain mostly unchanged due to this project; however, to implement a Low Impact Development (LID) approach, stormwater management BMPs will be proposed directly downstream of impervious areas. By considering the onsite grading and desired BMP locations, the storm drainage analysis is focused on six (6) drainage management areas (DMA). The remaining onsite area will not be re-graded; the proposed solar systems will be elevated above the existing ground surface. Therefore, runoff flows and volumes for these areas were not evaluated and these drainage areas are considered Self-Mitigating because the stormwater quality and quantity are not expected to change as a result of this project.

Table 1 below outlines each DMA in existing conditions; all areas are pervious.

DMA	Area (ac)
1	3.11
2	4.77
3	1.02
4	2.84
5	23.33
6	0.57
Total	35.65

Table 1 – Existing DMAs

Developed Conditions

The developed site consists of proposed solar array systems with appurtenant concrete equipment pads and gravel access roads. Grading activities will be primarily concentrated around the impervious areas only. Table 2 below outlines the drainage areas in developed conditions. Please see attached "Developed Conditions Exhibit".

DMA	Total Area (ac)	Impervious Area (ac)	Pervious Area (ac)
1	3.11	0.27	2.84
2	4.77	0.38	4.39
3	1.02	0.20	0.82
4	2.84	0.24	2.60
5	23.33	0.68	22.66
6	0.57	0.16	0.41
Total	35.65	1.92	33.73

Table 2 – Developed DMAs

Stormwater Management Design Standards

Water Quality Treatment

The project will disturb more than one acre, which requires specific sizing criteria be met for stormwater quality facilities. This project proposes infiltration trenches for water quality treatment. A Geotech Report prepared by GeoLabs, Inc., dated September 13, 2019, measured onsite infiltration at multiple locations and determined a site average of 11.7 in/hr. Per the Standards, a safety factor of 2 was applied to the average infiltration rate to size the water quality facilities.

Water Quantity Management

For water quantity management, the infiltration trenches will be sized to mitigate the developed peak flow rate to the predevelopment value. To accomplish this, the storage volume of an infiltration trench shall equal at least the total additional runoff volume for the appropriate storm intensity. Since all the drainage areas are less than 100 acres, the appropriate storm intensity corresponds to the 50-yr, 1-hr storm event. Per Plate 2 (see attached), the precipitation depth for the 50-yr storm is 3.2 inches (see attached). The corresponding peak rainfall intensity will be discussed in a later section.

Rational Method

Per the Standards, the Rational Method shall be used for drainage areas of 100 acres or less. Therefore, hand calculations in conjunction with reference tables and charts provided in the Standards were used to quantify all relevant runoff values. The Rational Method is dependent upon the runoff coefficient (C), rainfall intensity (I) and drainage area (A). The drainage areas are outlined in a previous section, while the methodologies for deriving C and I are discussed in the following sections.

Time of Concentration

The time of concentration (Tc) is needed to determine the peak rainfall intensity (I) for determining runoff via the Rational Method. Since the drainage areas have no well-defined channels, it is assumed all runoff with occur as overland flow. The times of concentration were determined for each drainage area using Plate 3 (see attached) of the Standards and are shown in Table 3.

DMA	Tc (min)
1	26
2	29
3	27.8
4	28.5
5	28.5
6	19.5

Table 3 – Times of Concentration

The proposed impervious areas will typically be implemented at the most downstream point of each drainage area, which is not expected to alter the times of concentration.

Correction Factor

A correction factor is used to convert the 50-yr, 1-storm precipitation depth to the rainfall intensity. Using the Tc calculated and Plate 4 from the Storm Drainage Standards, a correction factor was determined for each sub basin. Table 4 below shows the correction factor for each sub basin.

DMA	Correction Factor
1	1.6
2	1.5
3	1.6
4	1.5
5	1.5
6	1.8

Table 4 – Correction Factor

Rainfall Intensity

The appropriate rainfall value for the 50-yr, 1-hr storm were determined for the site using Plate 2 (see attached) of the Standards. This value was determined to be 3.2 in The rainfall value from Plate 2 was then multiplied by the correction factor determined in Table 4 to calculate the rainfall intensity for each basin. Table 5 shows the peak rainfall intensity for each basin.

DMA	Intensity (in/hr)
1	5.12
2	4.80
3	5.12
4	4.80
5	4.80
6	5.76

Table 5 – Rainfall Intensity

Runoff Coefficient

In existing conditions, all drainage areas are undeveloped with sparse vegetation, which reflects a runoff coefficient (C) of 0.30.

Per the Standards, runoff coefficients for existing conditions were determined using the peak rainfall intensities shown in Table 5 and Table 1 of The Standards. In developed conditions, certain areas will be paved or gravel, while most of the pervious area will remain the same cover type as in existing conditions. The runoff coefficient for developed conditions was weighted to account for different cover types. Runoff coefficients for each basin are shown in Table 6.

DMA	Existing C	Developed C
1	0.43	0.47
2	0.41	0.45
3	0.43	0.52
4	0.41	0.45
5	0.41	0.42
6	0.44	0.57

Table 6 – Runoff Coefficients

Runoff Volumes

Table 7 below outlines the existing and developed 50-yr runoff volumes for each basin and the resulting increase due to this project.

DMA	Existing Runoff (cf)	Developed Runoff (cf)	Increase in Runoff (cf)
1	15,538	16,999	1,461
2	22,722	24,894	2,172
3	5,104	6,180	1,077
4	13,534	14,893	1,359
5	111,131	114,983	3,852
6	2,921	3,785	864

Table 7 – Runoff Volumes

Stormwater Management Facilities

Proposed infiltration trenches will treat and manage stormwater runoff. The attached BMP Sizing Worksheets indicate the required volumes for each infiltration trench to provide sufficient water quality treatment. However, each trench will be sized to store the increase in runoff volume per basin shown in Table 7 above, which are in excess of the required water quality volumes (except for DMA 5), to provide sufficient water quantity management.

All infiltration trenches have a total depth of 3 ft, width of 9 ft, and will be filled with washed gravel with porosity of 0.35. Table 8 below outlines each infiltration trench's area and provided storage volume.

DMA	Trench Area (sf)	Provided Storage (cf)
1	1,436	1,508
2	2,142	2,249
3	1,035	1,087
4	1,305	1,370
5	6,143	6,450[(1)]
6	868	911

Table 8 – Infiltration Trench Dimensions

[(1)]Water Quality Volume exceeds 50-yr runoff volume increase

Conclusions

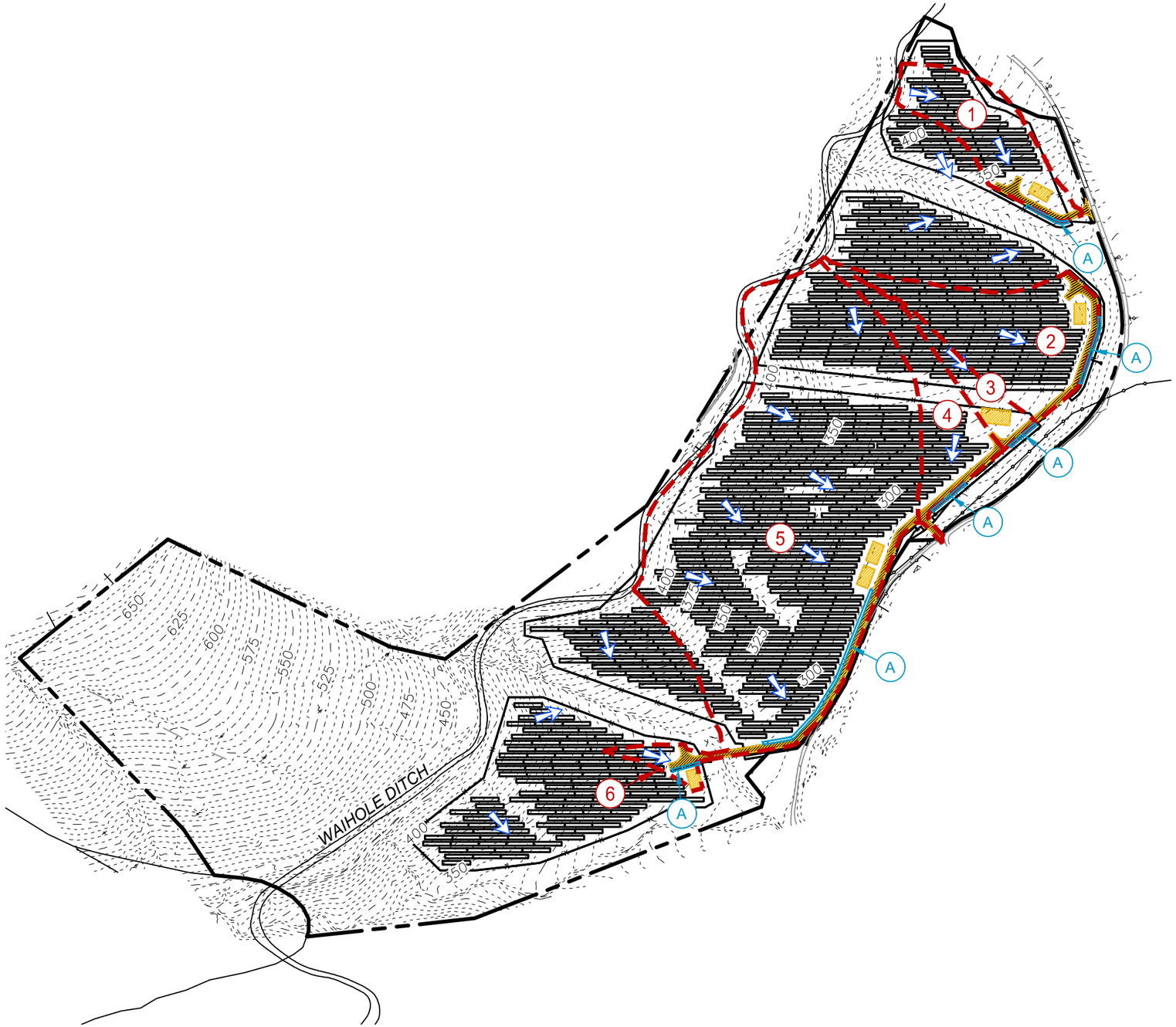
This project proposes minimal surface improvements, which are not expected to affect the drainage patterns of most of the site. In developed conditions, the ground underneath the solar panels will be undeveloped and grading activities will be concentrated around the access roads and equipment pads. Runoff is expected to occur only as overland flow and will discharge to proposed infiltration trenches for stormwater management.

Please take the time to review this memo and contact us if you have any questions or require clarification.

Attachments

1. Developed Conditions Exhibit
2. Hydrologic Soil Group Map
3. Time of Concentration (Plate 3)
4. Correction Factors (Plate 4)
5. 50-yr, 1-hr Rainfall Depth (Plate 2)
6. Coefficient of Runoff (Table 1)
7. BMP Sizing Worksheets

- - - E N D O F D O C U M E N T - - -



LEGEND

- BASIN BOUNDARY
- # BASIN TAG
- IMPERVIOUS AREA
- DRAINAGE DIRECTION
- A INFILTRATION TRENCH

DEVELOPED DRAINAGE AREAS

Basin	A ac	Aimp ac	Aper ac
1	3.11	0.27	2.84
2	4.77	0.38	4.39
3	1.02	0.20	0.82
4	2.84	0.24	2.60
5	23.33	0.68	22.66
6	0.57	0.16	0.41
Total	*35.65*	*1.92*	*33.73*

N
W E
S

SCALE: 1" = 400'

0 400 800 FT

AES SOLAR FARM - WEST OAHU

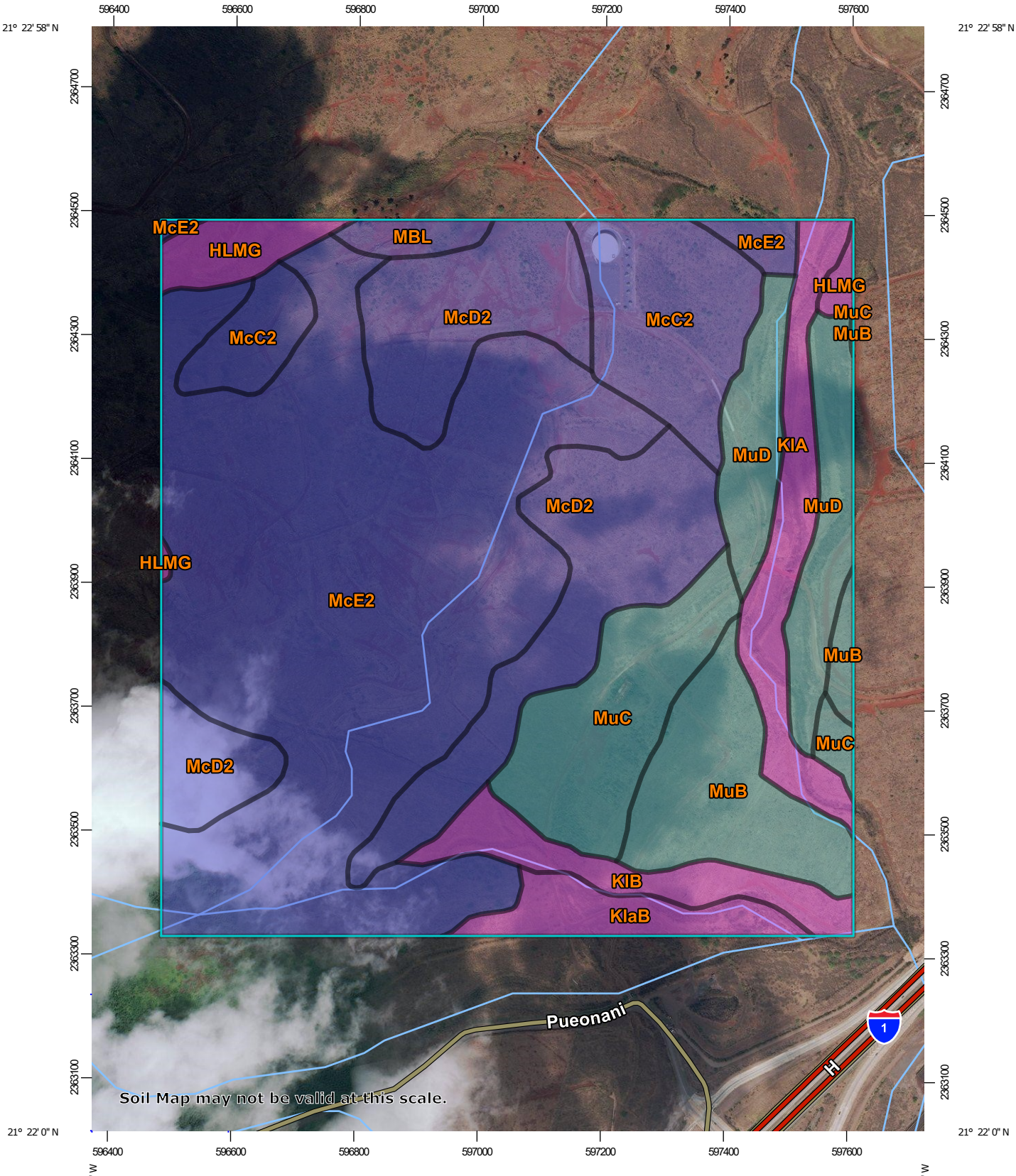
3J CONSULTING, INC
CIVIL ENGINEERING
WATER RESOURCES
COMMUNITY PLANNING

COUNTY OF HONOLULU

DEVELOPED CONDITIONS EXHIBIT

JAN 2020

Hydrologic Soil Group—Island of Oahu, Hawaii
(19537 - AES Solar West Oahu - HSG)



Map Scale: 1:8,720 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 100 200 400 600

Feet: 0 400 800 1600 2400

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 4N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Island of Oahu, Hawaii
Survey Area Data: Version 14, Sep 17, 2019

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Dec 31, 2009—Aug 14, 2016

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
HLMG	Helemano silty clay, 30 to 90 percent slopes	A	7.0	2.2%
KlA	Kawaihapai clay loam, 0 to 2 percent slopes, MLRA 158	A	15.3	4.8%
KlaB	Kawaihapai stony clay loam, 2 to 6 percent slopes, MLRA 158	A	8.6	2.7%
KlB	Kawaihapai clay loam, 2 to 6 percent slopes	A	10.9	3.4%
MBL	Mahana-Badland complex	B	3.1	1.0%
McC2	Mahana silty clay loam, 6 to 12 percent slopes, eroded	B	26.6	8.3%
McD2	Mahana silty clay loam, 12 to 20 percent slopes, eroded	B	56.0	17.4%
McE2	Mahana silty clay loam, 20 to 35 percent slopes, eroded	B	129.3	40.1%
MuB	Molokai silty clay loam, 3 to 7 percent slopes, MLRA 158	C	21.7	6.7%
MuC	Molokai silty clay loam, 7 to 15 percent slopes, MLRA 158	C	23.0	7.2%
MuD	Molokai silty clay loam, 15 to 25 percent slopes	C	20.7	6.4%
Totals for Area of Interest			**322.4**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

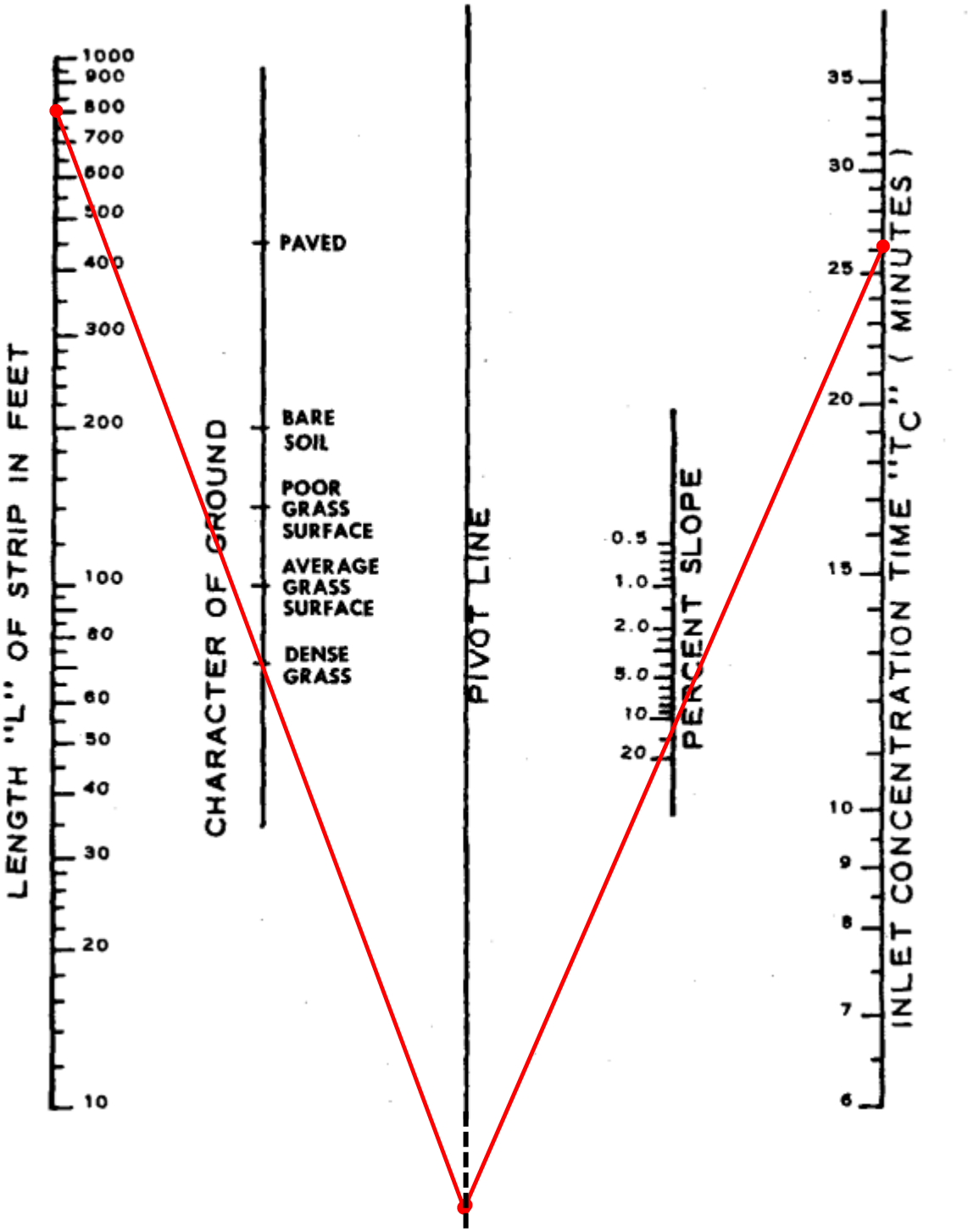
Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

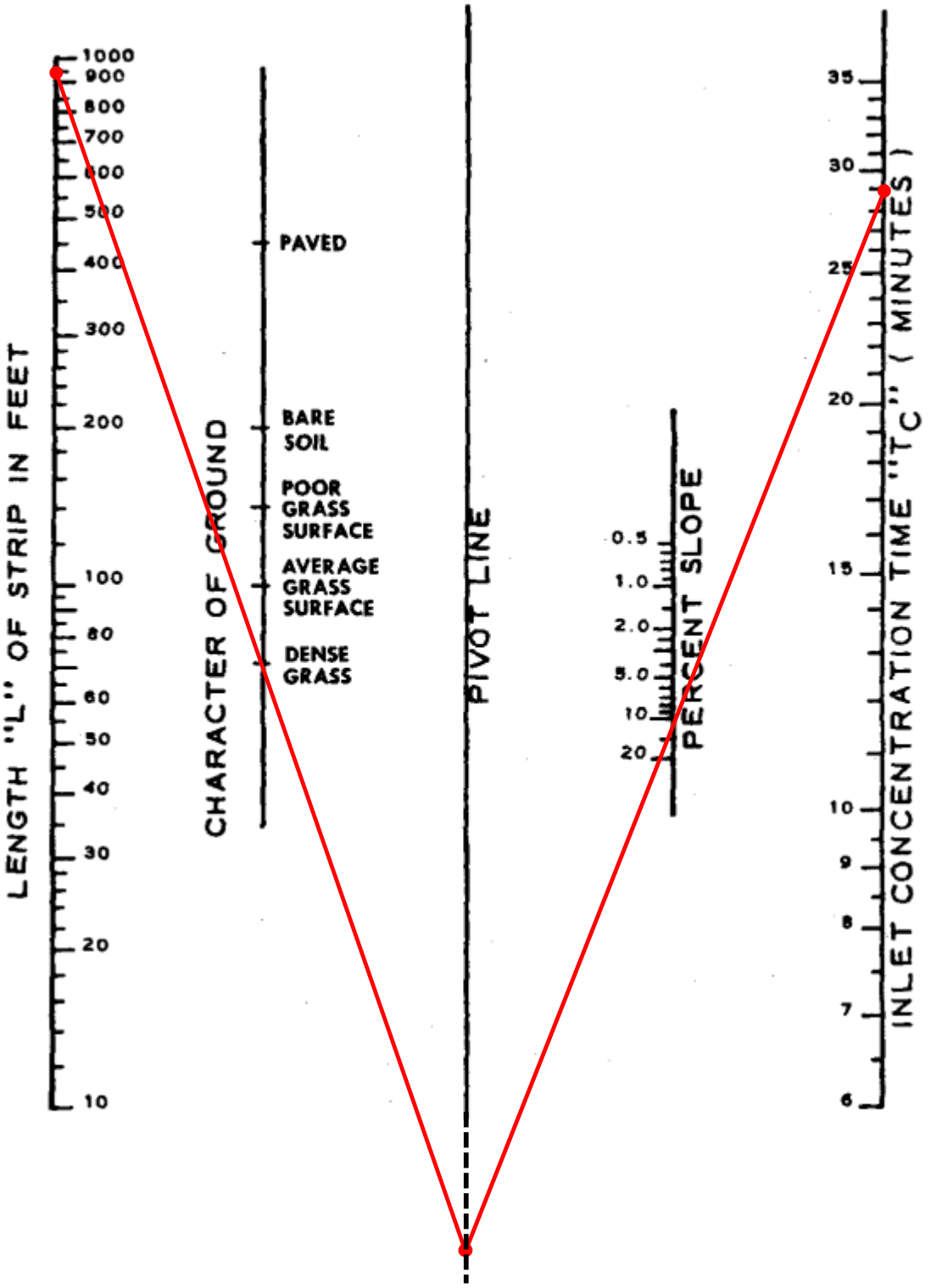
Tie-break Rule: Higher

Time of Concentration (Plate 3 from Storm Drainage Standards)

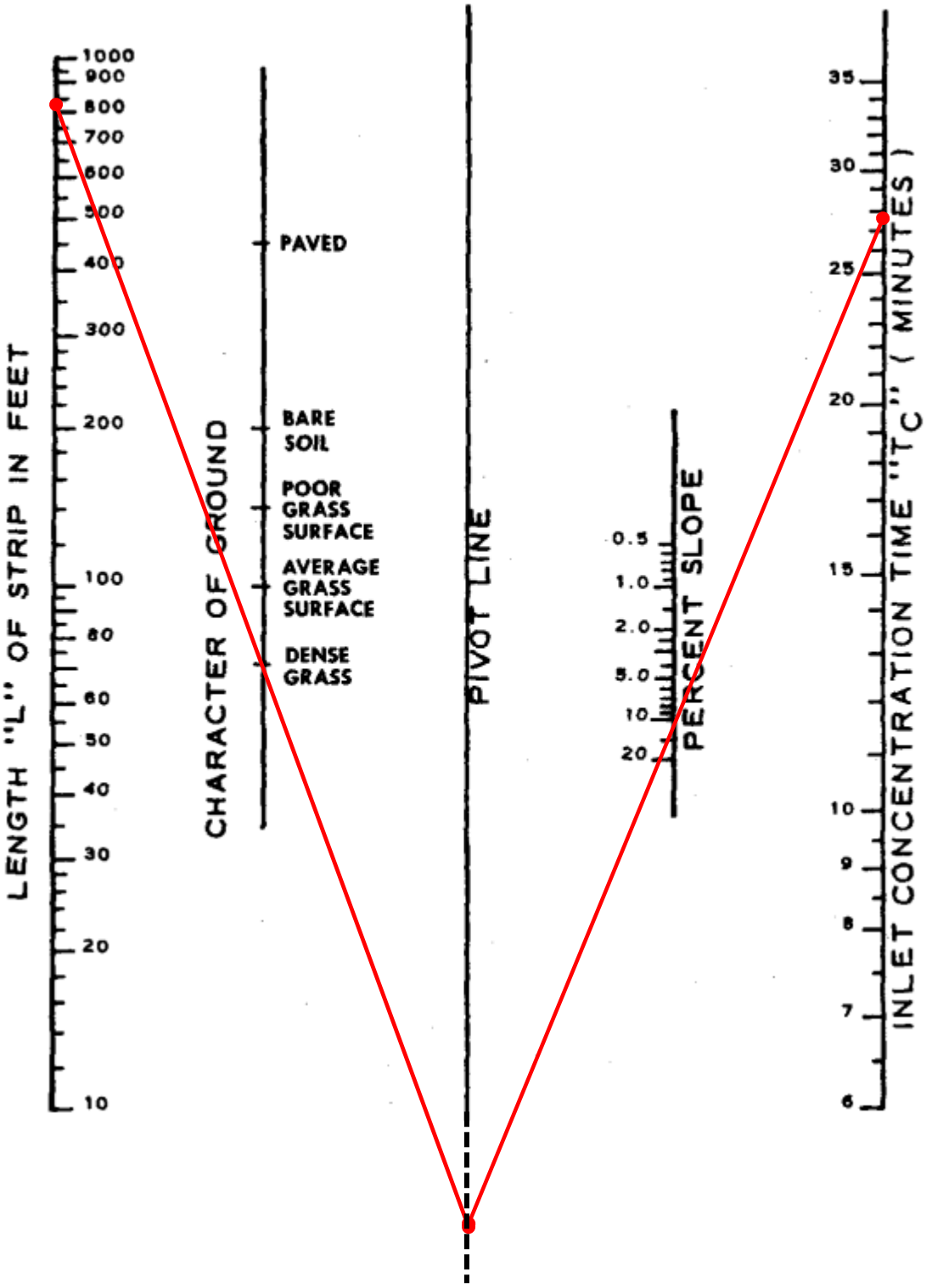
Basin 1



Basin 2


LENGTH "L" OF STRIP IN FEET
1000
900
800
700
600
500
400
300
200
100
80
60
50
40
30
20
10
CHARACTER OF GROUND
PAVED
BARE SOIL
POOR GRASS SURFACE
AVERAGE GRASS SURFACE
DENSE GRASS
PIVOT LINE
PERCENT SLOPE
0.5
1.0
2.0
5.0
10
20
INLET CONCENTRATION TIME "Tc" (MINUTES)
35
30
25
20
15
10
9
8
7
6

Basin 3


LENGTH "L" OF STRIP IN FEET
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CHARACTER OF GROUND
PAVED
BARE SOIL
POOR GRASS SURFACE
AVERAGE GRASS SURFACE
DENSE GRASS
PIVOT LINE
PERCENT SLOPE
0.5
1.0
2.0
5.0
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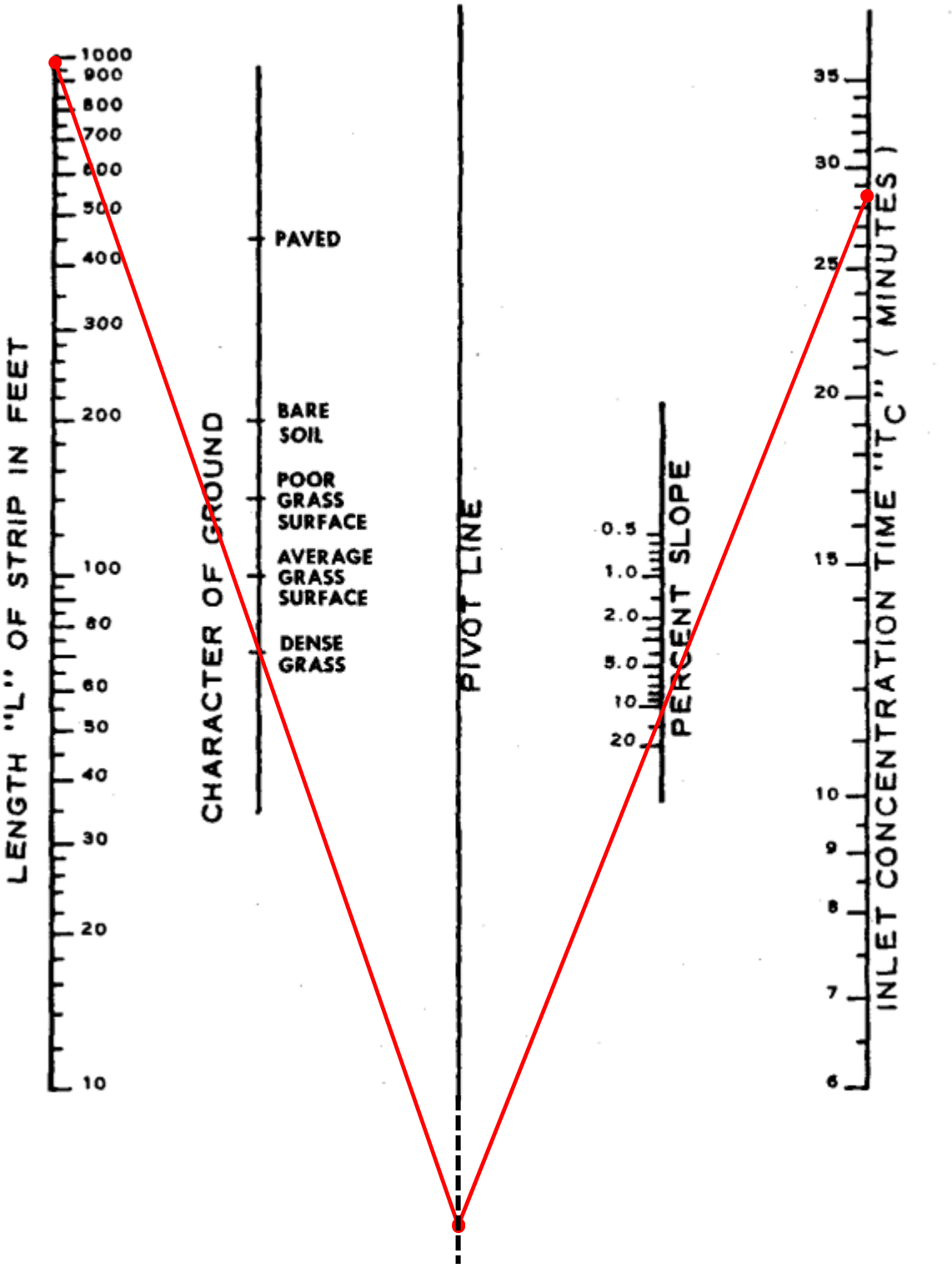
20
INLET CONCENTRATION TIME "Tc" (MINUTES)
35
30
25
20
15
10
9
8
7
6

Basin 4


LENGTH "L" OF STRIP IN FEET
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200
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80
60
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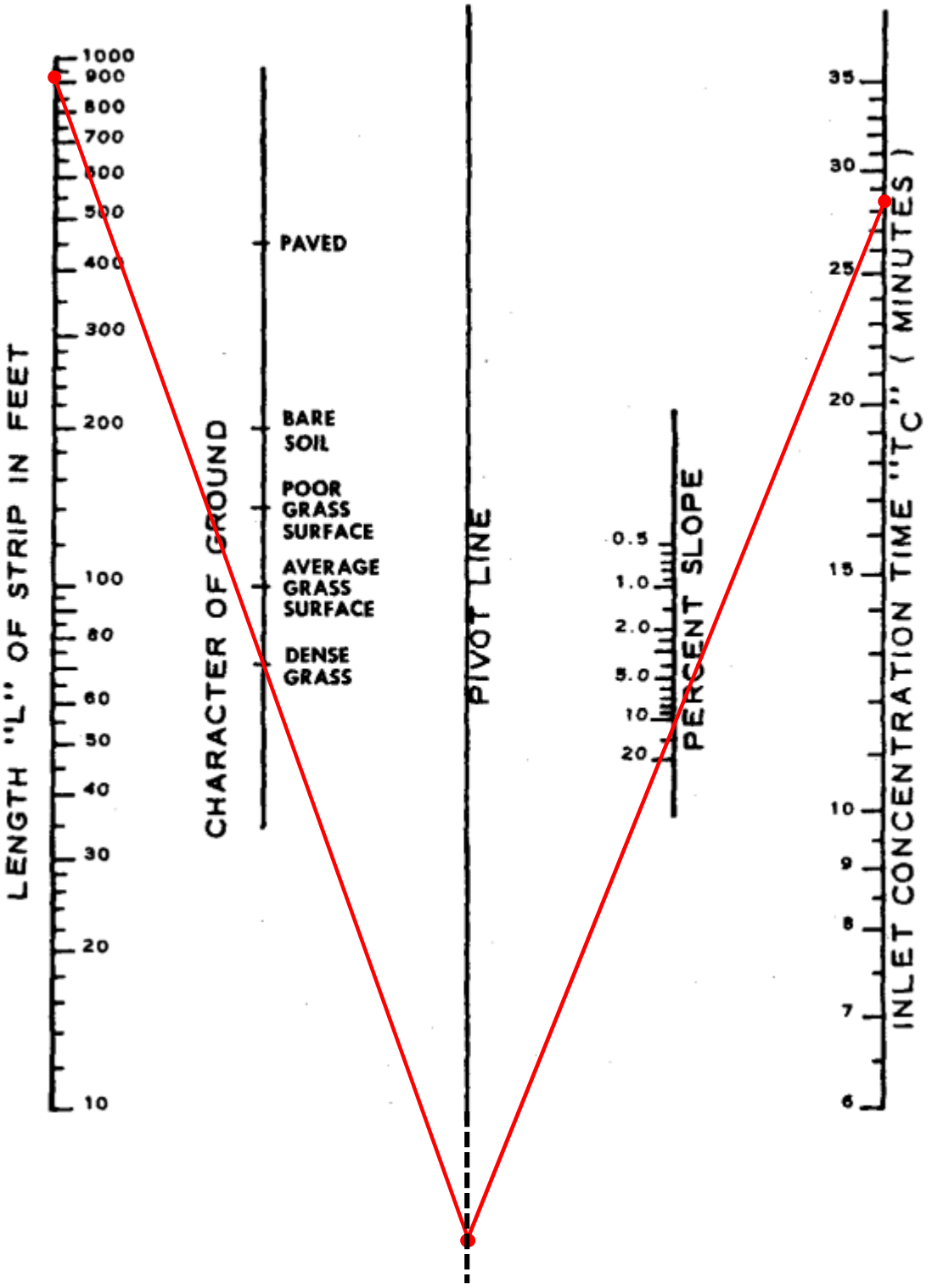
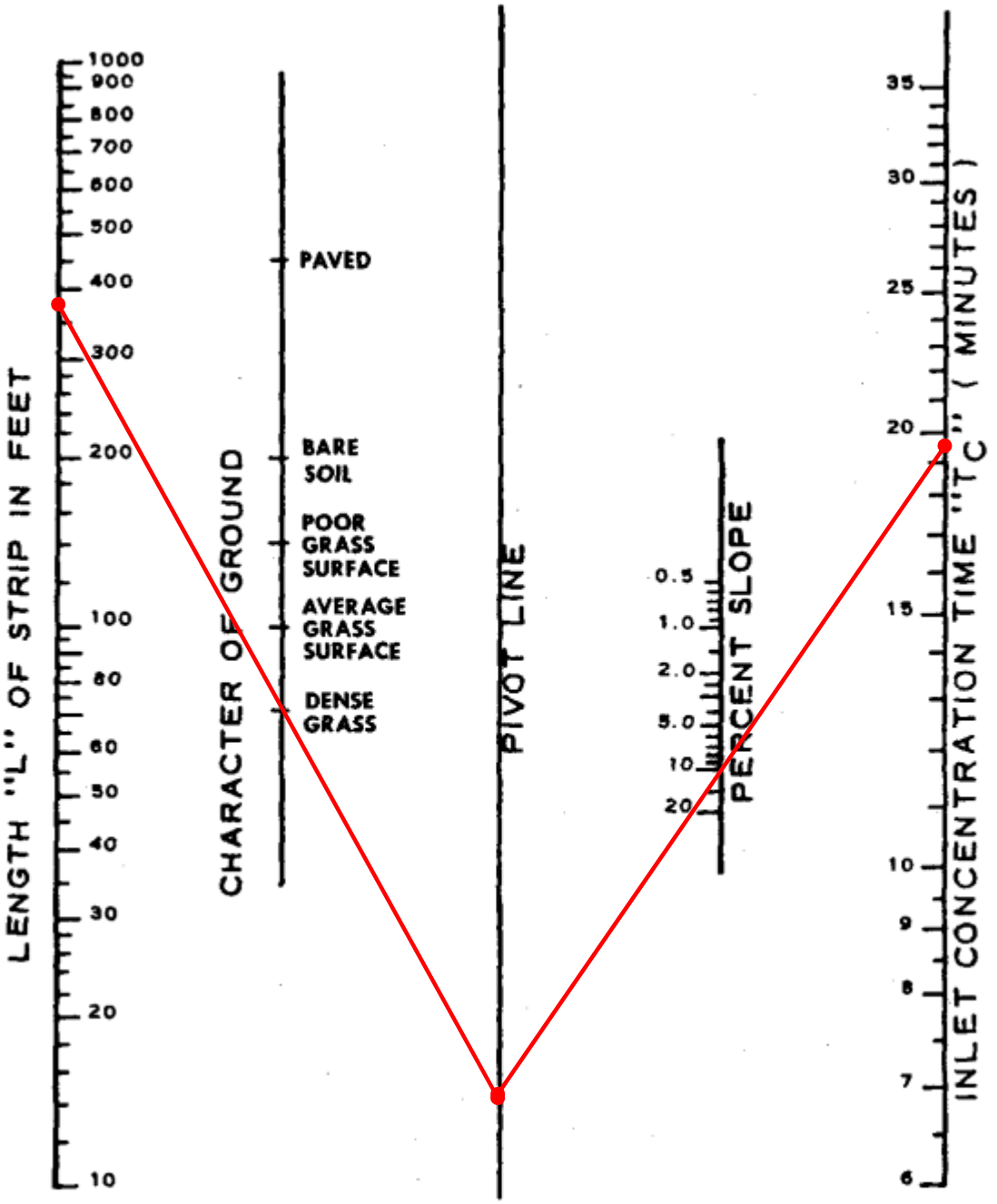
40
30
20
10
CHARACTER OF GROUND
PAVED
BARE SOIL
POOR GRASS SURFACE
AVERAGE GRASS SURFACE
DENSE GRASS
PIVOT LINE
PERCENT SLOPE
0.5
1.0
2.0
5.0
10
20
INLET CONCENTRATION TIME "Tc" (MINUTES)
35
30
25
20
15
10
9
8
7
6

Basin 5

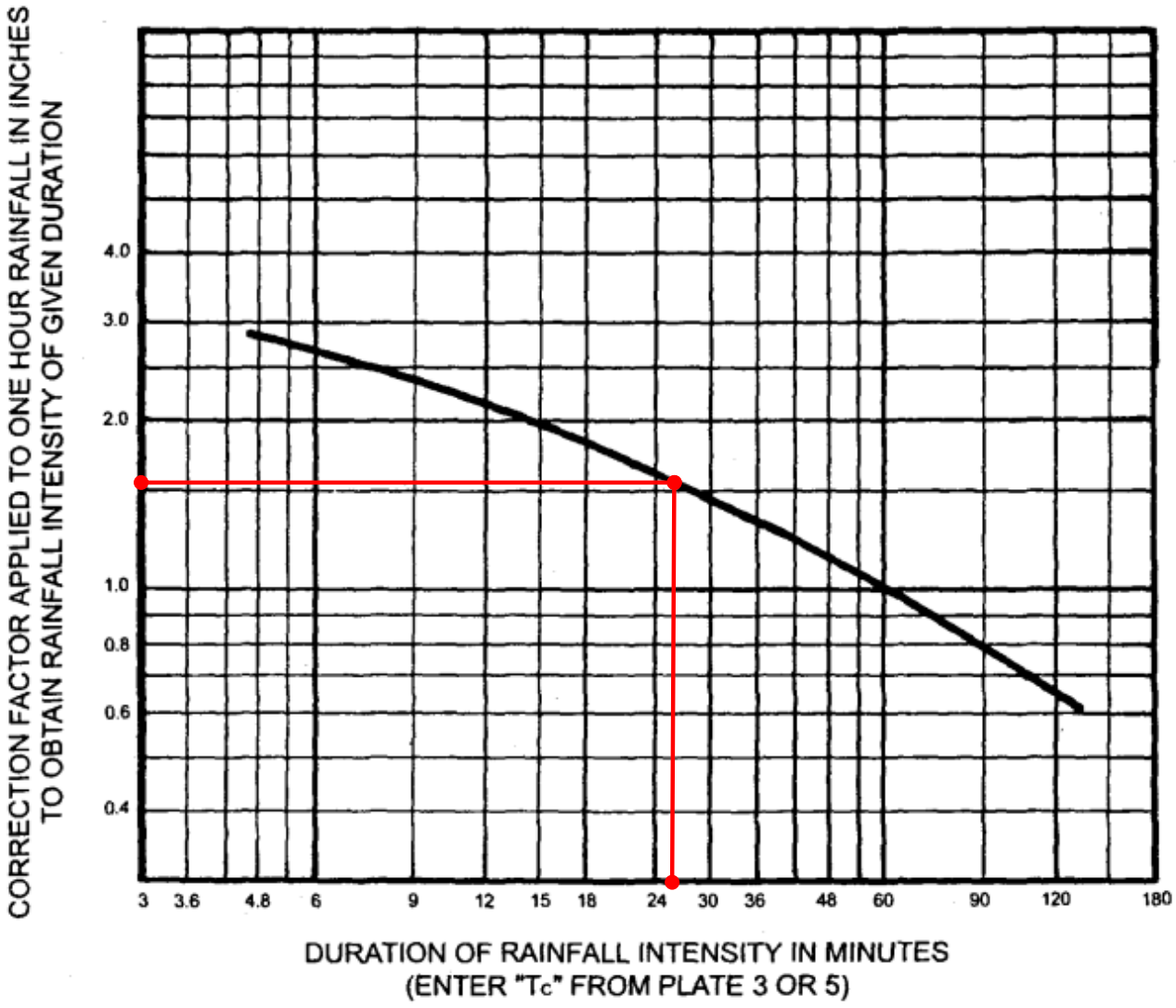

LENGTH "L" OF STRIP IN FEET
1000
900
800
700
600
500
400
300
200
100
80
60
50
40
30
20
10
CHARACTER OF GROUND
PAVED
BARE SOIL
POOR GRASS SURFACE
AVERAGE GRASS SURFACE
DENSE GRASS
PIVOT LINE
PERCENT SLOPE
0.5
1.0
2.0
5.0
10
20
INLET CONCENTRATION TIME "Tc" (MINUTES)
35
30
25
20
15
10
9
8
7
6

Basin 6

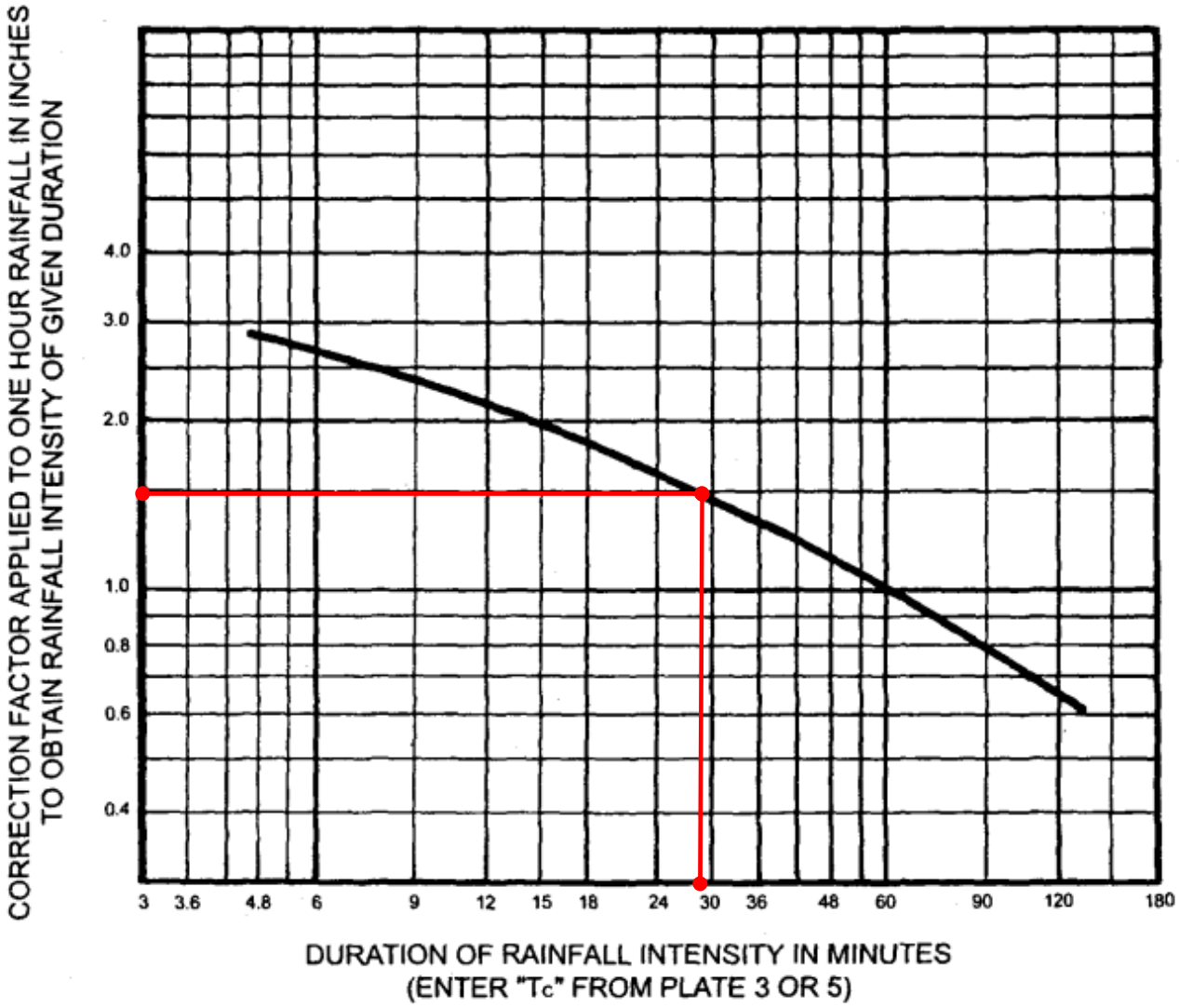

LENGTH "L" OF STRIP IN FEET
1000
900
800
700
600
500
400
300
200
100
80
60
50
40
30
20
10
CHARACTER OF GROUND
PAVED
BARE SOIL
POOR GRASS SURFACE
AVERAGE GRASS SURFACE
DENSE GRASS
PIVOT LINE
PERCENT SLOPE
0.5
1.0
2.0
5.0
10
20
INLET CONCENTRATION TIME "TC" (MINUTES)
35
30
25
20
15
10
9
8
7
6

Rainfall Intensity (Plate 4 from Storm Drainage Standards)

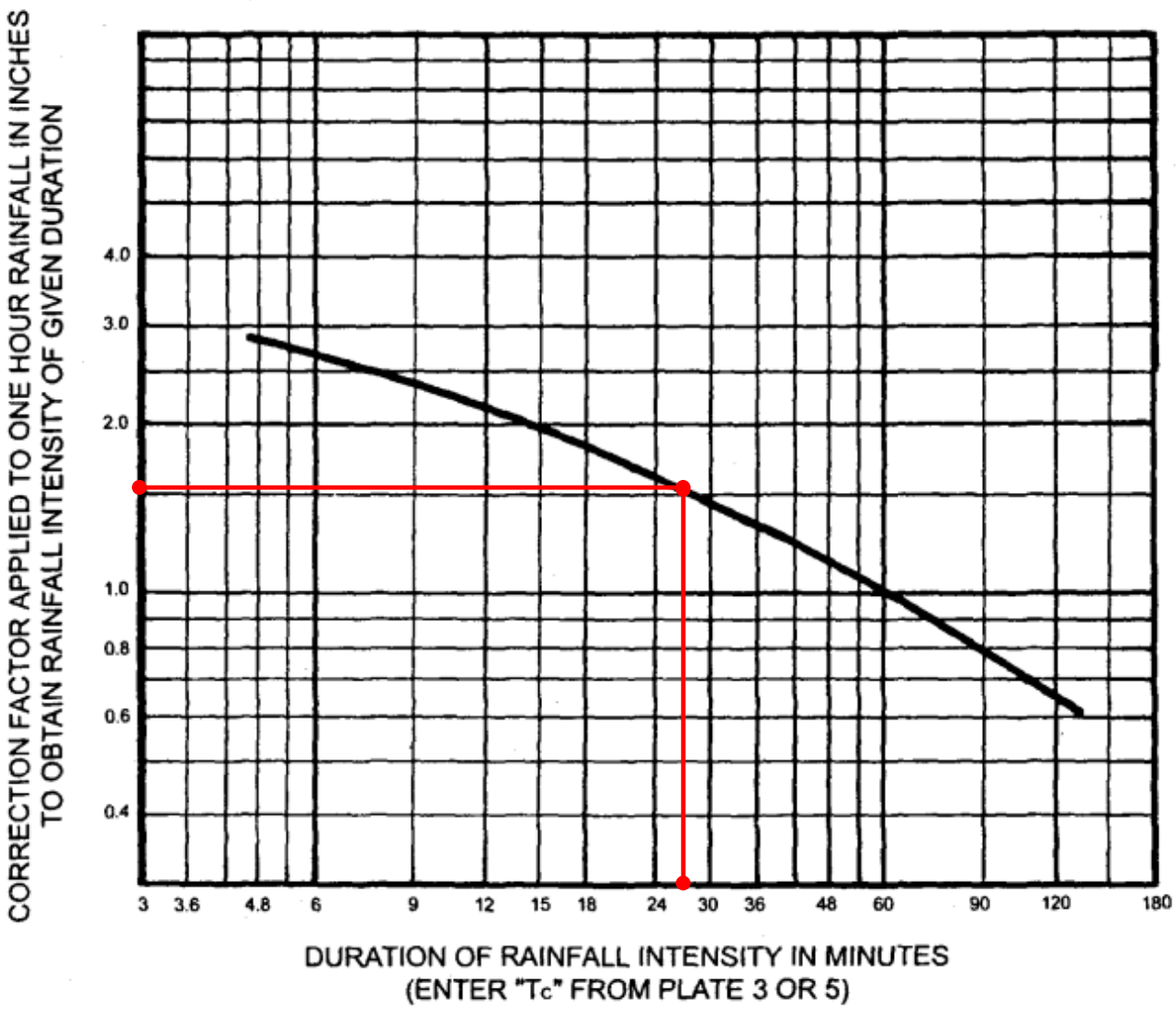
Basin 1



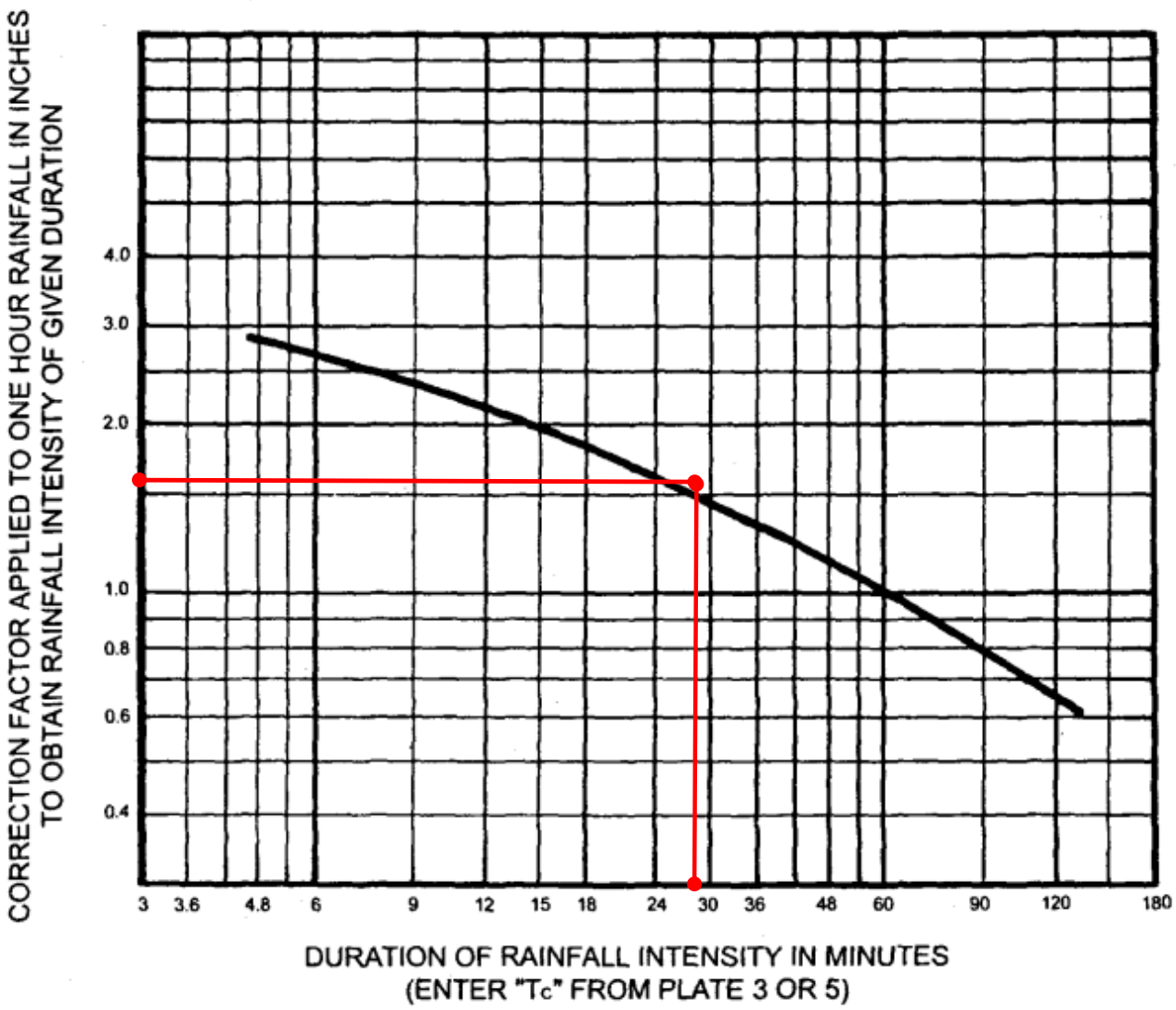
Basin 2


CORRECTION FACTOR APPLIED TO ONE HOUR RAINFALL IN INCHES
TO OBTAIN RAINFALL INTENSITY OF GIVEN DURATION
4.0
3.0
2.0
1.0
0.8
0.6
0.4
3
3.6
4.8
6
9
12
15
18
24
30
36
48
60
90
120
180
DURATION OF RAINFALL INTENSITY IN MINUTES
(ENTER "Tc" FROM PLATE 3 OR 5)

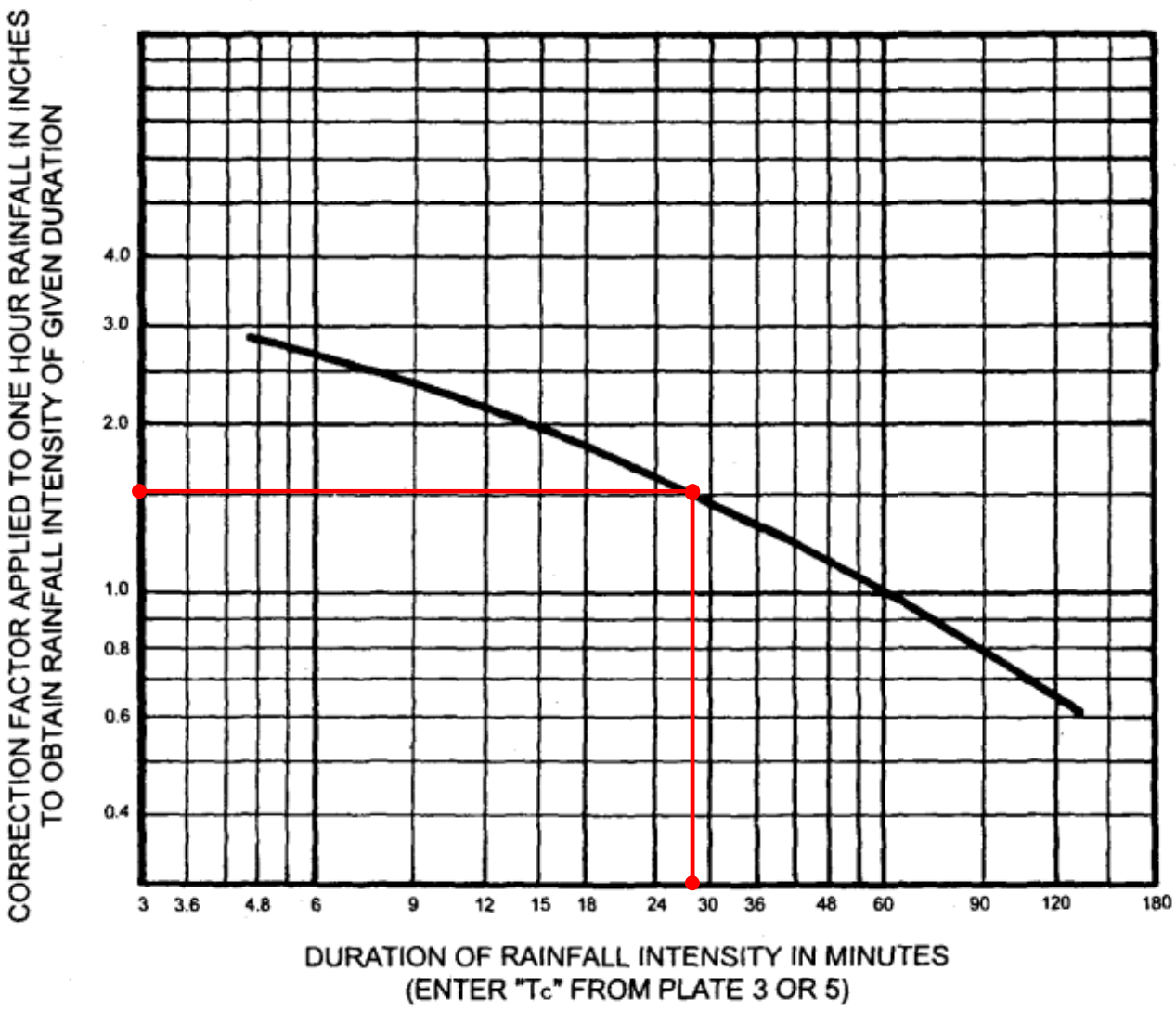
Basin 3


CORRECTION FACTOR APPLIED TO ONE HOUR RAINFALL IN INCHES
TO OBTAIN RAINFALL INTENSITY OF GIVEN DURATION
4.0
3.0
2.0
1.0
0.8
0.6
0.4
3
3.6
4.8
6
9
12
15
18
24
30
36
48
60
90
120
180
DURATION OF RAINFALL INTENSITY IN MINUTES
(ENTER "Tc" FROM PLATE 3 OR 5)

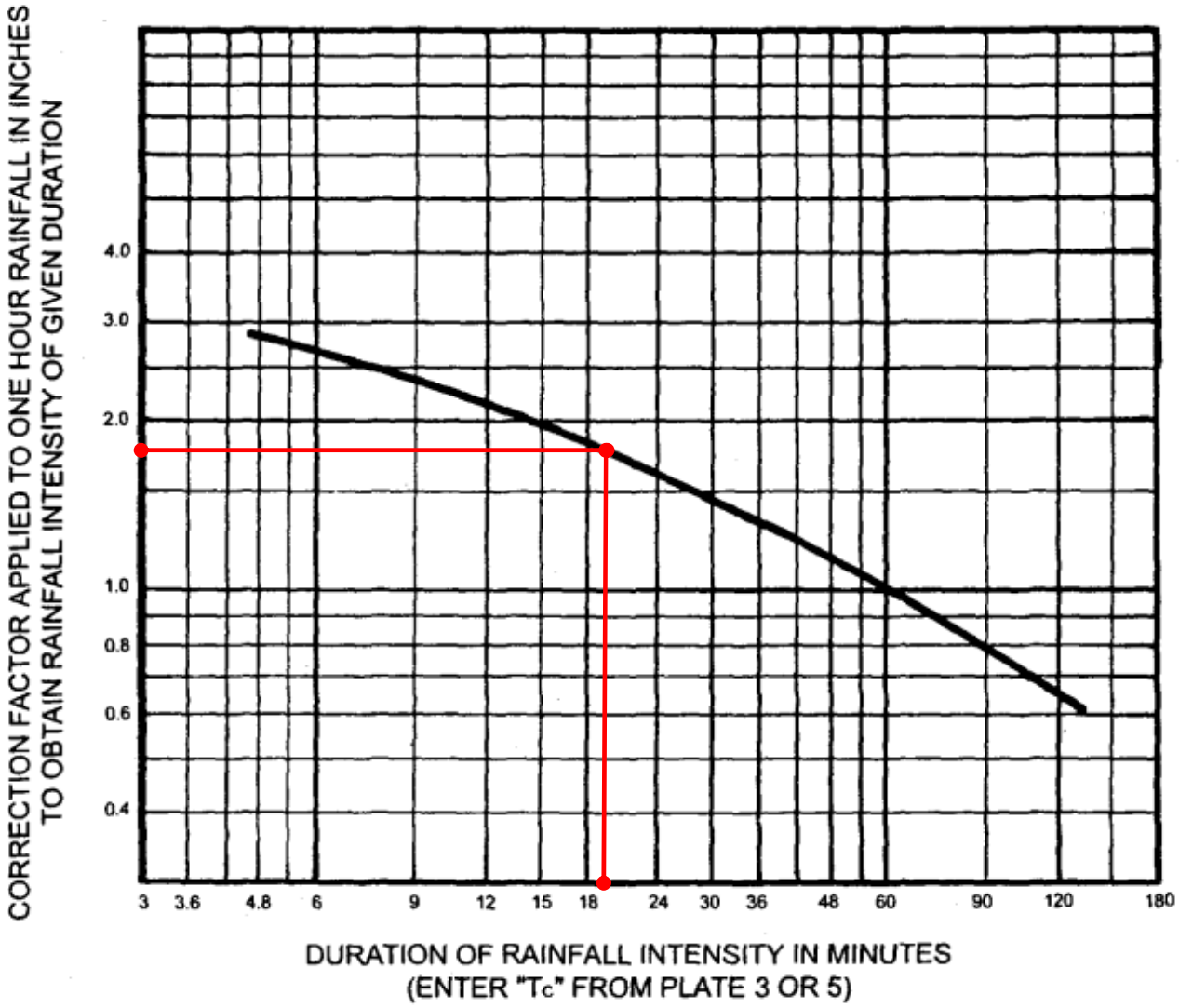
Basin 4

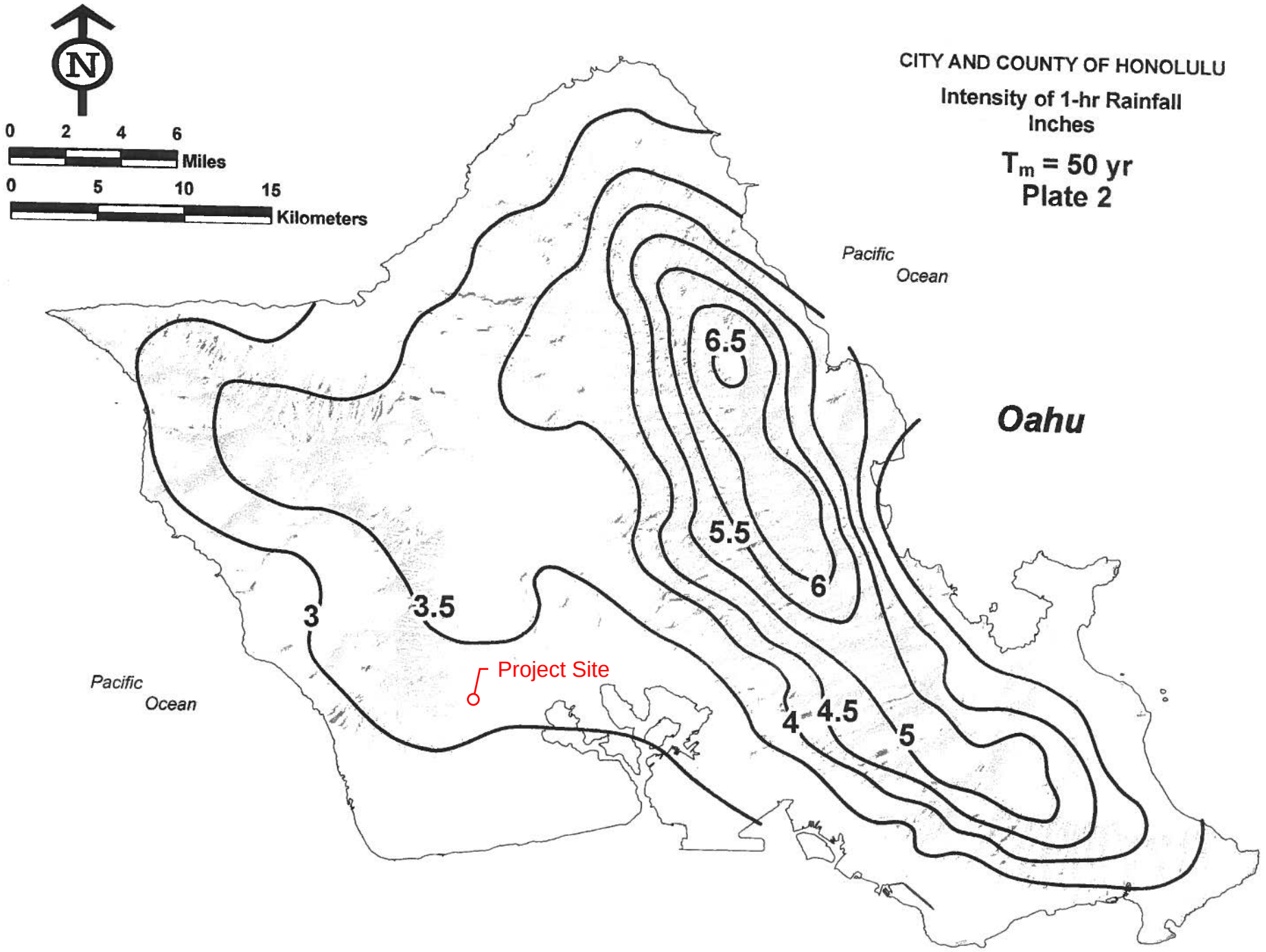

CORRECTION FACTOR APPLIED TO ONE HOUR RAINFALL IN INCHES
TO OBTAIN RAINFALL INTENSITY OF GIVEN DURATION
4.0
3.0
2.0
1.0
0.8
0.6
0.4
3
3.6
4.8
6
9
12
15
18
24
30
36
48
60
90
120
180
DURATION OF RAINFALL INTENSITY IN MINUTES
(ENTER "Tc" FROM PLATE 3 OR 5)

Basin 5


CORRECTION FACTOR APPLIED TO ONE HOUR RAINFALL IN INCHES
TO OBTAIN RAINFALL INTENSITY OF GIVEN DURATION
4.0
3.0
2.0
1.0
0.8
0.6
0.4
3
3.6
4.8
6
9
12
15
18
24
30
36
48
60
90
120
180
DURATION OF RAINFALL INTENSITY IN MINUTES
(ENTER "Tc" FROM PLATE 3 OR 5)

Basin 6


CORRECTION FACTOR APPLIED TO ONE HOUR RAINFALL IN INCHES
TO OBTAIN RAINFALL INTENSITY OF GIVEN DURATION
4.0
3.0
2.0
1.0
0.8
0.6
0.4
3
3.6
4.8
6
9
12
15
18
24
30
36
48
60
90
120
180
DURATION OF RAINFALL INTENSITY IN MINUTES
(ENTER "Tc" FROM PLATE 3 OR 5)

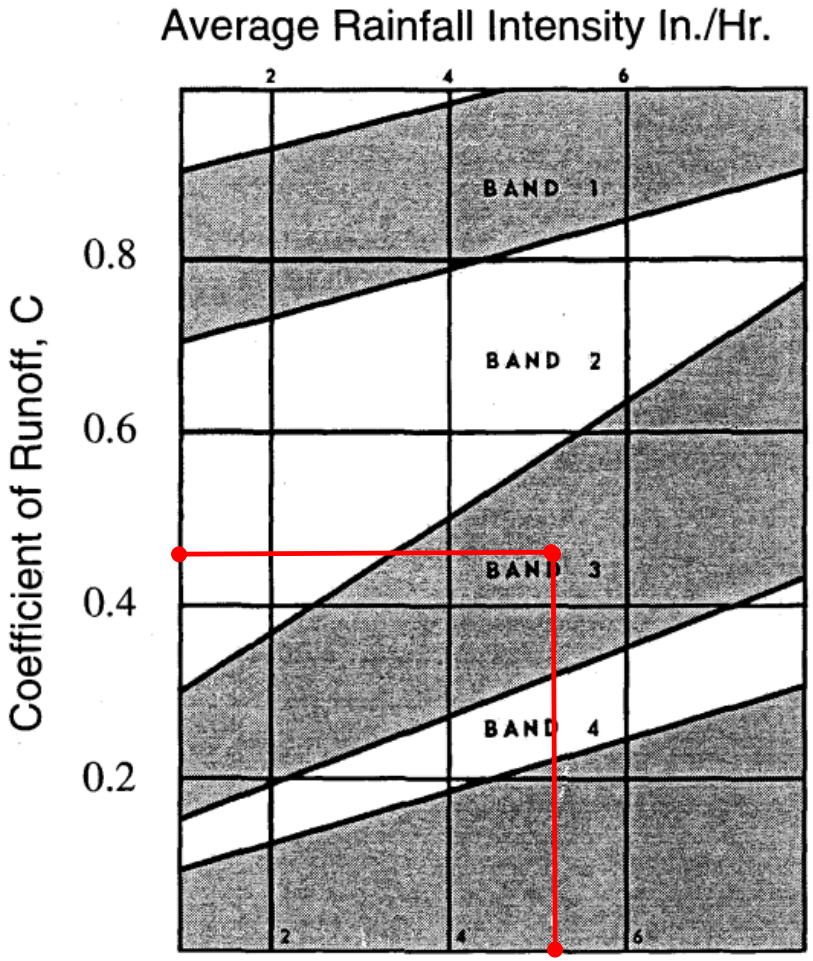


[Eff: APR 0 8 2011] (Auth: Sec 14-12.31, ROH) (Imp: Sec 14-12.31, ROH)

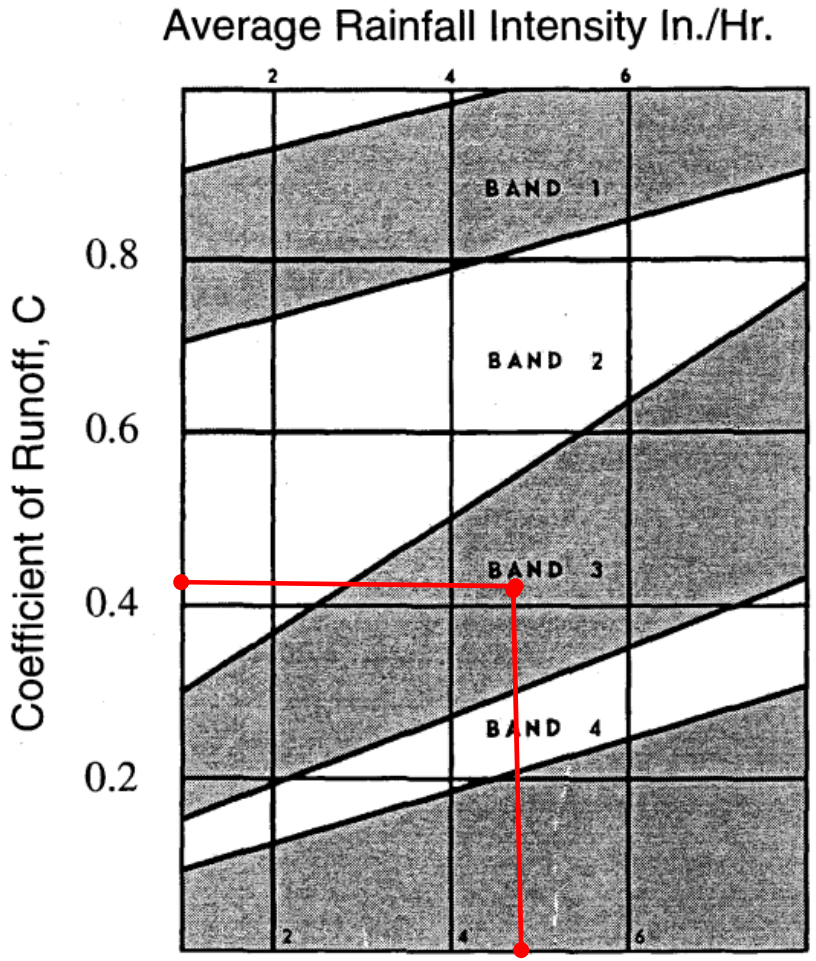
Source: National Oceanic and Atmospheric Administration (NOAA), National Weather Service, Silver Spring, Maryland, 2009

Runoff Coefficient (Table 1 from Storm Drainage Standards)

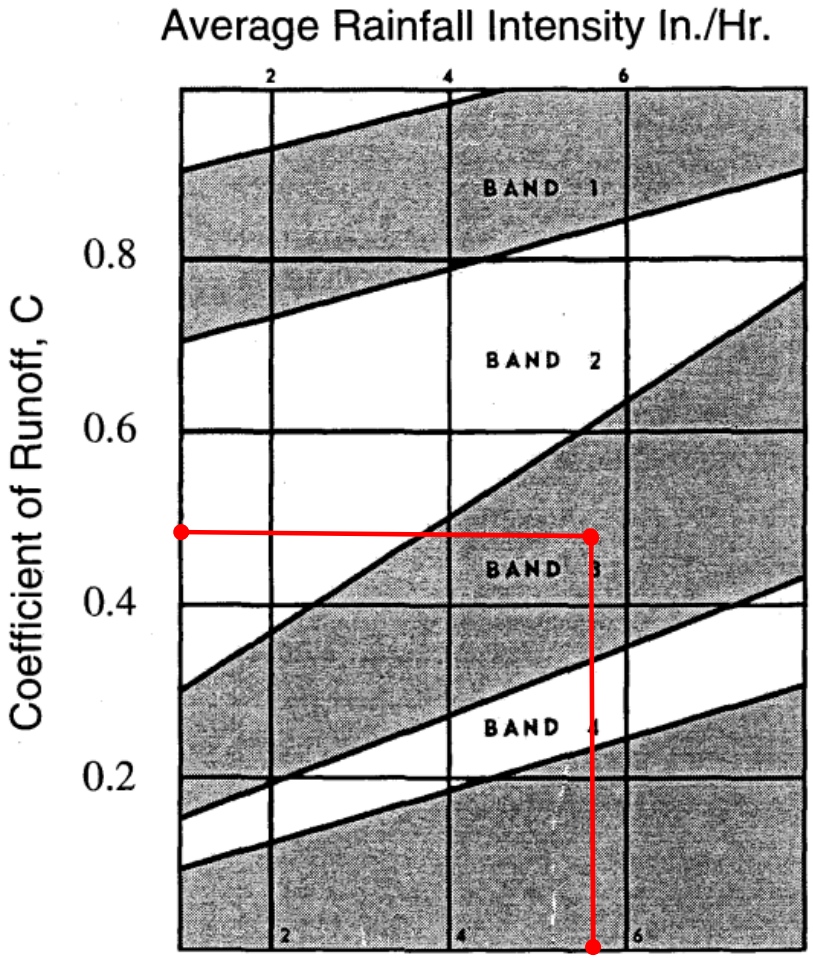
Basins 1 & 3



Basins 2, 4 & 5



Basin 6


Average Rainfall Intensity In./Hr.
2
4
6
Coefficient of Runoff, C
0.8
0.6
0.4
0.2
BAND 1
BAND 2
BAND 3
BAND 4
2
4
6

BMP Sizing Worksheet: Summary Sheet

Project: AES Solar Site - West Oahu **Date:** 1/30/2020

Overall site		
Total Project Area	4216897	sq-ft
Total Self-Mitigating Area	2663932	sq-ft
Total Self-Retaining Area		sq-ft
Total Deminimus Area		sq-ft
Total Drainage Area requiring Treatment	1552965	sq-ft
Drainage Management Area (DMA) treated with retention	1552965	sq-ft
DMA treated with harvest/reuse	0	sq-ft
DMA treated with biofiltration	0	sq-ft
DMA treated with alternative compliance	0	sq-ft

Drainage Management Area 1		
Area	135507	sq-ft
Treatment BMP:	Infiltration Trench	
Worksheet No.:	1 of 6	

Drainage Management Area 2		
Area	207821	sq-ft
Treatment BMP:	Infiltration Trench	
Worksheet No.:	2 of 6	

Drainage Management Area 3		
Area	44510	sq-ft
Treatment BMP:	Infiltration Trench	
Worksheet No.:	3 of 6	

Drainage Management Area 4		
Area	123787	sq-ft
Treatment BMP:	Infiltration Trench	
Worksheet No.:	4 of 6	

Drainage Management Area 5		
Area	1016446	sq-ft
Treatment BMP:	Infiltration Trench	
Worksheet No.:	5 of 6	

Drainage Management Area 6		
Area	24894	sq-ft
Treatment BMP:	Infiltration Trench	
Worksheet No.:	6 of 6	

BMP Sizing Worksheet: Infiltration Trench

Worksheet No. 1 of 6

Project: AES Solar Site - West Oahu **Date:** 1/30/2020

1. Water Quality Volume		
a. BMP Tributary Drainage Area, **A**	3.1	ac
b. % Impervious Area, **I**	8.6	%
c. Water Quality Design Storm Depth, **P**	1.0	in
d. Volumetric Runoff Coefficient, **C**	0.1274	
e. Water Quality Volume, **WQV**	1,439	cu-ft
2. Maximum Storage Depth		
a. Soil Infiltration Rate, **k** (0.5 min)	11.7	in/hr
b. Infiltration Rate Safety Factor, **Fs** (2 min)	2	
c. Drawdown Time, **t**	48	hrs
d. Max. Storage Depth, $\mathbf{d_{max}}$	23.4	ft
3. Design Storage Depths		
a. Ponding Depth, $\mathbf{d_p}$	0.00	ft
b. Backfill Material (Trench Rock) Thickness, $\mathbf{l_b}$	3.00	ft
c. Sand Layer Thickness, $\mathbf{l_s}$	0.0	ft
d. Backfill Material Porosity, $\mathbf{n_b}$	0.35	
e. Sand Porosity, $\mathbf{n_s}$	0.40	
f. Total Effective Storage Depth, $\mathbf{d_t}$	1.05	ft
4. BMP Area Requirements		
a. Reservoir Fill Time, **T**	2	hrs
b. Min. Surface Area excluding pretreatment, $\mathbf{A_{BMP}}$	710	sq-ft

BMP Sizing Worksheet: Infiltration Trench

Worksheet No. 2 of 6

Project: AES Solar Site - West Oahu **Date:** 1/30/2020

1. Water Quality Volume		
a. BMP Tributary Drainage Area, **A**	4.8	ac
b. % Impervious Area, **I**	8	%
c. Water Quality Design Storm Depth, **P**	1.0	in
d. Volumetric Runoff Coefficient, **C**	0.122	
e. Water Quality Volume, **WQV**	2,113	cu-ft
2. Maximum Storage Depth		
a. Soil Infiltration Rate, **k** (0.5 min)	11.7	in/hr
b. Infiltration Rate Safety Factor, **Fs** (2 min)	2	
c. Drawdown Time, **t**	48	hrs
d. Max. Storage Depth, $\mathbf{d_{max}}$	23.4	ft
3. Design Storage Depths		
a. Ponding Depth, $\mathbf{d_p}$	0.00	ft
b. Backfill Material (Trench Rock) Thickness, $\mathbf{l_b}$	3.00	ft
c. Sand Layer Thickness, $\mathbf{l_s}$	0.0	ft
d. Backfill Material Porosity, $\mathbf{n_b}$	0.35	
e. Sand Porosity, $\mathbf{n_s}$	0.40	
f. Total Effective Storage Depth, $\mathbf{d_t}$	1.05	ft
4. BMP Area Requirements		
a. Reservoir Fill Time, **T**	2	hrs
b. Min. Surface Area excluding pretreatment, $\mathbf{A_{BMP}}$	1,043	sq-ft

BMP Sizing Worksheet: Infiltration Trench

Worksheet No. 3 of 6

Project: AES Solar Site - West Oahu **Date:** 1/30/2020

1. Water Quality Volume		
a. BMP Tributary Drainage Area, **A**	1.0	ac
b. % Impervious Area, **I**	19.3	%
c. Water Quality Design Storm Depth, **P**	1.0	in
d. Volumetric Runoff Coefficient, **C**	0.2237	
e. Water Quality Volume, **WQV**	830	cu-ft
2. Maximum Storage Depth		
a. Soil Infiltration Rate, **k** (0.5 min)	11.7	in/hr
b. Infiltration Rate Safety Factor, **Fs** (2 min)	2	
c. Drawdown Time, **t**	48	hrs
d. Max. Storage Depth, $\mathbf{d_{max}}$	23.4	ft
3. Design Storage Depths		
a. Ponding Depth, $\mathbf{d_p}$	0.00	ft
b. Backfill Material (Trench Rock) Thickness, $\mathbf{l_b}$	3.00	ft
c. Sand Layer Thickness, $\mathbf{l_s}$	0.0	ft
d. Backfill Material Porosity, $\mathbf{n_b}$	0.35	
e. Sand Porosity, $\mathbf{n_s}$	0.40	
f. Total Effective Storage Depth, $\mathbf{d_t}$	1.05	ft
4. BMP Area Requirements		
a. Reservoir Fill Time, **T**	2	hrs
b. Min. Surface Area excluding pretreatment, $\mathbf{A_{BMP}}$	410	sq-ft

BMP Sizing Worksheet: Infiltration Trench

Worksheet No. 4 of 6

Project: AES Solar Site - West Oahu **Date:** 1/30/2020

1. Water Quality Volume		
a. BMP Tributary Drainage Area, **A**	2.8	ac
b. % Impervious Area, **I**	8.4	%
c. Water Quality Design Storm Depth, **P**	1.0	in
d. Volumetric Runoff Coefficient, **C**	0.1256	
e. Water Quality Volume, **WQV**	1,296	cu-ft
2. Maximum Storage Depth		
a. Soil Infiltration Rate, **k** (0.5 min)	11.7	in/hr
b. Infiltration Rate Safety Factor, **Fs** (2 min)	2	
c. Drawdown Time, **t**	48	hrs
d. Max. Storage Depth, $\mathbf{d_{max}}$	23.4	ft
3. Design Storage Depths		
a. Ponding Depth, $\mathbf{d_p}$	0.00	ft
b. Backfill Material (Trench Rock) Thickness, $\mathbf{l_b}$	3.00	ft
c. Sand Layer Thickness, $\mathbf{l_s}$	0.0	ft
d. Backfill Material Porosity, $\mathbf{n_b}$	0.35	
e. Sand Porosity, $\mathbf{n_s}$	0.40	
f. Total Effective Storage Depth, $\mathbf{d_t}$	1.05	ft
4. BMP Area Requirements		
a. Reservoir Fill Time, **T**	2	hrs
b. Min. Surface Area excluding pretreatment, $\mathbf{A_{BMP}}$	640	sq-ft

BMP Sizing Worksheet: Infiltration Trench

Worksheet No. 5 of 6

Project: AES Solar Site - West Oahu **Date:** 1/30/2020

1. Water Quality Volume		
a. BMP Tributary Drainage Area, **A**	23.3	ac
b. % Impervious Area, **I**	2.9	%
c. Water Quality Design Storm Depth, **P**	1.0	in
d. Volumetric Runoff Coefficient, **C**	0.0761	
e. Water Quality Volume, **WQV**	6,446	cu-ft
2. Maximum Storage Depth		
a. Soil Infiltration Rate, **k** (0.5 min)	11.7	in/hr
b. Infiltration Rate Safety Factor, **Fs** (2 min)	2	
c. Drawdown Time, **t**	48	hrs
d. Max. Storage Depth, $\mathbf{d_{max}}$	23.4	ft
3. Design Storage Depths		
a. Ponding Depth, $\mathbf{d_p}$	0.00	ft
b. Backfill Material (Trench Rock) Thickness, $\mathbf{l_b}$	3.00	ft
c. Sand Layer Thickness, $\mathbf{l_s}$	0.0	ft
d. Backfill Material Porosity, $\mathbf{n_b}$	0.35	
e. Sand Porosity, $\mathbf{n_s}$	0.40	
f. Total Effective Storage Depth, $\mathbf{d_t}$	1.05	ft
4. BMP Area Requirements		
a. Reservoir Fill Time, **T**	2	hrs
b. Min. Surface Area excluding pretreatment, $\mathbf{A_{BMP}}$	3,183	sq-ft

BMP Sizing Worksheet: Infiltration Trench

Worksheet No. 6 of 6

Project: AES Solar Site - West Oahu **Date:** 1/30/2020

1. Water Quality Volume		
a. BMP Tributary Drainage Area, **A**	0.6	ac
b. % Impervious Area, **I**	28.3	%
c. Water Quality Design Storm Depth, **P**	1.0	in
d. Volumetric Runoff Coefficient, **C**	0.3047	
e. Water Quality Volume, **WQV**	632	cu-ft
2. Maximum Storage Depth		
a. Soil Infiltration Rate, **k** (0.5 min)	11.7	in/hr
b. Infiltration Rate Safety Factor, **Fs** (2 min)	2	
c. Drawdown Time, **t**	48	hrs
d. Max. Storage Depth, $\mathbf{d_{max}}$	23.4	ft
3. Design Storage Depths		
a. Ponding Depth, $\mathbf{d_p}$	0.00	ft
b. Backfill Material (Trench Rock) Thickness, $\mathbf{l_b}$	3.00	ft
c. Sand Layer Thickness, $\mathbf{l_s}$	0.0	ft
d. Backfill Material Porosity, $\mathbf{n_b}$	0.35	
e. Sand Porosity, $\mathbf{n_s}$	0.40	
f. Total Effective Storage Depth, $\mathbf{d_t}$	1.05	ft
4. BMP Area Requirements		
a. Reservoir Fill Time, **T**	2	hrs
b. Min. Surface Area excluding pretreatment, $\mathbf{A_{BMP}}$	312	sq-ft

Attachment O
U.S. Fish and Wildlife Service and State of Hawai‘i Department of Land and Natural Resources Division of Forestry and Wildlife Consultation Letters

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122
Honolulu, Hawai‘i 96850

In Reply Refer To:
01EPIF00-2019-TA-460

September 3, 2019

Mr. Nick Molinari
AES Distributed Energy
282 Century Place
Louisville, Colorado 80027

Subject: Response to your Request for Technical Assistance Regarding the Proposed West O‘ahu Solar Plus Storage Project

Dear Mr. Molinari,

Thank you for your recent correspondence requesting technical assistance on species biology, habitat, or life requisite requirements. The Pacific Islands Fish and Wildlife Office (PIFWO) of the U.S. Fish and Wildlife Service (Service) appreciates your efforts to avoid or minimize effects to protected species associated with your proposed actions. We provide the following information for your consideration under the authorities of the Endangered Species Act (ESA) of 1973 (16 U.S.C. 1531 *et seq*.), as amended.

Due to significant workload constraints, PIFWO is currently unable to specifically address your information request. The table below lists the protected species most likely to be encountered by projects implemented within the Hawaiian Islands. Based on your project location and description, we have noted the species most likely to occur within the vicinity of the project area, in the '**Occurs In or Near Project Area'** column. Please note this list is not comprehensive and should only be used for general guidance. We have added to the PIFWO website, located at https://www.fws.gov/pacificislands/promo.cfm?id=177175840 recommended conservation measures intended to avoid or minimize adverse effects to these federally protected species and best management practices to minimize and avoid sedimentation and erosion impacts to water quality.

If you are representing a federal action agency, please use the official species list on our web-site for your section 7 consultation. You can find out if your project occurs in or near designated critical habitat here: https://ecos.fws.gov/ipac/.

Under section 7 of the ESA, it is the Federal agency's (or their non-Federal designee) responsibility to make the determination of whether or not the proposed project "may affect" federally listed species or designated critical habitat. A "may affect, not likely to adversely affect" determination is appropriate when effects to federally listed species are expected to be discountable (*i.e*., unlikely to occur), insignificant (minimal in size), or completely beneficial.

This conclusion requires written concurrence from the Service. If a "may affect, likely to adversely affect" determination is made, then the Federal agency must initiate formal consultation with the Service. Projects that are determined to have "no effect" on federally listed species and/or critical habitat do not require additional coordination or consultation.

Implementing the avoidance, minimization, or conservation measures for the species that may occur in your project area will normally enable you to make a "may affect, not likely to adversely affect" determination for your project. If it is determined that the proposed project may affect federally listed species, we recommend you contact our office early in the planning process so that we may assist you with the ESA compliance. If the proposed project is funded, authorized, or permitted by a Federal agency, then that agency should consult with us pursuant to section 7(a)(2) of the ESA. If no Federal agency is involved with the proposed project, the applicant should apply for an incidental take permit under section 10(a)(1)(B) of the ESA. A section 10 permit application must include a habitat conservation plan that identifies the effects of the action on listed species and their habitats, and defines measures to minimize and mitigate those adverse effects.

We appreciate your efforts to conserve endangered species. We regret that we cannot provide you with more specific protected species information for your project site. If you have questions that are not answered by the information on our website, you can contact PIFWO at (808) 792-9400 and ask to speak to the lead biologist for the island where your project is located.

Sincerely,

Island Team Manager
Pacific Islands Fish and Wildlife Office

cc: Ms. Lisa Kettley and Ms. Tiffany Agostini, Tetra Tech, Inc.

The table below lists the protected species most likely to be encountered by projects implemented within the Hawaiian Islands. For your guidance, we've marked species that may occur in the vicinity of your project, this list is not comprehensive and should only be used for general guidance.

Scientific Name	**Common Name / Hawaiian Name**	**Federal Status**	**May Occur In Project Area**
Mammals			
Lasiurus cinereus semotus	Hawaiian hoary bat/ ʻōpeʻapeʻa	E	☒
Reptiles			
Chelonia mydas	Green sea turtle/honu - Central North Pacific DPS	T	☐
Erectmochelys imbricata	Hawksbill sea turtle/ Honu ʻea	E	☐
Birds			
Anas wyvilliana	Hawaiian duck/ koloa	E	☐
Branta sandvicensis	Hawaiian goose/ nēnē	E	☐
Fulica alai	Hawaiian coot/ ʻalae kea	E	☐
Gallinula galeata sandvicensis	Hawaiian gallinule/ ʻalae ʻula	E	☐
Himantopus mexicanus knudseni	Hawaiian stilt/ Aeʻo	E	☐
Oceanodroma castro	Band-rumped storm-petrel/ ʻakēʻakē	E	☒
Pterodroma sandwichensis	Hawaiian petrel/ ʻuaʻu	E	☒
Puffinus auricularis newelli	Newell's shearwater/ ʻaʻo	T	☒
Ardenna pacificus	Wedge-tailed Shearwater/ ʻuaʻu kani	MBTA	☐
Gygis alba	White Tern/ manu-o-kū	MBTA	☐
Buteo solitarius	Hawaiian hawk/ ʻio	E	☐
Insects			
Manduca blackburni	Blackburn's sphinx moth	E	☐
Megalagrion pacificum	Pacific Hawaiian Damselfly	E	☐
M. xanthomelas	Orangeblack Hawaiian Damselfly	E	☐
M. nigrohamatum nigrolineatum	Blackline Hawaiian Damselfly	E	☐

Plants				
Scientific Name	**Common Name or Hawaiian Name**	**Federal Status**	**Locations**	**May Occur In Project Area**
Abutilon menziesii	Koʻoloaʻula	E	O, L, M, H	☐
Achyranthes splendens var. *rotundata*	ʻEwa hinahina	E	O	☐
Bonamia menziesii	No common name	E	K, O, L, M, H	☐
Canavalia pubescens	ʻĀwikiwiki	E	Ni, K, L, M	☐
Colubrina oppositifolia	Kauila	E	O, M, H	☐
Cyperus trachysanthos	Puʻukaʻa	E	K, O	☐
Gouania hillebrandii	No common name	E	Mo, M	☐
Hibiscus brackenridgei	Maʻo hau hele	E	O, Mo, L, M, H	☐
Ischaemum byrone	Hilo ischaemum	E	K, O, Mo, M, H	☐
Isodendrion pyrifolium	Wahine noho kula	E	O, H	☐
Marsilea villosa	ʻIhiʻihi	E	Ni, O, Mo	☐
Mezoneuron kavaiense	Uhiuhi	E	O, H	☐
Nothocestrum breviflorum	ʻAiea	E	H	☐
Panicum fauriei var. *carteri*	Carter's panicgrass	E	Molokini Islet (O), Mo	☐
Panicum niihauense	Lauʻehu	E	K	☐
Peucedanum sandwicense	Makou	E	K, O, Mo, M	☐
Pleomele (Chrysodracon) hawaiiensis	Halapepe	E	H	☐
Portulaca sclerocarpa	ʻIhi	E	L, H	☐
Portulaca villosa	ʻIhi	E	Le, Ka, Ni, O, Mo, M, L, H, Nihoa	☐
Pritchardia affinis (maideniana)	Loulu	E	H	☐
Pseudognaphalium sandwicensium var. *molokaiense*	ʻEnaʻena	E	Mo, M	☐
Scaevola coriacea	Dwarf naupaka	E	Mo, M	☐
Schenkia (*Centaurium*) *sebaeoides*	ʻĀwiwi	E	K, O, Mo, L, M	☐
Sesbania tomentosa	ʻŌhai	E	Ni, Ka, K, O, Mo, M, L, H, Necker, Nihoa	☐
Tetramolopium rockii	No common name	T	Mo	☐
Vigna o-wahuensis	No common name	E	Mo, M, L, H, Ka	☐

Location key: O=Oʻahu, K=Kauaʻi, M=Maui, H=Hawaiʻi Island, L=Lānaʻi, Mo=Molokaʻi, Ka=Kahoʻolawe, Ni=Niʻihau, Le=Lehua

DAVID Y. IGE
GOVERNOR OF HAWAII

SUZANNE D. CASE
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

ROBERT K. MASUDA
FIRST DEPUTY

M. KALEO MANUEL
DEPUTY DIRECTOR - WATER

AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
BUREAU OF CONVEYANCES
COMMISSION ON WATER RESOURCE MANAGEMENT
CONSERVATION AND COASTAL LANDS
CONSERVATION AND RESOURCES ENFORCEMENT
ENGINEERING
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
KAHOOLAWE ISLAND RESERVE COMMISSION
LAND
STATE PARKS

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF FORESTRY AND WILDLIFE
1151 PUNCHBOWL STREET, ROOM 325
HONOLULU, HAWAII 96813

JUN 2 8 2019

Mr. Nick Molinari
AES Distributed Energy, Inc.
4875 Pearl East Circle, Suite 200
Boulder, CO 80301

Log No. 19803

Dear Mr. Molinari:

The Department of Land and Natural Resources, Division of Forestry and Wildlife (DOFAW) has received your inquiry regarding Hawaii Revised Statutes Chapter 195D consultation for the proposed AES West O'ahu Solar Plus Storage Project near Kapolei in the 'Ewa District on the island of O'ahu, Hawai'i, TMK: (1) 9-2-002:007. Proposed work would include construction and operation of a 12.5 megawatt solar photovoltaic system on an approximately 80 acre parcel of land commonly known as the University of Hawai'i West O'ahu Mauka property.

We appreciate the inclusion of mitigation measures in the submitted Biological Report intended to avoid construction and operational impacts to State listed species. DOFAW provides the following additional comments on the potential of the proposed work to affect listed species in the vicinity of the project area in support of your request for information.

The State endangered Hawaiian Short-eared Owl or Pueo (*Asio flammeus sandwichensis*) is known to occur in the project site vicinity. Pueo are a crepuscular species, most active during dawn and dusk twilights. DOFAW recommends twilight pre-construction surveys by a qualified biologist prior to clearing vegetation. If Pueo nests are present, a buffer zone should be established in which no clearing occurs until nesting ceases, and DOFAW staff should be notified.

We note that artificial lighting can adversely impact seabirds that may pass through the area at night by causing disorientation. This disorientation can result in collision with manmade artifacts or grounding of birds. For nighttime lighting that might be required, DOFAW recommends that all lights be fully shielded and directed to avoid reflecting off the panels to minimize impacts. Solar panels may also reflect moonlight during moonlit nights that may attract and disorient seabirds; monitoring during moon phases should be considered to assess if impacts are occurring. Nighttime work that requires outdoor lighting should be avoided during the seabird fledging season from September 15 through December 15. This is the period when young seabirds take their maiden voyage to the open sea.

Studies have shown that solar power facilities on the mainland have been linked with avian mortality of a variety of bird species including waterbirds and raptors. As aforementioned, the project area is on open habitat where the Pueo may transit or reside near. In addition to pre-

construction surveys, you should consider implementing avian mortality avoidance measures during design and conducting surveys and monitoring during operation to assess the impacts of the project on listed species.

We appreciate your efforts to work with our office for the conservation of our native species. Should the scope of the project change significantly, or should it become apparent that threatened or endangered species may be impacted, please contact our staff as soon as possible. If you have any questions, please contact Jim Cogswell, Wildlife Program Manager at (808) 587-4187 or James.M.Cogswell@hawaii.gov.

Sincerely,

DAVID G. SMITH
Administrator

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122
Honolulu, Hawai‘i 96850

In Reply Refer To:
01EPIF00-2020-TA-0249

April 22, 2020

Mr. Raymond Young
City & County of Honolulu Dept. of Planning and Permitting
650 South King Street, 7th Floor,
Honolulu, Hawai‘i 96813

Subject: Technical Assistance for the Proposed West O‘ahu Solar Plus Storage Project Honouliuli, O‘ahu

Dear Mr. Young:

The U.S. Fish and Wildlife Service (Service) received your correspondence on April 8, 2020, requesting our comments for the proposed West O‘ahu Solar Plus Storage Project in Honouliuli, on the island of O‘ahu. The work involves the construction and operation of a 12.5-megawatt (MW) solar photovoltaic and 50-MW-hour (MWh) battery energy storage system facility on approximately 97 acres of land located in Honouliuli, about 3 miles northeast of Kapolei, within Tax Map Key (TMK): (1) 9-2-002:007. The solar energy system will contribute towards Hawai‘i’s goal of generating 100% of the state’s energy from renewable resources. The power generated by the project would be sold to Hawaiian Electric under a 25-year power purchase agreement. At the end of the Project’s operational life, the facilities would be decommissioned and the project area would be returned to substantially the same condition as existed prior to project development.

Our response is in accordance with section 7 of the Endangered Species Act of 1973 (ESA), as amended (16 U.S.C. 1531 et seq.). We have reviewed the information you provided and pertinent information in our files, as it pertains to federally listed species and designated critical habitat. Our data indicate the following federally listed species may occur or transit through the vicinity of the proposed project area: the federally endangered Hawaiian hoary bat *(Lasiurus cinereus semotus)*; Hawaiian stilt (*Himantopus mexicanus knudseni*), Hawaiian gallinule (*Gallinula galeata sandvicensis*), Hawaiian coot (*Fulica alai*), and endangered Hawaiian duck (*Anas wyvilliana*) (hereafter collectively referred to as Hawaiian waterbirds); Hawaiian petrel (*Pterodroma sandwichensis*), the Hawaii Distinct Population Segment (DPS) of band-rumped storm petrel (*Oceanodroma castro*), and the federally threatened Newell’s shearwater (*Puffinus auricularis newelli*) (hereafter collectively referred to as Hawaiian seabirds) have the potential to be in or fly through the vicinity of the project area. There is no designated critical habitat within

the project's action area. The Service offers you the below species-specific avoidance and minimization measures that may be applicable to assist with planning of your proposed project.

Hawaiian hoary bat
The Hawaiian hoary bat roosts in both exotic and native woody vegetation across all islands and will leave young unattended in trees and shrubs when they forage. If trees or shrubs 15 feet (ft.) or taller are cleared during the pupping season, there is a risk that young bats could inadvertently be harmed or killed since they are too young to fly or may not move away. Additionally, Hawaiian hoary bats forage for insects from as low as three feet to higher than 500 ft. above the ground and can become entangled in barbed wire used for fencing.

To avoid and minimize impacts to the endangered Hawaiian hoary bat we recommend incorporating the following applicable measures into your project description:

- Do not disturb, remove, or trim woody plants greater than 15 ft. tall during the bat birthing and pup-rearing season (June 1 through September 15).
- Do not use barbed wire for fencing.

Hawaiian Waterbirds
Listed Hawaiian waterbirds are found in fresh and brackish-water marshes and natural or man-made ponds. Hawaiian stilts may also be found wherever ephemeral or persistent standing water may occur.

To avoid and minimize potential project impacts to the Hawaiian waterbirds we recommend you incorporate the following applicable measures into your project description.

- In areas where waterbirds are known to be present, post and implement reduced speed limits, and inform project personnel and contractors about the presence of endangered species on-site.
- If water resources are located within or adjacent to the project site, incorporate applicable best management practices regarding work in aquatic environments into the project design (see enclosure).
- Have a biological monitor that is familiar with the species' biology conduct nest surveys where appropriate habitat occurs within the vicinity of the proposed project site prior to project initiation. Repeat surveys again within three days of project initiation and after any subsequent delay of work of three or more days (during which the birds may attempt to nest). If a nest or active brood is found:
    - Contact the Service within 48 hours for further guidance.
    - Establish and maintain a 100-foot buffer around all active nests and/or broods until the chicks/ducklings have fledged. Do not conduct potentially disruptive activities or habitat alteration within this buffer.
    - Have a biological monitor that is familiar with the species' biology present on the project site during all construction or earth moving activities until the

chicks/ducklings fledge to ensure that Hawaiian waterbirds and nests are not adversely impacted.

Hawaiian Seabirds

Hawaiian seabirds may traverse the project area at night during the breeding, nesting and fledging seasons (March 1 to December 15). Outdoor lighting could result in seabird disorientation, fallout, and injury or mortality. Seabirds are attracted to lights and after circling the lights they may become exhausted and collide with nearby wires, buildings, or other structures or they may land on the ground. Downed seabirds are subject to increased mortality due to collision with automobiles, starvation, and predation by dogs, cats, and other predators. Young birds (fledglings) traversing the project area between September 15 and December 15, in their first flights from their mountain nests to the sea, are particularly vulnerable.

To avoid and minimize potential project impacts to Hawaiian seabirds we recommend you incorporate the following applicable measures into your project description:

- Fully shield all outdoor lights so the bulb can only be seen from below bulb height and only use when necessary.
- Install automatic motion sensor switches and controls on all outdoor lights or turn off lights when human activity is not occurring in the lighted area.
- Avoid nighttime construction during the seabird fledging period, September 15 through December 15.

Implementing the avoidance, minimization, or conservation measures for the species that may occur in your project area will normally enable you to make a "may affect, not likely to adversely affect" determination for your project. If it is determined that the proposed project may affect federally listed species, we recommend you contact our office early in the planning process so that we may assist you with the ESA compliance. If the proposed project is funded, authorized, or permitted by a Federal agency, then that agency should consult with us pursuant to section 7(a)(2) of the ESA. If no Federal agency is involved with the proposed project, the applicant should apply for an incidental take permit under section 10(a)(1)(B) of the ESA. A section 10 permit application must include a habitat conservation plan that identifies the effects of the action on listed species and their habitats, and defines measures to minimize and mitigate those adverse effects.

Thank you for participating with us in the protection of our endangered species. If you have any further questions or concerns regarding this consultation, please contact Becca Frager, Endangered Species Biologist, 808-792-9462, e-mail: rebecca_frager@fws.gov. When referring to this project, please include this reference number: 01EPIF00-2020-TA-0249.

Sincerely,

Island Team Manager
Oahu, Kauai, Northwestern Hawaiian Islands, and American Samoa

Attachment P
Glare Study and FAA Determination of No Hazard to Air Navigation

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
10101 Hillwood Parkway
Fort Worth, TX 76177

Aeronautical Study No.
2020-AWP-5926-OE

Issued Date: 06/09/2020

Nick Molinari
AES Distributed Energy
4875 Pearl East Circle
#200
Boulder, CO 80301

**** DETERMINATION OF NO HAZARD TO AIR NAVIGATION ****

The Federal Aviation Administration has conducted an aeronautical study under the provisions of 49 U.S.C., Section 44718 and if applicable Title 14 of the Code of Federal Regulations, part 77, concerning:

Structure:	Solar Panel Oahu N
Location:	O'ahu, HI
Latitude:	21-22-41.87N NAD 83
Longitude:	158-03-43.75W
Heights:	419 feet site elevation (SE)
	11 feet above ground level (AGL)
	430 feet above mean sea level (AMSL)

This aeronautical study revealed that the structure does not exceed obstruction standards and would not be a hazard to air navigation provided the following condition(s), if any, is(are) met:

Based on this evaluation, marking and lighting are not necessary for aviation safety. However, if marking/ lighting are accomplished on a voluntary basis, we recommend it be installed in accordance with FAA Advisory circular 70/7460-1 L Change 2.

This determination expires on 12/09/2021 unless:

(a) the construction is started (not necessarily completed) and FAA Form 7460-2, Notice of Actual Construction or Alteration, is received by this office.
(b) extended, revised, or terminated by the issuing office.
(c) the construction is subject to the licensing authority of the Federal Communications Commission (FCC) and an application for a construction permit has been filed, as required by the FCC, within 6 months of the date of this determination. In such case, the determination expires on the date prescribed by the FCC for completion of construction, or the date the FCC denies the application.

NOTE: REQUEST FOR EXTENSION OF THE EFFECTIVE PERIOD OF THIS DETERMINATION MUST BE E-FILED AT LEAST 15 DAYS PRIOR TO THE EXPIRATION DATE. AFTER RE-EVALUATION OF CURRENT OPERATIONS IN THE AREA OF THE STRUCTURE TO DETERMINE THAT NO

SIGNIFICANT AERONAUTICAL CHANGES HAVE OCCURRED, YOUR DETERMINATION MAY BE ELIGIBLE FOR ONE EXTENSION OF THE EFFECTIVE PERIOD.

This determination is based, in part, on the foregoing description which includes specific coordinates, heights, frequency(ies) and power. Any changes in coordinates, heights, and frequencies or use of greater power, except those frequencies specified in the Colo Void Clause Coalition; Antenna System Co-Location; Voluntary Best Practices, effective 21 Nov 2007, will void this determination. Any future construction or alteration, including increase to heights, power, or the addition of other transmitters, requires separate notice to the FAA.This determination includes all previously filed frequencies and power for this structure.

If construction or alteration is dismantled or destroyed, you must submit notice to the FAA within 5 days after the construction or alteration is dismantled or destroyed.

This determination does include temporary construction equipment such as cranes, derricks, etc., which may be used during actual construction of the structure. However, this equipment shall not exceed the overall heights as indicated above. Equipment which has a height greater than the studied structure requires separate notice to the FAA.

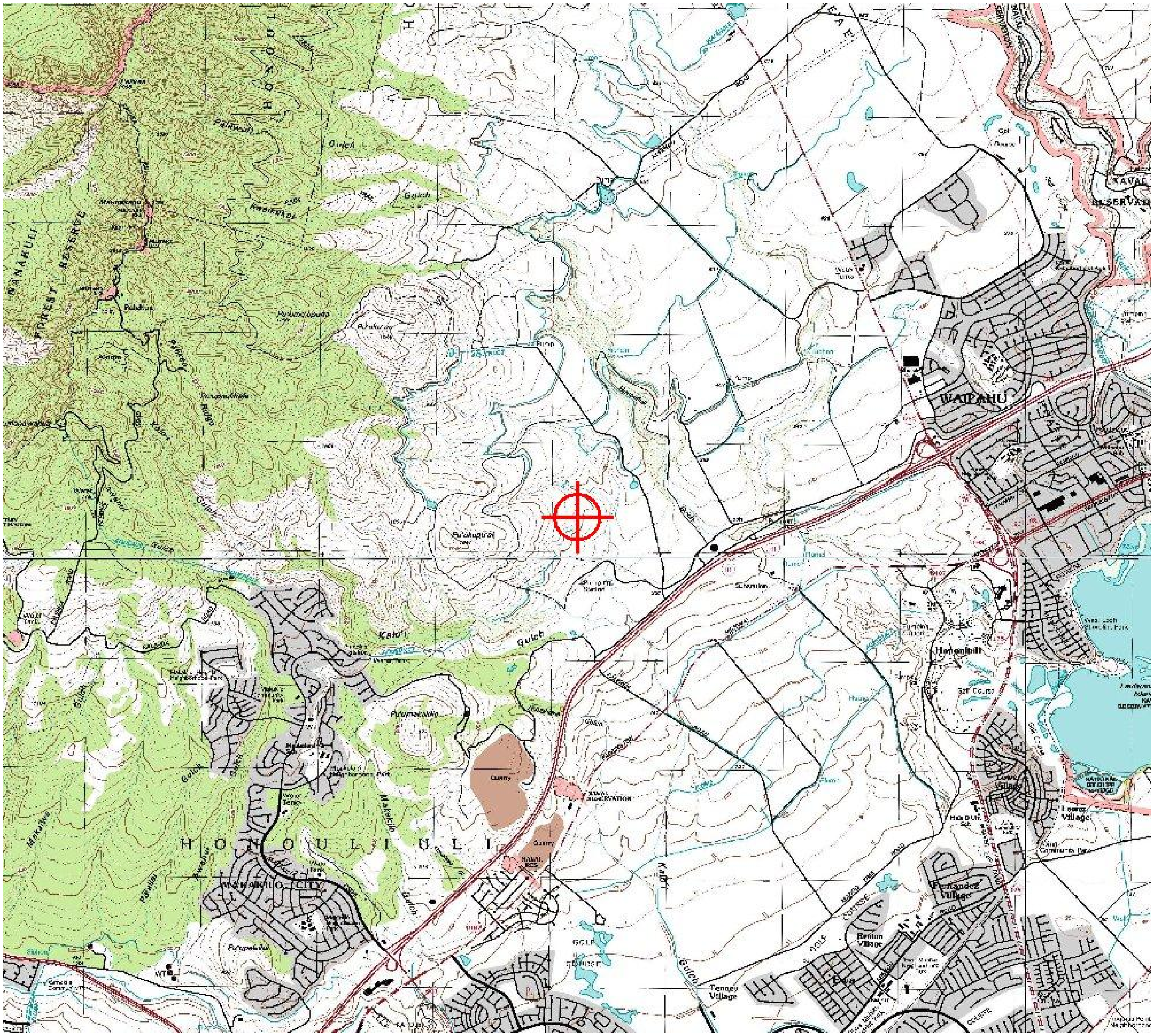
This determination concerns the effect of this structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

If we can be of further assistance, please contact our office at (907) 271-5863, or robert.van.haastert@faa.gov. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2020-AWP-5926-OE.

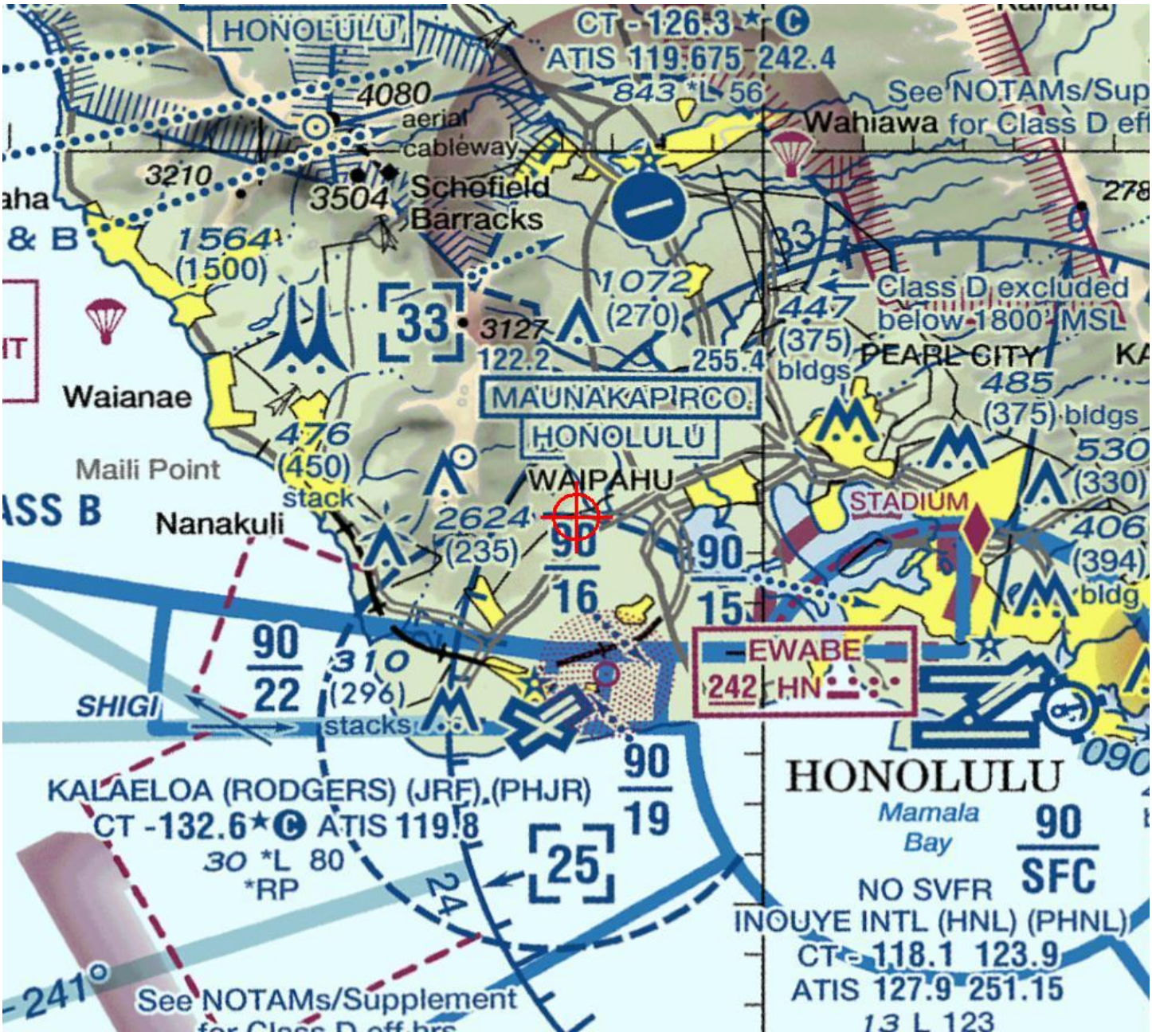
Signature Control No: 440873441-442419363 (DNE)
Robert van Haastert
Supervisor

Attachment(s)
Map(s)

TOPO Map for ASN 2020-AWP-5926-OE



Sectional Map for ASN 2020-AWP-5926-OE



Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
10101 Hillwood Parkway
Fort Worth, TX 76177

Aeronautical Study No.
2020-AWP-5927-OE

Issued Date: 06/09/2020

Nick Molinari
AES Distributed Energy
4875 Pearl East Circle
#200
Boulder, CO 80301

**** DETERMINATION OF NO HAZARD TO AIR NAVIGATION ****

The Federal Aviation Administration has conducted an aeronautical study under the provisions of 49 U.S.C., Section 44718 and if applicable Title 14 of the Code of Federal Regulations, part 77, concerning:

Structure:	Solar Panel Oahu E
Location:	O'ahu, HI
Latitude:	21-22-32.53N NAD 83
Longitude:	158-03-37.67W
Heights:	303 feet site elevation (SE) 11 feet above ground level (AGL) 314 feet above mean sea level (AMSL)

This aeronautical study revealed that the structure does not exceed obstruction standards and would not be a hazard to air navigation provided the following condition(s), if any, is(are) met:

Based on this evaluation, marking and lighting are not necessary for aviation safety. However, if marking/ lighting are accomplished on a voluntary basis, we recommend it be installed in accordance with FAA Advisory circular 70/7460-1 L Change 2.

This determination expires on 12/09/2021 unless:

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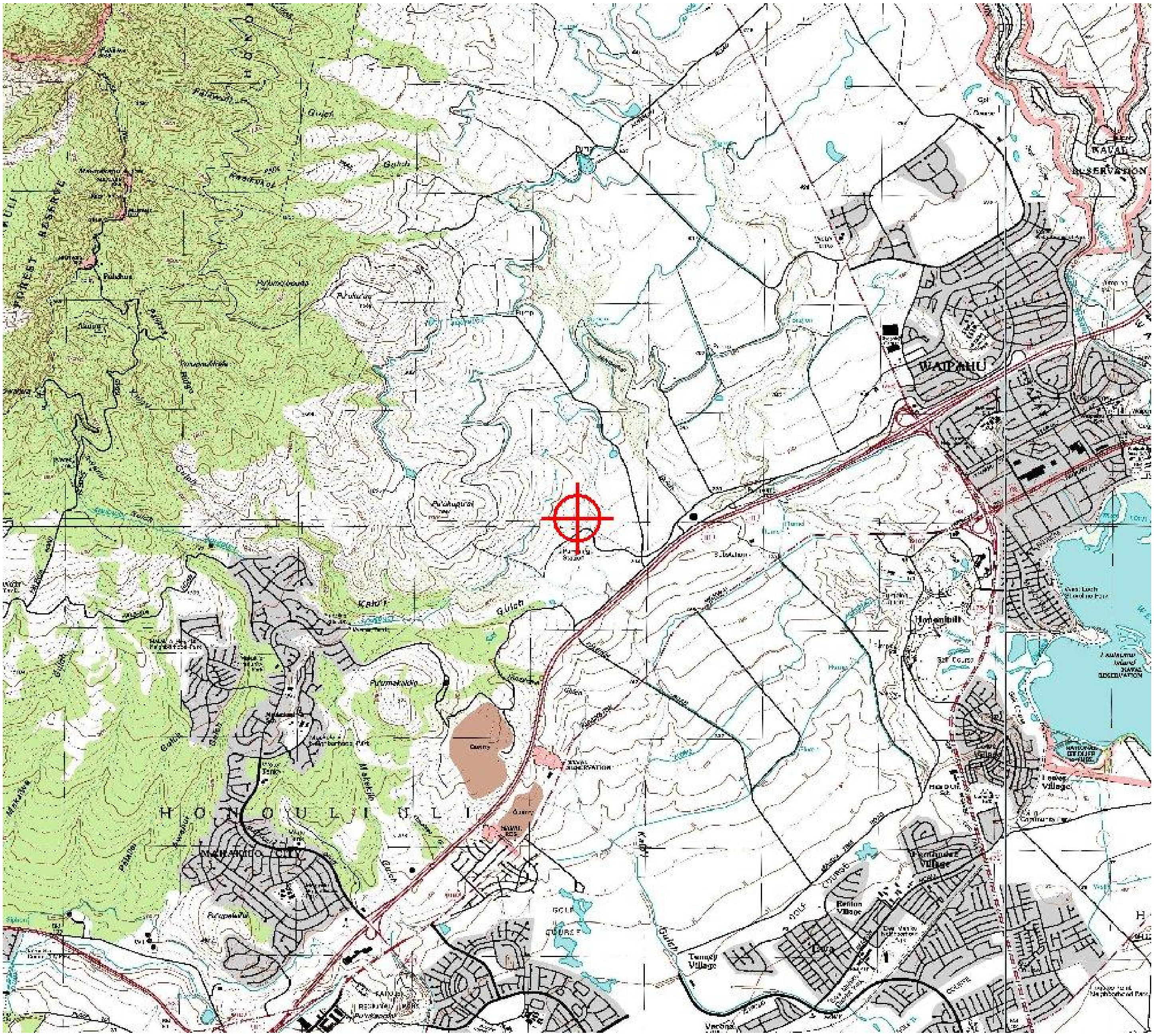
If we can be of further assistance, please contact our office at (907) 271-5863, or robert.van.haastert@faa.gov. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2020-AWP-5927-OE.

Signature Control No: 440873442-442419364 (DNE)
Robert van Haastert
Supervisor

Attachment(s)
Map(s)

TOPO Map for ASN 2020-AWP-5927-OE



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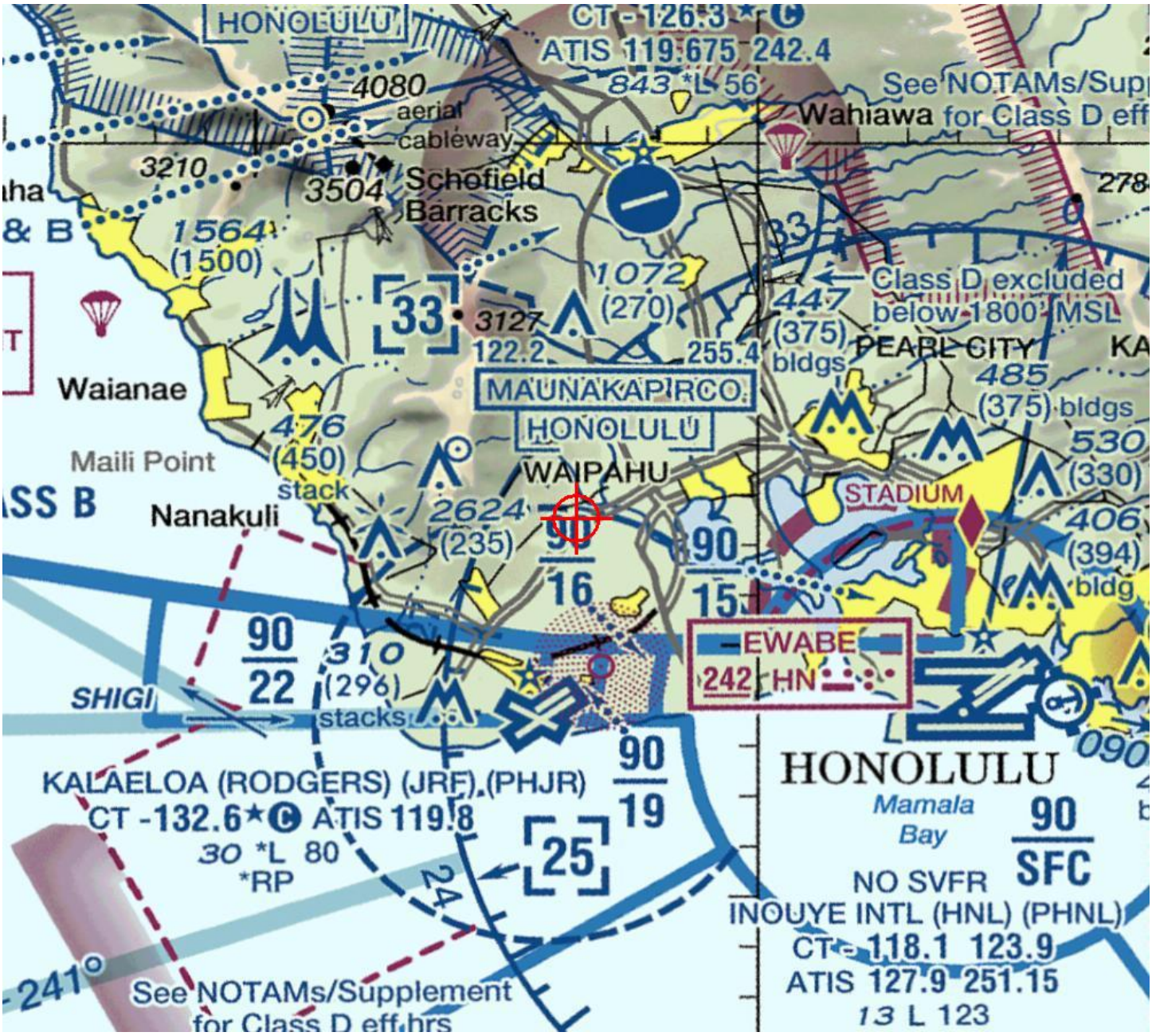

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Obstruction Evaluation Group
10101 Hillwood Parkway
Fort Worth, TX 76177

Aeronautical Study No.
2020-AWP-5928-OE

Issued Date: 06/09/2020

Nick Molinari
AES Distributed Energy
4875 Pearl East Circle
#200
Boulder, CO 80301

**** DETERMINATION OF NO HAZARD TO AIR NAVIGATION ****

The Federal Aviation Administration has conducted an aeronautical study under the provisions of 49 U.S.C., Section 44718 and if applicable Title 14 of the Code of Federal Regulations, part 77, concerning:

Structure:	Solar Panel Oahu Central-SE
Location:	O'ahu, HI
Latitude:	21-22-24.47N NAD 83
Longitude:	158-03-45.57W
Heights:	308 feet site elevation (SE) 11 feet above ground level (AGL) 319 feet above mean sea level (AMSL)

This aeronautical study revealed that the structure does not exceed obstruction standards and would not be a hazard to air navigation provided the following condition(s), if any, is(are) met:

Based on this evaluation, marking and lighting are not necessary for aviation safety. However, if marking/ lighting are accomplished on a voluntary basis, we recommend it be installed in accordance with FAA Advisory circular 70/7460-1 L Change 2.

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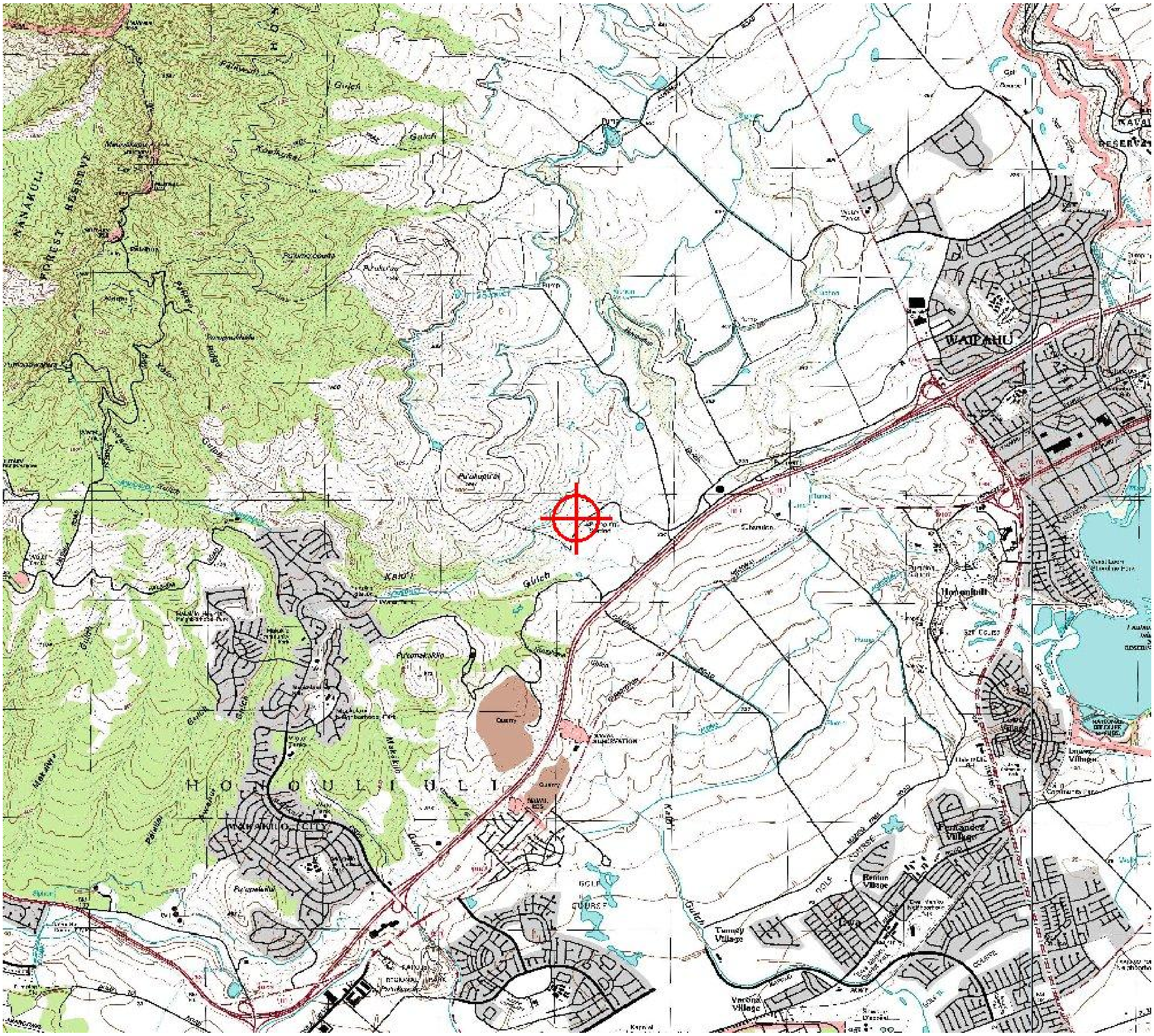
If we can be of further assistance, please contact our office at (907) 271-5863, or robert.van.haastert@faa.gov. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2020-AWP-5928-OE.

Signature Control No: 440873443-442419367 (DNE)
Robert van Haastert
Supervisor

Attachment(s)
Map(s)

TOPO Map for ASN 2020-AWP-5928-OE



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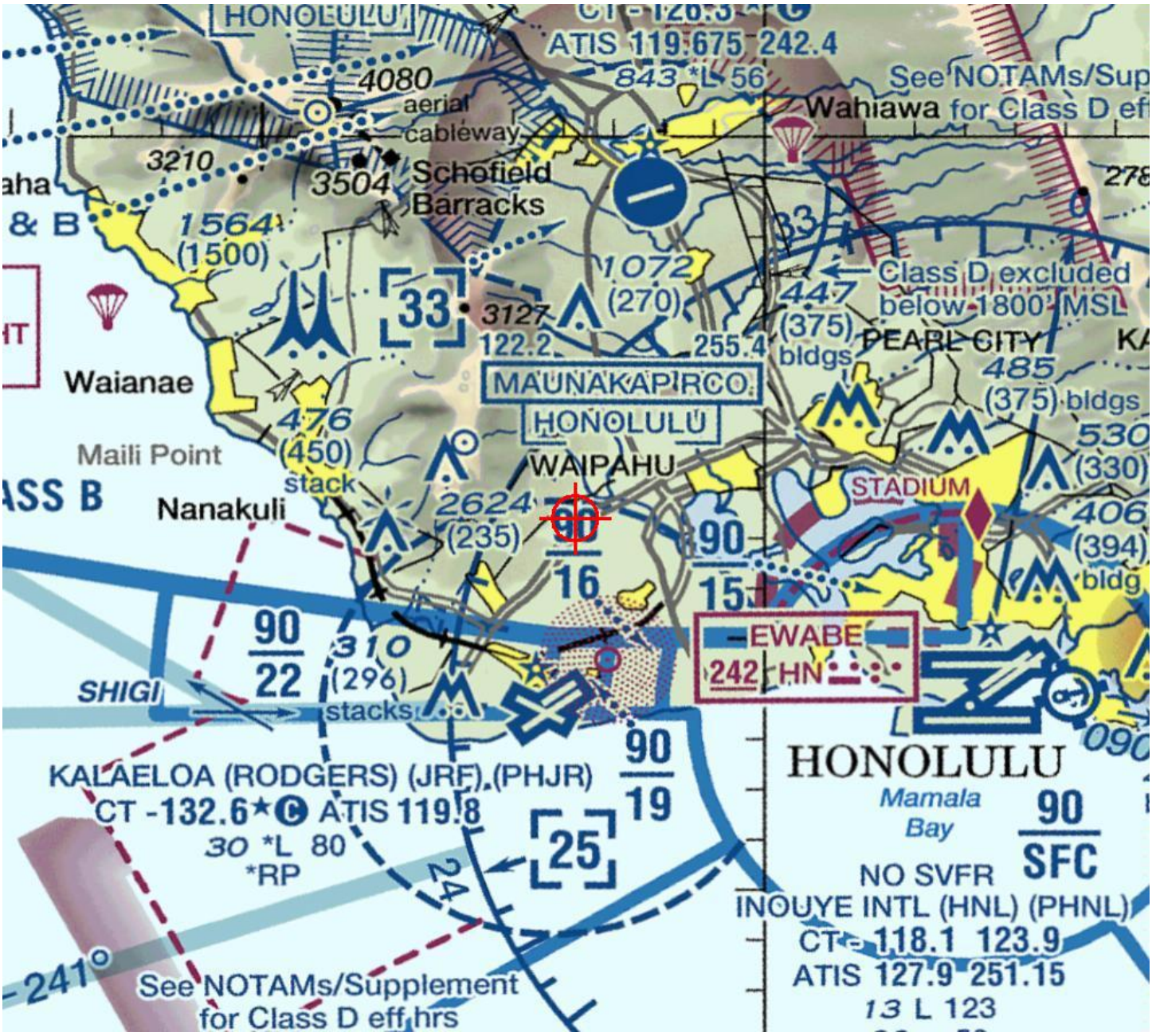

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10101 Hillwood Parkway
Fort Worth, TX 76177

Aeronautical Study No.
2020-AWP-5929-OE

Issued Date: 06/09/2020

Nick Molinari
AES Distributed Energy
4875 Pearl East Circle
#200
Boulder, CO 80301

**** DETERMINATION OF NO HAZARD TO AIR NAVIGATION ****

The Federal Aviation Administration has conducted an aeronautical study under the provisions of 49 U.S.C., Section 44718 and if applicable Title 14 of the Code of Federal Regulations, part 77, concerning:

Structure:	Solar Panel Oahu S
Location:	O'ahu, HI
Latitude:	21-22-16.45N NAD 83
Longitude:	158-03-49.78W
Heights:	280 feet site elevation (SE)
	11 feet above ground level (AGL)
	291 feet above mean sea level (AMSL)

This aeronautical study revealed that the structure does not exceed obstruction standards and would not be a hazard to air navigation provided the following condition(s), if any, is(are) met:

Based on this evaluation, marking and lighting are not necessary for aviation safety. However, if marking/ lighting are accomplished on a voluntary basis, we recommend it be installed in accordance with FAA Advisory circular 70/7460-1 L Change 2.

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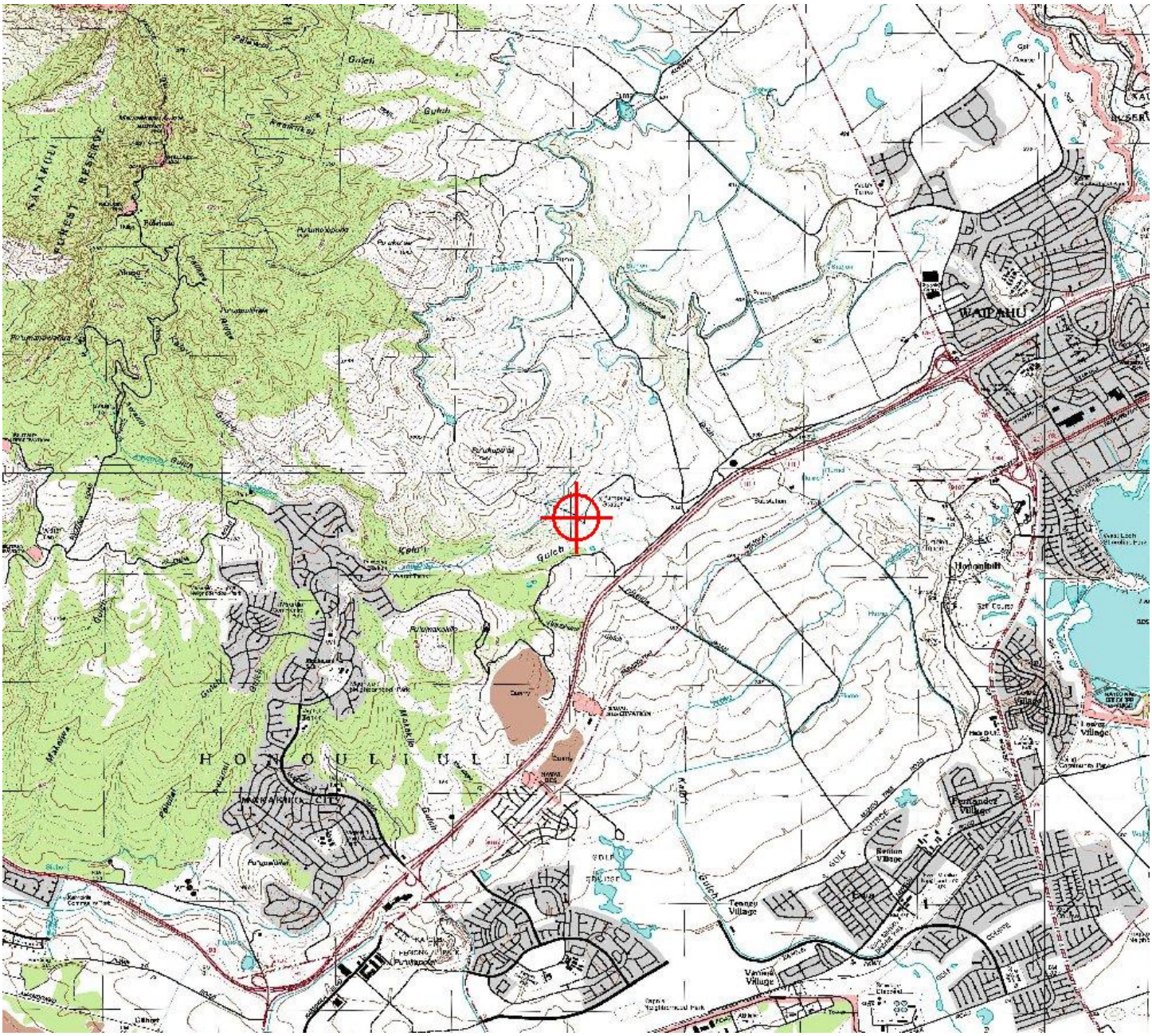
Signature Control No: 440873444-442419365 (DNE)
Robert van Haastert
Supervisor

Attachment(s)
Map(s)

TOPO Map for ASN 2020-AWP-5929-OE



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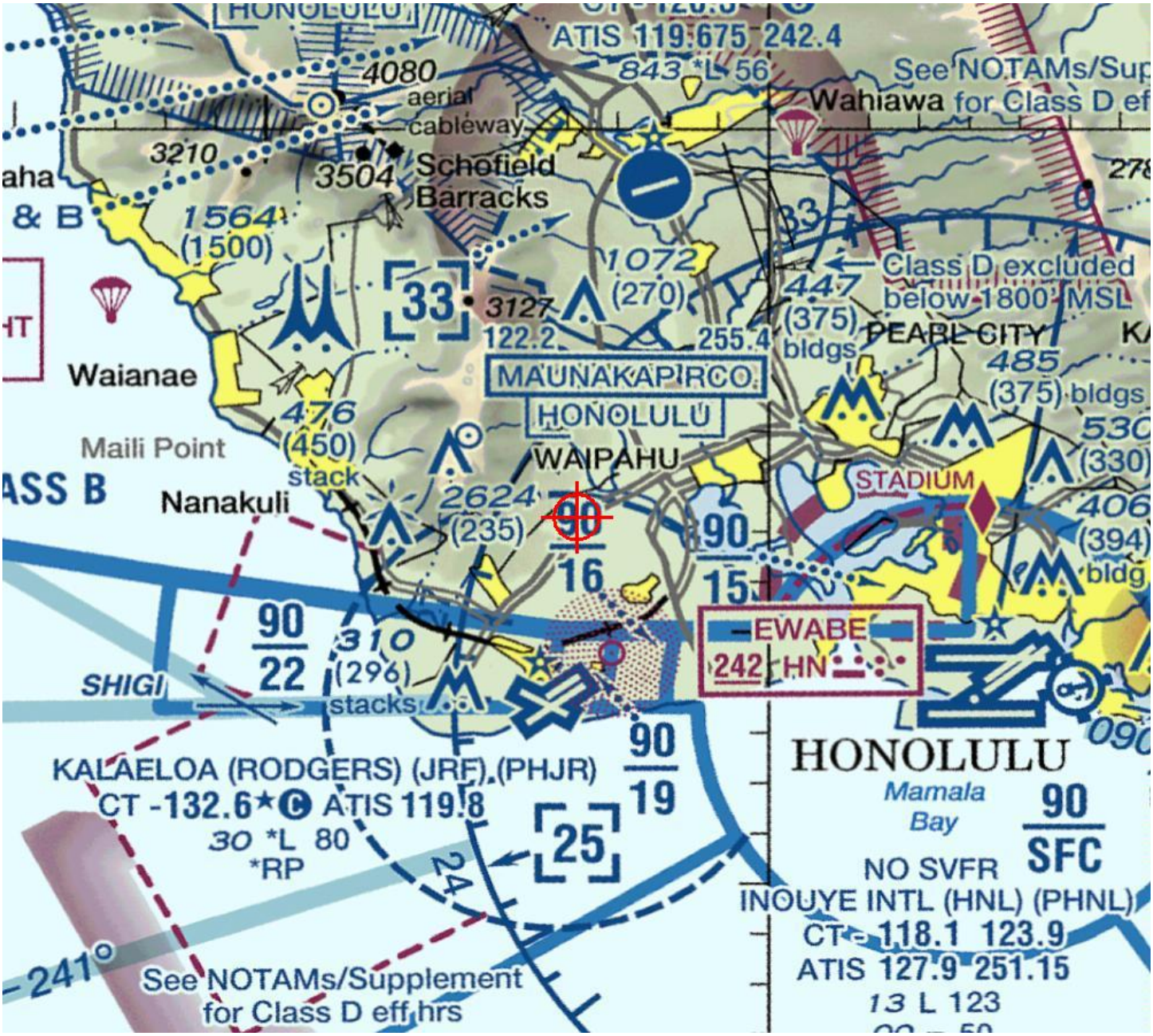

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Obstruction Evaluation Group
10101 Hillwood Parkway
Fort Worth, TX 76177

Aeronautical Study No.
2020-AWP-5930-OE

Issued Date: 06/09/2020

Nick Molinari
AES Distributed Energy
4875 Pearl East Circle
#200
Boulder, CO 80301

**** DETERMINATION OF NO HAZARD TO AIR NAVIGATION ****

The Federal Aviation Administration has conducted an aeronautical study under the provisions of 49 U.S.C., Section 44718 and if applicable Title 14 of the Code of Federal Regulations, part 77, concerning:

Structure:	Solar Panel Oahu W
Location:	O'ahu, HI
Latitude:	21-22-15.98N NAD 83
Longitude:	158-04-01.25W
Heights:	420 feet site elevation (SE)
	11 feet above ground level (AGL)
	431 feet above mean sea level (AMSL)

This aeronautical study revealed that the structure does not exceed obstruction standards and would not be a hazard to air navigation provided the following condition(s), if any, is(are) met:

Based on this evaluation, marking and lighting are not necessary for aviation safety. However, if marking/ lighting are accomplished on a voluntary basis, we recommend it be installed in accordance with FAA Advisory circular 70/7460-1 L Change 2.

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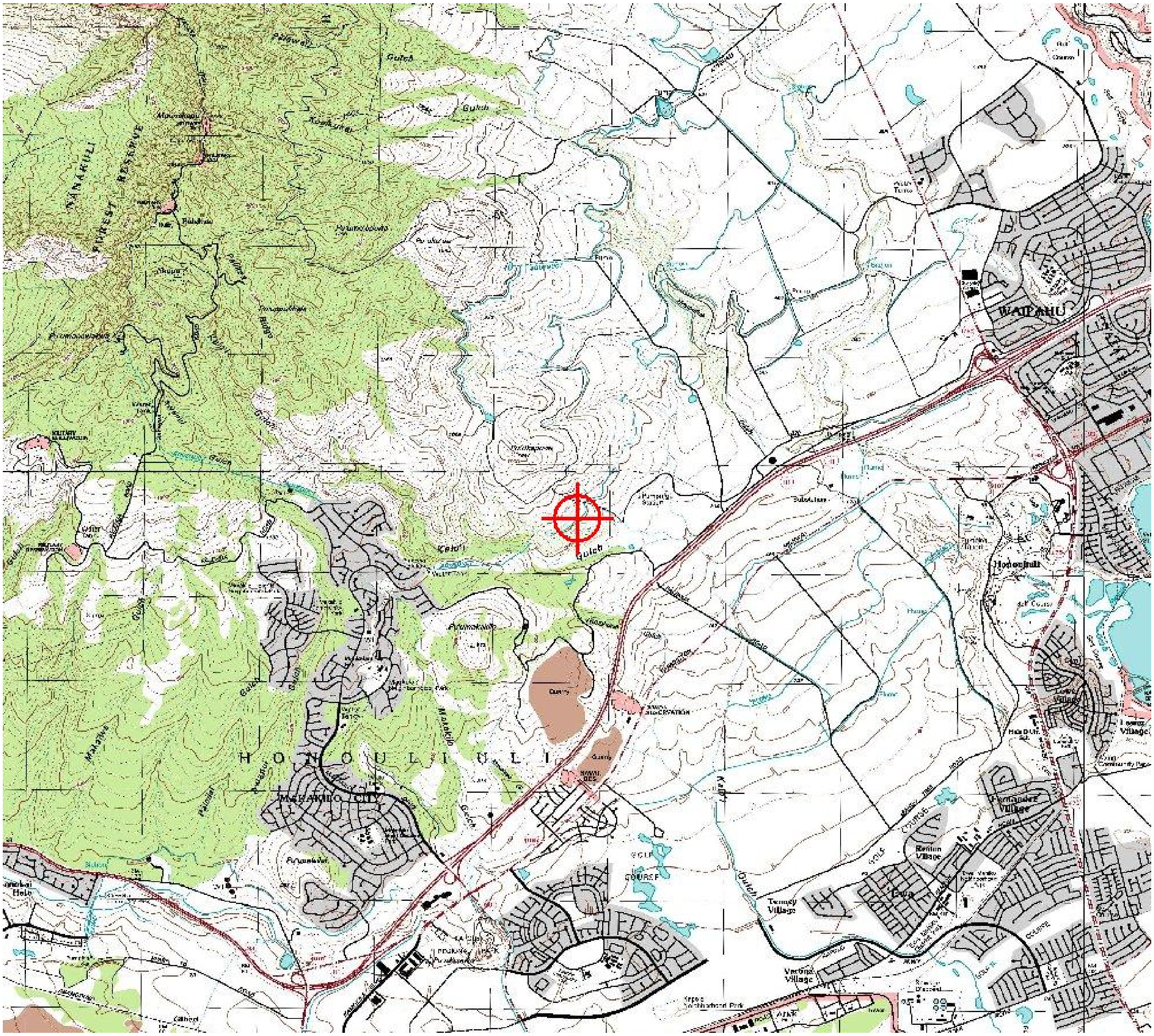
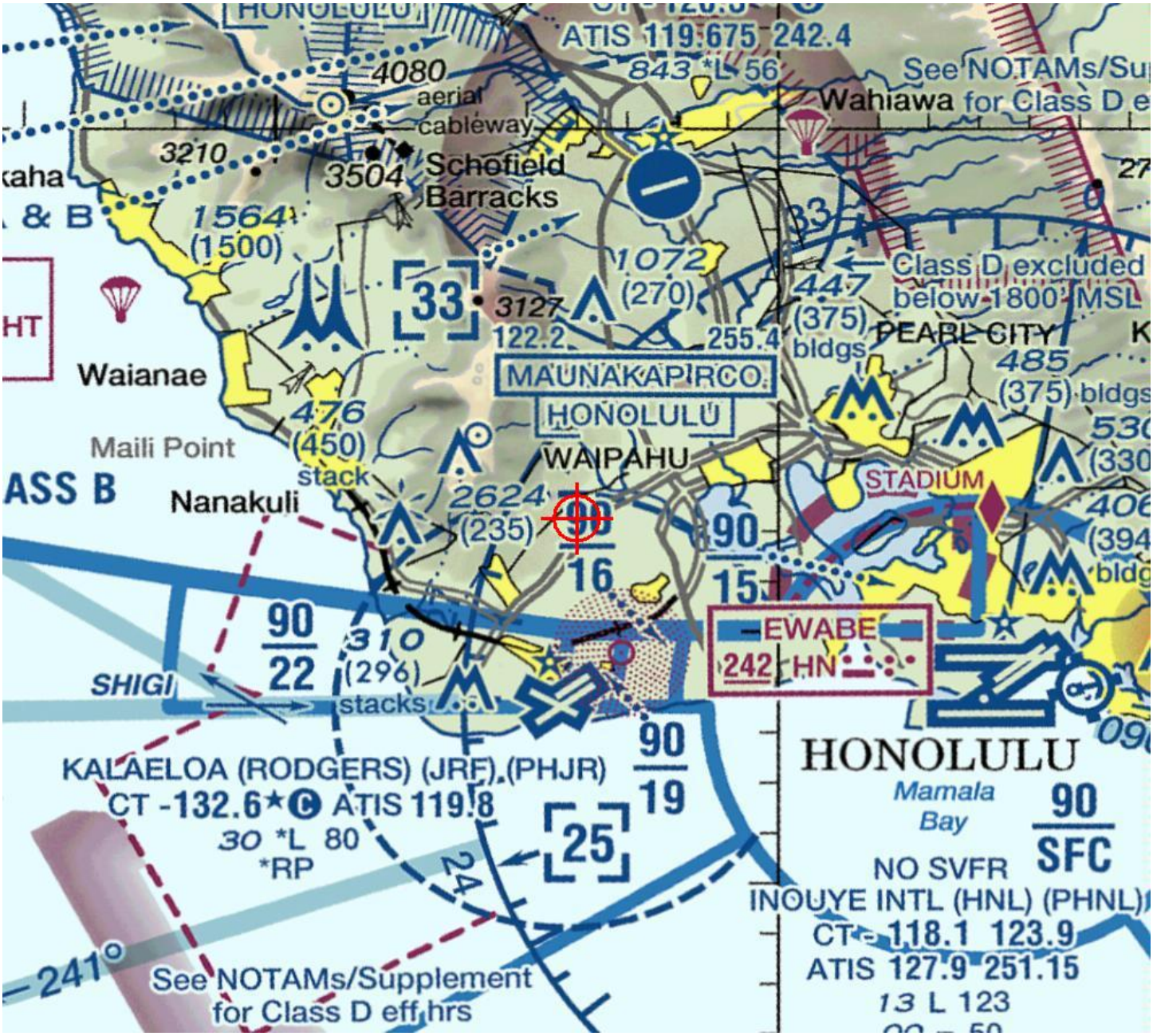
Signature Control No: 440873445-442419366 (DNE)
Robert van Haastert
Supervisor

Attachment(s)
Map(s)

TOPO Map for ASN 2020-AWP-5930-OE

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10101 Hillwood Parkway
Fort Worth, TX 76177

Aeronautical Study No.
2020-AWP-5931-OE

Issued Date: 06/09/2020

Nick Molinari
AES Distributed Energy
4875 Pearl East Circle
#200
Boulder, CO 80301

**** DETERMINATION OF NO HAZARD TO AIR NAVIGATION ****

The Federal Aviation Administration has conducted an aeronautical study under the provisions of 49 U.S.C., Section 44718 and if applicable Title 14 of the Code of Federal Regulations, part 77, concerning:

Structure:	Solar Panel Oahu Central-SE
Location:	O'ahu, HI
Latitude:	21-22-27.78N NAD 83
Longitude:	158-03-51.21W
Heights:	418 feet site elevation (SE)
	11 feet above ground level (AGL)
	429 feet above mean sea level (AMSL)

This aeronautical study revealed that the structure does not exceed obstruction standards and would not be a hazard to air navigation provided the following condition(s), if any, is(are) met:

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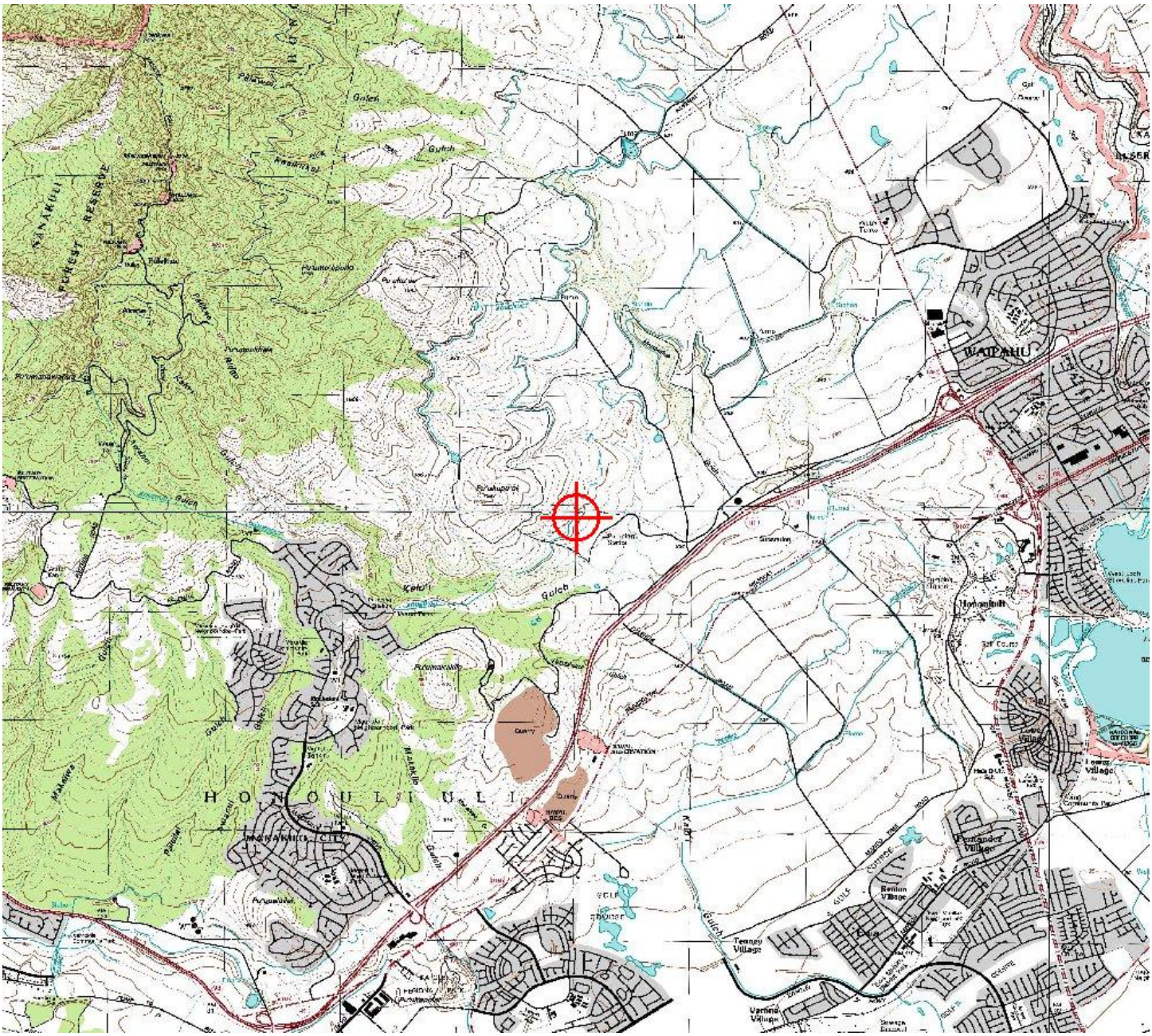
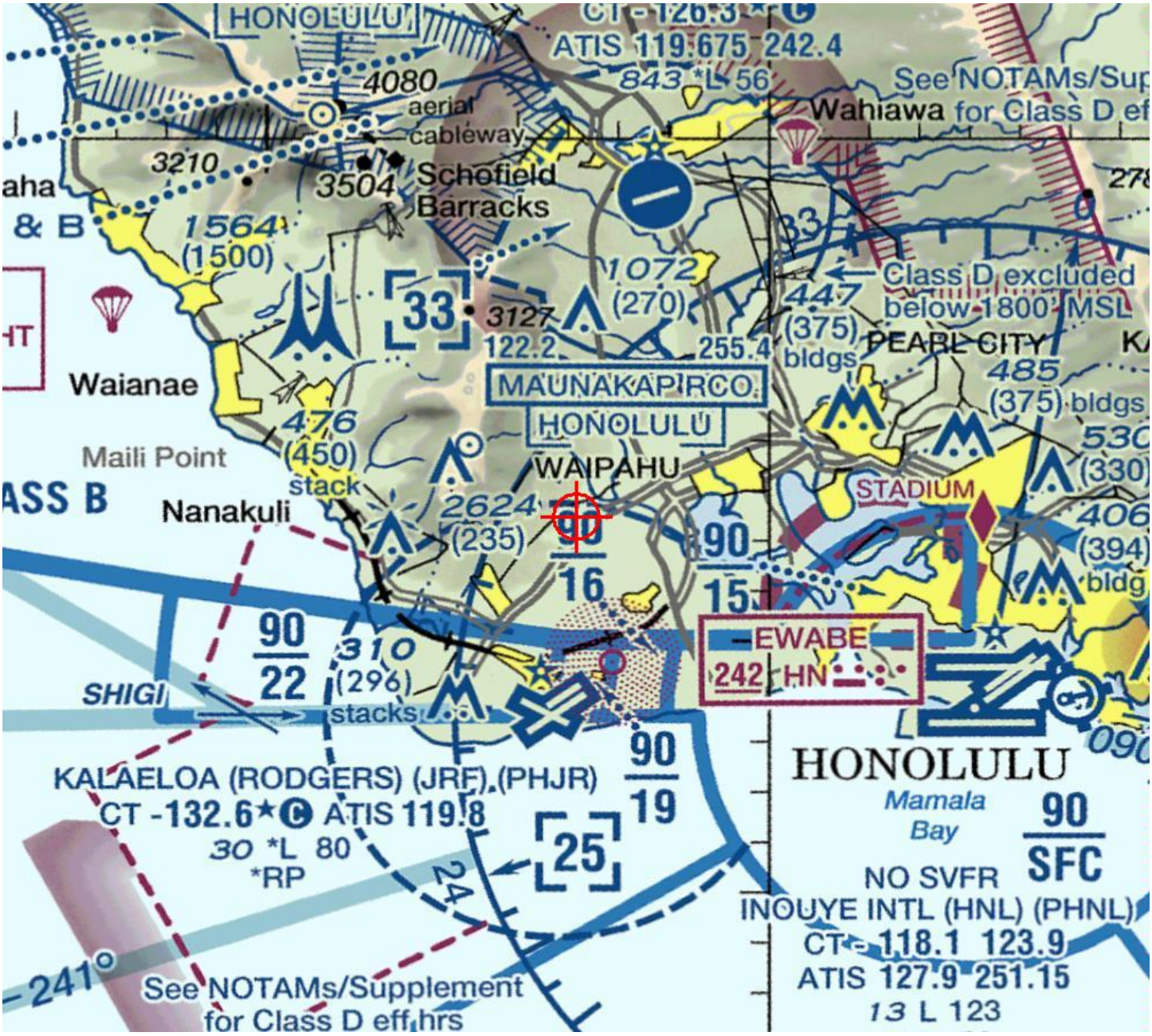
Signature Control No: 440873446-442419362 (DNE)
Robert van Haastert
Supervisor

Attachment(s)
Map(s)

TOPO Map for ASN 2020-AWP-5931-OE



Sectional Map for ASN 2020-AWP-5931-OE



Glare Analysis Report for the West O‘ahu Solar Plus Storage Project

‘Ewa District, O‘ahu, Hawai‘i

Prepared for:

AES Distributed Energy

Prepared by:

Tetra Tech, Inc.

February 2020

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Table of Contents

List of Tables

List of Attachments

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Executive Summary

At the request of AES Distributed Energy (AES), Tetra Tech, Inc. (Tetra Tech) conducted a glint and glare analysis of the proposed West Oahu Solar Plus Storage Project (Project). The analysis was conducted using the Solar Glare Hazard Analysis Tool (SGHAT) software through an online tool (GlareGauge) developed by Sandia National Laboratories and hosted by ForgeSolar. A total of three glare analyses were conducted for the Project. The first two analyses included three observation points from the surrounding community (to the west, south and east) and three segmented traffic routes (H-1 Freeway, Farrington Highway, and Kualakai Parkway). Analysis 1 represents the point of view from an average first floor residential/commercial structure and typical commuter car, while Analysis 2 represents the point of view from an average second floor residential/ commercial structure and typical semi-tractor-trailer truck. The third analysis included 14 final approach flight paths and two air traffic control towers (ATCTs) associated with Kalaeloa Airport, Daniel K. Inouye International Airport and Wheeler Army Airfield.

The results of the analysis indicate that none of the residential/commercial observation points would experience glare as a result of the Project. Analysis 1 and 2 predicted that a limited amount of green glare (the least severe type of glare) would occur at two segments along Farrington Highway and at two segments along H-1 Freeway southeast of the Project area. In addition, a very limited amount of yellow glare was predicted along one segment of H-1 Freeway. The predicted occurrences of glare along these roadway segments would occur intermittently in the evening hours during certain months of the year, for a period of less than 15 minutes per day. The results of Analysis 3 indicate that no glare would be experienced at Kalaeloa Airport or Wheeler Army Airfield. A limited amount of green glare was predicted for three of the final approach paths and the ATCT for Daniel K. Inouye International Airport, located approximately 8 miles from the Project area. The predicted occurrences of glare from these locations would occur intermittently in the evening hours during certain months of the year, for a period of less than 10 minutes per day. As recommended by the Federal Aviation Administration (FAA) Notice Criteria Tool (NCT), the Project will be formally filed with the FAA Obstruction Evaluation Group (OEG).

It is important to note that the GlareGauge model does not account for varying ambient conditions (i.e., cloudy days, precipitation), atmospheric attenuation, screening due to existing topography not located within the defined array layouts, or existing vegetation or structures (including fences or walls); nor does the tool allow proposed landscaping to be included. In this instance, an existing berm and vegetation are located along portions of the northern side of H1 Freeway and would be expected to screen views of the Project from vehicular traffic along the modeled segments of H1 Freeway; views of portions of the Project from vehicular traffic along the modeled segments of Farrington Highway may also be intermittently screened by vegetation and other existing features. Therefore, the model results are conservative and may predict glare at locations where glare will not actually be experienced.

1.0 Introduction

The Project involves construction and operation of a solar photovoltaic and battery energy storage system on land owned by University of Hawai‘i (UH), approximately 3 miles northeast of Kapolei on the southwest side of O‘ahu. The Project area encompasses approximately 95.5 acres in an area commonly referred to as the UH West O‘ahu Mauka Lands property and is within tax map key (TMK) 9-2-002:007. The topography of the site ranges from relatively flat to moderately sloping. The elevation along the southeastern boundary of the Project area is approximately 280 feet above mean sea level (amsl) and rises to approximately 675 feet amsl in the northwestern portion.

The UH West O‘ahu Mauka Lands property is bordered on its southeastern edge by the H1 Freeway, beyond which is the UH West O‘ahu campus and the city of Kapolei. The southern and western portions of the property are bordered by vacant land, with Makakilo Quarry and the residential community of Makakilo located just beyond. The area north of the Project area generally comprises open space associated with the Waianae Mountains. The former Honouliuli Internment Camp site, which the National Park Service (NPS) is currently working to incorporate as a National Monument, is located to the northeast. The eastern portion of the property is bordered by Honouliuli Gulch and a variety of agricultural operations; further east is Kunia Road and the Village Park community.

As an industry standard, the term “glint and glare” analysis is typically used to describe an analysis of potential ocular impacts to defined receptors. As a point of clarification, ForgeSolar defines glint and glare in the following statement:

> *Glint is typically defined as a momentary flash of bright light, often caused by a reflection off a moving source. A typical example of glint is a momentary solar reflection from a moving car. Glare is defined as a continuous source of bright light. Glare is generally associated with stationary objects, which, due to the slow relative movement of the sun, reflect sunlight for a longer duration.*

Based on the ForgeSolar definitions of glint and glare and the stationary nature of the Project solar photovoltaic modules (fixed tilt), the potential reflectance from the Project modeled throughout this report is referred to as glare.

Tetra Tech completed a glare analysis using the SGHAT software, developed by Sandia Laboratories, now hosted by ForgeSolar (as discussed further below). The SGHAT software is considered an industry best practice and conservative model that effectively models the potential for glare at defined receptors from defined solar energy generating facilities. As discussed further below, the model is conservative in that it does not account for potential screening such as existing or proposed vegetation, topography outside of the defined areas, buildings, walls, or fences.

This report summarizes the glare analysis conducted based on the preliminary Project layout provided by AES dated December 4, 2019. Included as attachments are the Preliminary Site Plan that formed the basis of the analysis (Attachment A); Figure 1: PV Array Areas, Figure 2: Receptors and Figure 3: Airport Receptors (Attachment B); and the glare analysis reports generated by the ForgeSolar tool (Attachment C).

2.0 FAA Notice Criteria Consultation

The FAA developed Technical Guidance for Evaluating Selected Solar Technologies on Airports in 2010, in addition to FAA regulatory guidance under 78 FR 63276 Interim Policy, FAA Review of Solar Energy System Projects on Federally Obligated Airports (collectively referred to as FAA Guidance). The FAA Guidance recommends that glare analyses should be performed on a site-specific basis using the Sandia Laboratories SGHAT. This guidance applies to solar facilities located on federally-obligated airport property; it is not mandatory for a proposed solar installation that is not on an airport (and for which a Form 7460-1 is filed with FAA pursuant to CFR Title 14 Part 77.9, as discussed below), but is considered to be an industry best practice for solar facilities in general. The SGHAT is the standard for measuring potential ocular impact as a result of solar facilities (78 FR 63276).

According to 78 FR 63276, the FAA has determined that "glint and glare from solar energy systems could result in an ocular impact to pilots and/or air traffic control (ATC) facilities and compromise the safety of the air transportation system." The FAA has developed the following criteria for analysis of solar energy projects located on jurisdictional airports:

- No potential for glint or glare in the existing or planned ATCT cab; and
- No potential for glare or "low potential for after-image" along the final approach path for any existing landing threshold or future landing thresholds (including any planned interim phases of the landing thresholds) as shown on the current FAA-approved Airport Layout Plan (ALP). The final approach path is defined as two miles from 50 feet above the landing threshold using a standard three-degree glidepath.

The online FAA NCT reports whether a proposed structure is in proximity to a jurisdictional air navigation facility and if formal submission to the FAA OEG under CFR Title 14 Part 77.9 (Safe, Efficient Use, and Preservation of the Navigable Airspace) is recommended. The NCT also identifies final approach flight paths that may be considered vulnerable to a proposed structure's impact on navigation signal reception. The NCT was utilized to determine if the proposed Project is located within an FAA-identified impact area based on the Project boundaries and height above ground surface. The FAA NCT Report stated that a formal filing with the FAA OEG is recommended, and referenced Kalaeloa Airport (John Rodgers Field, JRF) to the south, Daniel K. Inouye International Airport (Honolulu International, HNL) to the east, and Wheeler Army Airfield (HHI) to the northeast. Based on this information, these three airport facilities were included in the SGHAT analysis, as further discussed below.

3.0 Glare Analysis Methods

The SGHAT is considered to be an industry best practice for analysis of glare related to solar energy generating facilities. Tetra Tech utilized the SGHAT technology as part of an online tool (GlareGauge) developed by Sandia National Laboratories and hosted by ForgeSolar. GlareGauge provides a quantitative assessment of the following:

- When and where glare has the potential to occur throughout the year for a defined solar array polygon; and
- Potential effects on the human eye at locations where glare is predicted.

The following statement was issued by Sandia Laboratories regarding the SGHAT technology:

> *Sandia developed SGHAT v. 3.0, a web-based tool and methodology to evaluate potential glint/glare associated with solar energy installations. The validated tool provides a quantified assessment of when and where glare will occur, as well as information about potential ocular impacts. The calculations and methods are based on analyses, test data, a database of different photovoltaic module surfaces (e.g. anti-reflective coating, texturing), and models developed over several years at Sandia. The results are presented in a simple easy-to-interpret plot that specifies when glare will occur throughout the year, with color indicating the potential ocular hazard (Sandia Laboratories, 2016).*

Note, however, that technology changes continue to occur to address issues such as reflectivity. The model, therefore, presents a conservative assessment based upon simplifying assumptions inherent in the model, as well as industry improvements since the most recent update of such assumptions.

Based on the predicted retinal irradiance (intensity) and subtended angle (size/distance) of the glare source to receptor, the GlareGauge categorizes potential glare where it is predicted by the model to occur in accordance with three tiers of severity (ocular hazards) that are shown by different colors in the model output:

- Red glare: glare predicted with a potential for permanent eye damage (retinal burn)
- Yellow glare: glare predicted with a potential for temporary after-image
- Green glare: glare predicted with a low potential for temporary after-image

These categories of glare are calculated using a typical observer's blink response time, ocular transmission coefficient (the amount of radiation absorbed in the eye prior to reaching the retina), pupil diameter, and eye focal length (the distance between where rays intersect in the eye and the retina). As a point of comparison, direct viewing of the sun without a filter is considered to be on the border between yellow glare and red glare, while typical camera flashes are considered to be lower tier yellow glare. Upon exposure to yellow glare, the observer may experience a temporary spot in their vision temporarily lasting after the exposure. Upon exposure to green glare, the observer may experience a bright reflection but typically no spot lasting after exposure.

4.0 Glare Analysis Inputs

The modules to be used for the proposed Project are smooth glass surface material with an anti-reflection coating (ARC), which are parameters selected in the glare analyses. Values associated with panel reflectivity and reflective scatter were not altered from the GlareGauge standard input averaged from various module reflectance profiles produced from module research concluded in 2016; therefore, as previously noted, the model does not incorporate further advances in anti-reflective coatings since that time.

Tetra Tech performed three separate glare analyses: the first two analyses included three proximal segmented vehicular traffic routes and three observation points (OPs; two taken from the Tetra Tech visual simulation viewpoints and one taken near residential and commercial receptors to the east). Analysis 1 and 2 differ in the heights assumed for the OP and vehicular routes; Analysis 1 represents the point of view from an average first floor residential/commercial structure and typical commuter car, while Analysis 2 represents the point of view from an average second floor residential/commercial structure and typical semi-tractor-trailer truck. Analysis 3 is focused on modeling the airport receptors referenced in the NCT results; it includes 14 two-mile final approach flight paths and two ATCTs associated with Kalaeloa Airport (John Rodgers Field, JRF), Daniel K. Inouye International Airport (Honolulu International, HNL), and Wheeler Army Airfield (HHI). In Analysis 3, a typical 30-degree maximum downward viewing angle and 50-degree maximum azimuthal viewing angle from the aircraft cockpit were included among other parameters presented in Table 2. For all three analyses, the Project Area consisted of nine separate "PV Array Areas", which are segmented polygons generally representative of the proposed Project layout dated December 4, 2019 (Attachment A). Segmentation of the Project layout allows GlareGauge to more accurately represent potential ocular impacts as a result of the Project. The additional input features used in the analyses are summarized in Table 1 and Table 2.

Table 1. Glare Analyses Input Features

Analysis No.[1]	Racking Type	Module Orientation	Tilt[2] (degrees)	Module Height[3] (feet)	OP Height[4] (feet)	Route Height[5] (feet)	ATCT	Flight Paths
1	Fixed	South-facing	15	7.6	6	5	-	-
2	Fixed	South-facing	15	7.6	16	9	-	-
3	Fixed	South-facing	15	7.6	-	-	2	14

1.Noted on page 1 of each analysis in Attachment C.

2. Module tilt for fixed arrays.

3. Average module centroid height above ground surface.

4. Height of observation point receptor: 6 feet represents an average first floor residential/commercial point of view and 16 feet represents an average second floor residential/commercial point of view.

5. Height of vehicular route receptor: 5 feet represents typical commuter car height and 9 feet represents typical semi-tractor-trailer truck views.

Table 2. Analysis 3 Input Features

Flight Path/ATCT Name	Associated Airport	True Direction (degrees)	Threshold Crossing Height (feet)	Glide Path[1] (degrees)	Height Above Ground (feet)
HHI RWY 24	Wheeler Army Airfield	248[2]	50[3]	3[3]	-
HHI RWY 6	Wheeler Army Airfield	68[2]	50[3]	3[3]	-
HNL RWY 04L	Daniel K. Inouye International Airport	53	50	3	-
HNL RWY 04R	Daniel K. Inouye International Airport	53	71	3	-
HNL RWY 08R	Daniel K. Inouye International Airport	90	96	3.25	-
HNL RWY 22L	Daniel K. Inouye International Airport	233	80	3.44	-
HNL RWY 22R	Daniel K. Inouye International Airport	233	50[3]	3[3]	-
HNL RWY 26L	Daniel K. Inouye International Airport	270	75	3	-
JRF RWY 04L	Kalaeloa Airport	55	35	3	-
JRF RWY 04R	Kalaeloa Airport	55	55	3	-
JRF RWY 11	Kalaeloa Airport	118	48	3	-
JRF RWY 22L	Kalaeloa Airport	235	32	3	-
JRF RWY 22R	Kalaeloa Airport	235	33	3	-
JRF RWY 29	Kalaeloa Airport	298	52	3	-
1-ATCT	Kalaeloa Airport	-	-	-	50[4]
2-ATCT	Daniel K. Inouye International Airport	-	-	-	50[4]

1. Angle of descent along final approach flight path.

2.Unable to be confirmed based on public information. Estimated based on runway direction on aerial photography.

3. Unable to be confirmed based on public information. Default parameters in the SGHAT software which references the FAA criteria found in Section 2.0 were used.

4. Unable to be confirmed based on public information. A conservative height of 50 feet was used based on aerial photography and Google street views.

5.0 Glare Analysis Assumptions

The GlareGauge model is bound by conservative limitations. The following assumptions provide a level of conservatism to the GlareGauge model:

- The GlareGauge model simulates PV arrays as infinitesimally small modules within planar convex polygons exemplifying the tilt and orientation characteristics defined by the user. Gaps between modules, variable heights of the PV array within the polygons, and supporting structures are not considered in the analysis. Since the actual module rows will be separated by open space, this model assumption could result in indication of glare in locations where panels will not be located. In addition, the supporting structures are considered to have reflectivity values that are negligible relative to the module surfaces included in the model.
- The GlareGauge model does not consider obstacles (either man-made or natural) between the defined PV arrays and the receptors such as vegetative screening (existing or planted), buildings, topography, etc. Where such features exist, they would screen views of the Project and, thus, minimize or eliminate glare from those locations.
- The GlareGauge model does not consider the potential effect of shading from existing topography between the sun and the Project outside of the defined areas. In this instance, the lower slopes of the Waianae Mountains are located to the northwest of the Project. This ridgeline may shade the Project from the sun's position at certain times of the year in the evening hours. The GlareGauge model does not account for this potential shading effect.
- The direct normal irradiance (DNI) is defined as variable using a typical clear day irradiance profile. This profile has a lower DNI in the mornings and evenings and a maximum of 1,000 Watts per square meter (W/m^2) at solar noon. The irradiance profile uses the coordinates from Google Maps and a sun position algorithm to scale the DNI throughout the year. The actual daily DNI would be affected by precipitation, cloud cover, atmospheric attenuation (radiation intensity affected by gaseous constituents), and other environmental factors not considered in the GlareGauge model. This may result in modeled predicted glare occurrences when in fact the glare is not actually occurring due to cloud cover, rain, or other atmospheric conditions.

Note that hazard zone boundaries shown in the Glare Hazard plots are an approximation; actual ocular impacts encompass a continuous, not discrete, spectrum.

6.0 Glare Analysis Results

Tetra Tech performed three separate glare analyses to provide a quantitative assessment of the potential for glare from the Project based on different receptor characteristics. The GlareGauge model's predicted results for the Project are summarized in the following sections partitioned according to the receptor parameters.

6.1 Analysis 1: First Story and Commuter Car View Results

Analysis 1 included three OPs at six feet above ground surface (typical first story receptor height) and three segmented vehicular traffic routes at five feet above ground surface (typical commuter vehicle receptor height). The southern (OP 1) and western (OP 2) residential OPs were selected in the glare analysis to match representative residential viewpoints selected in the visual simulation analysis. The eastern OP (OP 3) was selected in order to capture a representative viewpoint of the residential and commercial receptors in Village Park. The route segment extents were based on the results of a preliminary viewshed analysis dated November 2019.

Table 3 represents the glare summary in annual minutes of glare for Analysis 1. In general, green glare is predicted in limited amounts on Farrington Highway and H1 Freeway and a very limited amount of yellow glare is predicted on H1 Freeway. No red glare is predicted at the defined receptors.

Table 3. Analysis 1 Annual Minutes of Glare Summary

Receptor	Green Glare	Yellow Glare	Red Glare
OP 1	0	0	0
OP 2	0	0	0
OP 3	0	0	0
Farrington-1[1]	1,578	0	0
Farrington-2	4,785	0	0
H1 Freeway-1[2]	0	0	0
H1 Freeway-2	104	0	0
H1 Freeway-3	2,498	35	0
H1 Freeway-4	0	0	0
Kualakai-1[3]	0	0	0
Kualakai-2	0	0	0
Kualakai-3	0	0	0
Kualakai-4	0	0	0
Kualakai-5	0	0	0

1. Segments of Farrington Highway to the south of the Project. Segment 1 is to the east of Segment 2 as depicted in Figure 2.
2. Segments of H1 Freeway (Queen Liliuokalani Freeway) to the south of the Project. Segment 1 to Segment 4 is from east to west.
3. Segments of Kualakai Parkway to the south of the Project. Segment 1 to Segment 5 is from north to south.

Table 4 represents the detailed glare summary for both Analysis 1 and Analysis 2. The predicted green glare at the receptors is between the hours of 6:00 PM and 7:00 PM and ranges from April through mid-September. Less than 15 minutes of green glare per day is predicted within the one-hour period. The limited amount of yellow glare on H1 Freeway-3 is predicted between 6:00 PM and 7:00 PM from mid-May to mid-July. Less than 5 minutes of yellow glare per day is predicted within the one-hour period. Glare was not predicted at the defined residential/commercial OPs or along Kualakai Parkway.

Table 4. Analysis 1 and Analysis 2 Detailed Glare Summary

Receptor	Green Glare Time of Day Range	Green Glare Time of Year Range	Yellow Glare Time of Day Range	Yellow Glare Time of Year Range
Farrington-1	6:00 - 7:00 PM	April to May; mid-July to mid-September	N/A	N/A
Farrington-2	6:00 - 7:00 PM	April to mid-September	N/A	N/A
H1 Freeway-2	6:00 - 7:00 PM	April to mid-May; August to mid-September	N/A	N/A
H1 Freeway-3	6:00 - 7:00 PM	April to May; July to mid-September	6:00 - 7:00 PM	mid-May to mid-July

6.2 Analysis 2: Second Story and Tractor-Trailer View Results

Analysis 2 included the same OP locations at 16 feet above ground surface (typical second story receptor height) and the same segmented vehicular traffic routes at nine feet above ground surface (typical tractor-trailer receptor height).

Table 5 represents the glare summary in annual minutes of glare for Analysis 2. Similar to Analysis 1, green glare is predicted at limited amounts on Farrington Highway and H1 Freeway and a very limited amount of yellow glare is predicted on H1 Freeway. No red glare is predicted at the defined receptors.

Table 5. Analysis 2 Annual Minutes of Glare Summary

Receptor	Green Glare	Yellow Glare	Red Glare
OP 1	0	0	0
OP 2	0	0	0
OP 3	0	0	0
Farrington-1[1]	1,608	0	0
Farrington-2	4,840	0	0
H1 Freeway-1[2]	0	0	0
H1 Freeway-2	118	0	0
H1 Freeway-3	2,624	50	0
H1 Freeway-4	0	0	0
Kualakai-1[3]	0	0	0

Receptor	Green Glare	Yellow Glare	Red Glare
Kualakai-2	0	0	0
Kualakai-3	0	0	0
Kualakai-4	0	0	0
Kualakai-5	0	0	0

As seen in Table 5, the second story and tractor-trailer view results show a minimal increase in annual glare minutes from each receptor exhibiting glare. For example, green glare at H1 Freeway-3 increased by 126 annual minutes, which is a 5% increase in annual green glare minutes from the commuter car height at the H1 Freeway-3 route segment (as shown in Table 3). No significant changes were noted from the time of day and/or the time of year for predicted glare in Analysis 2 (see Table 4 for detailed glare summary).

6.3 Analysis 3: Flight Path and ATCT Results

Analysis 3 included 14 proximal two-mile final approach flight paths and two ATCTs (as outlined in Table 2). The final approach flight paths that were modeled are located at the airports that were referenced in the NCT results: Kalaeloa Airport (John Rodgers Field, JRF), Daniel K. Inouye International Airport (Honolulu International, HNL), and Wheeler Army Airfield (HHI). Table 5 represents the glare summary in annual minutes of glare for Analysis 3.

Table 6. Analysis 3 Annual Minutes of Glare Summary

Receptor	Green Glare	Yellow Glare	Red Glare
HHI RWY 24	0	0	0
HHI RWY 6	0	0	0
HNL RWY 04L	0	0	0
HNL RWY 04R	0	0	0
HNL RWY 08R	0	0	0
HNL RWY 22L	847	0	0
HNL RWY 22R	866	0	0
HNL RWY 26L	2,149	0	0
JRF RWY 04L	0	0	0
JRF RWY 04R	0	0	0
JRF RWY 11	0	0	0
JRF RWY 22L	0	0	0
JRF RWY 22R	0	0	0
JRF RWY 29	0	0	0
1-ATCT	0	0	0
2-ATCT	749	0	0

As noted in Section 2.0, the FAA has developed the following criteria (78 FR 63276) for analysis of solar energy projects located on jurisdictional airports:

- No potential for glint or glare in the existing or planned ATCT cab; and
- No potential for glare or "low potential for after-image" along the final approach path for any existing landing threshold or future landing thresholds (including any planned interim phases of the landing thresholds) as shown on the current FAA-approved ALP.

The green glare noted in the SGHAT and summarized in this report is considered the "low potential for after-image" described in the applicable FAA criteria. As seen in Table 6, a low potential for after-image (green glare) is predicted in limited amounts along three two-mile final approach paths and the ATCT at Daniel K. Inouye International Airport. The potential green glare is predicted at the flight paths facing the southwest (HNL RWY 22L and HNL RWY 22R) and west (HNL RWY 26L). As summarized in Table 7, the green glare along the flight paths is sporadically limited to April to September between 6:00PM and 7:00PM, not exceeding 10 minutes per day. The green glare at the ATCT (2-ATCT) is sporadically limited to May to August, also between 6:00PM and 7:00PM and not exceeding 10 minutes per day. No yellow glare or red glare was predicted in Analysis 3. As previously noted, in addition to the other conservative values built into the model, visual screening by existing or proposed vegetation or other visual barriers cannot be accounted for in the GlareGauge model. In addition, the model assumes constant ideal (sunny) conditions; however, this area has an average of 78 days of precipitation per year (WRCC 2012). These atmospheric conditions would further reduce the actual occurrence of glare from the Project, such that actual glare conditions are expected to be less than predicted.

Table 7. Analysis 3 Detailed Glare Summary

Receptor	Green Glare Time of Day Range	Green Glare Time of Year Range	Yellow Glare Time of Day Range	Yellow Glare Time of Year Range
HNL RWY 22L	6:00 - 7:00 PM	Mid-April to May; mid-August to September	N/A	N/A
HNL RWY 22R	6:00 - 7:00 PM	Mid-April to May; mid-August to September	N/A	N/A
HNL RWY 26L	6:00 - 7:00 PM	Mid-May to August	N/A	N/A
2-ATCT	6:00 - 7:00 PM	Mid-May to August	N/A	N/A

7.0 Summary

The preliminary Project layout was modeled using GlareGauge to evaluate the potential extent of glare the Project may cause to receptors at three observation points to the east, south and west; receptors along segments of Farrington Highway, H1 Freeway, and Kualakai Parkway; and 14 proximal two-mile final approach flight paths and two ATCTs associated with Kalaeloa Airport (John Rodgers Field, JRF), Daniel K. Inouye International Airport (Honolulu International, HNL), and Wheeler Army Airfield (HHI). In order to better analyze the potential for glare as a result of sunlight reflectance from the Project and accommodate GlareGauge conservatisms noted in Section 4.0, nine array segments (PV Arrays) were modeled within the Project Area. Three separate glare analyses (Analysis 1, Analysis 2 and Analysis 3) were performed to provide a quantitative assessment of the potential for glare as a result of the Project, based on views from first- and second-story structures, commuter vehicles and semi-tractor-trailer trucks, and proximal two-mile final approach flight paths and ATCTs at airports referenced in the FAA NCT results. A summary of total glare predicted based on the analyses is presented in Table 8.

Table 8. Project Glare Summary

Analysis No.	OP Height (feet)	Route Height (feet)	Total Green Glare Predicted (annual minutes)[1]	Total Yellow Glare Predicted (annual minutes)	Total Red Glare Predicted (annual minutes)	Total Glare Predicted (annual minutes)	Total Potential Glare Percentage of Annual Daylight Hours[2]
1	6	5	8,965	35	0	9,000	3.4
2	16	9	9,190	50	0	9,240	3.5
3	50 (ATCTs)	Variable (flight paths)	4,611	0	0	4,611	1.8

1. Total annual daylight minutes equal approximately 262,800.
2. Total annual daylight hours equal approximately 4,380.

None of the residential/commercial OPs to the east (OP 3), south (OP 1) and/or west (OP 2) of the Project were predicted to experience glare as a result of the Project. Green glare (the least severe type of glare) was predicted in Analysis 1 and Analysis 2 at two segments along Farrington Highway (Farrington-1 and Farrington-2) and at two segments along H1 Freeway (H1 Freeway-2 and H1 Freeway-3) to the south of the Project. In addition, a very limited amount of yellow glare (85 combined annual minutes) was predicted at segment H1 Freeway-3. As previously noted, the GlareGauge model does not account for varying ambient conditions (i.e., cloudy days, precipitation); atmospheric attenuation; screening due to existing topography not located within the defined array layouts; or existing vegetation or structures (including fences or walls); nor does the tool allow proposed landscaping to be included. In this instance, an existing berm and vegetation are located along portions of the northern side of H1 Freeway and would be expected to screen views of the Project from vehicular traffic along the modeled segments of H1 Freeway; views of portions of the

Project from vehicular traffic along the modeled segments of Farrington Highway may also be intermittently screened by vegetation and other existing features. Therefore, the model results are conservative and may predict glare at locations where glare will not actually be experienced.

Based on Analysis 3, a total of 4,611 annual minutes (approximately 1.8% of annual daylight hours) of green glare was predicted at three two-mile final approach flight paths (RWY 22L, RWY 22R, and RWY 26L) and the ATCT at the Daniel K. Inouye International Airport, located approximately eight miles east of the Project. As recommended by the NCT, the Project will be formally filed with the FAA OEG to more comprehensively study the impacts of the Project to proximal navigable airspace. In addition, it is recommended that the State of Hawai‘i Department of Transportation (DOT) Airports Division be consulted regarding these results.

8.0 References

FAA, 2010a. Federal Aviation Administration. CFR Title 14 Part 77.9 Notice of Proposed Construction or Alteration Requiring Notice. 2010.

FAA, 2010b. Federal Aviation Administration. Technical Guidance for Evaluating Selected Solar Technologies on Airports. 2010.

Ho et al. Sandia National Laboratories, Solar Glare Hazard Analysis Tool (SGHAT) Technical Reference Manual. March 2015.

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Sandia, 2016. Sandia National Laboratories, Solar Glare Hazard Analysis Tool (SGHAT) User's Manual v. 3.0. December 6, 2016.

WRCC (Western Regional Climate Center), 2012. Period of Record General Climate Summary – Precipitation. Ewa Plantation 741, Hawaii. Available online at: https://wrcc.dri.edu/cgi-bin/cliGCStP.pl?hi0507

Attachment A. Preliminary Site Plan

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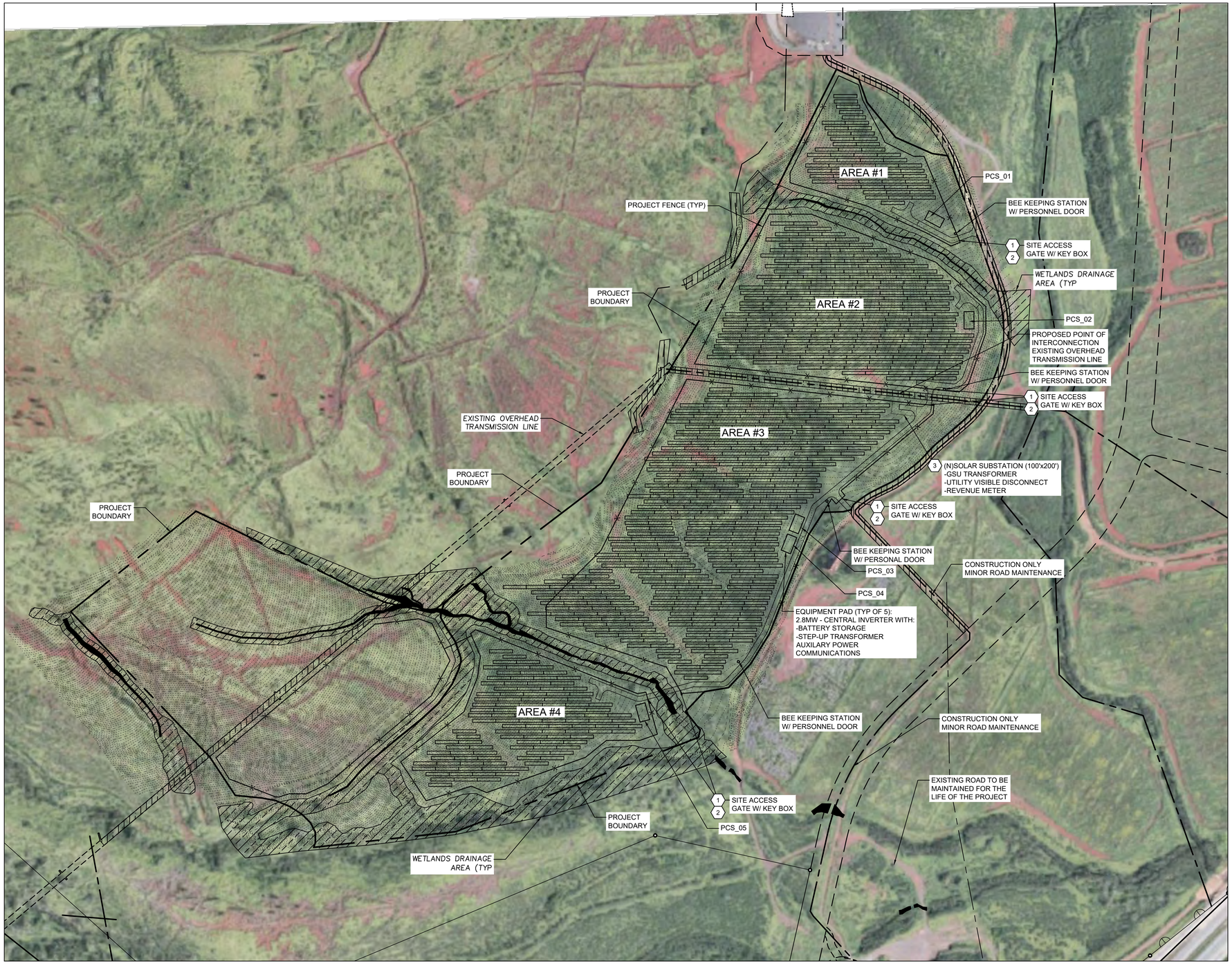

LEGEND

PCS	PCS POWER CONVERSION STATION
	PCS BOUNDARY

GENERAL NOTES

1. REFER TO CIVIL DRAWINGS FOR PERIMETER FENCE, ROADS AND GATES.
2. REFER TO SOLTEC DRAWINGS FOR TRACKER PILE LOCATIONS.
3. PV SITE WILL NOT HAVE SITE LIGHTING OR SECURITY CAMERAS.

KEYED NOTES

1. CONTRACTOR TO FURNISH AND INSTALL KNOX BOX ACCESS ENCLOSURE AT ENTRANCE TO EVERY ROAD.
2. INSTALL FENCE GROUNDING. SEE E511 FOR DETAILS.
3. SUBSTATION LOCATION IS PENDING, AND SUBJECT TO CHANGE.

DESIGN SPECIFICATIONS

DC SYSTEM VOLTAGE	1500V	
ARRAY CAPACITY	17.407MW DC	
	12.5MW AC POI	
DC/AC RATIO	1.39	
MODULE	JINKO - EAGLE BIFACIAL 4C-72M	
MODULE WATTAGE	405Wp	
MODULE QUANTITY	AREA #1	3,192
	AREA #2	12,656
	AREA #3	20,776
	AREA #4	6,384
	AREA #5	-
	TOTAL	43,008
STRINGS	1,536 STRINGS OF 28 MODULES	
INVERTERS (QTY)	(5) 2.8MW CENTRAL INVERTERS WITH INTEGRAL BESS DC/DC CONVERSION	
BATTERY STORAGE	(10) 1,300kW BATTERY CONTAINERS	
RACKING SYSTEM	FIXED TILT 15°	
AZIMUTH	0°	
PANEL TILT ANGLE	15°	
ROW TO ROW SPACING	21' - 7"	
GROUND COVER RATIO	0.62 (TBC)	
FENCED IN AREA	AREA #1	APPROX. 4.6 ACRES
	AREA #2	APPROX. 13.26 ACRES
	AREA #3	APPROX. 22.04 ACRES
	AREA #4	APPROX. 8.18 ACRES
	AREA #5	APPROX. 7.79 ACRES
	TOTAL	APPROX. 56.23 ACRES

1. MODULES ARE POSITIONED TWO DEEP IN PORTRAIT ORIENTATION.

NOTE: EACH TRACKER CONTAINS (2) STRINGS OF (28) PV MODULES.

2 / - TRACKER STRING DETAIL
SCALE: NONE

N
W E
S

SCALE: 1" = 200'
0 200' 400' FT

AES
Distributed Energy
AES Distributed Energy
282 Century Pl. Suite 2000
Louisville, CO 80027 USA

HDR 3J CONSULTING
CIVIL ENGINEERING
WATER RESOURCES
COMMUNITY PLANNING
9600 SW NIMBUS AVE, SUITE 100, BEAVERTON, OR 97008

SYSTEM DESCRIPTION

REVISIONS

REV	BY	DATE	DESCRIPTION

PE STAMP

OVERALL SITE PLAN
WEST OAHU SOLAR AES DE
OAHU, HI

PROJECT NUMBER
19537
PHASE
ISSUED FOR REVIEW
MILESTONE
30% DESIGN

ELECTRICAL DESIGNER

STRUCTURAL DESIGNER

DATE	SCALE
12-04-2019	1"=200'

TITLE

DRAWING
C200

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Attachment B. Figures

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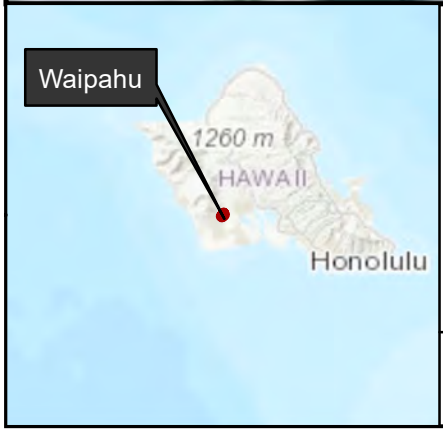


Legend

Project Layout (PV Array Areas)

*Locations are approximate

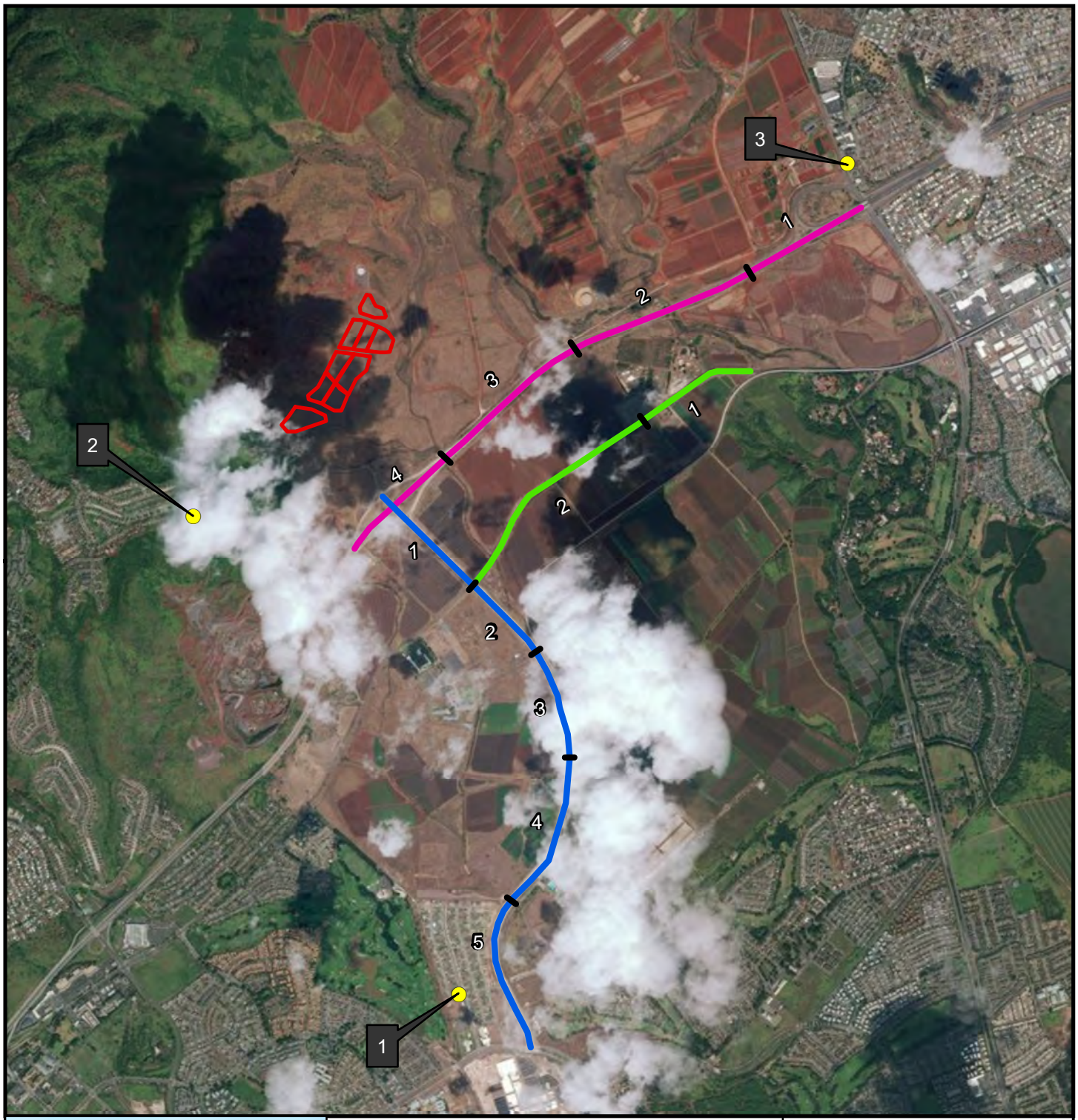
Feet
0 375 750 1,500

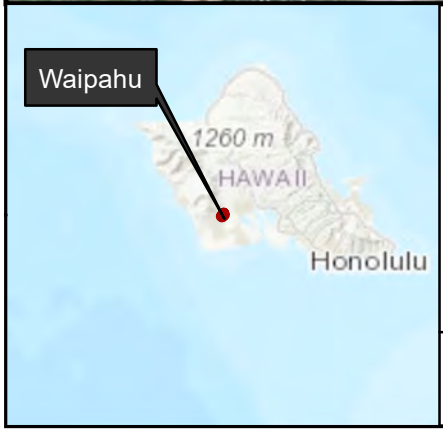
TETRA TECH

Figure 1
PV Array Areas

West Oahu Solar
Oahu, Hawaii

Sources: ESRI Digital Globe 2018 (Basemap)





Legend

- Project Layout (PV Array Areas)
- OPs
- Farrington
- Highway 1 (H1)
- Kualakai

*Locations are approximate

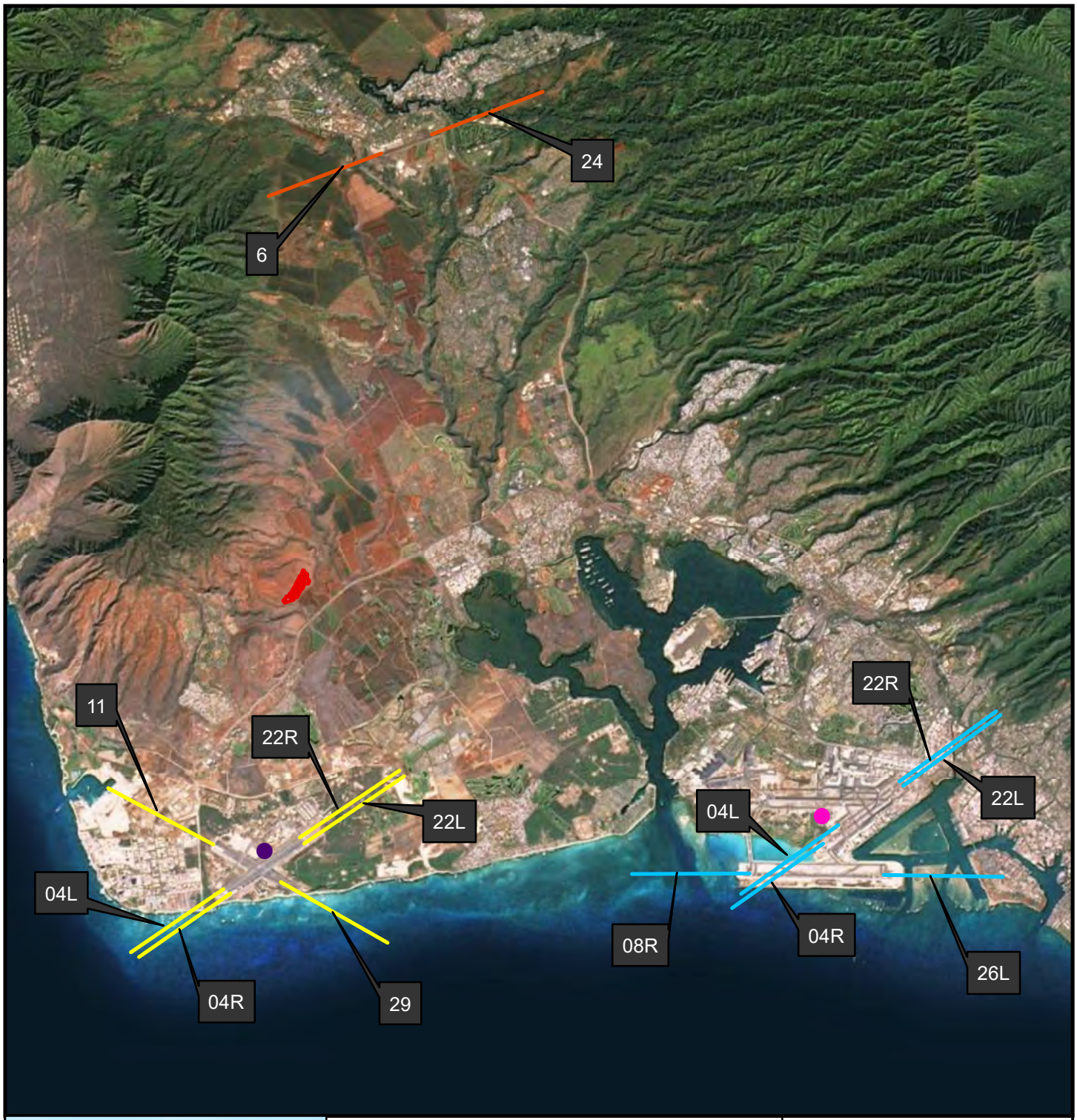
0 1,625 3,250 6,500 Feet

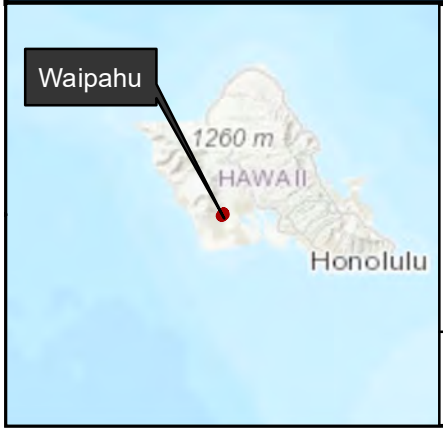
TETRA TECH

Figure 2
Receptors

West Oahu Solar
Oahu, Hawaii

Sources: ESRI Digital Globe 2018 (Basemap)





Legend

- Project Layout (PV Array Areas)
- HNL Final Approach
- HNL ATCT
- JRF Final Approach
- JRF ATCT
- HHI Final Approach

*Locations are approximate

0 1.25 2.5 5 Miles

TETRA TECH

Figure 3
Airport Receptors

West Oahu Solar
Oahu, Hawaii

Sources: ESRI Digital Globe 2018 (Basemap)

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Attachment C. ForgeSolar Glare Analysis Reports

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FORGESOLAR GLARE ANALYSIS

Project: **AES - Hawaii**
Site configuration: **West Oahu Solar**
Analysis conducted by Josh Burdett (joshua.burdett@tetratech.com) at 20:36 on 12 Dec, 2019.

U.S. FAA 2013 Policy Adherence

The following table summarizes the policy adherence of the glare analysis based on the 2013 U.S. Federal Aviation Administration Interim Policy 78 FR 63276. This policy requires the following criteria be met for solar energy systems on airport property:

- No "yellow" glare (potential for after-image) for any flight path from threshold to 2 miles
- No glare of any kind for Air Traffic Control Tower(s) ("ATCT") at cab height.
- Default analysis and observer characteristics (see list below)

ForgeSolar does not represent or speak officially for the FAA and cannot approve or deny projects. Results are informational only.

COMPONENT	STATUS	DESCRIPTION
Analysis parameters	PASS	Analysis time interval and eye characteristics used are acceptable
Flight path(s)	N/A	No flight paths analyzed
ATCT(s)	N/A	No ATCT receptors designated

Default glare analysis parameters and observer eye characteristics (for reference only):

- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

FAA Policy 78 FR 63276 can be read at https://www.federalregister.gov/d/2013-24729

SITE CONFIGURATION

Analysis Parameters

DNI: peaks at 1,000.0 W/m^2
Time interval: 1 min
Ocular transmission coefficient: 0.5
Pupil diameter: 0.002 m
Eye focal length: 0.017 m
Sun subtended angle: 9.3 mrad
Site Config ID: 34061.6258

PV Array(s)

Name: PV Area 1
Axis tracking: Fixed (no rotation)
Tilt: 15.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.378202	-158.062098	414.48	7.60	422.08
2	21.377800	-158.062280	419.04	7.60	426.64
3	21.377602	-158.062377	415.86	7.60	423.46
4	21.377450	-158.062465	411.42	7.60	419.02
5	21.377213	-158.062374	398.76	7.60	406.36
6	21.376973	-158.061441	350.35	7.60	357.96
7	21.377008	-158.060918	333.62	7.60	341.22
8	21.377120	-158.060923	338.28	7.60	345.88
9	21.377490	-158.061106	356.91	7.60	364.51
10	21.377622	-158.061476	374.30	7.60	381.90
11	21.378147	-158.061891	404.33	7.60	411.93

Name: PV Area 2-1
Axis tracking: Fixed (no rotation)
Tilt: 15.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.376881	-158.062833	410.48	7.60	418.08
2	21.376459	-158.063010	418.17	7.60	425.77
3	21.375907	-158.063270	403.44	7.60	411.04
4	21.375544	-158.063457	390.88	7.60	398.48
5	21.375315	-158.063565	394.11	7.60	401.71
6	21.375277	-158.063152	370.95	7.60	378.55
7	21.375227	-158.062736	356.59	7.60	364.19
8	21.375574	-158.062618	369.95	7.60	377.55
9	21.376031	-158.062454	383.79	7.60	391.39
10	21.376511	-158.062293	385.02	7.60	392.62
11	21.376713	-158.062218	382.76	7.60	390.36
12	21.376833	-158.062401	392.49	7.60	400.09

Name: PV Area 2-2
Axis tracking: Fixed (no rotation)
Tilt: 15.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.376711	-158.062205	381.82	7.60	389.42
2	21.376361	-158.062326	386.07	7.60	393.67
3	21.375894	-158.062492	380.15	7.60	387.75
4	21.375450	-158.062645	364.88	7.60	372.48
5	21.375217	-158.062728	355.93	7.60	363.53
6	21.375152	-158.062331	344.64	7.60	352.24
7	21.375065	-158.061803	333.62	7.60	341.22
8	21.375484	-158.061666	342.96	7.60	350.56
9	21.375989	-158.061513	354.20	7.60	361.80
10	21.376499	-158.061365	347.02	7.60	354.62
11	21.376598	-158.061776	365.54	7.60	373.14

Name: PV Area 2-3
Axis tracking: Fixed (no rotation)
Tilt: 15.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.376496	-158.061349	345.68	7.60	353.28
2	21.376129	-158.061451	353.34	7.60	360.94
3	21.375649	-158.061591	344.73	7.60	352.33
4	21.375267	-158.061711	337.77	7.60	345.37
5	21.375055	-158.061786	333.19	7.60	340.80
6	21.375025	-158.061175	318.48	7.60	326.08
7	21.375050	-158.060813	303.34	7.60	310.94
8	21.375095	-158.060542	290.44	7.60	298.04
9	21.375475	-158.060413	294.34	7.60	301.94
10	21.375724	-158.060362	297.35	7.60	304.95
11	21.376002	-158.060582	314.55	7.60	322.15
12	21.376299	-158.060797	321.82	7.60	329.42

Name: PV Area 3-1
Axis tracking: Fixed (no rotation)
Tilt: 15.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.374960	-158.063771	403.94	7.60	411.54
2	21.374550	-158.064018	409.08	7.60	416.68
3	21.374006	-158.064372	405.79	7.60	413.39
4	21.373486	-158.063921	358.12	7.60	365.72
5	21.374071	-158.063321	356.56	7.60	364.16
6	21.374800	-158.062698	341.18	7.60	348.79
7	21.375030	-158.063702	401.45	7.60	409.05

Name: PV Area 3-2
Axis tracking: Fixed (no rotation)
Tilt: 15.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.373471	-158.063900	356.53	7.60	364.13
2	21.373052	-158.063605	329.89	7.60	337.49
3	21.372872	-158.063063	308.33	7.60	315.93
4	21.373132	-158.062811	306.55	7.60	314.15
5	21.373511	-158.062468	302.42	7.60	310.02
6	21.373911	-158.062012	300.71	7.60	308.31
7	21.374650	-158.061711	322.58	7.60	330.18
8	21.374790	-158.062634	337.82	7.60	345.42
9	21.374361	-158.063010	346.18	7.60	353.78
10	21.373771	-158.063557	360.52	7.60	368.12
11	21.373431	-158.063927	356.09	7.60	363.69

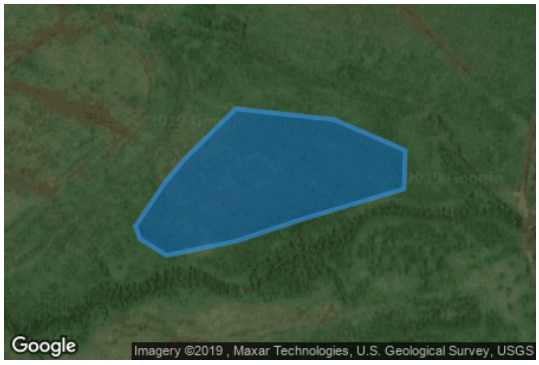
Name: PV Area 3-3
Axis tracking: Fixed (no rotation)
Tilt: 15.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.373971	-158.064423	405.46	7.60	413.06
2	21.373346	-158.064702	408.59	7.60	416.19
3	21.372987	-158.064917	407.08	7.60	414.68
4	21.372597	-158.065507	390.32	7.60	397.92
5	21.372397	-158.065474	370.08	7.60	377.68
6	21.372093	-158.064670	325.30	7.60	332.90
7	21.372627	-158.064343	352.86	7.60	360.46
8	21.373376	-158.063887	352.43	7.60	360.03

Name: PV Area 3-4
Axis tracking: Fixed (no rotation)
Tilt: 15.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.373311	-158.063844	348.21	7.60	355.81
2	21.372912	-158.064117	354.61	7.60	362.22
3	21.372332	-158.064477	337.76	7.60	345.36
4	21.372073	-158.064616	321.88	7.60	329.48
5	21.371838	-158.064101	301.52	7.60	309.12
6	21.371713	-158.063763	289.80	7.60	297.40
7	21.371698	-158.063415	280.75	7.60	288.35
8	21.372113	-158.063200	288.24	7.60	295.85
9	21.372807	-158.063007	305.71	7.60	313.31
10	21.372967	-158.063495	325.17	7.60	332.77
11	21.373032	-158.063661	332.00	7.60	339.60
12	21.373232	-158.063774	341.54	7.60	349.14

Name: PV Area 4
Axis tracking: Fixed (no rotation)
Tilt: 15.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material



Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.371341	-158.066427	397.82	7.60	405.42
2	21.371151	-158.066598	400.08	7.60	407.68
3	21.370776	-158.066875	379.77	7.60	387.37
4	21.370671	-158.066832	364.94	7.60	372.54
5	21.370531	-158.066590	351.04	7.60	358.64
6	21.370651	-158.065957	338.58	7.60	346.18
7	21.370836	-158.065356	317.01	7.60	324.61
8	21.371091	-158.064434	293.63	7.60	301.23
9	21.371416	-158.064423	295.80	7.60	303.40
10	21.371675	-158.065072	321.71	7.60	329.31
11	21.371765	-158.065963	374.69	7.60	382.29

Discrete Observation Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (ft)	Height (ft)
OP 1	1	21.338918	-158.055780	62.34	6.00
OP 2	2	21.365603	-158.072233	580.70	5.00
OP 3	3	21.386054	-158.033239	227.55	5.00

Route Receptor(s)

Name: Farrington -1
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.374314	-158.038678	145.95	5.00	150.95
2	21.374270	-158.040953	161.53	5.00	166.53
3	21.374074	-158.041468	165.25	5.00	170.25
4	21.371476	-158.045244	172.88	5.00	177.88

Name: Farrington - 2
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.371337	-158.045416	172.99	5.00	177.99
2	21.368939	-158.049107	172.07	5.00	177.07
3	21.366881	-158.052196	167.23	5.00	172.23
4	21.366321	-158.052604	164.96	5.00	169.96
5	21.362824	-158.054514	154.31	5.00	159.31
6	21.362164	-158.055179	155.55	5.00	160.55

Name: H 1 - 1
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.383670	-158.032421	174.50	5.00	179.50
2	21.383101	-158.033311	183.18	5.00	188.18
3	21.382202	-158.034942	180.15	5.00	185.15
4	21.381033	-158.037012	192.95	5.00	197.95
5	21.379864	-158.039115	181.51	5.00	186.51

Name: H 1 - 2
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.379784	-158.039212	180.23	5.00	185.23
2	21.378825	-158.040950	184.82	5.00	189.83
3	21.378086	-158.042849	176.17	5.00	181.17
4	21.377196	-158.045166	170.51	5.00	175.51
5	21.376093	-158.047863	197.59	5.00	202.59
6	21.375454	-158.049472	200.45	5.00	205.45

Name: H 1 - 3
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.375384	-158.049558	200.81	5.00	205.81
2	21.374635	-158.050770	224.53	5.00	229.53
3	21.373785	-158.051961	218.02	5.00	223.02
4	21.372457	-158.053453	212.66	5.00	217.66
5	21.370868	-158.055212	204.08	5.00	209.08
6	21.369140	-158.057100	199.86	5.00	204.86

Name: H 1 - 4
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.369060	-158.057143	198.86	5.00	203.86
2	21.366202	-158.060383	213.91	5.00	218.92
3	21.365253	-158.061435	206.63	5.00	211.63
4	21.364254	-158.062325	213.41	5.00	218.41

Name: Kualakai - 1
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.366859	-158.060799	229.85	5.00	234.85
2	21.366040	-158.059962	204.96	5.00	209.96
3	21.365001	-158.058804	185.96	5.00	190.96
4	21.363982	-158.057624	172.93	5.00	177.93
5	21.362703	-158.056143	160.77	5.00	165.77
6	21.362083	-158.055499	157.30	5.00	162.30

Name: Kualakai - 2
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.361924	-158.055349	155.26	5.00	160.26
2	21.361124	-158.054319	148.95	5.00	153.95
3	21.360365	-158.053525	138.32	5.00	143.32
4	21.359526	-158.052602	140.78	5.00	145.78
5	21.358646	-158.051766	140.91	5.00	145.91

Name: Kualakai - 3
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.358466	-158.051594	139.44	5.00	144.44
2	21.357647	-158.051122	134.59	5.00	139.59
3	21.356528	-158.050478	125.14	5.00	130.14
4	21.355149	-158.049899	119.06	5.00	124.06
5	21.353670	-158.049491	111.60	5.00	116.60
6	21.352431	-158.049362	102.67	5.00	107.67

Name: Kualakai - 4
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.352347	-158.049384	102.24	5.00	107.24
2	21.351248	-158.049384	95.16	5.00	100.16
3	21.349290	-158.049706	84.68	5.00	89.68
4	21.347391	-158.050199	78.74	5.00	83.74
5	21.345253	-158.051744	77.85	5.00	82.85
6	21.344313	-158.052667	75.37	5.00	80.37

Name: Kualakai - 5
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.344193	-158.052796	74.68	5.00	79.68
2	21.343174	-158.053439	70.98	5.00	75.98
3	21.342295	-158.053697	68.90	5.00	73.90
4	21.341075	-158.053718	68.79	5.00	73.79
5	21.339097	-158.052860	59.09	5.00	64.09
6	21.336099	-158.051379	55.78	5.00	60.78

GLARE ANALYSIS RESULTS

Summary of Glare

PV Array Name	Tilt (°)	Orient (°)	"Green" Glare min	"Yellow" Glare min	Energy kWh
PV Area 1	15.0	180.0	1,237	0	-
PV Area 2-1	15.0	180.0	0	0	-
PV Area 2-2	15.0	180.0	840	0	-
PV Area 2-3	15.0	180.0	1,173	0	-
PV Area 3-1	15.0	180.0	1,216	0	-
PV Area 3-2	15.0	180.0	1,028	35	-
PV Area 3-3	15.0	180.0	472	0	-
PV Area 3-4	15.0	180.0	1,253	0	-
PV Area 4	15.0	180.0	1,746	0	-

Total annual glare received by each receptor

Receptor	Annual Green Glare (min)	Annual Yellow Glare (min)
OP 1	0	0
OP 2	0	0
OP 3	0	0
Farrington -1	1578	0
Farrington - 2	4785	0
H 1 - 1	0	0
H 1 - 2	104	0
H 1 - 3	2498	35
H 1 - 4	0	0
Kualakai - 1	0	0
Kualakai - 2	0	0
Kualakai - 3	0	0
Kualakai - 4	0	0
Kualakai - 5	0	0

Results for: PV Area 1

Receptor	Green Glare (min)	Yellow Glare (min)
OP 1	0	0
OP 2	0	0
OP 3	0	0
Farrington -1	538	0
Farrington - 2	0	0
H 1 - 1	0	0
H 1 - 2	104	0
H 1 - 3	595	0
H 1 - 4	0	0
Kualakai - 1	0	0
Kualakai - 2	0	0
Kualakai - 3	0	0
Kualakai - 4	0	0
Kualakai - 5	0	0

Point Receptor: OP 1

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 2

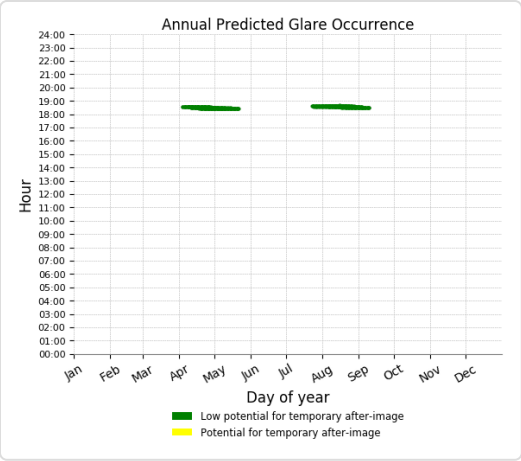
0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 3

0 minutes of yellow glare
0 minutes of green glare

Route: Farrington -1

0 minutes of yellow glare
538 minutes of green glare



Route: Farrington - 2

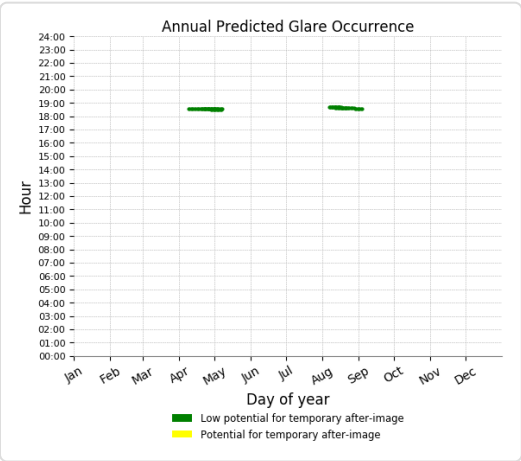
0 minutes of yellow glare
0 minutes of green glare

Route: H 1 - 1

0 minutes of yellow glare
0 minutes of green glare

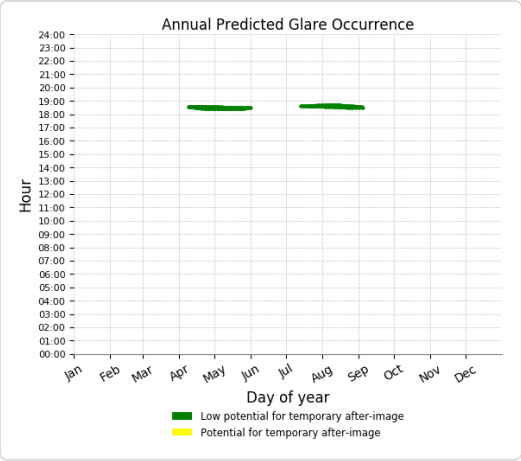
Route: H 1 - 2

0 minutes of yellow glare
104 minutes of green glare



Route: H 1 - 3

0 minutes of yellow glare
595 minutes of green glare



Route: H 1 - 4

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 1

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 2

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 3

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 4

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 5

0 minutes of yellow glare
0 minutes of green glare

Results for: PV Area 2-1

Receptor	Green Glare (min)	Yellow Glare (min)
OP 1	0	0
OP 2	0	0
OP 3	0	0
Farrington -1	0	0
Farrington - 2	0	0
H 1 - 1	0	0
H 1 - 2	0	0
H 1 - 3	0	0
H 1 - 4	0	0
Kualakai - 1	0	0
Kualakai - 2	0	0
Kualakai - 3	0	0
Kualakai - 4	0	0
Kualakai - 5	0	0

Point Receptor: OP 1

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 2

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 3

0 minutes of yellow glare
0 minutes of green glare

Route: Farrington -1

0 minutes of yellow glare
0 minutes of green glare

Route: Farrington - 2

0 minutes of yellow glare
0 minutes of green glare

Route: H 1 - 1

0 minutes of yellow glare
0 minutes of green glare

Route: H 1 - 2

0 minutes of yellow glare
0 minutes of green glare

Route: H 1 - 3

0 minutes of yellow glare
0 minutes of green glare

Route: H 1 - 4

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 1

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 2

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 3

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 4

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 5

0 minutes of yellow glare
0 minutes of green glare

Results for: PV Area 2-2

Receptor	Green Glare (min)	Yellow Glare (min)
OP 1	0	0
OP 2	0	0
OP 3	0	0
Farrington -1	312	0
Farrington - 2	305	0
H 1 - 1	0	0
H 1 - 2	0	0
H 1 - 3	223	0
H 1 - 4	0	0
Kualakai - 1	0	0
Kualakai - 2	0	0
Kualakai - 3	0	0
Kualakai - 4	0	0
Kualakai - 5	0	0

Point Receptor: OP 1

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 2

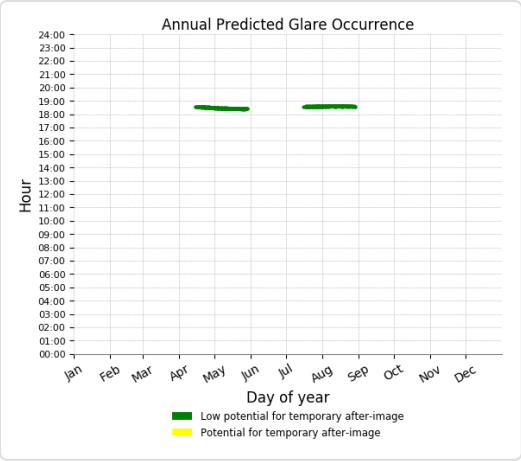
0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 3

0 minutes of yellow glare
0 minutes of green glare

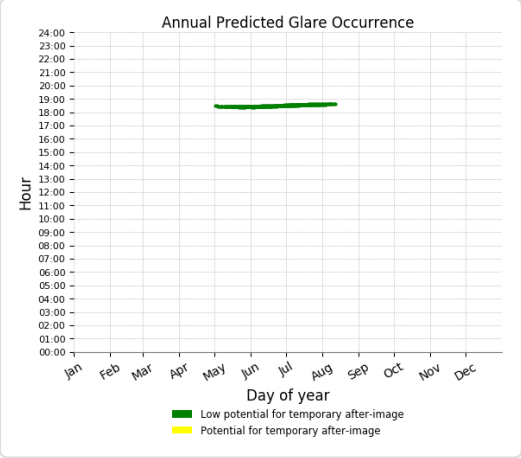
Route: Farrington -1

0 minutes of yellow glare
312 minutes of green glare



Route: Farrington - 2

0 minutes of yellow glare
305 minutes of green glare



Route: H 1 - 1

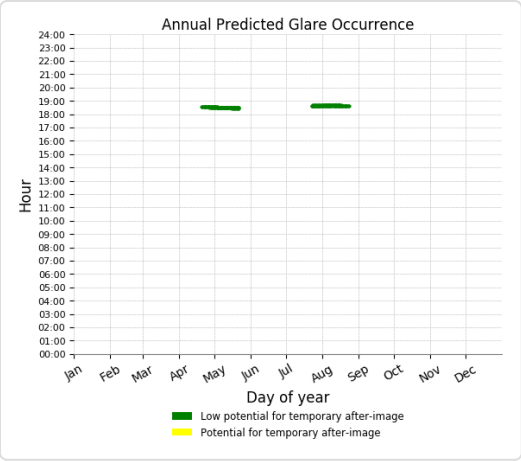
0 minutes of yellow glare
0 minutes of green glare

Route: H 1 - 2

0 minutes of yellow glare
0 minutes of green glare

Route: H 1 - 3

0 minutes of yellow glare
223 minutes of green glare



Route: H 1 - 4

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 1

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 2

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 3

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 4

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 5

0 minutes of yellow glare
0 minutes of green glare

Results for: PV Area 2-3

Receptor	Green Glare (min)	Yellow Glare (min)
OP 1	0	0
OP 2	0	0
OP 3	0	0
Farrington -1	412	0
Farrington - 2	404	0
H 1 - 1	0	0
H 1 - 2	0	0
H 1 - 3	357	0
H 1 - 4	0	0
Kualakai - 1	0	0
Kualakai - 2	0	0
Kualakai - 3	0	0
Kualakai - 4	0	0
Kualakai - 5	0	0

Point Receptor: OP 1

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 2

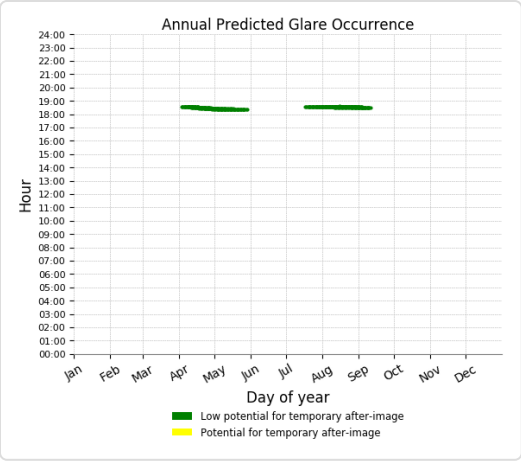
0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 3

0 minutes of yellow glare
0 minutes of green glare

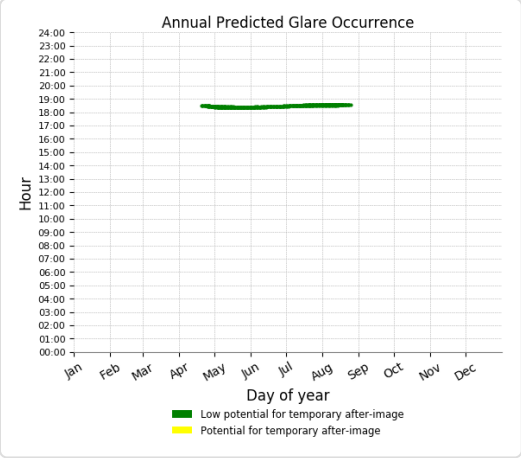
Route: Farrington -1

0 minutes of yellow glare
412 minutes of green glare



Route: Farrington - 2

0 minutes of yellow glare
404 minutes of green glare



Route: H 1 - 1

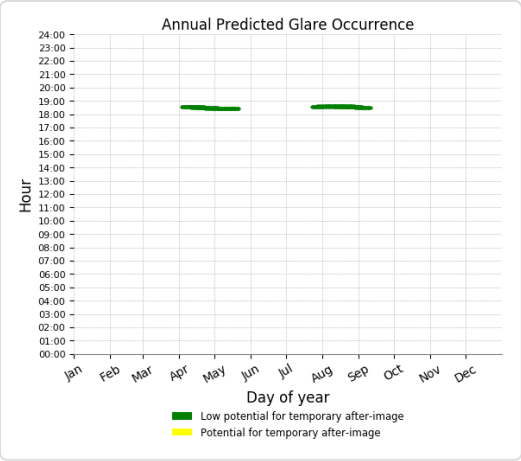
0 minutes of yellow glare
0 minutes of green glare

Route: H 1 - 2

0 minutes of yellow glare
0 minutes of green glare

Route: H 1 - 3

0 minutes of yellow glare
357 minutes of green glare



Route: H 1 - 4

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 1

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 2

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 3

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 4

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 5

0 minutes of yellow glare
0 minutes of green glare

Results for: PV Area 3-1

Receptor	Green Glare (min)	Yellow Glare (min)
OP 1	0	0
OP 2	0	0
OP 3	0	0
Farrington -1	191	0
Farrington - 2	751	0
H 1 - 1	0	0
H 1 - 2	0	0
H 1 - 3	274	0
H 1 - 4	0	0
Kualakai - 1	0	0
Kualakai - 2	0	0
Kualakai - 3	0	0
Kualakai - 4	0	0
Kualakai - 5	0	0

Point Receptor: OP 1

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 2

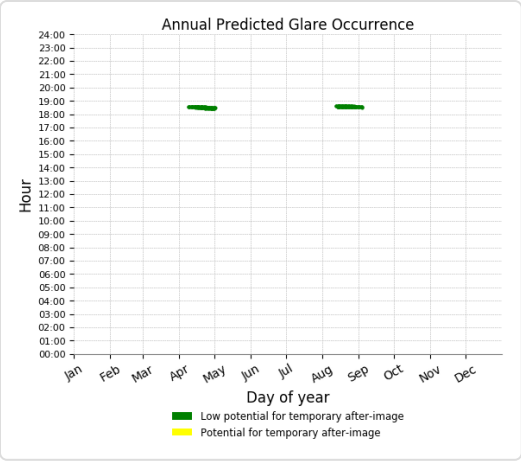
0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 3

0 minutes of yellow glare
0 minutes of green glare

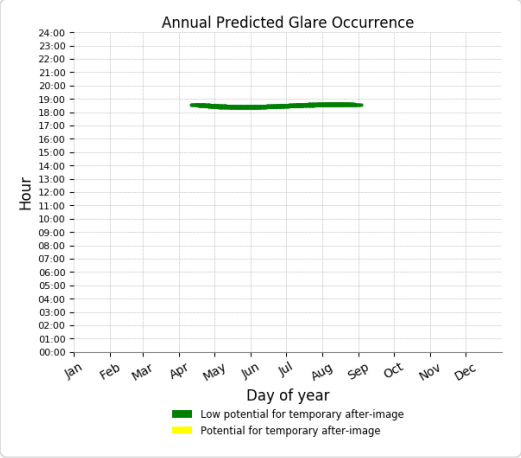
Route: Farrington -1

0 minutes of yellow glare
191 minutes of green glare



Route: Farrington - 2

0 minutes of yellow glare
751 minutes of green glare



Route: H 1 - 1

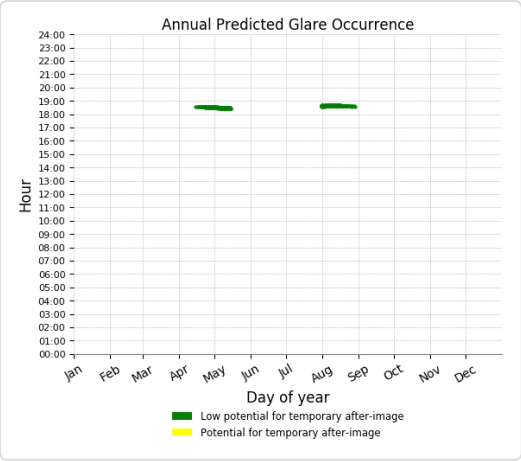
0 minutes of yellow glare
0 minutes of green glare

Route: H 1 - 2

0 minutes of yellow glare
0 minutes of green glare

Route: H 1 - 3

0 minutes of yellow glare
274 minutes of green glare



Route: H 1 - 4

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 1

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 2

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 3

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 4

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 5

0 minutes of yellow glare
0 minutes of green glare

Results for: PV Area 3-2

Receptor	Green Glare (min)	Yellow Glare (min)
OP 1	0	0
OP 2	0	0
OP 3	0	0
Farrington -1	123	0
Farrington - 2	614	0
H 1 - 1	0	0
H 1 - 2	0	0
H 1 - 3	291	35
H 1 - 4	0	0
Kualakai - 1	0	0
Kualakai - 2	0	0
Kualakai - 3	0	0
Kualakai - 4	0	0
Kualakai - 5	0	0

Point Receptor: OP 1

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 2

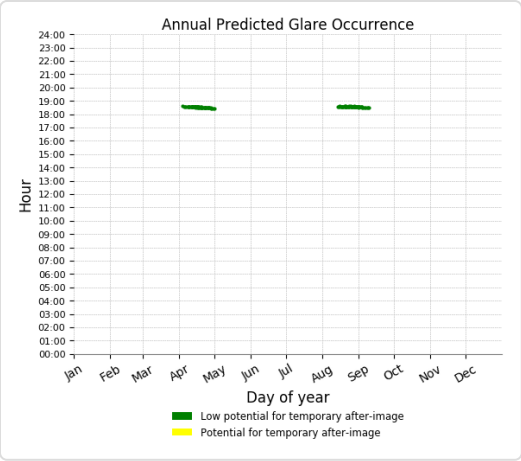
0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 3

0 minutes of yellow glare
0 minutes of green glare

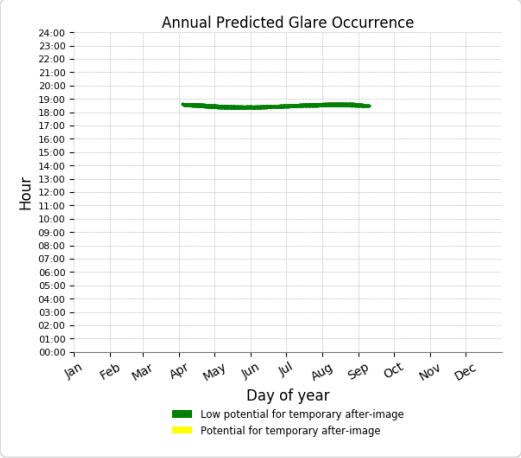
Route: Farrington -1

0 minutes of yellow glare
123 minutes of green glare



Route: Farrington - 2

0 minutes of yellow glare
614 minutes of green glare



Route: H 1 - 1

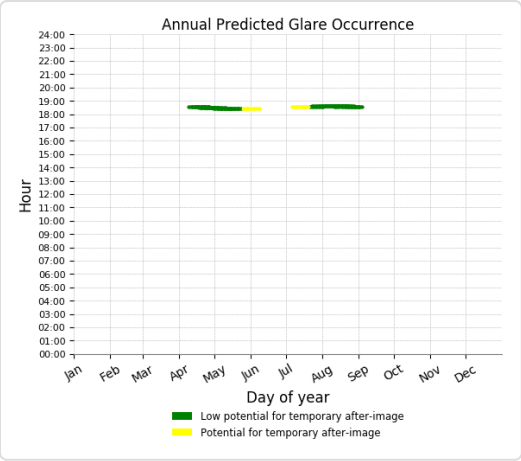
0 minutes of yellow glare
0 minutes of green glare

Route: H 1 - 2

0 minutes of yellow glare
0 minutes of green glare

Route: H 1 - 3

35 minutes of yellow glare
291 minutes of green glare



Route: H 1 - 4

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 1

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 2

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 3

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 4

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 5

0 minutes of yellow glare
0 minutes of green glare

Results for: PV Area 3-3

Receptor	Green Glare (min)	Yellow Glare (min)
OP 1	0	0
OP 2	0	0
OP 3	0	0
Farrington -1	0	0
Farrington - 2	444	0
H 1 - 1	0	0
H 1 - 2	0	0
H 1 - 3	28	0
H 1 - 4	0	0
Kualakai - 1	0	0
Kualakai - 2	0	0
Kualakai - 3	0	0
Kualakai - 4	0	0
Kualakai - 5	0	0

Point Receptor: OP 1

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 2

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 3

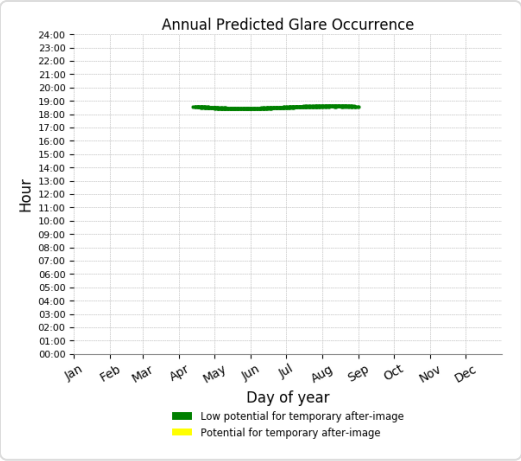
0 minutes of yellow glare
0 minutes of green glare

Route: Farrington -1

0 minutes of yellow glare
0 minutes of green glare

Route: Farrington - 2

0 minutes of yellow glare
444 minutes of green glare



Route: H 1 - 1

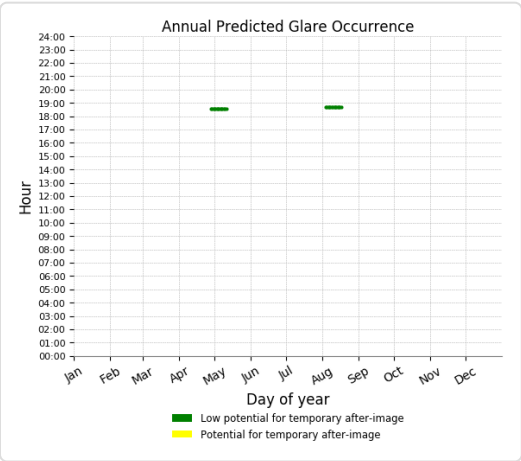
0 minutes of yellow glare
0 minutes of green glare

Route: H 1 - 2

0 minutes of yellow glare
0 minutes of green glare

Route: H 1 - 3

0 minutes of yellow glare
28 minutes of green glare



Route: H 1 - 4

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 1

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 2

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 3

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 4

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 5

0 minutes of yellow glare
0 minutes of green glare

Results for: PV Area 3-4

Receptor	Green Glare (min)	Yellow Glare (min)
OP 1	0	0
OP 2	0	0
OP 3	0	0
Farrington -1	2	0
Farrington - 2	883	0
H 1 - 1	0	0
H 1 - 2	0	0
H 1 - 3	368	0
H 1 - 4	0	0
Kualakai - 1	0	0
Kualakai - 2	0	0
Kualakai - 3	0	0
Kualakai - 4	0	0
Kualakai - 5	0	0

Point Receptor: OP 1

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 2

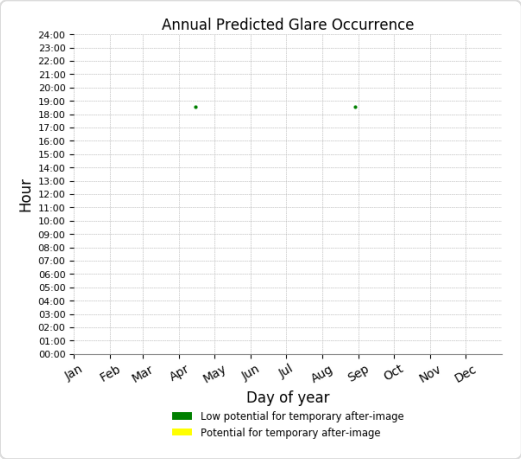
0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 3

0 minutes of yellow glare
0 minutes of green glare

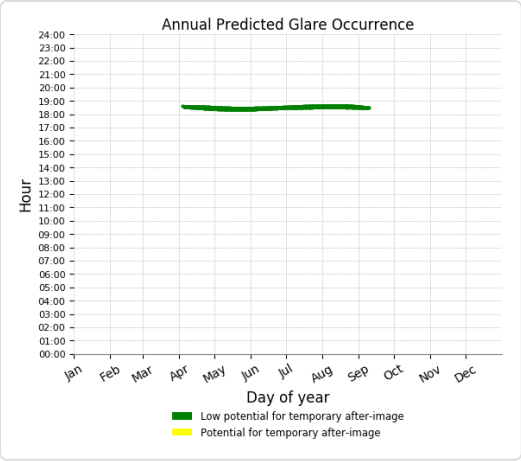
Route: Farrington -1

0 minutes of yellow glare
2 minutes of green glare



Route: Farrington - 2

0 minutes of yellow glare
883 minutes of green glare



Route: H 1 - 1

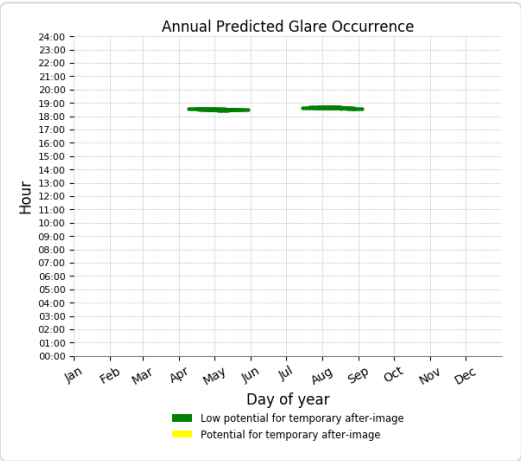
0 minutes of yellow glare
0 minutes of green glare

Route: H 1 - 2

0 minutes of yellow glare
0 minutes of green glare

Route: H 1 - 3

0 minutes of yellow glare
368 minutes of green glare



Route: H 1 - 4

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 1

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 2

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 3

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 4

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 5

0 minutes of yellow glare
0 minutes of green glare

Results for: PV Area 4

Receptor	Green Glare (min)	Yellow Glare (min)
OP 1	0	0
OP 2	0	0
OP 3	0	0
Farrington -1	0	0
Farrington - 2	1384	0
H 1 - 1	0	0
H 1 - 2	0	0
H 1 - 3	362	0
H 1 - 4	0	0
Kualakai - 1	0	0
Kualakai - 2	0	0
Kualakai - 3	0	0
Kualakai - 4	0	0
Kualakai - 5	0	0

Point Receptor: OP 1

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 2

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 3

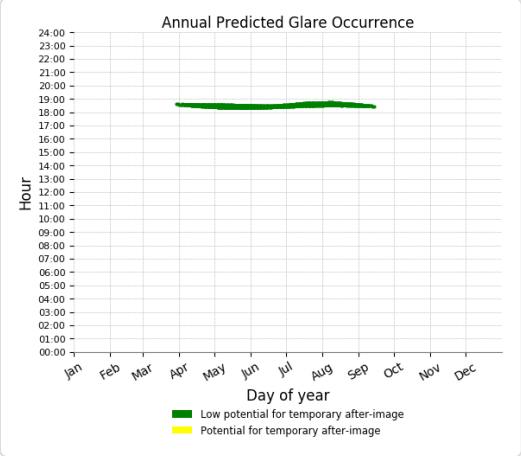
0 minutes of yellow glare
0 minutes of green glare

Route: Farrington -1

0 minutes of yellow glare
0 minutes of green glare

Route: Farrington - 2

0 minutes of yellow glare
1384 minutes of green glare



Route: H 1 - 1

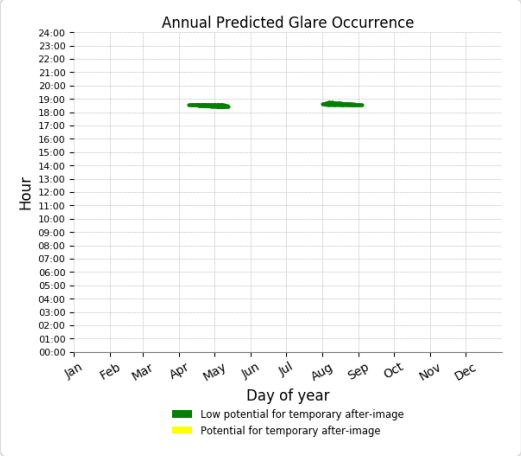
0 minutes of yellow glare
0 minutes of green glare

Route: H 1 - 2

0 minutes of yellow glare
0 minutes of green glare

Route: H 1 - 3

0 minutes of yellow glare
362 minutes of green glare



Route: H 1 - 4

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 1

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 2

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 3

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 4

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 5

0 minutes of yellow glare
0 minutes of green glare

Assumptions

"Green" glare is glare with low potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
"Yellow" glare is glare with potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
Glare analyses do not account for physical obstructions between reflectors and receptors. This includes buildings, tree cover and geographic obstructions.
Several calculations utilize the PV array centroid, rather than the actual glare spot location, due to algorithm limitations. This may affect results for large PV footprints. Additional analyses of array sub-sections can provide additional information on expected glare.
The subtended source angle (glare spot size) is constrained by the PV array footprint size. Partitioning large arrays into smaller sections will reduce the maximum potential subtended angle, potentially impacting results if actual glare spots are larger than the sub-array size. Additional analyses of the combined area of adjacent sub-arrays can provide more information on potential glare hazards. (See previous point on related limitations.)
Glare locations displayed on receptor plots are approximate. Actual glare-spot locations may differ.
Glare vector plots are simplified representations of analysis data. Actual glare emanations and results may differ.
The glare hazard determination relies on several approximations including observer eye characteristics, angle of view, and typical blink response time. Actual results and glare occurrence may differ.
Hazard zone boundaries shown in the Glare Hazard plot are an approximation and visual aid based on aggregated research data. Actual ocular impact outcomes encompass a continuous, not discrete, spectrum.

FORGESOLAR GLARE ANALYSIS

Project: **AES - Hawaii**
Site configuration: **West Oahu Solar - upper**
Analysis conducted by Josh Burdett (joshua.burdett@tetratech.com) at 19:59 on 16 Dec, 2019.

U.S. FAA 2013 Policy Adherence

The following table summarizes the policy adherence of the glare analysis based on the 2013 U.S. Federal Aviation Administration Interim Policy 78 FR 63276. This policy requires the following criteria be met for solar energy systems on airport property:

- No "yellow" glare (potential for after-image) for any flight path from threshold to 2 miles
- No glare of any kind for Air Traffic Control Tower(s) ("ATCT") at cab height.
- Default analysis and observer characteristics (see list below)

ForgeSolar does not represent or speak officially for the FAA and cannot approve or deny projects. Results are informational only.

COMPONENT	STATUS	DESCRIPTION
Analysis parameters	PASS	Analysis time interval and eye characteristics used are acceptable
Flight path(s)	N/A	No flight paths analyzed
ATCT(s)	N/A	No ATCT receptors designated

Default glare analysis parameters and observer eye characteristics (for reference only):

- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

FAA Policy 78 FR 63276 can be read at https://www.federalregister.gov/d/2013-24729

SITE CONFIGURATION

Analysis Parameters

DNI: peaks at 1,000.0 W/m^2
Time interval: 1 min
Ocular transmission coefficient: 0.5
Pupil diameter: 0.002 m
Eye focal length: 0.017 m
Sun subtended angle: 9.3 mrad
Site Config ID: 34346.6258

PV Array(s)

Name: PV Area 1
Axis tracking: Fixed (no rotation)
Tilt: 15.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.378202	-158.062098	414.48	7.60	422.08
2	21.377800	-158.062280	419.04	7.60	426.64
3	21.377602	-158.062377	415.86	7.60	423.46
4	21.377450	-158.062465	411.42	7.60	419.02
5	21.377213	-158.062374	398.76	7.60	406.36
6	21.376973	-158.061441	350.35	7.60	357.96
7	21.377008	-158.060918	333.62	7.60	341.22
8	21.377120	-158.060923	338.28	7.60	345.88
9	21.377490	-158.061106	356.91	7.60	364.51
10	21.377622	-158.061476	374.30	7.60	381.90
11	21.378147	-158.061891	404.33	7.60	411.93

Name: PV Area 2-1
Axis tracking: Fixed (no rotation)
Tilt: 15.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.376881	-158.062833	410.48	7.60	418.08
2	21.376459	-158.063010	418.17	7.60	425.77
3	21.375907	-158.063270	403.44	7.60	411.04
4	21.375544	-158.063457	390.88	7.60	398.48
5	21.375315	-158.063565	394.11	7.60	401.71
6	21.375277	-158.063152	370.95	7.60	378.55
7	21.375227	-158.062736	356.59	7.60	364.19
8	21.375574	-158.062618	369.95	7.60	377.55
9	21.376031	-158.062454	383.79	7.60	391.39
10	21.376511	-158.062293	385.02	7.60	392.62
11	21.376713	-158.062218	382.76	7.60	390.36
12	21.376833	-158.062401	392.49	7.60	400.09

Name: PV Area 2-2
Axis tracking: Fixed (no rotation)
Tilt: 15.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.376711	-158.062205	381.82	7.60	389.42
2	21.376361	-158.062326	386.07	7.60	393.67
3	21.375894	-158.062492	380.15	7.60	387.75
4	21.375450	-158.062645	364.88	7.60	372.48
5	21.375217	-158.062728	355.93	7.60	363.53
6	21.375152	-158.062331	344.64	7.60	352.24
7	21.375065	-158.061803	333.62	7.60	341.22
8	21.375484	-158.061666	342.96	7.60	350.56
9	21.375989	-158.061513	354.20	7.60	361.80
10	21.376499	-158.061365	347.02	7.60	354.62
11	21.376598	-158.061776	365.54	7.60	373.14

Name: PV Area 2-3
Axis tracking: Fixed (no rotation)
Tilt: 15.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.376496	-158.061349	345.68	7.60	353.28
2	21.376129	-158.061451	353.34	7.60	360.94
3	21.375649	-158.061591	344.73	7.60	352.33
4	21.375267	-158.061711	337.77	7.60	345.37
5	21.375055	-158.061786	333.19	7.60	340.80
6	21.375025	-158.061175	318.48	7.60	326.08
7	21.375050	-158.060813	303.34	7.60	310.94
8	21.375095	-158.060542	290.44	7.60	298.04
9	21.375475	-158.060413	294.34	7.60	301.94
10	21.375724	-158.060362	297.35	7.60	304.95
11	21.376002	-158.060582	314.55	7.60	322.15
12	21.376299	-158.060797	321.82	7.60	329.42

Name: PV Area 3-1
Axis tracking: Fixed (no rotation)
Tilt: 15.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.374960	-158.063771	403.94	7.60	411.54
2	21.374550	-158.064018	409.08	7.60	416.68
3	21.374006	-158.064372	405.79	7.60	413.39
4	21.373486	-158.063921	358.12	7.60	365.72
5	21.374071	-158.063321	356.56	7.60	364.16
6	21.374800	-158.062698	341.18	7.60	348.79
7	21.375030	-158.063702	401.45	7.60	409.05

Name: PV Area 3-2
Axis tracking: Fixed (no rotation)
Tilt: 15.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.373471	-158.063900	356.53	7.60	364.13
2	21.373052	-158.063605	329.89	7.60	337.49
3	21.372872	-158.063063	308.33	7.60	315.93
4	21.373132	-158.062811	306.55	7.60	314.15
5	21.373511	-158.062468	302.42	7.60	310.02
6	21.373911	-158.062012	300.71	7.60	308.31
7	21.374650	-158.061711	322.58	7.60	330.18
8	21.374790	-158.062634	337.82	7.60	345.42
9	21.374361	-158.063010	346.18	7.60	353.78
10	21.373771	-158.063557	360.52	7.60	368.12
11	21.373431	-158.063927	356.09	7.60	363.69

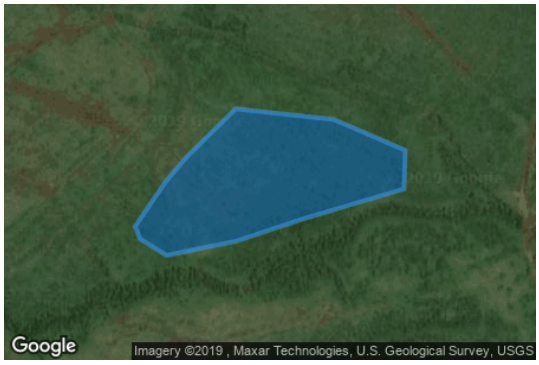
Name: PV Area 3-3
Axis tracking: Fixed (no rotation)
Tilt: 15.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.373971	-158.064423	405.46	7.60	413.06
2	21.373346	-158.064702	408.59	7.60	416.19
3	21.372987	-158.064917	407.08	7.60	414.68
4	21.372597	-158.065507	390.32	7.60	397.92
5	21.372397	-158.065474	370.08	7.60	377.68
6	21.372093	-158.064670	325.30	7.60	332.90
7	21.372627	-158.064343	352.86	7.60	360.46
8	21.373376	-158.063887	352.43	7.60	360.03

Name: PV Area 3-4
Axis tracking: Fixed (no rotation)
Tilt: 15.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.373311	-158.063844	348.21	7.60	355.81
2	21.372912	-158.064117	354.61	7.60	362.22
3	21.372332	-158.064477	337.76	7.60	345.36
4	21.372073	-158.064616	321.88	7.60	329.48
5	21.371838	-158.064101	301.52	7.60	309.12
6	21.371713	-158.063763	289.80	7.60	297.40
7	21.371698	-158.063415	280.75	7.60	288.35
8	21.372113	-158.063200	288.24	7.60	295.85
9	21.372807	-158.063007	305.71	7.60	313.31
10	21.372967	-158.063495	325.17	7.60	332.77
11	21.373032	-158.063661	332.00	7.60	339.60
12	21.373232	-158.063774	341.54	7.60	349.14

Name: PV Area 4
Axis tracking: Fixed (no rotation)
Tilt: 15.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material



Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.371341	-158.066427	397.82	7.60	405.42
2	21.371151	-158.066598	400.08	7.60	407.68
3	21.370776	-158.066875	379.77	7.60	387.37
4	21.370671	-158.066832	364.94	7.60	372.54
5	21.370531	-158.066590	351.04	7.60	358.64
6	21.370651	-158.065957	338.58	7.60	346.18
7	21.370836	-158.065356	317.01	7.60	324.61
8	21.371091	-158.064434	293.63	7.60	301.23
9	21.371416	-158.064423	295.80	7.60	303.40
10	21.371675	-158.065072	321.71	7.60	329.31
11	21.371765	-158.065963	374.69	7.60	382.29

Discrete Observation Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (ft)	Height (ft)
OP 1	1	21.338918	-158.055780	62.34	16.00
OP 2	2	21.365603	-158.072233	580.70	16.00
OP 3	3	21.386054	-158.033239	227.55	16.00

Route Receptor(s)

Name: Farrington -1
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.374314	-158.038678	145.95	9.00	154.95
2	21.374270	-158.040953	161.53	9.00	170.53
3	21.374074	-158.041468	165.25	9.00	174.25
4	21.371476	-158.045244	172.88	9.00	181.88

Name: Farrington - 2
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.371337	-158.045416	172.99	9.00	181.99
2	21.368939	-158.049107	172.07	9.00	181.07
3	21.366881	-158.052196	167.23	9.00	176.23
4	21.366321	-158.052604	164.96	9.00	173.96
5	21.362824	-158.054514	154.31	9.00	163.31
6	21.362164	-158.055179	155.55	9.00	164.55

Name: H 1 - 1
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.383670	-158.032421	174.50	9.00	183.50
2	21.383101	-158.033311	183.18	9.00	192.18
3	21.382202	-158.034942	180.15	9.00	189.15
4	21.381033	-158.037012	192.95	9.00	201.95
5	21.379864	-158.039115	181.51	9.00	190.51

Name: H 1 - 2
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.379784	-158.039212	180.23	9.00	189.23
2	21.378825	-158.040950	184.82	9.00	193.83
3	21.378086	-158.042849	176.17	9.00	185.17
4	21.377196	-158.045166	170.51	9.00	179.51
5	21.376093	-158.047863	197.59	9.00	206.59
6	21.375454	-158.049472	200.45	9.00	209.45

Name: H 1 - 3
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.375384	-158.049558	200.81	9.00	209.81
2	21.374635	-158.050770	224.53	9.00	233.53
3	21.373785	-158.051961	218.02	9.00	227.02
4	21.372457	-158.053453	212.66	9.00	221.66
5	21.370868	-158.055212	204.08	9.00	213.08
6	21.369140	-158.057100	199.86	9.00	208.86

Name: H 1 - 4
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.369060	-158.057143	198.86	9.00	207.86
2	21.366202	-158.060383	213.91	9.00	222.92
3	21.365253	-158.061435	206.63	9.00	215.63
4	21.364254	-158.062325	213.41	9.00	222.41

Name: Kualakai - 1
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.366859	-158.060799	229.85	9.00	238.85
2	21.366040	-158.059962	204.96	9.00	213.96
3	21.365001	-158.058804	185.96	9.00	194.96
4	21.363982	-158.057624	172.93	9.00	181.93
5	21.362703	-158.056143	160.77	9.00	169.77
6	21.362083	-158.055499	157.30	9.00	166.30

Name: Kualakai - 2
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.361924	-158.055349	155.26	9.00	164.27
2	21.361124	-158.054319	148.95	9.00	157.95
3	21.360365	-158.053525	138.32	9.00	147.32
4	21.359526	-158.052602	140.78	9.00	149.78
5	21.358646	-158.051766	140.91	9.00	149.91

Name: Kualakai - 3
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.358466	-158.051594	139.44	9.00	148.44
2	21.357647	-158.051122	134.59	9.00	143.59
3	21.356528	-158.050478	125.14	9.00	134.14
4	21.355149	-158.049899	119.06	9.00	128.06
5	21.353670	-158.049491	111.60	9.00	120.60
6	21.352431	-158.049362	102.67	9.00	111.67

Name: Kualakai - 4
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.352347	-158.049384	102.24	9.00	111.24
2	21.351248	-158.049384	95.16	9.00	104.16
3	21.349290	-158.049706	84.68	9.00	93.68
4	21.347391	-158.050199	78.74	9.00	87.74
5	21.345253	-158.051744	77.85	9.00	86.85
6	21.344313	-158.052667	75.37	9.00	84.37

Name: Kualakai - 5
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.344193	-158.052796	74.68	9.00	83.68
2	21.343174	-158.053439	70.98	9.00	79.98
3	21.342295	-158.053697	68.90	9.00	77.90
4	21.341075	-158.053718	68.79	9.00	77.79
5	21.339097	-158.052860	59.09	9.00	68.09
6	21.336099	-158.051379	55.78	9.00	64.78

GLARE ANALYSIS RESULTS

Summary of Glare

PV Array Name	Tilt (°)	Orient (°)	"Green" Glare min	"Yellow" Glare min	Energy kWh
PV Area 1	15.0	180.0	1,278	0	-
PV Area 2-1	15.0	180.0	0	0	-
PV Area 2-2	15.0	180.0	849	0	-
PV Area 2-3	15.0	180.0	1,215	0	-
PV Area 3-1	15.0	180.0	1,253	0	-
PV Area 3-2	15.0	180.0	1,042	50	-
PV Area 3-3	15.0	180.0	466	0	-
PV Area 3-4	15.0	180.0	1,289	0	-
PV Area 4	15.0	180.0	1,798	0	-

Total annual glare received by each receptor

Receptor	Annual Green Glare (min)	Annual Yellow Glare (min)
OP 1	0	0
OP 2	0	0
OP 3	0	0
Farrington -1	1608	0
Farrington - 2	4840	0
H 1 - 1	0	0
H 1 - 2	118	0
H 1 - 3	2624	50
H 1 - 4	0	0
Kualakai - 1	0	0
Kualakai - 2	0	0
Kualakai - 3	0	0
Kualakai - 4	0	0
Kualakai - 5	0	0

Results for: PV Area 1

Receptor	Green Glare (min)	Yellow Glare (min)
OP 1	0	0
OP 2	0	0
OP 3	0	0
Farrington -1	542	0
Farrington - 2	0	0
H 1 - 1	0	0
H 1 - 2	118	0
H 1 - 3	618	0
H 1 - 4	0	0
Kualakai - 1	0	0
Kualakai - 2	0	0
Kualakai - 3	0	0
Kualakai - 4	0	0
Kualakai - 5	0	0

Point Receptor: OP 1

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 2

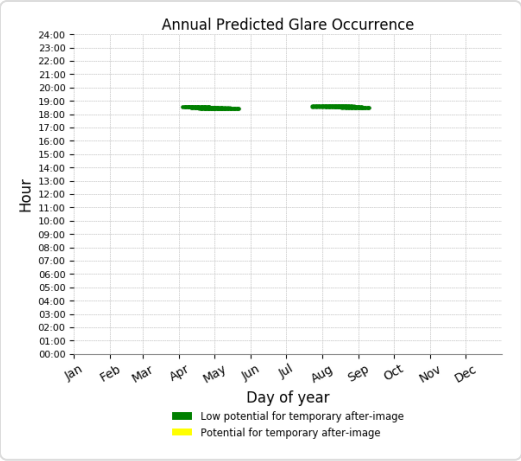
0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 3

0 minutes of yellow glare
0 minutes of green glare

Route: Farrington -1

0 minutes of yellow glare
542 minutes of green glare



Route: Farrington - 2

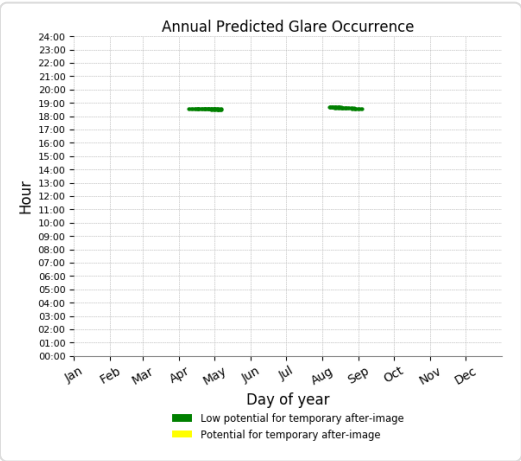
0 minutes of yellow glare
0 minutes of green glare

Route: H 1 - 1

0 minutes of yellow glare
0 minutes of green glare

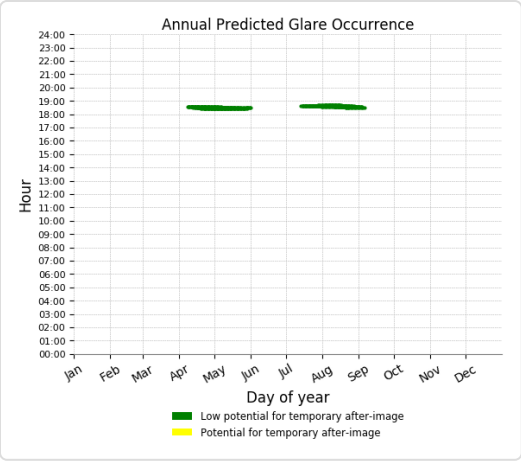
Route: H 1 - 2

0 minutes of yellow glare
118 minutes of green glare



Route: H 1 - 3

0 minutes of yellow glare
618 minutes of green glare



Route: H 1 - 4

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 1

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 2

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 3

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 4

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 5

0 minutes of yellow glare
0 minutes of green glare

Results for: PV Area 2-1

Receptor	Green Glare (min)	Yellow Glare (min)
OP 1	0	0
OP 2	0	0
OP 3	0	0
Farrington -1	0	0
Farrington - 2	0	0
H 1 - 1	0	0
H 1 - 2	0	0
H 1 - 3	0	0
H 1 - 4	0	0
Kualakai - 1	0	0
Kualakai - 2	0	0
Kualakai - 3	0	0
Kualakai - 4	0	0
Kualakai - 5	0	0

Point Receptor: OP 1

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 2

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 3

0 minutes of yellow glare
0 minutes of green glare

Route: Farrington -1

0 minutes of yellow glare
0 minutes of green glare

Route: Farrington - 2

0 minutes of yellow glare
0 minutes of green glare

Route: H 1 - 1

0 minutes of yellow glare
0 minutes of green glare

Route: H 1 - 2

0 minutes of yellow glare
0 minutes of green glare

Route: H 1 - 3

0 minutes of yellow glare
0 minutes of green glare

Route: H 1 - 4

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 1

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 2

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 3

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 4

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 5

0 minutes of yellow glare
0 minutes of green glare

Results for: PV Area 2-2

Receptor	Green Glare (min)	Yellow Glare (min)
OP 1	0	0
OP 2	0	0
OP 3	0	0
Farrington -1	318	0
Farrington - 2	299	0
H 1 - 1	0	0
H 1 - 2	0	0
H 1 - 3	232	0
H 1 - 4	0	0
Kualakai - 1	0	0
Kualakai - 2	0	0
Kualakai - 3	0	0
Kualakai - 4	0	0
Kualakai - 5	0	0

Point Receptor: OP 1

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 2

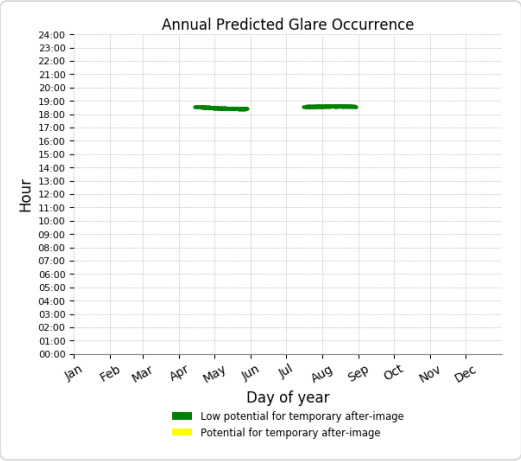
0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 3

0 minutes of yellow glare
0 minutes of green glare

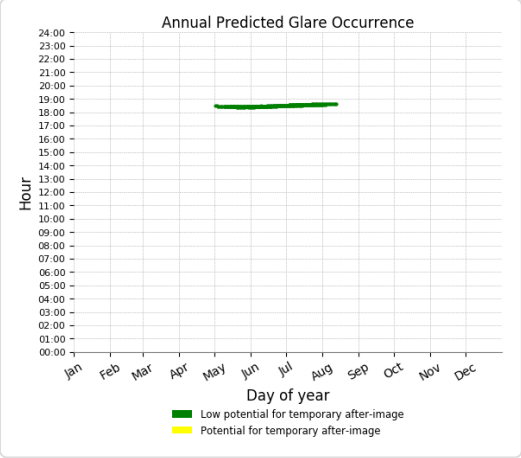
Route: Farrington -1

0 minutes of yellow glare
318 minutes of green glare



Route: Farrington - 2

0 minutes of yellow glare
299 minutes of green glare



Route: H 1 - 1

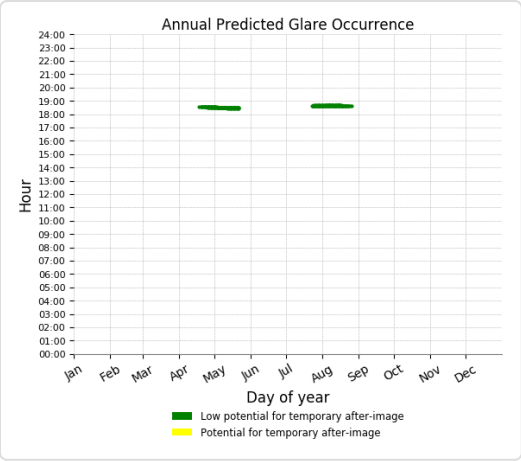
0 minutes of yellow glare
0 minutes of green glare

Route: H 1 - 2

0 minutes of yellow glare
0 minutes of green glare

Route: H 1 - 3

0 minutes of yellow glare
232 minutes of green glare



Route: H 1 - 4

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 1

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 2

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 3

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 4

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 5

0 minutes of yellow glare
0 minutes of green glare

Results for: PV Area 2-3

Receptor	Green Glare (min)	Yellow Glare (min)
OP 1	0	0
OP 2	0	0
OP 3	0	0
Farrington -1	421	0
Farrington - 2	413	0
H 1 - 1	0	0
H 1 - 2	0	0
H 1 - 3	381	0
H 1 - 4	0	0
Kualakai - 1	0	0
Kualakai - 2	0	0
Kualakai - 3	0	0
Kualakai - 4	0	0
Kualakai - 5	0	0

Point Receptor: OP 1

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 2

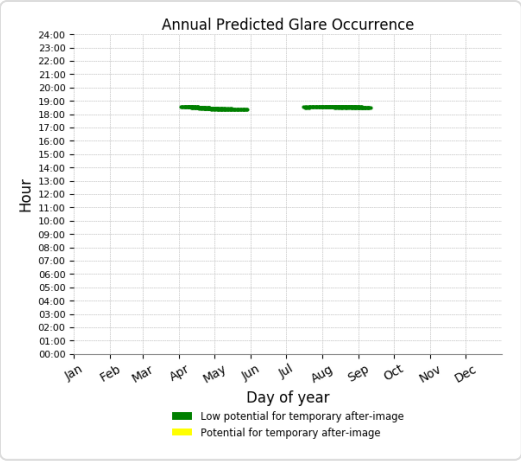
0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 3

0 minutes of yellow glare
0 minutes of green glare

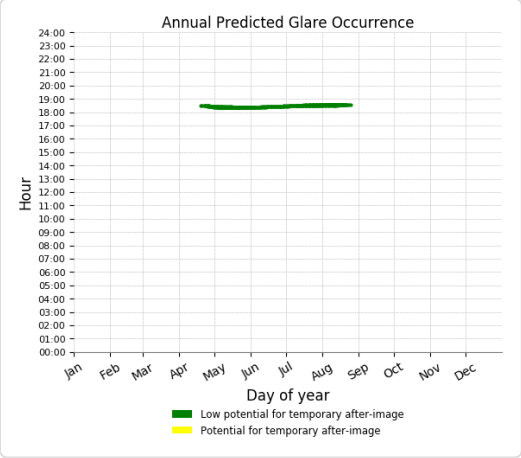
Route: Farrington -1

0 minutes of yellow glare
421 minutes of green glare



Route: Farrington - 2

0 minutes of yellow glare
413 minutes of green glare



Route: H 1 - 1

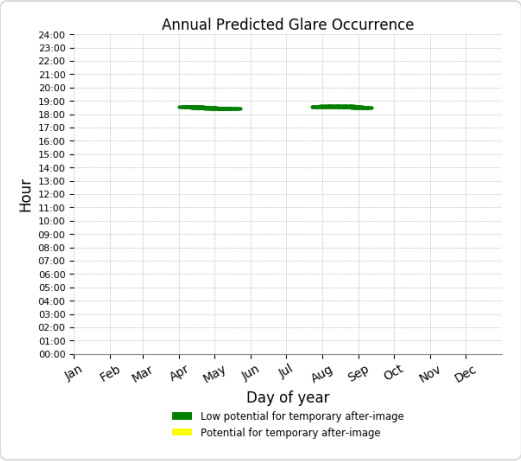
0 minutes of yellow glare
0 minutes of green glare

Route: H 1 - 2

0 minutes of yellow glare
0 minutes of green glare

Route: H 1 - 3

0 minutes of yellow glare
381 minutes of green glare



Route: H 1 - 4

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 1

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 2

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 3

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 4

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 5

0 minutes of yellow glare
0 minutes of green glare

Results for: PV Area 3-1

Receptor	Green Glare (min)	Yellow Glare (min)
OP 1	0	0
OP 2	0	0
OP 3	0	0
Farrington -1	198	0
Farrington - 2	770	0
H 1 - 1	0	0
H 1 - 2	0	0
H 1 - 3	285	0
H 1 - 4	0	0
Kualakai - 1	0	0
Kualakai - 2	0	0
Kualakai - 3	0	0
Kualakai - 4	0	0
Kualakai - 5	0	0

Point Receptor: OP 1

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 2

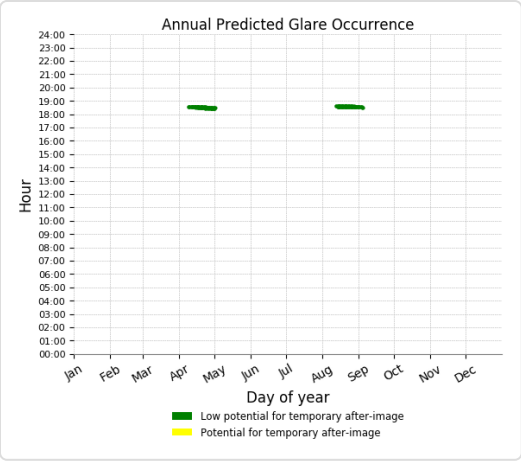
0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 3

0 minutes of yellow glare
0 minutes of green glare

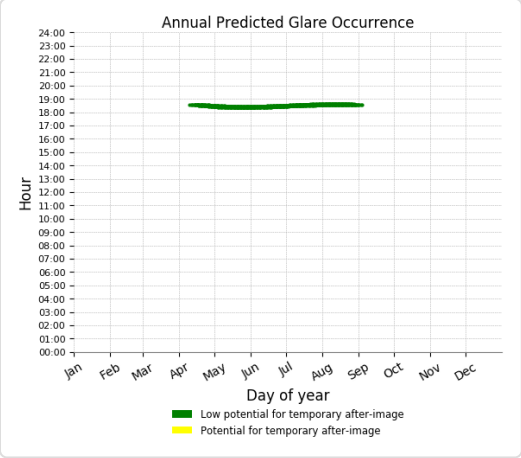
Route: Farrington -1

0 minutes of yellow glare
198 minutes of green glare



Route: Farrington - 2

0 minutes of yellow glare
770 minutes of green glare



Route: H 1 - 1

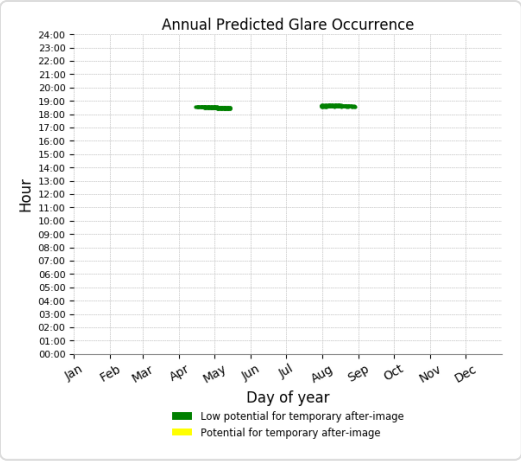
0 minutes of yellow glare
0 minutes of green glare

Route: H 1 - 2

0 minutes of yellow glare
0 minutes of green glare

Route: H 1 - 3

0 minutes of yellow glare
285 minutes of green glare



Route: H 1 - 4

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 1

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 2

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 3

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 4

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 5

0 minutes of yellow glare
0 minutes of green glare

Results for: PV Area 3-2

Receptor	Green Glare (min)	Yellow Glare (min)
OP 1	0	0
OP 2	0	0
OP 3	0	0
Farrington -1	125	0
Farrington - 2	614	0
H 1 - 1	0	0
H 1 - 2	0	0
H 1 - 3	303	50
H 1 - 4	0	0
Kualakai - 1	0	0
Kualakai - 2	0	0
Kualakai - 3	0	0
Kualakai - 4	0	0
Kualakai - 5	0	0

Point Receptor: OP 1

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 2

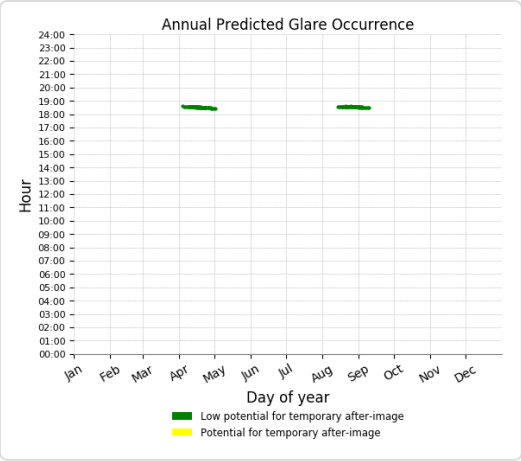
0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 3

0 minutes of yellow glare
0 minutes of green glare

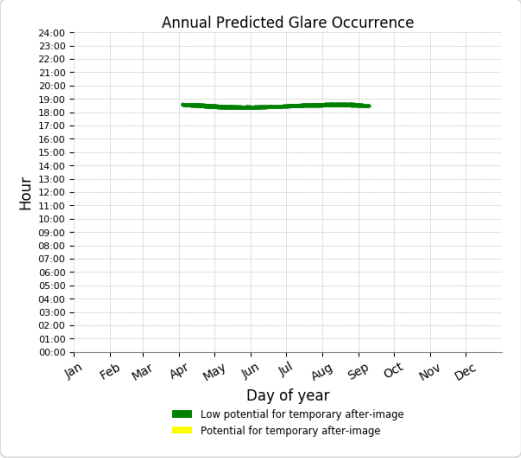
Route: Farrington -1

0 minutes of yellow glare
125 minutes of green glare



Route: Farrington - 2

0 minutes of yellow glare
614 minutes of green glare



Route: H 1 - 1

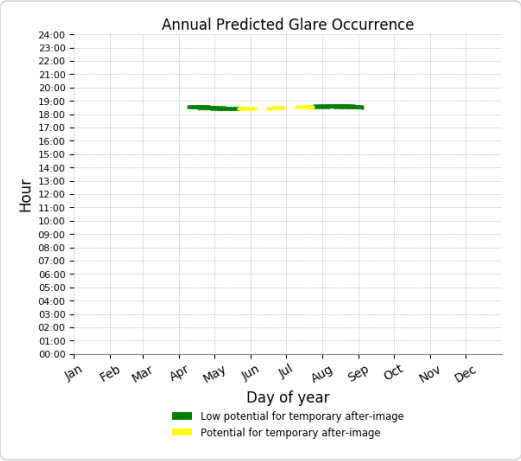
0 minutes of yellow glare
0 minutes of green glare

Route: H 1 - 2

0 minutes of yellow glare
0 minutes of green glare

Route: H 1 - 3

50 minutes of yellow glare
303 minutes of green glare



Route: H 1 - 4

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 1

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 2

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 3

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 4

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 5

0 minutes of yellow glare
0 minutes of green glare

Results for: PV Area 3-3

Receptor	Green Glare (min)	Yellow Glare (min)
OP 1	0	0
OP 2	0	0
OP 3	0	0
Farrington -1	0	0
Farrington - 2	442	0
H 1 - 1	0	0
H 1 - 2	0	0
H 1 - 3	24	0
H 1 - 4	0	0
Kualakai - 1	0	0
Kualakai - 2	0	0
Kualakai - 3	0	0
Kualakai - 4	0	0
Kualakai - 5	0	0

Point Receptor: OP 1

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 2

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 3

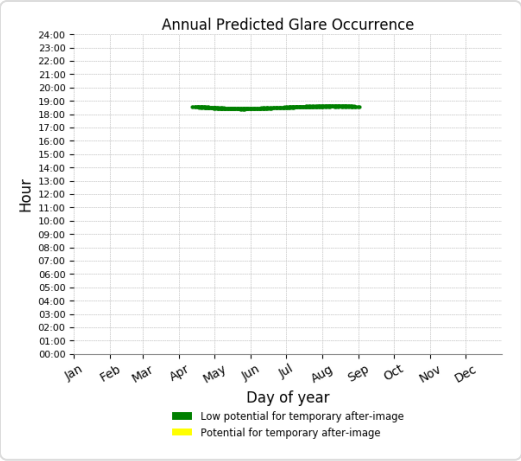
0 minutes of yellow glare
0 minutes of green glare

Route: Farrington -1

0 minutes of yellow glare
0 minutes of green glare

Route: Farrington - 2

0 minutes of yellow glare
442 minutes of green glare



Route: H 1 - 1

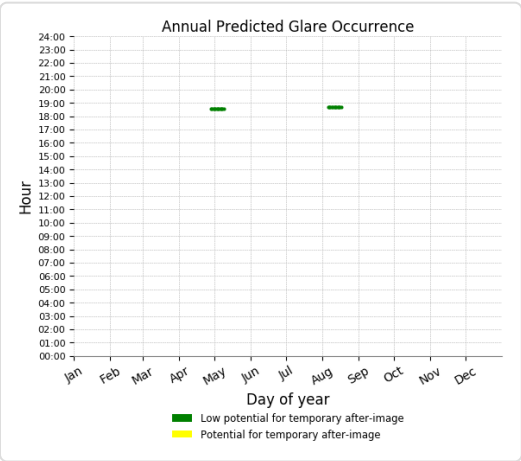
0 minutes of yellow glare
0 minutes of green glare

Route: H 1 - 2

0 minutes of yellow glare
0 minutes of green glare

Route: H 1 - 3

0 minutes of yellow glare
24 minutes of green glare



Route: H 1 - 4

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 1

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 2

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 3

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 4

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 5

0 minutes of yellow glare
0 minutes of green glare

Results for: PV Area 3-4

Receptor	Green Glare (min)	Yellow Glare (min)
OP 1	0	0
OP 2	0	0
OP 3	0	0
Farrington -1	4	0
Farrington - 2	892	0
H 1 - 1	0	0
H 1 - 2	0	0
H 1 - 3	393	0
H 1 - 4	0	0
Kualakai - 1	0	0
Kualakai - 2	0	0
Kualakai - 3	0	0
Kualakai - 4	0	0
Kualakai - 5	0	0

Point Receptor: OP 1

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 2

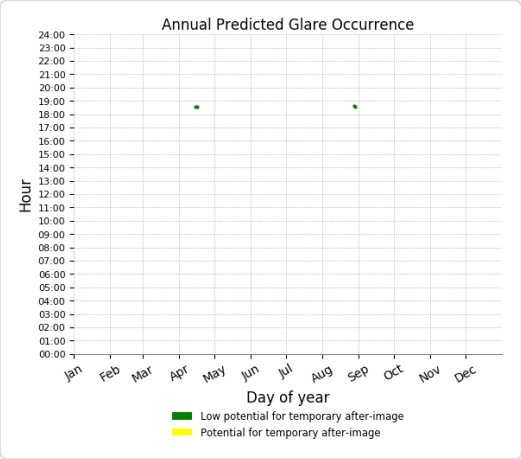
0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 3

0 minutes of yellow glare
0 minutes of green glare

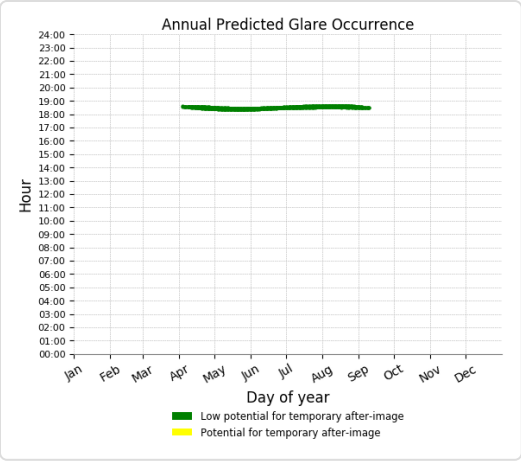
Route: Farrington -1

0 minutes of yellow glare
4 minutes of green glare



Route: Farrington - 2

0 minutes of yellow glare
892 minutes of green glare



Route: H 1 - 1

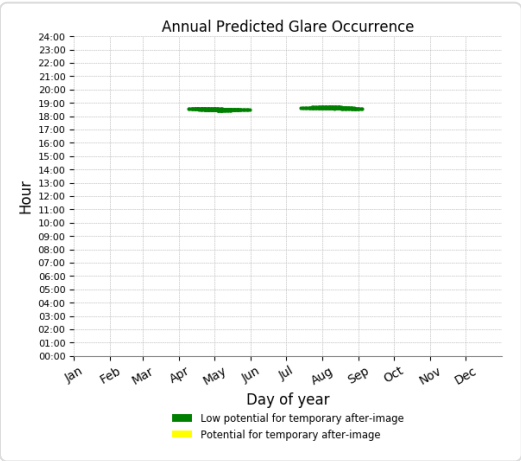
0 minutes of yellow glare
0 minutes of green glare

Route: H 1 - 2

0 minutes of yellow glare
0 minutes of green glare

Route: H 1 - 3

0 minutes of yellow glare
393 minutes of green glare



Route: H 1 - 4

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 1

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 2

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 3

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 4

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 5

0 minutes of yellow glare
0 minutes of green glare

Results for: PV Area 4

Receptor	Green Glare (min)	Yellow Glare (min)
OP 1	0	0
OP 2	0	0
OP 3	0	0
Farrington -1	0	0
Farrington - 2	1410	0
H 1 - 1	0	0
H 1 - 2	0	0
H 1 - 3	388	0
H 1 - 4	0	0
Kualakai - 1	0	0
Kualakai - 2	0	0
Kualakai - 3	0	0
Kualakai - 4	0	0
Kualakai - 5	0	0

Point Receptor: OP 1

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 2

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 3

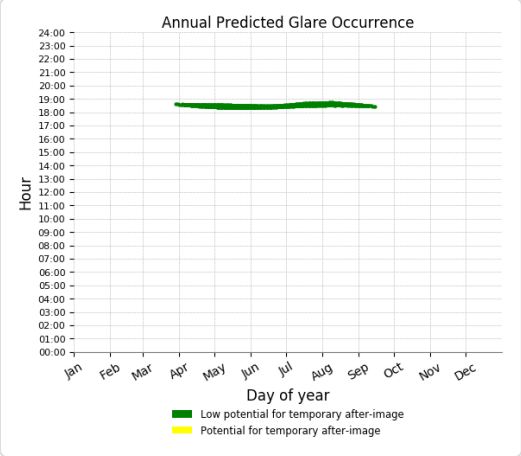
0 minutes of yellow glare
0 minutes of green glare

Route: Farrington -1

0 minutes of yellow glare
0 minutes of green glare

Route: Farrington - 2

0 minutes of yellow glare
1410 minutes of green glare



Route: H 1 - 1

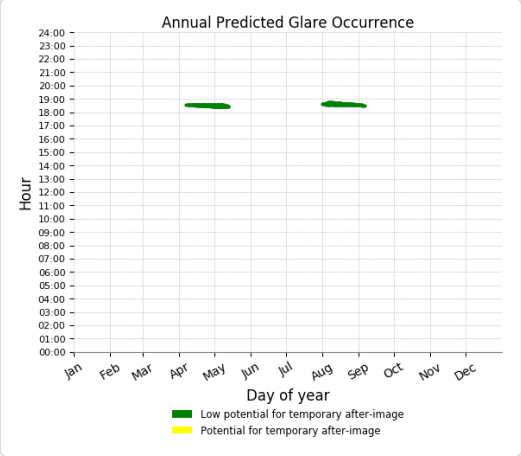
0 minutes of yellow glare
0 minutes of green glare

Route: H 1 - 2

0 minutes of yellow glare
0 minutes of green glare

Route: H 1 - 3

0 minutes of yellow glare
388 minutes of green glare



Route: H 1 - 4

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 1

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 2

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 3

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 4

0 minutes of yellow glare
0 minutes of green glare

Route: Kualakai - 5

0 minutes of yellow glare
0 minutes of green glare

Assumptions

"Green" glare is glare with low potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
"Yellow" glare is glare with potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
Glare analyses do not account for physical obstructions between reflectors and receptors. This includes buildings, tree cover and geographic obstructions.
Several calculations utilize the PV array centroid, rather than the actual glare spot location, due to algorithm limitations. This may affect results for large PV footprints. Additional analyses of array sub-sections can provide additional information on expected glare.
The subtended source angle (glare spot size) is constrained by the PV array footprint size. Partitioning large arrays into smaller sections will reduce the maximum potential subtended angle, potentially impacting results if actual glare spots are larger than the sub-array size. Additional analyses of the combined area of adjacent sub-arrays can provide more information on potential glare hazards. (See previous point on related limitations.)
Glare locations displayed on receptor plots are approximate. Actual glare-spot locations may differ.
Glare vector plots are simplified representations of analysis data. Actual glare emanations and results may differ.
The glare hazard determination relies on several approximations including observer eye characteristics, angle of view, and typical blink response time. Actual results and glare occurrence may differ.
Hazard zone boundaries shown in the Glare Hazard plot are an approximation and visual aid based on aggregated research data. Actual ocular impact outcomes encompass a continuous, not discrete, spectrum.

FORGESOLAR GLARE ANALYSIS

Project: **AES - Hawaii**
Site configuration: **West Oahu - FAA**
Analysis conducted by Josh Burdett (joshua.burdett@tetratech.com) at 16:43 on 21 Jan, 2020.

U.S. FAA 2013 Policy Adherence

The following table summarizes the policy adherence of the glare analysis based on the 2013 U.S. Federal Aviation Administration Interim Policy 78 FR 63276. This policy requires the following criteria be met for solar energy systems on airport property:

- No "yellow" glare (potential for after-image) for any flight path from threshold to 2 miles
- No glare of any kind for Air Traffic Control Tower(s) ("ATCT") at cab height.
- Default analysis and observer characteristics (see list below)

ForgeSolar does not represent or speak officially for the FAA and cannot approve or deny projects. Results are informational only.

COMPONENT	STATUS	DESCRIPTION
Analysis parameters	PASS	Analysis time interval and eye characteristics used are acceptable
Flight path(s)	PASS	Flight path receptor(s) do not receive yellow glare
ATCT(s)	FAIL	Receptor(s) marked as ATCT receive green and/or yellow glare

Default glare analysis parameters and observer eye characteristics (for reference only):

- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

FAA Policy 78 FR 63276 can be read at https://www.federalregister.gov/d/2013-24729

SITE CONFIGURATION

Analysis Parameters

DNI: peaks at 1,000.0 W/m^2
Time interval: 1 min
Ocular transmission coefficient: 0.5
Pupil diameter: 0.002 m
Eye focal length: 0.017 m
Sun subtended angle: 9.3 mrad
Site Config ID: 34872.6258

PV Array(s)

Name: PV Area 1
Axis tracking: Fixed (no rotation)
Tilt: 15.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.378202	-158.062098	414.48	7.60	422.08
2	21.377800	-158.062280	419.04	7.60	426.64
3	21.377602	-158.062377	415.86	7.60	423.46
4	21.377450	-158.062465	411.42	7.60	419.02
5	21.377213	-158.062374	398.76	7.60	406.36
6	21.376973	-158.061441	350.35	7.60	357.96
7	21.377008	-158.060918	333.62	7.60	341.22
8	21.377120	-158.060923	338.28	7.60	345.88
9	21.377490	-158.061106	356.91	7.60	364.51
10	21.377622	-158.061476	374.30	7.60	381.90
11	21.378147	-158.061891	404.33	7.60	411.93

Name: PV Area 2-1
Axis tracking: Fixed (no rotation)
Tilt: 15.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.376881	-158.062833	410.48	7.60	418.08
2	21.376459	-158.063010	418.17	7.60	425.77
3	21.375907	-158.063270	403.44	7.60	411.04
4	21.375544	-158.063457	390.88	7.60	398.48
5	21.375315	-158.063565	394.11	7.60	401.71
6	21.375277	-158.063152	370.95	7.60	378.55
7	21.375227	-158.062736	356.59	7.60	364.19
8	21.375574	-158.062618	369.95	7.60	377.55
9	21.376031	-158.062454	383.79	7.60	391.39
10	21.376511	-158.062293	385.02	7.60	392.62
11	21.376713	-158.062218	382.76	7.60	390.36
12	21.376833	-158.062401	392.49	7.60	400.09

Name: PV Area 2-2
Axis tracking: Fixed (no rotation)
Tilt: 15.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.376711	-158.062205	381.82	7.60	389.42
2	21.376361	-158.062326	386.07	7.60	393.67
3	21.375894	-158.062492	380.15	7.60	387.75
4	21.375450	-158.062645	364.88	7.60	372.48
5	21.375217	-158.062728	355.93	7.60	363.53
6	21.375152	-158.062331	344.64	7.60	352.24
7	21.375065	-158.061803	333.62	7.60	341.22
8	21.375484	-158.061666	342.96	7.60	350.56
9	21.375989	-158.061513	354.20	7.60	361.80
10	21.376499	-158.061365	347.02	7.60	354.62
11	21.376598	-158.061776	365.54	7.60	373.14

Name: PV Area 2-3
Axis tracking: Fixed (no rotation)
Tilt: 15.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.376496	-158.061349	345.68	7.60	353.28
2	21.376129	-158.061451	353.34	7.60	360.94
3	21.375649	-158.061591	344.73	7.60	352.33
4	21.375267	-158.061711	337.77	7.60	345.37
5	21.375055	-158.061786	333.19	7.60	340.80
6	21.375025	-158.061175	318.48	7.60	326.08
7	21.375050	-158.060813	303.34	7.60	310.94
8	21.375095	-158.060542	290.44	7.60	298.04
9	21.375475	-158.060413	294.34	7.60	301.94
10	21.375724	-158.060362	297.35	7.60	304.95
11	21.376002	-158.060582	314.55	7.60	322.15
12	21.376299	-158.060797	321.82	7.60	329.42

Name: PV Area 3-1
Axis tracking: Fixed (no rotation)
Tilt: 15.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.374960	-158.063771	403.94	7.60	411.54
2	21.374550	-158.064018	409.08	7.60	416.68
3	21.374006	-158.064372	405.79	7.60	413.39
4	21.373486	-158.063921	358.12	7.60	365.72
5	21.374071	-158.063321	356.56	7.60	364.16
6	21.374800	-158.062698	341.18	7.60	348.79
7	21.375030	-158.063702	401.45	7.60	409.05

Name: PV Area 3-2
Axis tracking: Fixed (no rotation)
Tilt: 15.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.373471	-158.063900	356.53	7.60	364.13
2	21.373052	-158.063605	329.89	7.60	337.49
3	21.372872	-158.063063	308.33	7.60	315.93
4	21.373132	-158.062811	306.55	7.60	314.15
5	21.373511	-158.062468	302.42	7.60	310.02
6	21.373911	-158.062012	300.71	7.60	308.31
7	21.374650	-158.061711	322.58	7.60	330.18
8	21.374790	-158.062634	337.82	7.60	345.42
9	21.374361	-158.063010	346.18	7.60	353.78
10	21.373771	-158.063557	360.52	7.60	368.12
11	21.373431	-158.063927	356.09	7.60	363.69

Name: PV Area 3-3
Axis tracking: Fixed (no rotation)
Tilt: 15.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.373971	-158.064423	405.46	7.60	413.06
2	21.373346	-158.064702	408.59	7.60	416.19
3	21.372987	-158.064917	407.08	7.60	414.68
4	21.372597	-158.065507	390.32	7.60	397.92
5	21.372397	-158.065474	370.08	7.60	377.68
6	21.372093	-158.064670	325.30	7.60	332.90
7	21.372627	-158.064343	352.86	7.60	360.46
8	21.373376	-158.063887	352.43	7.60	360.03

Name: PV Area 3-4
Axis tracking: Fixed (no rotation)
Tilt: 15.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.373311	-158.063844	348.21	7.60	355.81
2	21.372912	-158.064117	354.61	7.60	362.22
3	21.372332	-158.064477	337.76	7.60	345.36
4	21.372073	-158.064616	321.88	7.60	329.48
5	21.371838	-158.064101	301.52	7.60	309.12
6	21.371713	-158.063763	289.80	7.60	297.40
7	21.371698	-158.063415	280.75	7.60	288.35
8	21.372113	-158.063200	288.24	7.60	295.85
9	21.372807	-158.063007	305.71	7.60	313.31
10	21.372967	-158.063495	325.17	7.60	332.77
11	21.373032	-158.063661	332.00	7.60	339.60
12	21.373232	-158.063774	341.54	7.60	349.14

Name: PV Area 4
Axis tracking: Fixed (no rotation)
Tilt: 15.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.371341	-158.066427	397.82	7.60	405.42
2	21.371151	-158.066598	400.08	7.60	407.68
3	21.370776	-158.066875	379.77	7.60	387.37
4	21.370671	-158.066832	364.94	7.60	372.54
5	21.370531	-158.066590	351.04	7.60	358.64
6	21.370651	-158.065957	338.58	7.60	346.18
7	21.370836	-158.065356	317.01	7.60	324.61
8	21.371091	-158.064434	293.63	7.60	301.23
9	21.371416	-158.064423	295.80	7.60	303.40
10	21.371675	-158.065072	321.71	7.60	329.31
11	21.371765	-158.065963	374.69	7.60	382.29

Flight Path Receptor(s)

Name: HHI RWY 24
Description:
Threshold height: 50 ft
Direction: 248.0°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	21.484137	-158.030623	836.65	50.00	886.65
Two-mile	21.494967	-158.001780	962.56	477.54	1440.10

Name: HHI RWY 6
Description:
Threshold height: 50 ft
Direction: 68.0°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	21.479376	-158.043476	816.49	50.00	866.49
Two-mile	21.468545	-158.072317	1132.87	287.08	1419.95

Name: HNL RWY 04L
Description:
Threshold height: 50 ft
Direction: 53.0°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	21.318627	-157.922958	6.56	50.00	56.56
Two-mile	21.301227	-157.947774	-24.77	634.79	610.02

Name: HNL RWY 04R
Description:
Threshold height: 71 ft
Direction: 53.0°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	21.314206	-157.926770	3.28	71.00	74.28
Two-mile	21.296806	-157.951585	-81.63	709.37	627.74

Name: HNL RWY 08R
Description:
Threshold height: 96 ft
Direction: 90.0°
Glide slope: 3.25°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	21.306817	-157.945391	3.15	96.00	99.15
Two-mile	21.306817	-157.976461	-12.57	711.39	698.82

Name: HNL RWY 22L
Description:
Threshold height: 80 ft
Direction: 233.0°
Glide slope: 3.44°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	21.328555	-157.906434	3.28	80.00	83.28
Two-mile	21.345955	-157.881617	98.61	619.49	718.10

Name: HNL RWY 22R
Description:
Threshold height: 50 ft
Direction: 233.0°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	21.329580	-157.907432	6.32	50.00	56.33
Two-mile	21.346980	-157.882614	113.79	495.99	609.78

Name: HNL RWY 26L
Description:
Threshold height: 75 ft
Direction: 270.0°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	21.306822	-157.911122	3.08	75.00	78.09
Two-mile	21.306827	-157.880052	8.34	623.20	631.54

Name: JRF RWY 04L
Description:
Threshold height: 35 ft
Direction: 55.0°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	21.301104	-158.080872	13.12	35.00	48.13
Two-mile	21.284521	-158.106322	-24.50	626.08	601.58

Name: JRF RWY 04R
Description:
Threshold height: 55 ft
Direction: 55.0°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	21.299691	-158.079822	13.11	55.00	68.11
Two-mile	21.283107	-158.105272	-28.50	650.06	621.56

Name: JRF RWY 11
Description:
Threshold height: 48 ft
Direction: 118.0°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	21.311555	-158.083631	35.84	48.00	83.84
Two-mile	21.325129	-158.111066	16.69	620.60	637.30

Name: JRF RWY 22L
Description:
Threshold height: 32 ft
Direction: 235.0°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	21.312291	-158.060624	26.25	32.00	58.25
Two-mile	21.328874	-158.035172	31.89	579.82	611.70

Name: JRF RWY 22R
Description:
Threshold height: 33 ft
Direction: 235.0°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	21.313722	-158.061641	29.53	33.00	62.53
Two-mile	21.330305	-158.036189	32.81	583.17	615.99

Name: JRF RWY 29
Description:
Threshold height: 52 ft
Direction: 298.0°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

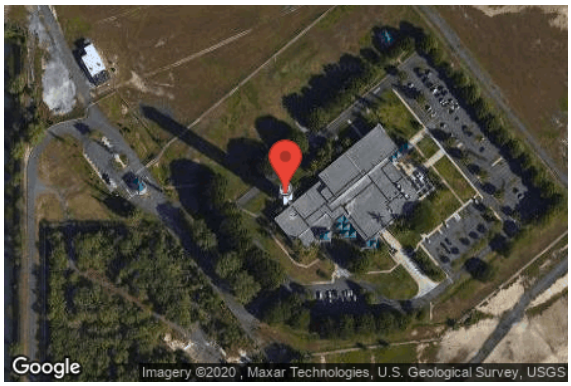
Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	21.302899	-158.066468	9.84	52.00	61.85
Two-mile	21.289326	-158.039035	-38.09	653.40	615.30

Discrete Observation Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (ft)	Height (ft)
1-ATCT	1	21.310381	-158.070840	29.53	50.00
2-ATCT	2	21.320915	-157.927214	6.77	50.00

Map image of 1-ATCT

Map image of 2-ATCT



GLARE ANALYSIS RESULTS

Summary of Glare

PV Array Name	Tilt (°)	Orient (°)	"Green" Glare min	"Yellow" Glare min	Energy kWh
PV Area 1	15.0	180.0	602	0	-
PV Area 2-1	15.0	180.0	266	0	-
PV Area 2-2	15.0	180.0	212	0	-
PV Area 2-3	15.0	180.0	417	0	-
PV Area 3-1	15.0	180.0	660	0	-
PV Area 3-2	15.0	180.0	451	0	-
PV Area 3-3	15.0	180.0	567	0	-
PV Area 3-4	15.0	180.0	623	0	-
PV Area 4	15.0	180.0	813	0	-

Total annual glare received by each receptor

Receptor	Annual Green Glare (min)	Annual Yellow Glare (min)
HHI RWY 24	0	0
HHI RWY 6	0	0

Receptor	Annual Green Glare (min)	Annual Yellow Glare (min)
HNL RWY 04L	0	0
HNL RWY 04R	0	0
HNL RWY 08R	0	0
HNL RWY 22L	847	0
HNL RWY 22R	866	0
HNL RWY 26L	2149	0
JRF RWY 04L	0	0
JRF RWY 04R	0	0
JRF RWY 11	0	0
JRF RWY 22L	0	0
JRF RWY 22R	0	0
JRF RWY 29	0	0
1-ATCT	0	0
2-ATCT	749	0

Results for: PV Area 1

Receptor	Green Glare (min)	Yellow Glare (min)
HHI RWY 24	0	0
HHI RWY 6	0	0
HNL RWY 04L	0	0
HNL RWY 04R	0	0
HNL RWY 08R	0	0
HNL RWY 22L	93	0
HNL RWY 22R	112	0
HNL RWY 26L	346	0
JRF RWY 04L	0	0
JRF RWY 04R	0	0
JRF RWY 11	0	0
JRF RWY 22L	0	0
JRF RWY 22R	0	0
JRF RWY 29	0	0
1-ATCT	0	0
2-ATCT	51	0

Flight Path: HHI RWY 24

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HHI RWY 6

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 04L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 04R

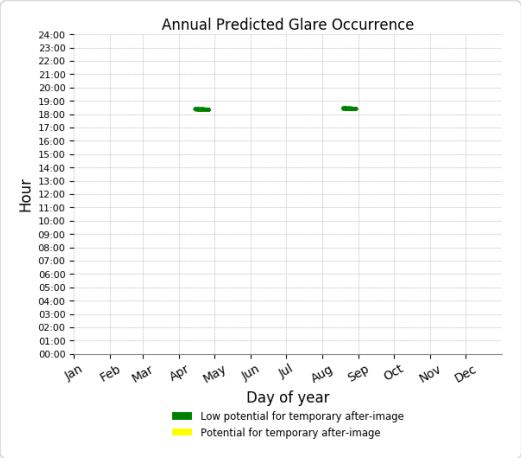
0 minutes of yellow glare
0 minutes of green glare

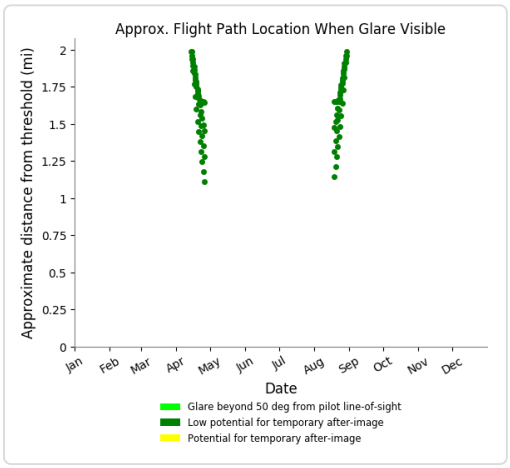
Flight Path: HNL RWY 08R

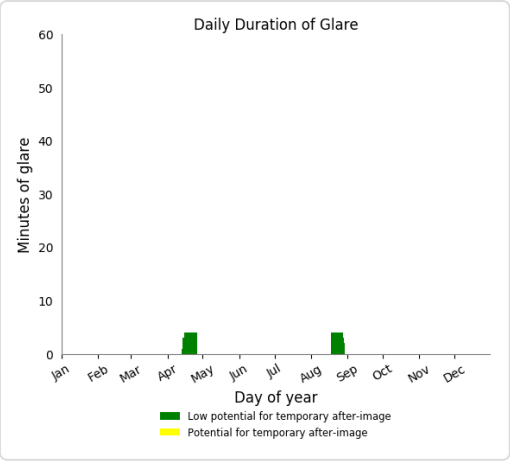
0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 22L

0 minutes of yellow glare
93 minutes of green glare



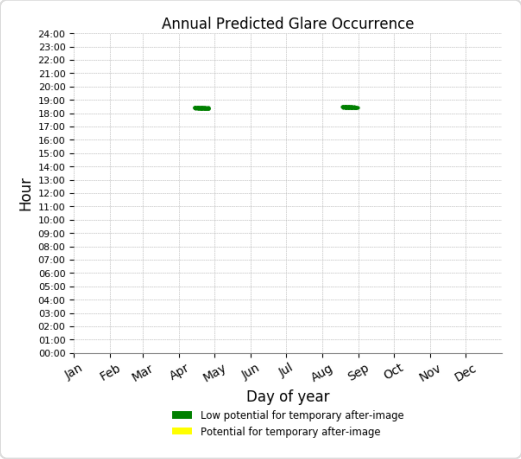


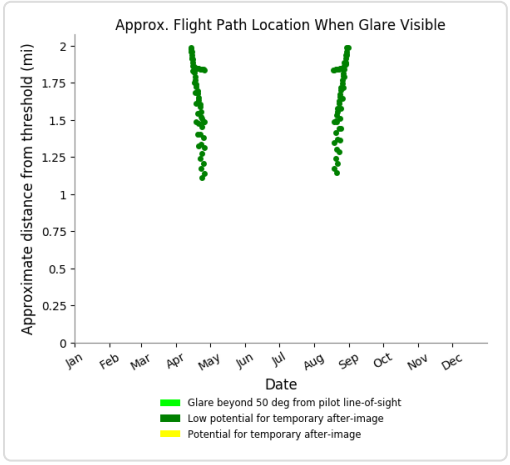


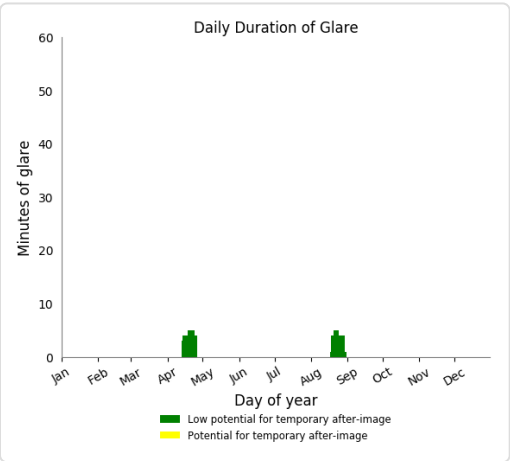
Flight Path: HNL RWY 22R

0 minutes of yellow glare

112 minutes of green glare



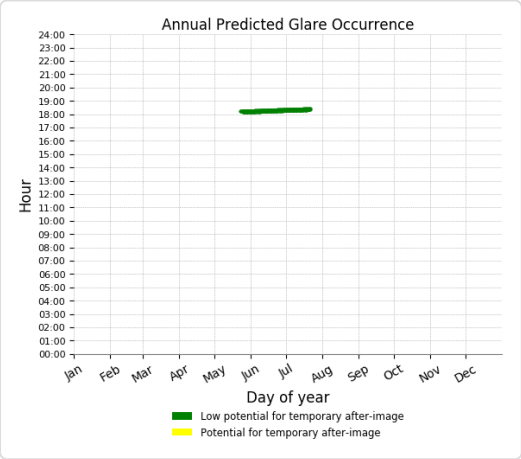


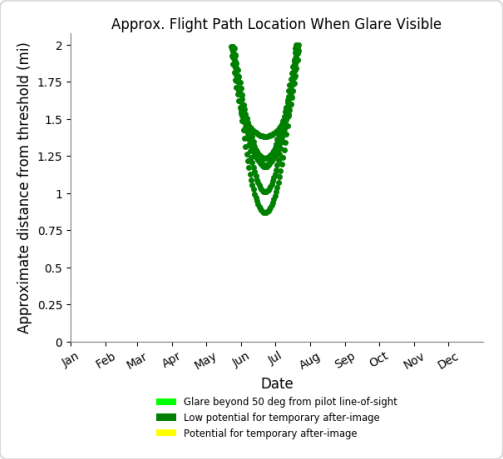


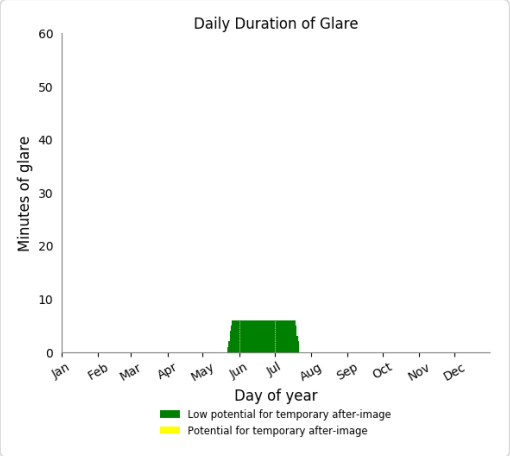
Flight Path: HNL RWY 26L

0 minutes of yellow glare

346 minutes of green glare







Flight Path: JRF RWY 04L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 04R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 11

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 22L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 22R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 29

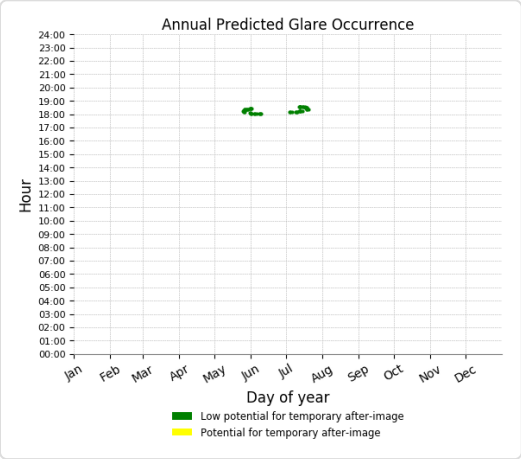
0 minutes of yellow glare
0 minutes of green glare

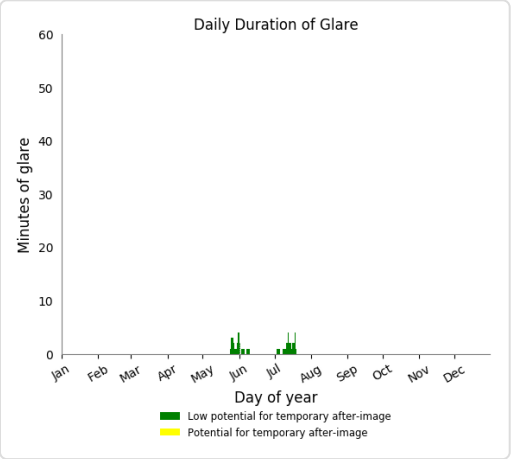
Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 2-ATCT

0 minutes of yellow glare
51 minutes of green glare





Results for: PV Area 2-1

Receptor	Green Glare (min)	Yellow Glare (min)
HHI RWY 24	0	0
HHI RWY 6	0	0
HNL RWY 04L	0	0
HNL RWY 04R	0	0
HNL RWY 08R	0	0
HNL RWY 22L	31	0
HNL RWY 22R	29	0
HNL RWY 26L	151	0

Receptor	Green Glare (min)	Yellow Glare (min)
JRF RWY 04L	0	0
JRF RWY 04R	0	0
JRF RWY 11	0	0
JRF RWY 22L	0	0
JRF RWY 22R	0	0
JRF RWY 29	0	0
1-ATCT	0	0
2-ATCT	55	0

Flight Path: HHI RWY 24

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HHI RWY 6

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 04L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 04R

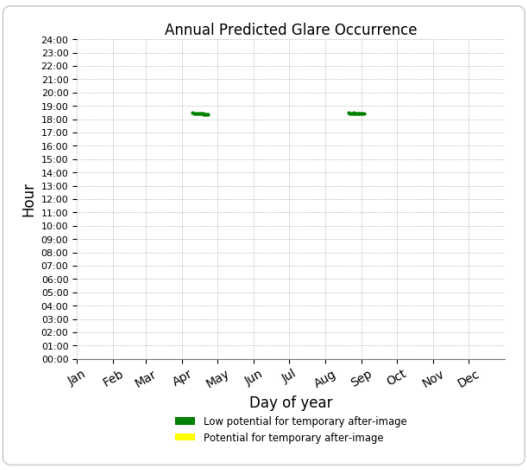
0 minutes of yellow glare
0 minutes of green glare

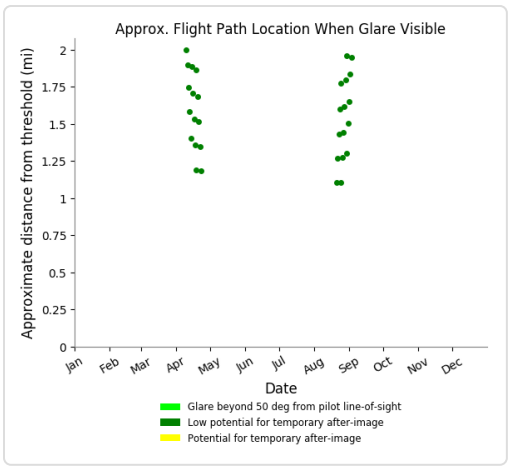
Flight Path: HNL RWY 08R

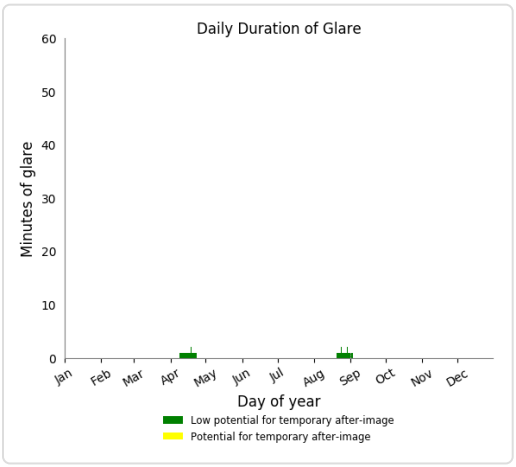
0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 22L

0 minutes of yellow glare
31 minutes of green glare



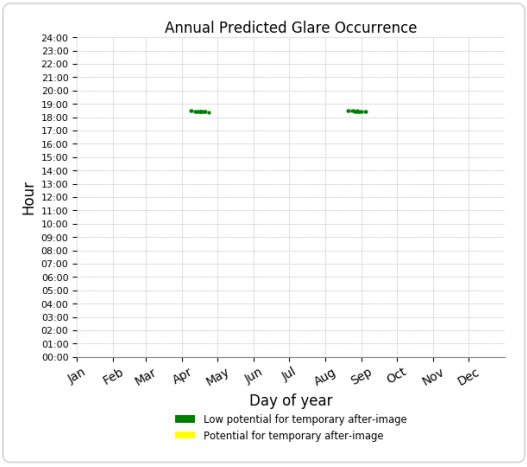


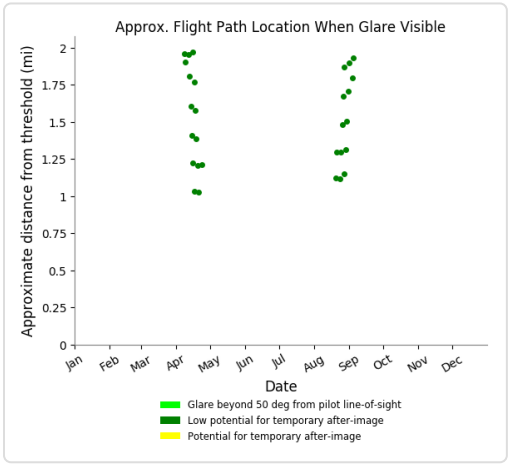


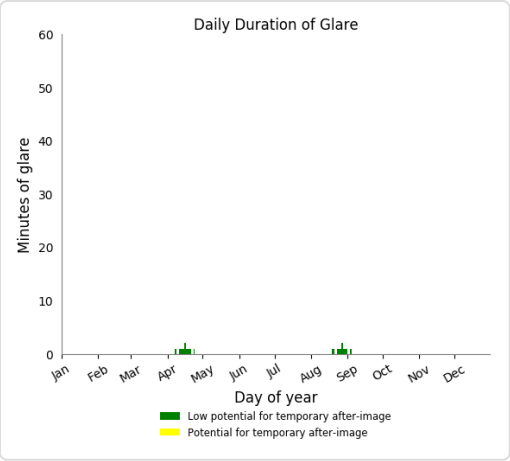
Flight Path: HNL RWY 22R

0 minutes of yellow glare

29 minutes of green glare



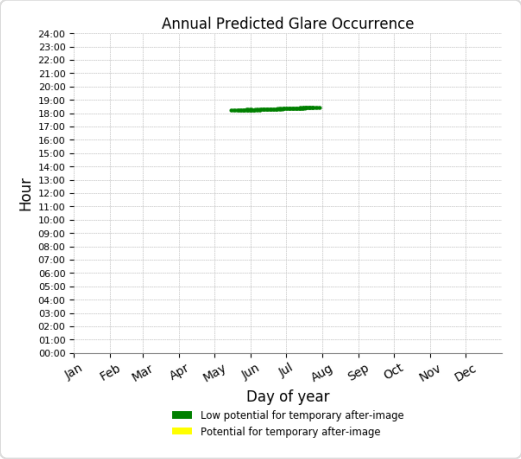


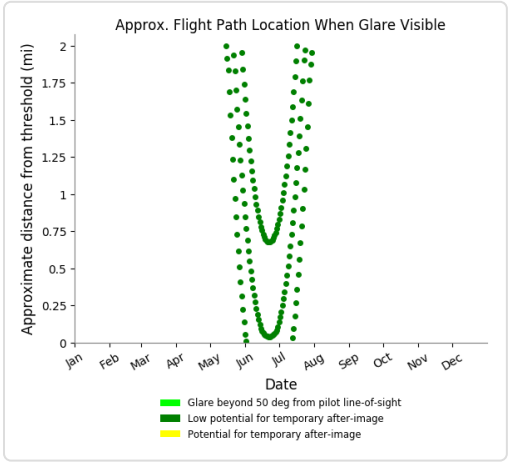


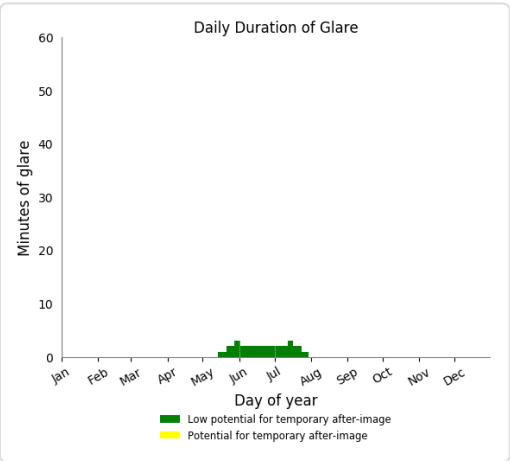
Flight Path: HNL RWY 26L

0 minutes of yellow glare

151 minutes of green glare







Flight Path: JRF RWY 04L

0 minutes of yellow glare

0 minutes of green glare

Flight Path: JRF RWY 04R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 11

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 22L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 22R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 29

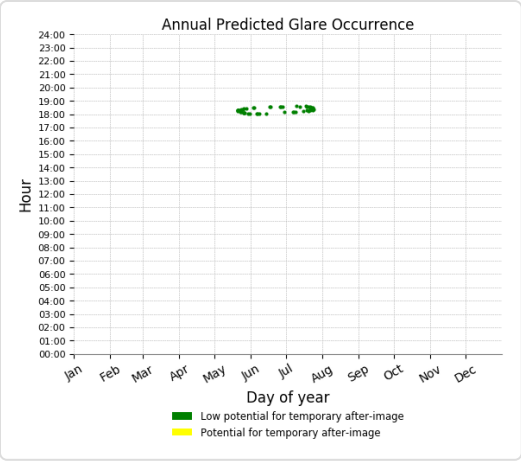
0 minutes of yellow glare
0 minutes of green glare

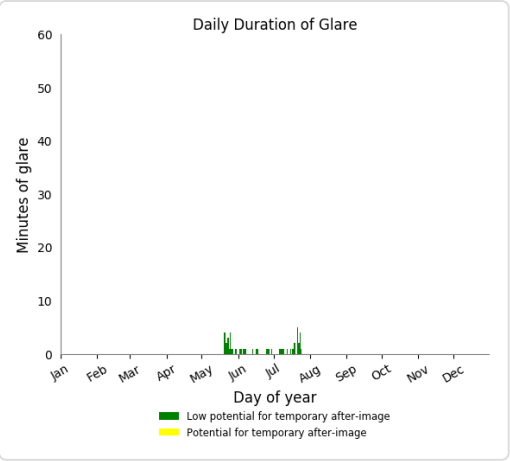
Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 2-ATCT

0 minutes of yellow glare
55 minutes of green glare





Results for: PV Area 2-2

Receptor	Green Glare (min)	Yellow Glare (min)
HHI RWY 24	0	0
HHI RWY 6	0	0
HNL RWY 04L	0	0
HNL RWY 04R	0	0
HNL RWY 08R	0	0
HNL RWY 22L	33	0
HNL RWY 22R	32	0
HNL RWY 26L	82	0
JRF RWY 04L	0	0
JRF RWY 04R	0	0
JRF RWY 11	0	0
JRF RWY 22L	0	0
JRF RWY 22R	0	0
JRF RWY 29	0	0
1-ATCT	0	0
2-ATCT	65	0

Flight Path: HHI RWY 24

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HHI RWY 6

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 04L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 04R

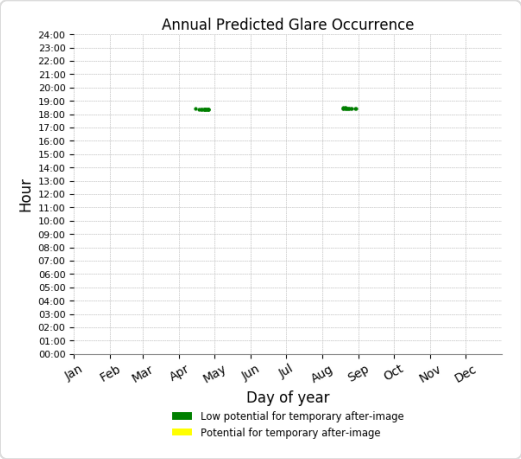
0 minutes of yellow glare
0 minutes of green glare

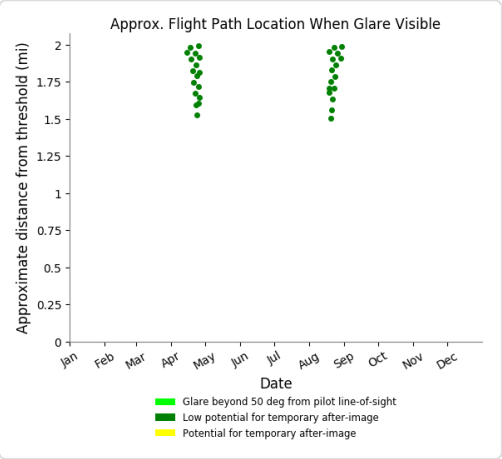
Flight Path: HNL RWY 08R

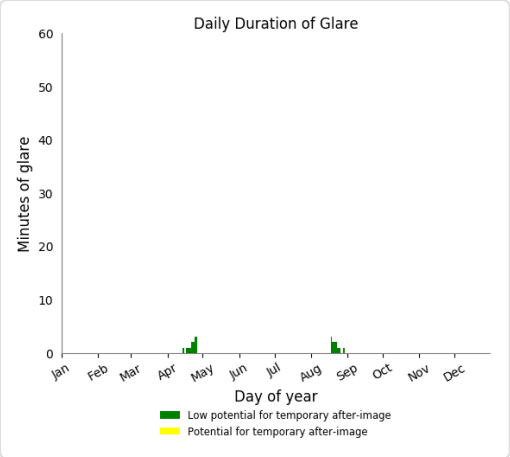
0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 22L

0 minutes of yellow glare
33 minutes of green glare



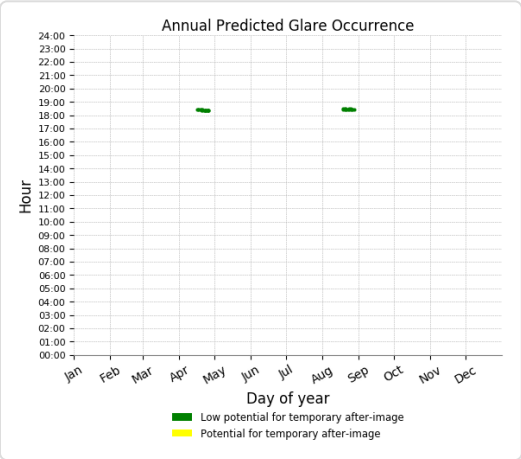


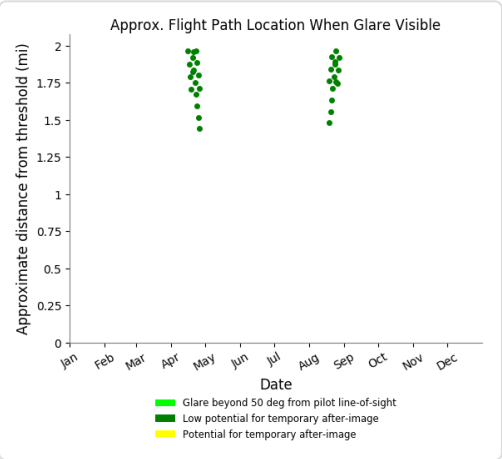


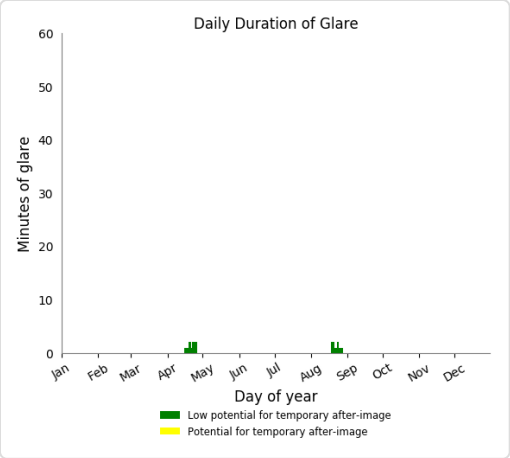
Flight Path: HNL RWY 22R

0 minutes of yellow glare

32 minutes of green glare



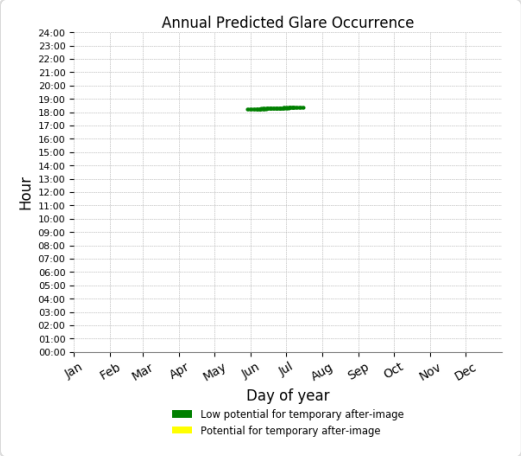


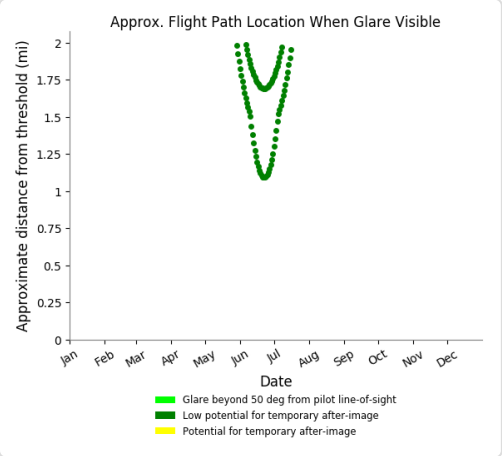


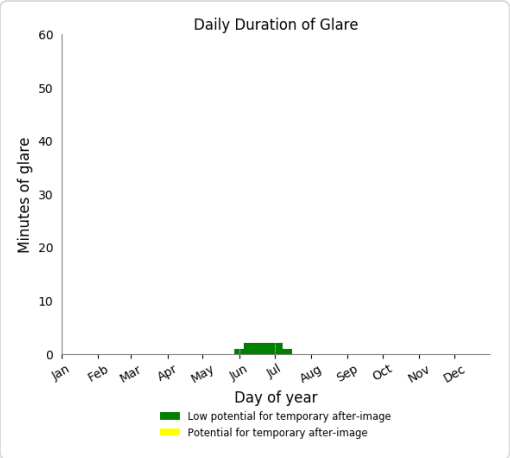
Flight Path: HNL RWY 26L

0 minutes of yellow glare

82 minutes of green glare







Flight Path: JRF RWY 04L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 04R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 11

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 22L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 22R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 29

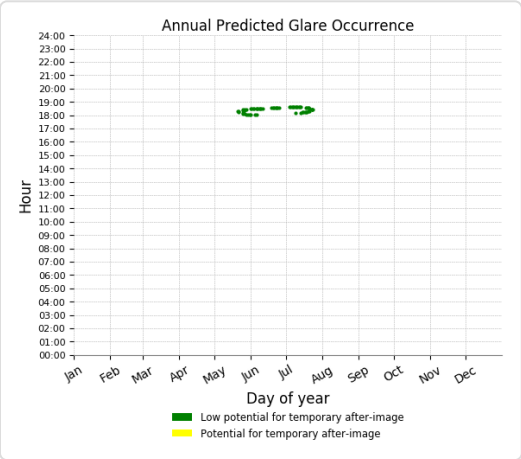
0 minutes of yellow glare
0 minutes of green glare

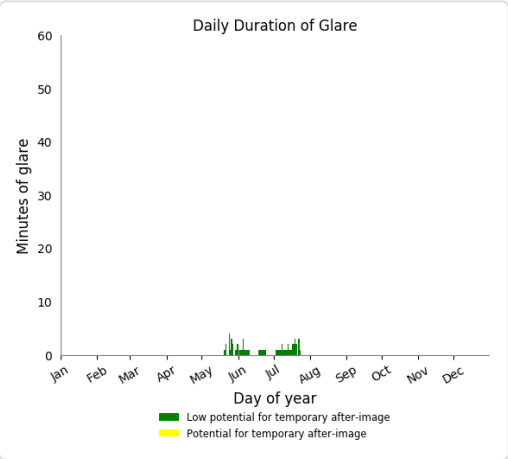
Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 2-ATCT

0 minutes of yellow glare
65 minutes of green glare





Results for: PV Area 2-3

Receptor	Green Glare (min)	Yellow Glare (min)
HHI RWY 24	0	0
HHI RWY 6	0	0
HNL RWY 04L	0	0
HNL RWY 04R	0	0
HNL RWY 08R	0	0
HNL RWY 22L	72	0
HNL RWY 22R	75	0
HNL RWY 26L	224	0
JRF RWY 04L	0	0
JRF RWY 04R	0	0
JRF RWY 11	0	0
JRF RWY 22L	0	0
JRF RWY 22R	0	0
JRF RWY 29	0	0
1-ATCT	0	0
2-ATCT	46	0

Flight Path: HHI RWY 24

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HHI RWY 6

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 04L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 04R

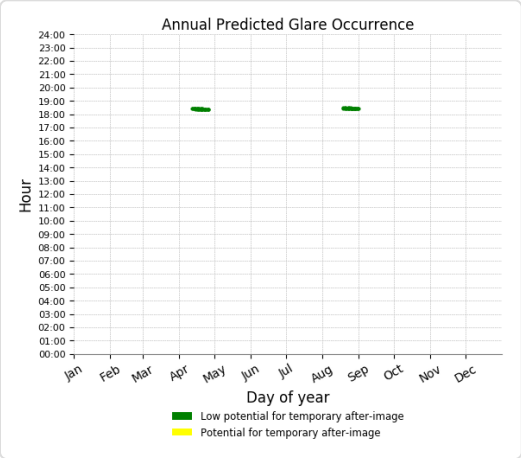
0 minutes of yellow glare
0 minutes of green glare

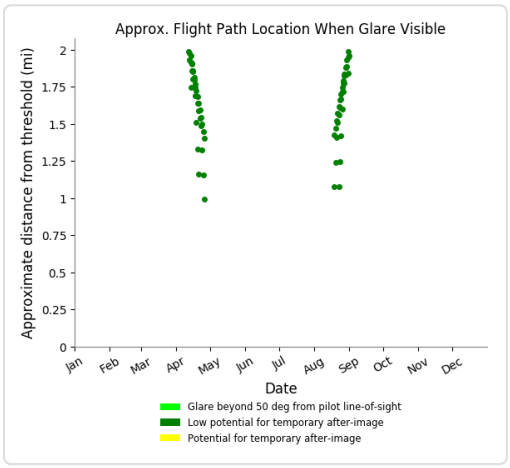
Flight Path: HNL RWY 08R

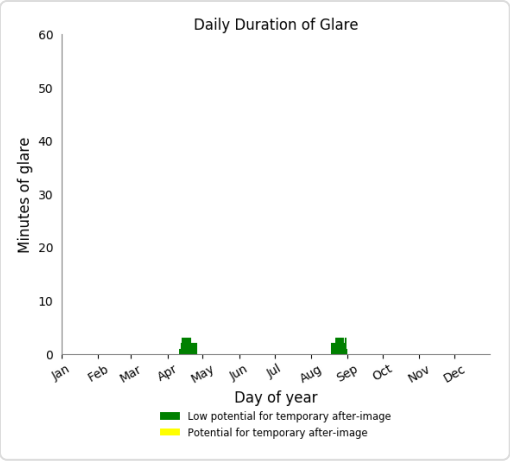
0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 22L

0 minutes of yellow glare
72 minutes of green glare



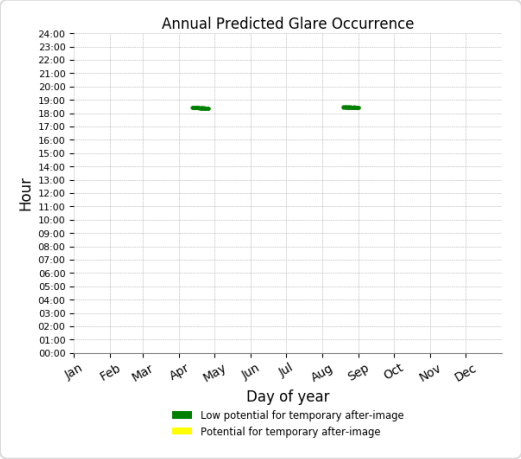


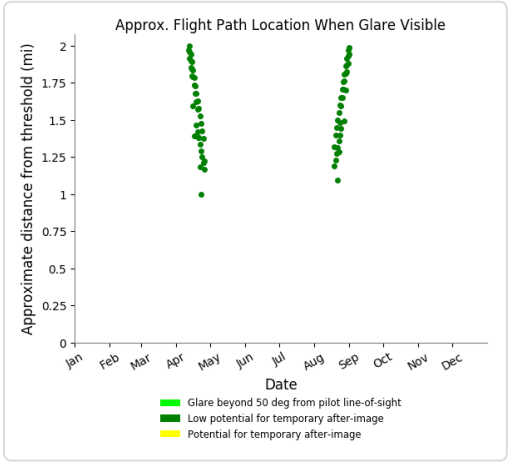


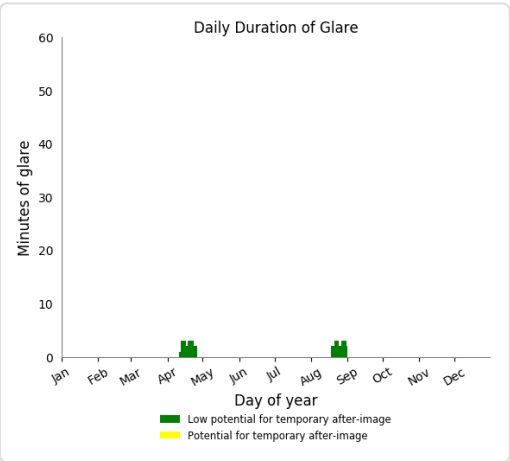
Flight Path: HNL RWY 22R

0 minutes of yellow glare

75 minutes of green glare



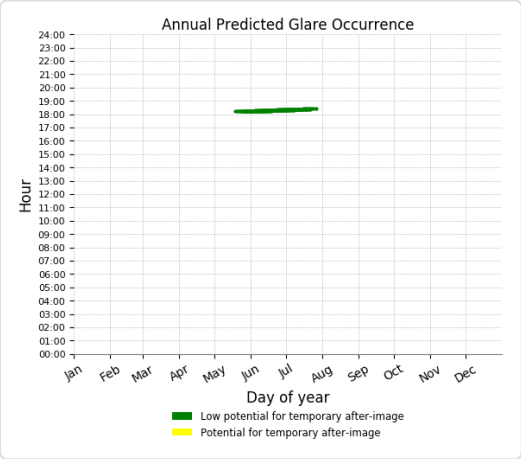


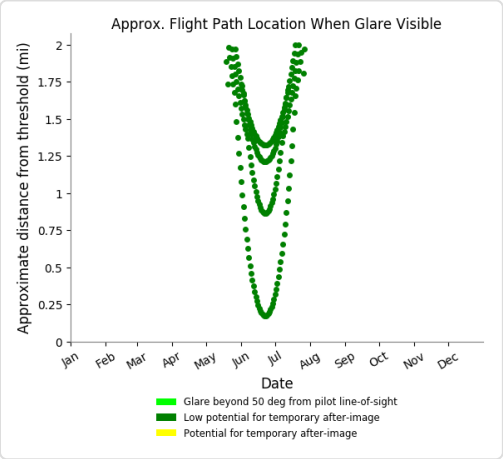


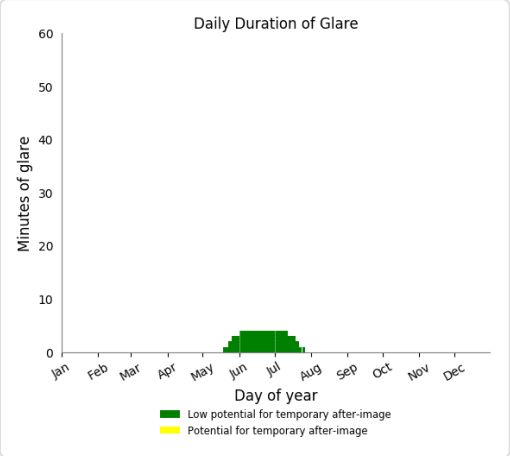
Flight Path: HNL RWY 26L

0 minutes of yellow glare

224 minutes of green glare







Flight Path: JRF RWY 04L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 04R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 11

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 22L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 22R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 29

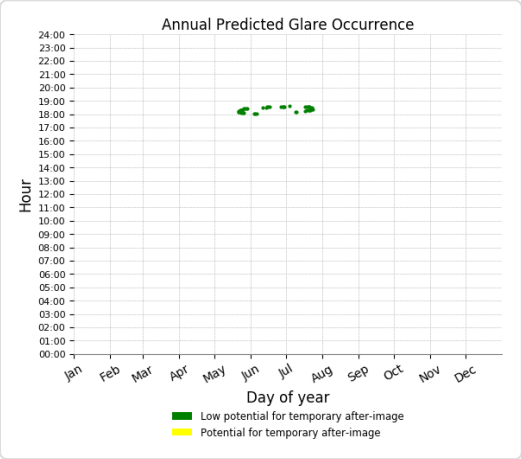
0 minutes of yellow glare
0 minutes of green glare

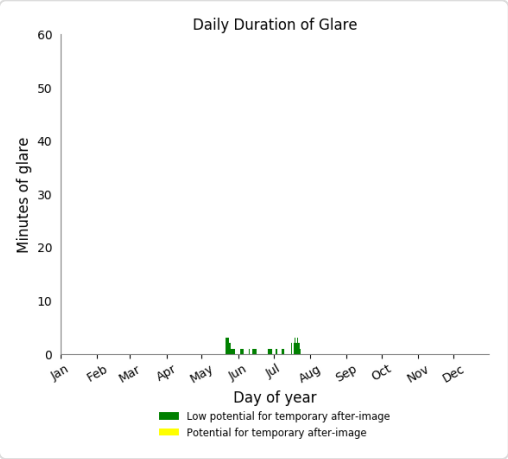
Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 2-ATCT

0 minutes of yellow glare
46 minutes of green glare





Results for: PV Area 3-1

Receptor	Green Glare (min)	Yellow Glare (min)
HHI RWY 24	0	0
HHI RWY 6	0	0
HNL RWY 04L	0	0
HNL RWY 04R	0	0
HNL RWY 08R	0	0
HNL RWY 22L	132	0
HNL RWY 22R	133	0
HNL RWY 26L	292	0

Receptor	Green Glare (min)	Yellow Glare (min)
JRF RWY 04L	0	0
JRF RWY 04R	0	0
JRF RWY 11	0	0
JRF RWY 22L	0	0
JRF RWY 22R	0	0
JRF RWY 29	0	0
1-ATCT	0	0
2-ATCT	103	0

Flight Path: HHI RWY 24

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HHI RWY 6

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 04L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 04R

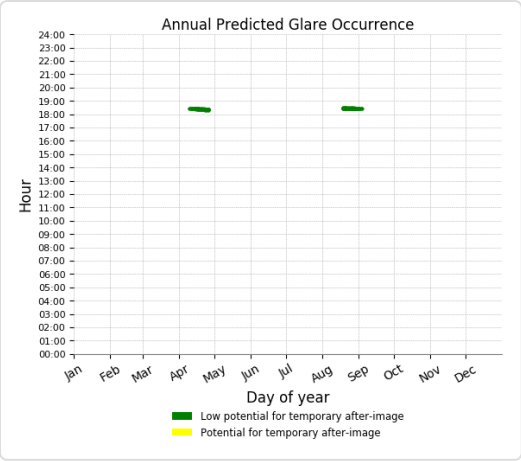
0 minutes of yellow glare
0 minutes of green glare

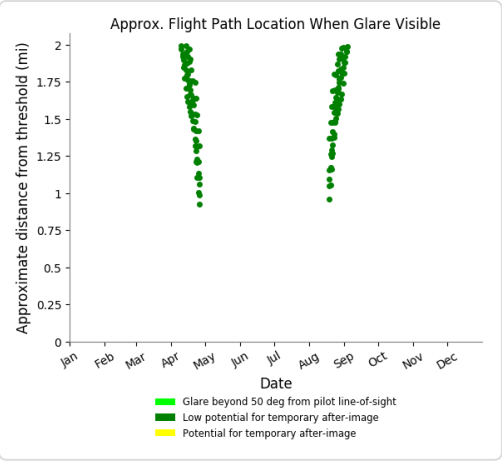
Flight Path: HNL RWY 08R

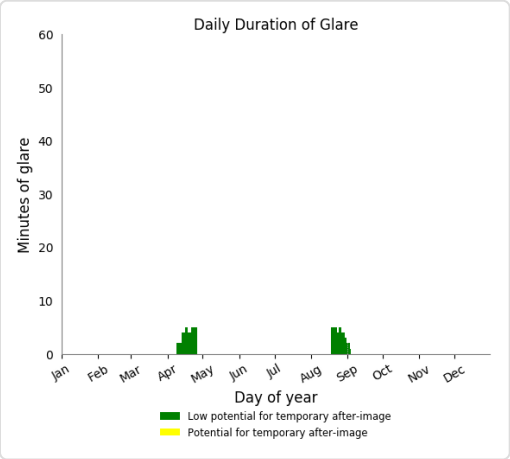
0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 22L

0 minutes of yellow glare
132 minutes of green glare



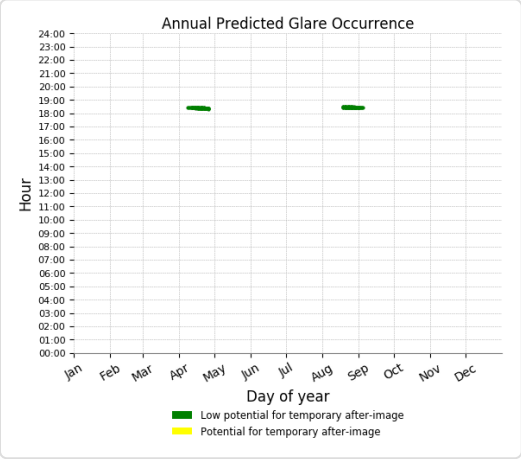


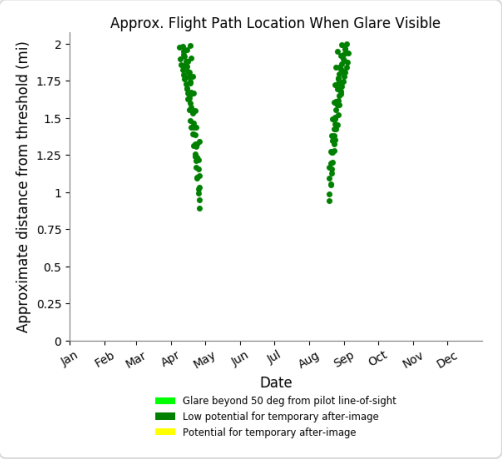


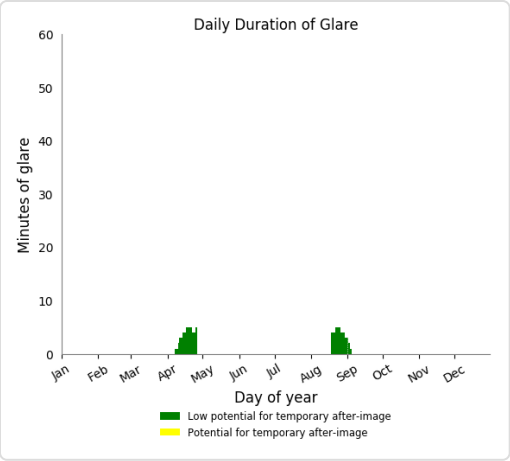
Flight Path: HNL RWY 22R

0 minutes of yellow glare

133 minutes of green glare



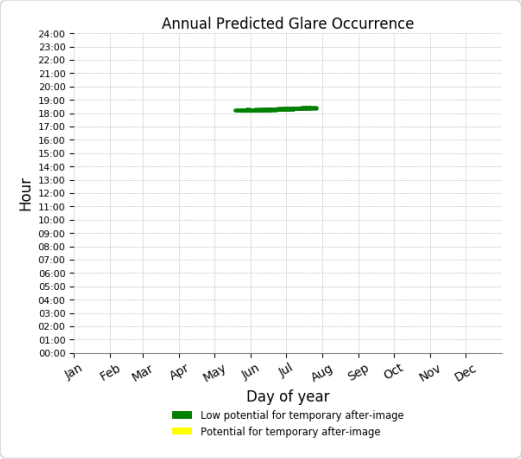


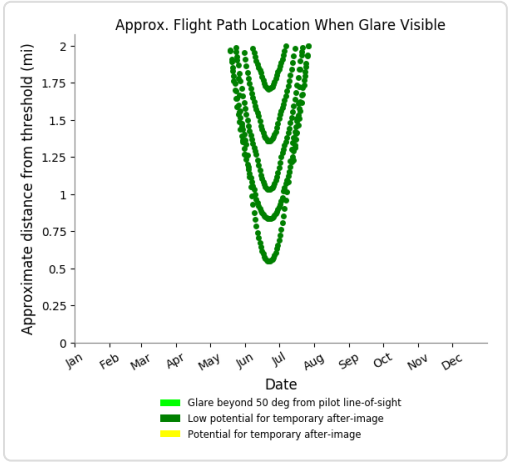


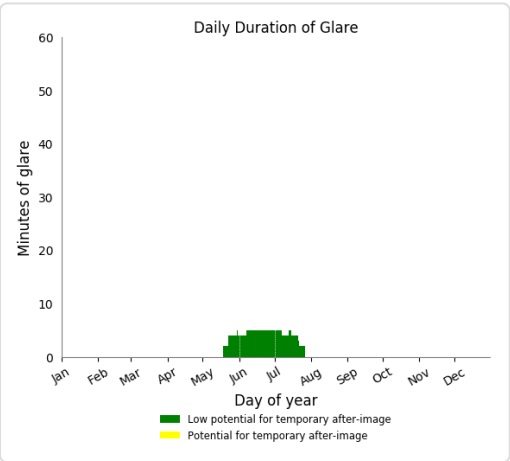
Flight Path: HNL RWY 26L

0 minutes of yellow glare

292 minutes of green glare







Flight Path: JRF RWY 04L

0 minutes of yellow glare

0 minutes of green glare

Flight Path: JRF RWY 04R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 11

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 22L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 22R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 29

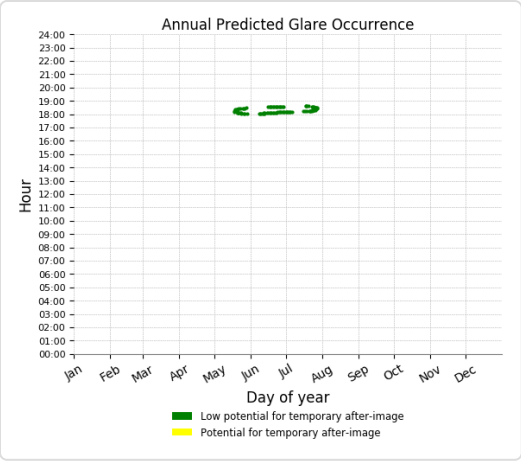
0 minutes of yellow glare
0 minutes of green glare

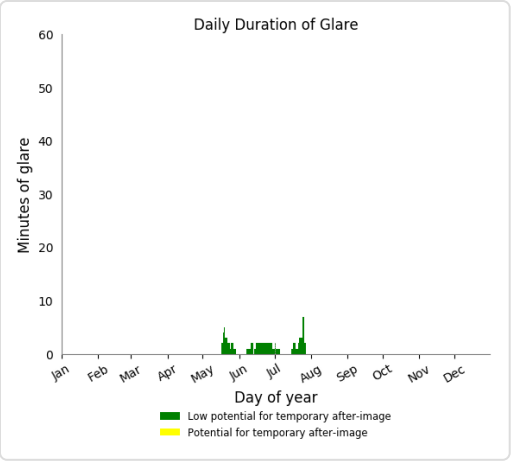
Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 2-ATCT

0 minutes of yellow glare
103 minutes of green glare





Results for: PV Area 3-2

Receptor	Green Glare (min)	Yellow Glare (min)
HHI RWY 24	0	0
HHI RWY 6	0	0
HNL RWY 04L	0	0
HNL RWY 04R	0	0
HNL RWY 08R	0	0
HNL RWY 22L	80	0
HNL RWY 22R	81	0
HNL RWY 26L	193	0
JRF RWY 04L	0	0
JRF RWY 04R	0	0
JRF RWY 11	0	0
JRF RWY 22L	0	0
JRF RWY 22R	0	0
JRF RWY 29	0	0
1-ATCT	0	0
2-ATCT	97	0

Flight Path: HHI RWY 24

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HHI RWY 6

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 04L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 04R

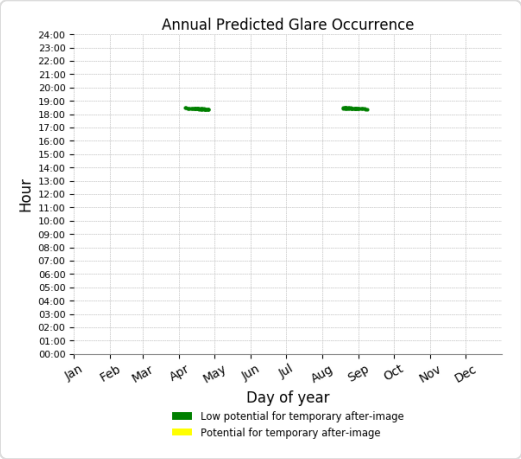
0 minutes of yellow glare
0 minutes of green glare

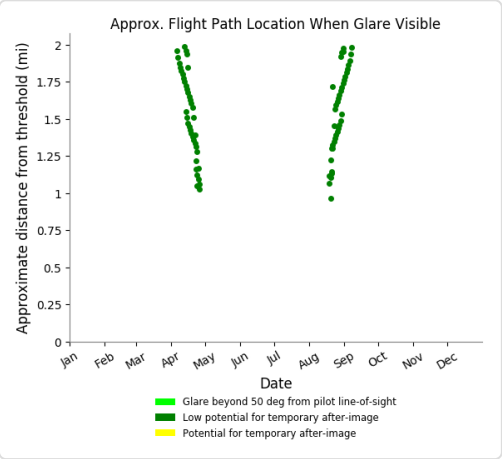
Flight Path: HNL RWY 08R

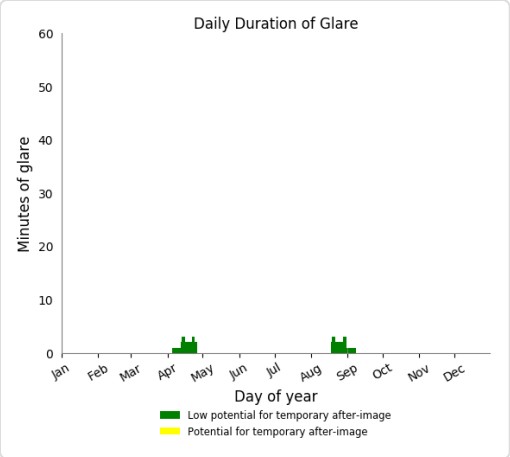
0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 22L

0 minutes of yellow glare
80 minutes of green glare



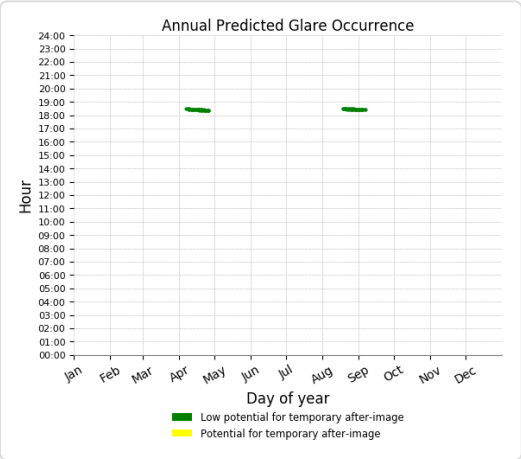


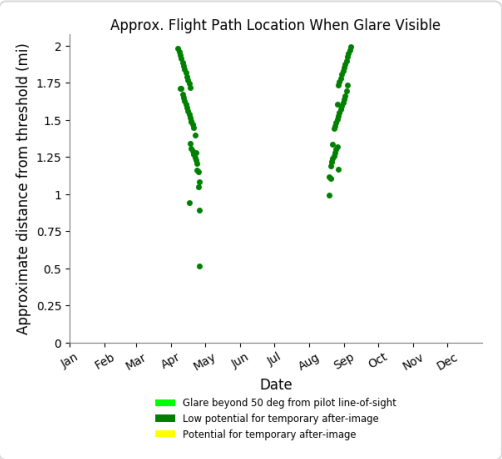


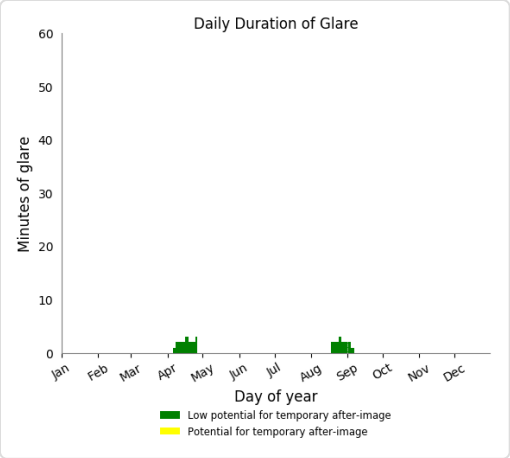
Flight Path: HNL RWY 22R

0 minutes of yellow glare

81 minutes of green glare



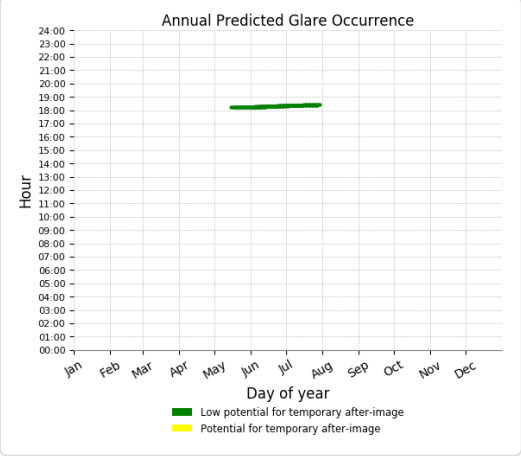


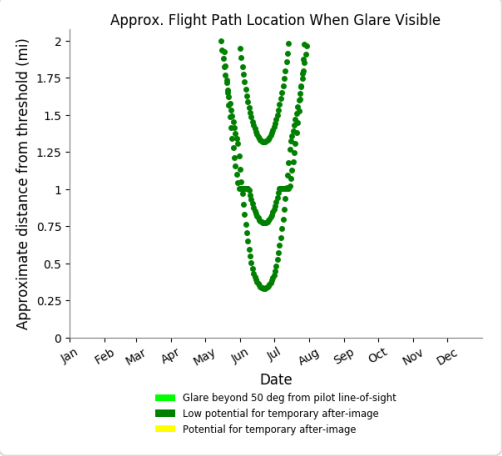


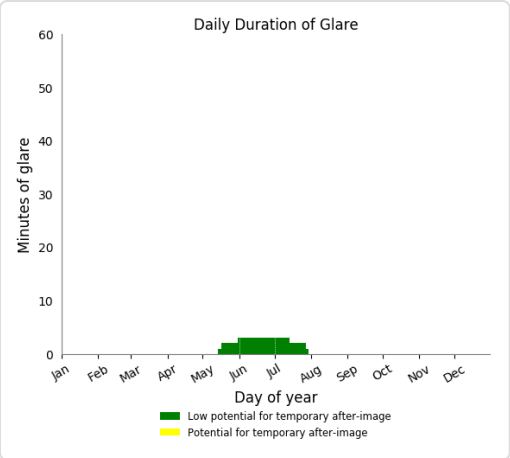
Flight Path: HNL RWY 26L

0 minutes of yellow glare

193 minutes of green glare







Flight Path: JRF RWY 04L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 04R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 11

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 22L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 22R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 29

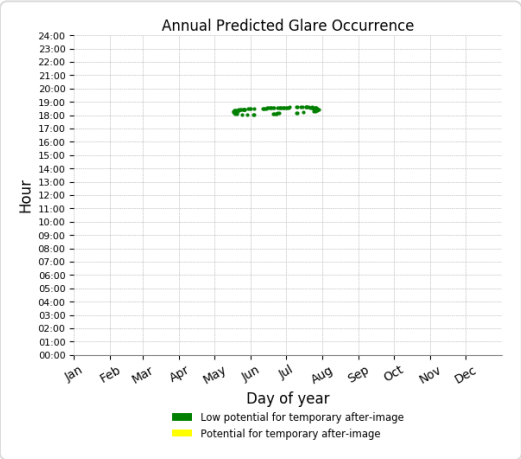
0 minutes of yellow glare
0 minutes of green glare

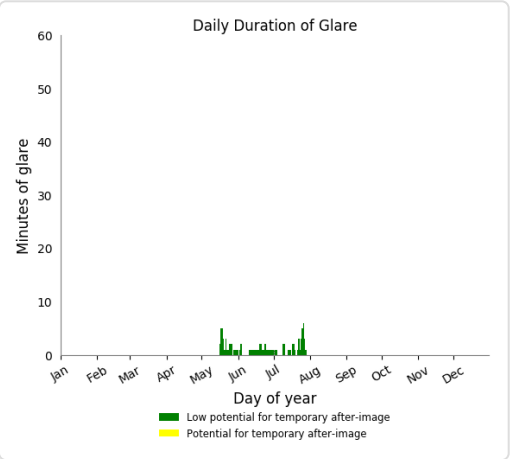
Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 2-ATCT

0 minutes of yellow glare
97 minutes of green glare





Results for: PV Area 3-3

Receptor	Green Glare (min)	Yellow Glare (min)
HHI RWY 24	0	0
HHI RWY 6	0	0
HNL RWY 04L	0	0
HNL RWY 04R	0	0
HNL RWY 08R	0	0
HNL RWY 22L	108	0
HNL RWY 22R	110	0
HNL RWY 26L	284	0
JRF RWY 04L	0	0
JRF RWY 04R	0	0
JRF RWY 11	0	0
JRF RWY 22L	0	0
JRF RWY 22R	0	0
JRF RWY 29	0	0
1-ATCT	0	0
2-ATCT	65	0

Flight Path: HHI RWY 24

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HHI RWY 6

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 04L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 04R

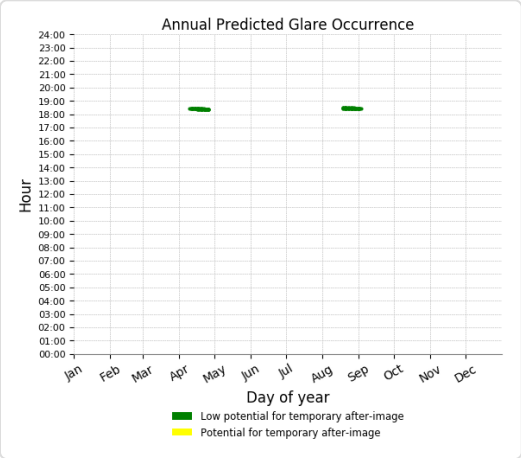
0 minutes of yellow glare
0 minutes of green glare

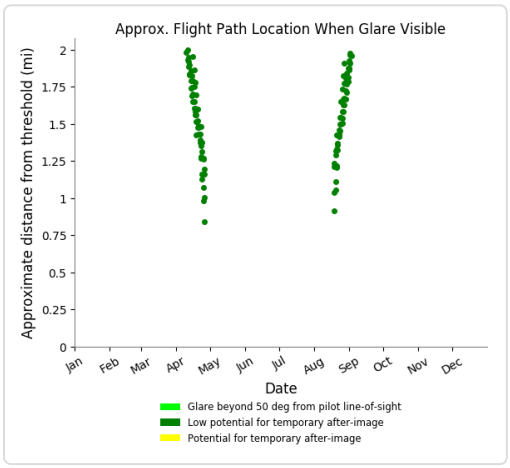
Flight Path: HNL RWY 08R

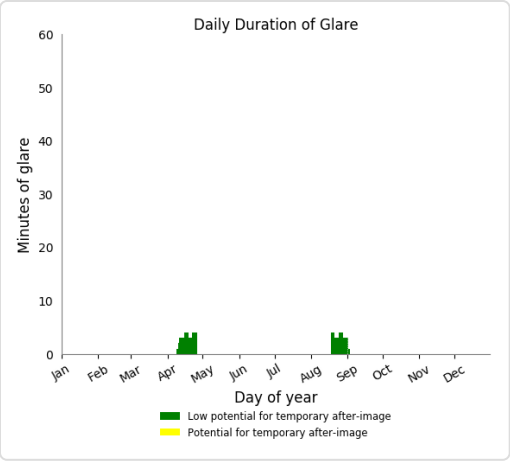
0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 22L

0 minutes of yellow glare
108 minutes of green glare



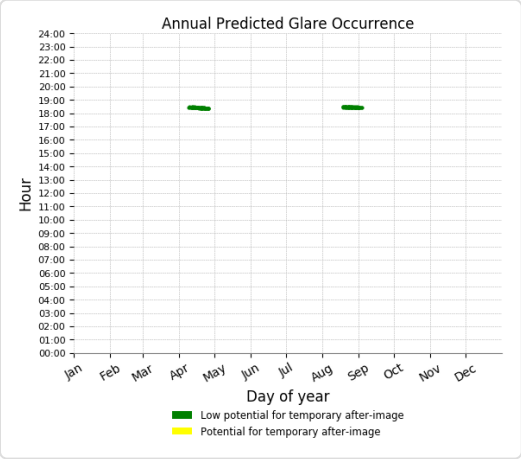


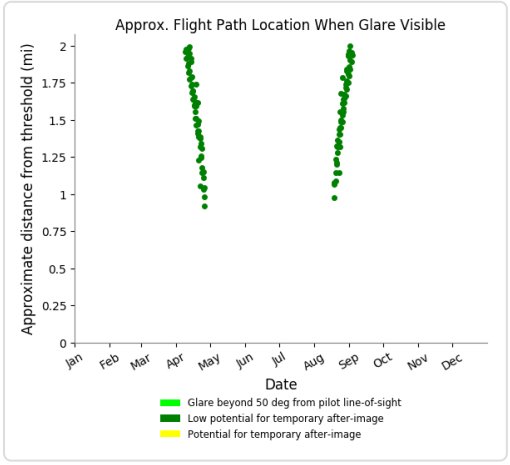


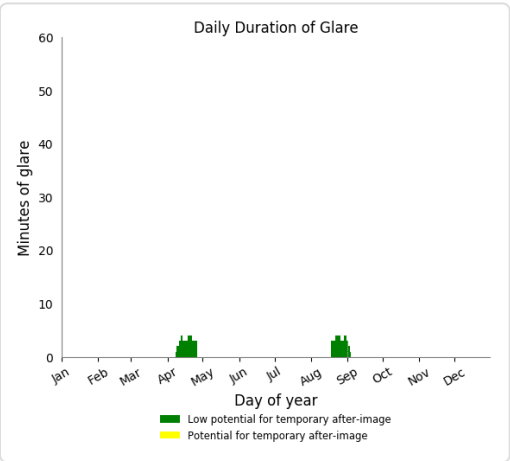
Flight Path: HNL RWY 22R

0 minutes of yellow glare

110 minutes of green glare



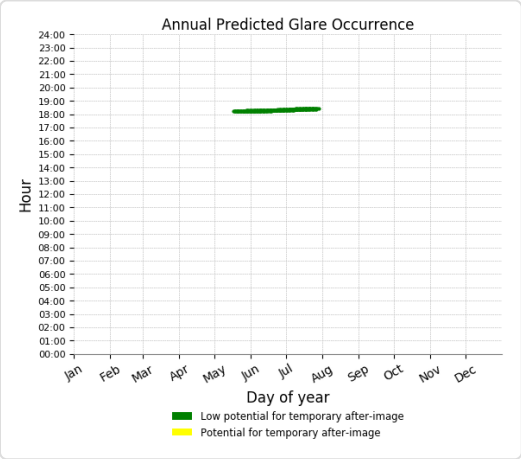


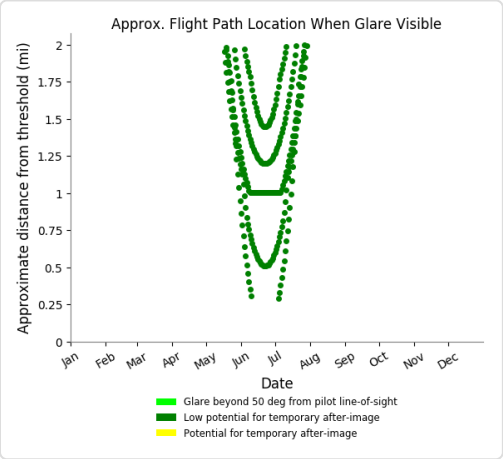


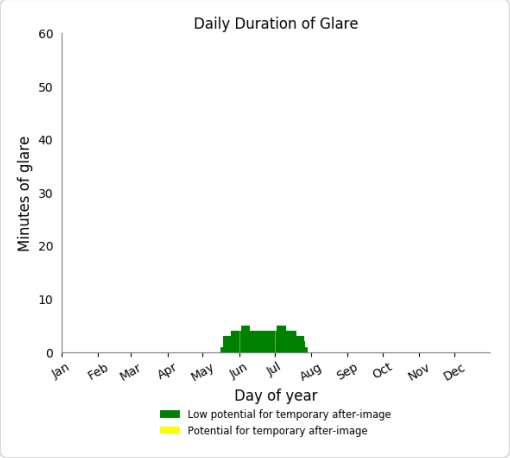
Flight Path: HNL RWY 26L

0 minutes of yellow glare

284 minutes of green glare







Flight Path: JRF RWY 04L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 04R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 11

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 22L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 22R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 29

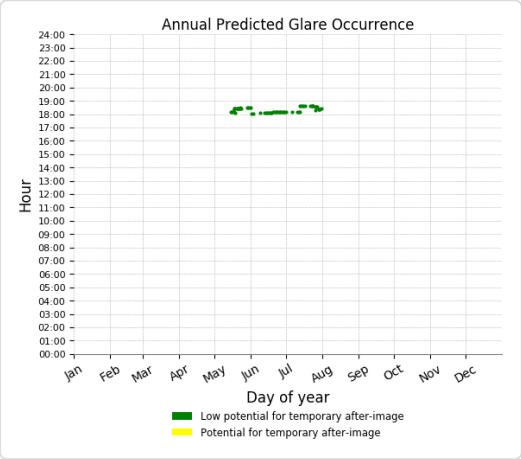
0 minutes of yellow glare
0 minutes of green glare

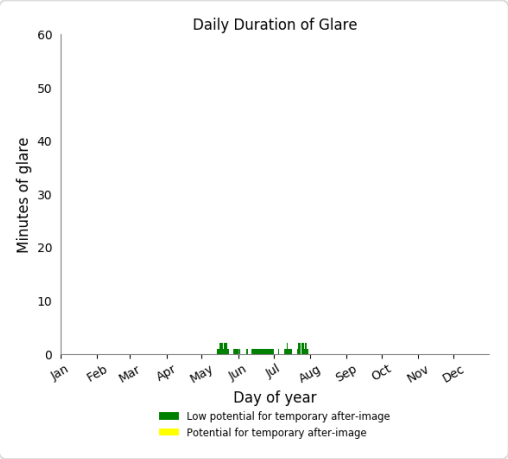
Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 2-ATCT

0 minutes of yellow glare
65 minutes of green glare





Results for: PV Area 3-4

Receptor	Green Glare (min)	Yellow Glare (min)
HHI RWY 24	0	0
HHI RWY 6	0	0
HNL RWY 04L	0	0
HNL RWY 04R	0	0
HNL RWY 08R	0	0
HNL RWY 22L	142	0
HNL RWY 22R	135	0
HNL RWY 26L	266	0

Receptor	Green Glare (min)	Yellow Glare (min)
JRF RWY 04L	0	0
JRF RWY 04R	0	0
JRF RWY 11	0	0
JRF RWY 22L	0	0
JRF RWY 22R	0	0
JRF RWY 29	0	0
1-ATCT	0	0
2-ATCT	80	0

Flight Path: HHI RWY 24

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HHI RWY 6

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 04L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 04R

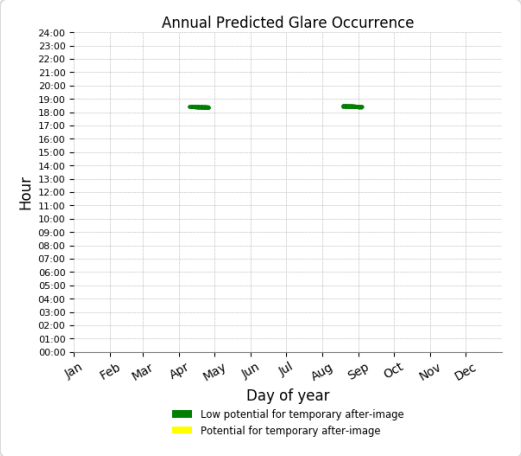
0 minutes of yellow glare
0 minutes of green glare

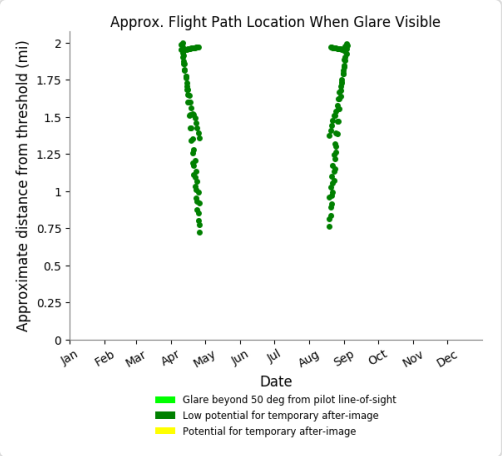
Flight Path: HNL RWY 08R

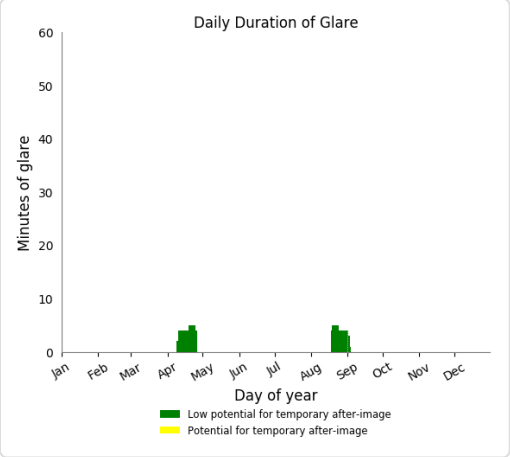
0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 22L

0 minutes of yellow glare
142 minutes of green glare



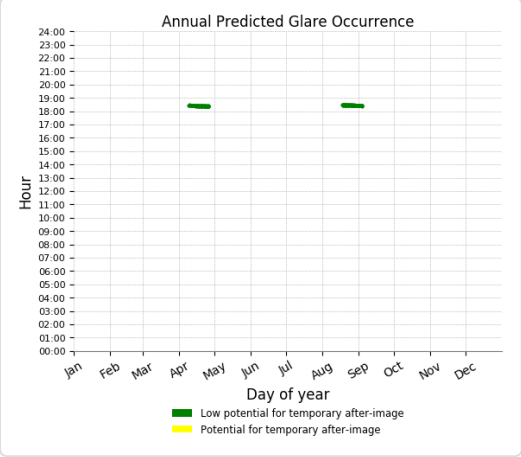


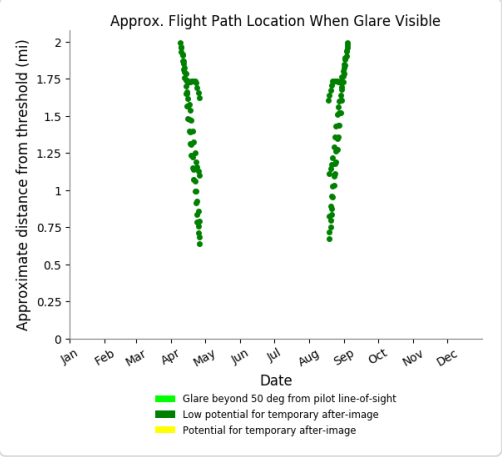


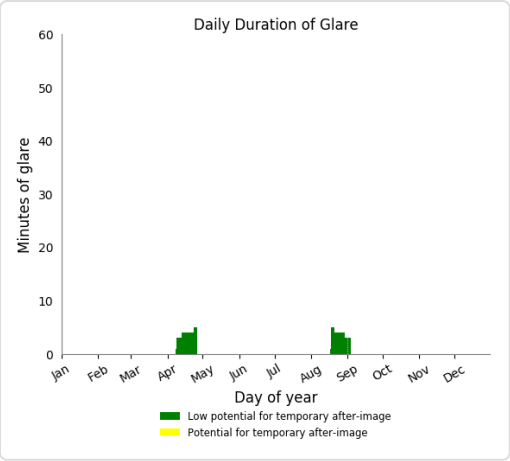
Flight Path: HNL RWY 22R

0 minutes of yellow glare

135 minutes of green glare



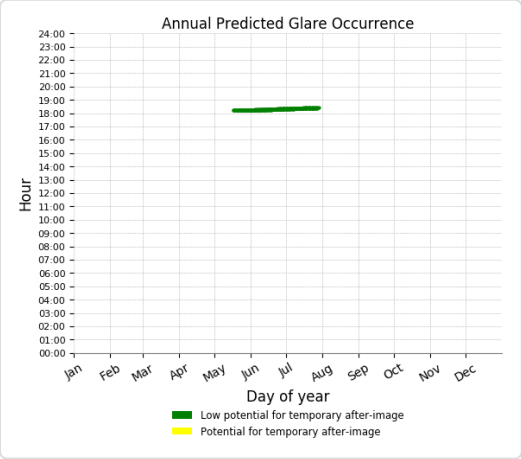


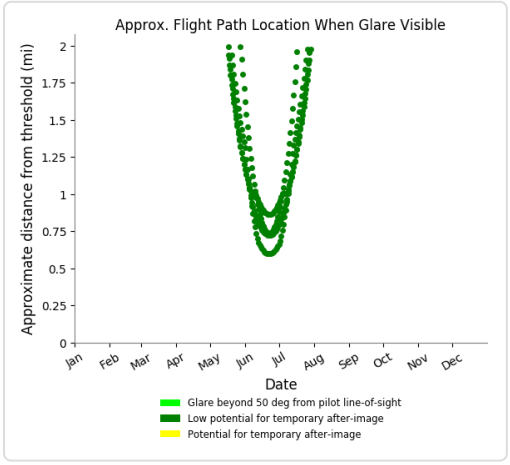


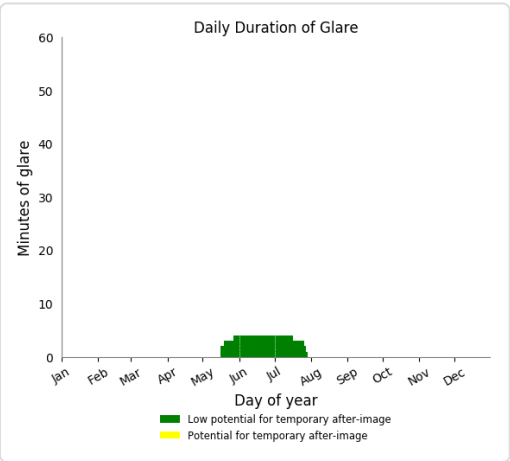
Flight Path: HNL RWY 26L

0 minutes of yellow glare

266 minutes of green glare







Flight Path: JRF RWY 04L

0 minutes of yellow glare

0 minutes of green glare

Flight Path: JRF RWY 04R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 11

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 22L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 22R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 29

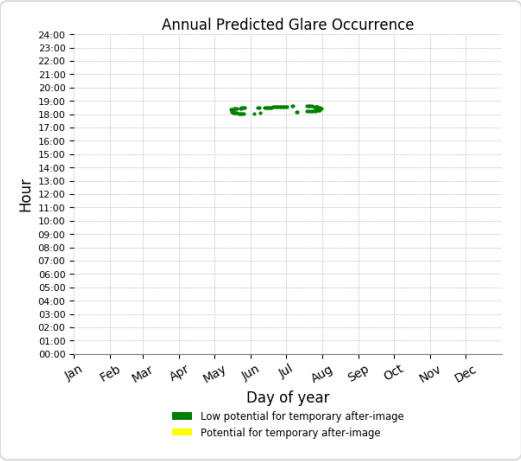
0 minutes of yellow glare
0 minutes of green glare

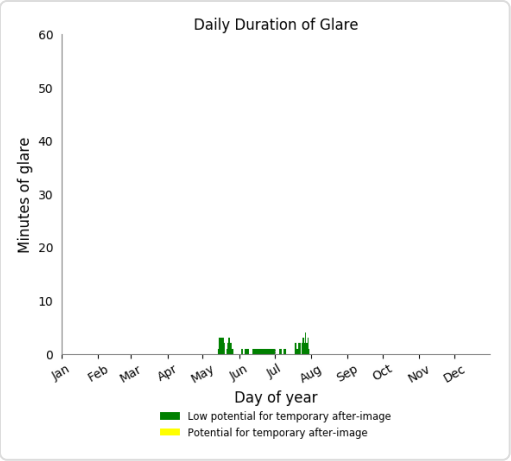
Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 2-ATCT

0 minutes of yellow glare
80 minutes of green glare





Results for: PV Area 4

Receptor	Green Glare (min)	Yellow Glare (min)
HHI RWY 24	0	0
HHI RWY 6	0	0
HNL RWY 04L	0	0
HNL RWY 04R	0	0
HNL RWY 08R	0	0
HNL RWY 22L	156	0
HNL RWY 22R	159	0
HNL RWY 26L	311	0
JRF RWY 04L	0	0
JRF RWY 04R	0	0
JRF RWY 11	0	0
JRF RWY 22L	0	0
JRF RWY 22R	0	0
JRF RWY 29	0	0
1-ATCT	0	0
2-ATCT	187	0

Flight Path: HHI RWY 24

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HHI RWY 6

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 04L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 04R

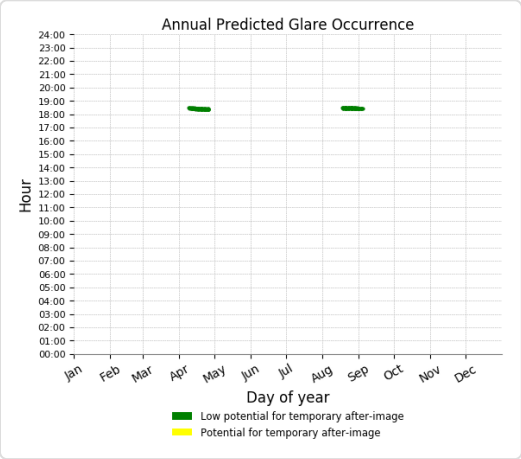
0 minutes of yellow glare
0 minutes of green glare

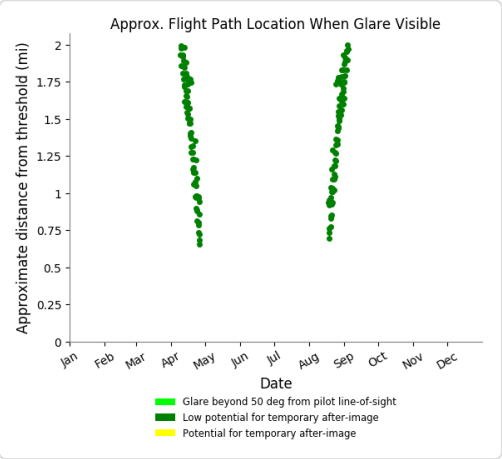
Flight Path: HNL RWY 08R

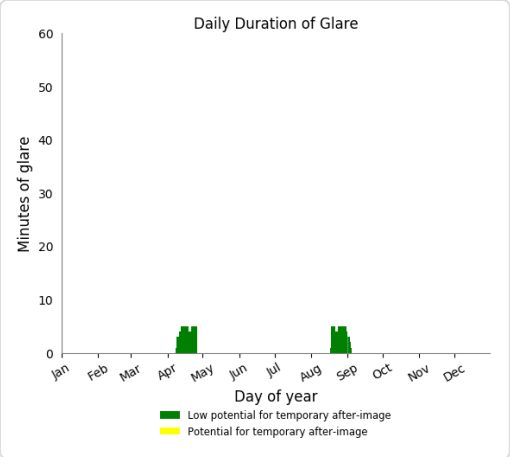
0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 22L

0 minutes of yellow glare
156 minutes of green glare

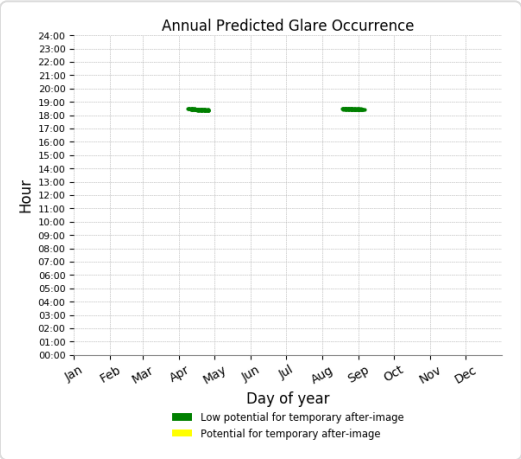


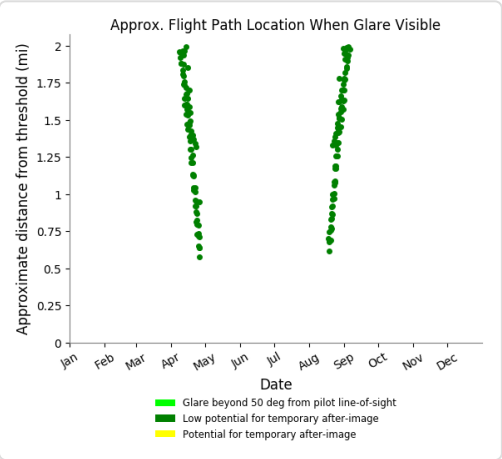


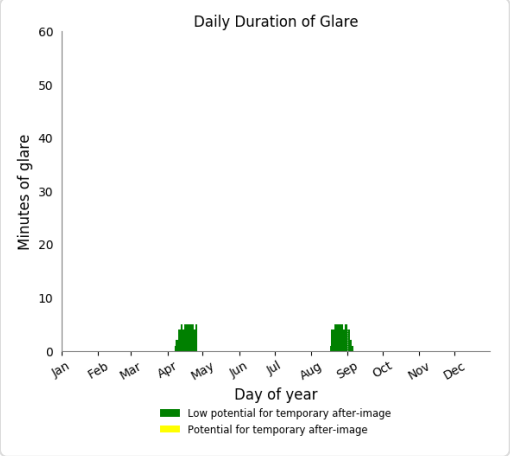


Flight Path: HNL RWY 22R

0 minutes of yellow glare
159 minutes of green glare

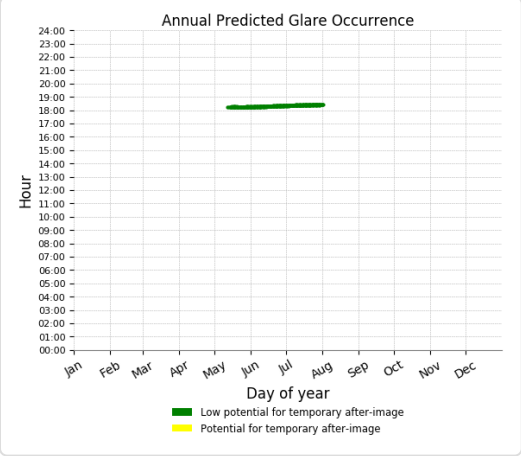


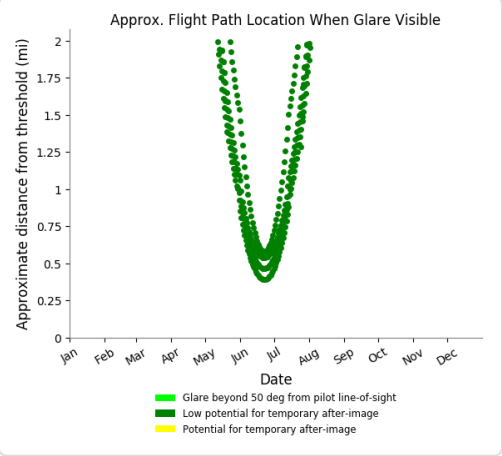


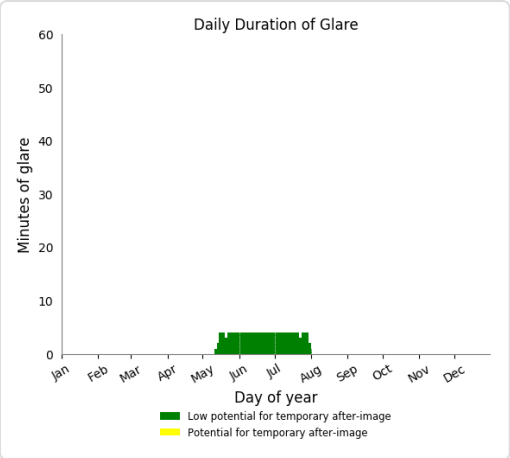


Flight Path: HNL RWY 26L

0 minutes of yellow glare
311 minutes of green glare







Flight Path: JRF RWY 04L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 04R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 11

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 22L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 22R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 29

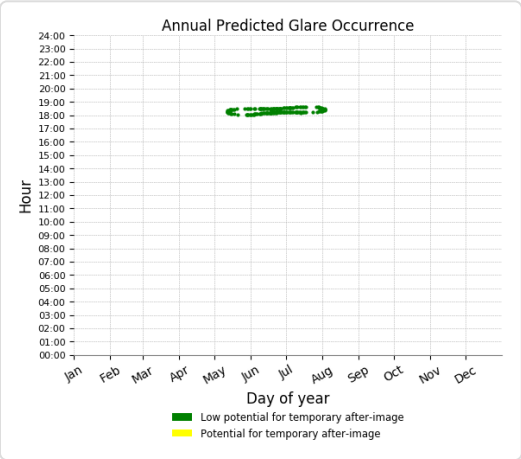
0 minutes of yellow glare
0 minutes of green glare

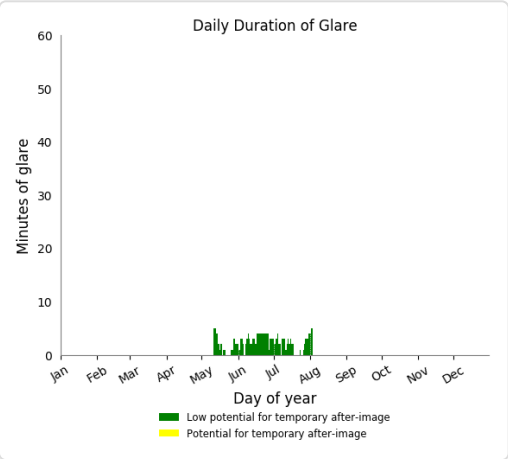
Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 2-ATCT

0 minutes of yellow glare
187 minutes of green glare





Assumptions

"Green" glare is glare with low potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
"Yellow" glare is glare with potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
Glare analyses do not account for physical obstructions between reflectors and receptors. This includes buildings, tree cover and geographic obstructions.
Several calculations utilize the PV array centroid, rather than the actual glare spot location, due to algorithm limitations. This may affect results for large PV footprints. Additional analyses of array sub-sections can provide additional information on expected glare.
The subtended source angle (glare spot size) is constrained by the PV array footprint size. Partitioning large arrays into smaller sections will reduce the maximum potential subtended angle, potentially impacting results if actual glare spots are larger than the sub-array size. Additional analyses of the combined area of adjacent sub-arrays can provide more information on potential glare hazards. (See previous point on related limitations.)
Glare locations displayed on receptor plots are approximate. Actual glare-spot locations may differ.
Glare vector plots are simplified representations of analysis data. Actual glare emanations and results may differ.
The glare hazard determination relies on several approximations including observer eye characteristics, angle of view, and typical blink response time. Actual results and glare occurrence may differ.
Hazard zone boundaries shown in the Glare Hazard plot are an approximation and visual aid based on aggregated research data. Actual ocular impact outcomes encompass a continuous, not discrete, spectrum.

Attachment Q
Traffic Impact Analysis Report

AES WEST OAHU SOLAR PLUS STORAGE PROJECT

TRAFFIC IMPACT ANALYSIS REPORT

KAPOLEI, OAHU, HAWAII

February 18, 2020

Prepared for:
AES Distributed Energy
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Louisville, CO 80027

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AES WEST OAHU SOLAR PLUS STORAGE PROJECT
TRAFFIC IMPACT ANALYSIS REPORT

Kapolei, Oahu, Hawaii

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Civil Engineers • Surveyors
Honolulu • Wailuku • Hilo, Hawaii

February 18, 2020

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APPENDICES

AUSTIN, TSUTSUMI & ASSOCIATES, INC. CIVIL ENGINEERS • SURVEYORS
CONTINUING THE ENGINEERING PRACTICE FOUNDED BY H. A. R. AUSTIN IN 1934

TERRANCE S. ARASHIRO, P.E.
ADRIENNE W.L.H. WONG, P.E., LEED AP
DEANNA M.R. HAYASHI, P.E.
PAUL K. ARITA, P.E.
ERIK S. KANESHIRO, L.P.L.S., LEED AP
MATT K. NAKAMOTO, P.E.
GARRETT K. TOKUOKA, P.E.

TRAFFIC IMPACT ANALYSIS REPORT
AES West Oahu Solar Plus Storage Project
Kapolei, Oahu, Hawaii

1. INTRODUCTION

This report documents the findings of a traffic study conducted by Austin, Tsutsumi, and Associates, Inc. (ATA) to evaluate the traffic impacts resulting from the proposed AES West Oahu Solar Plus Storage Project (hereinafter referred to as the "Project") located in Kapolei, Oahu, Hawaii.

1.1 Project Location

The Project is located in Kapolei on the island of Oahu on parcels of land more specifically identified as TMK: (1) 9-2-002:007. The Project will be located on approximately 80 acres of land within the larger mauka lands parcel owned by the University of Hawaii (UH) West Oahu near Makakilo, mauka (mountain side) of the H-1 freeway (H-1).

See Figure 1.1 for Project Location.

1.2 Project Description

The Project is envisioned to develop a solar and battery storage facility on an approximately 80 acre area within the currently undeveloped UH West Oahu mauka lands parcel. The Project will host a 12.5 megawatt (MW) ground-mounted solar photovoltaic (PV) system, 50 MW-hour battery energy storage system, and related interconnection and ancillary facilities. The site will be accessed from Palehua Road at an existing gated entry located north of the Kualakai Parkway intersection with the H-1 westbound on- and off-ramps. The Project is anticipated to be completed by the end of Year 2021.

See Figure 1.2 for a Preliminary Project Site Plan.

AES WEST OAHU SOLAR PLUS STORAGE PROJECT

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Engineers & Surveyors

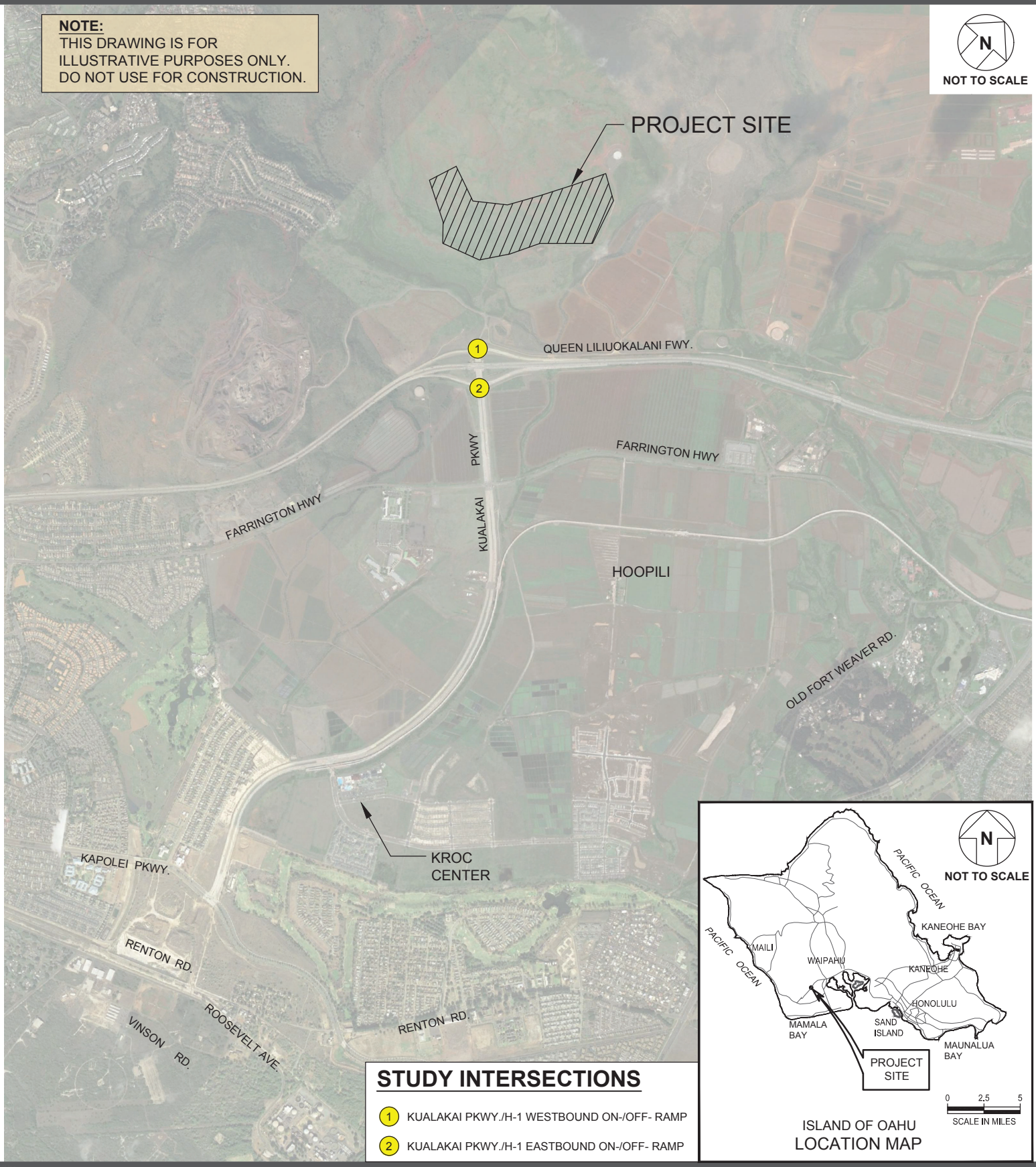
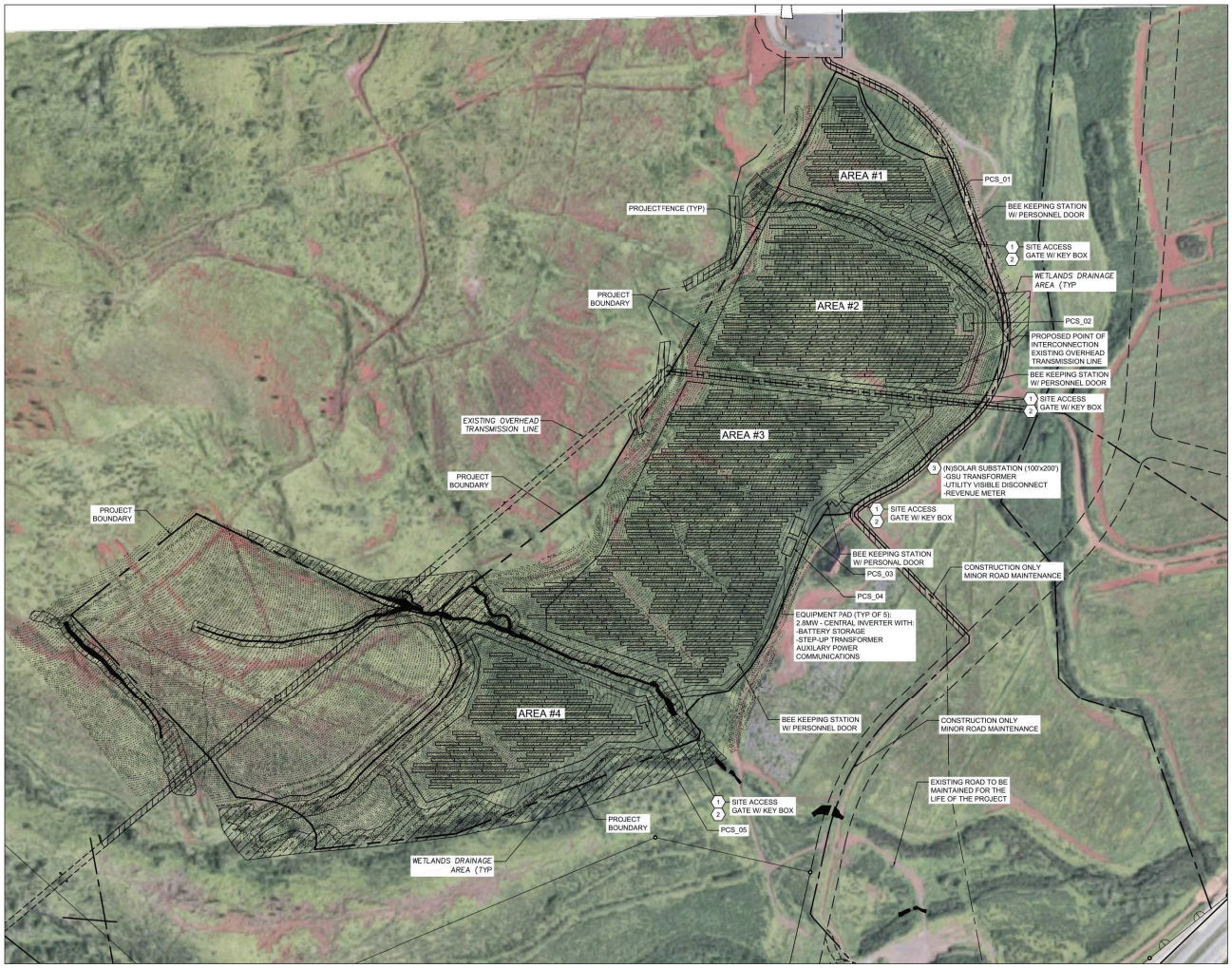


FIGURE 1.1

PROJECT LOCATION



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SITE PLAN OBTAINED FROM AES DISTRIBUTED ENERGY.

LEGEND

PCS — PCS POWER CONVERSION STATION

PCS BOUNDARY

GENERAL NOTES

1. REFER TO CIVIL DRAWINGS FOR PERIMETER FENCE, ROADS AND GATES.
2. REFER TO SOLTEC DRAWINGS FOR TRACKER PILE LOCATIONS.
3. PV SITE WILL NOT HAVE SITE LIGHTING OR SECURITY CAMERAS.

KEYED NOTES

1. CONTRACTOR TO FURNISH AND INSTALL KNOX BOX ACCESS ENCLOSURE AT ENTRANCE TO EVERY ROAD.
2. INSTALL FENCE GROUNDING. SEE E511 FOR DETAILS.
3. SUBSTATION LOCATION IS PENDING, AND SUBJECT TO CHANGE.

DESIGN SPECIFICATIONS

DC SYSTEM VOLTAGE	1500V	
ARRAY CAPACITY	17.407MW DC	
	12.5MW AC POI	
DC/AC RATIO	1.39	
MODULE	JINKO - EAGLE BIFACIAL 4C-72M	
MODULE WATTAGE	405Wp	
MODULE QUANTITY	AREA #1	3,192
	AREA #2	12,656
	AREA #3	20,776
	AREA #4	6,384
	AREA #5	-
	TOTAL	43,008
STRINGS	1,536 STRINGS OF 28 MODULES	
INVERTERS (QTY)	(5) 2.8MW CENTRAL INVERTERS WITH INTEGRAL BESS DC/DC CONVERSION	
BATTERY STORAGE	(10) 1,300kW BATTERY CONTAINERS	
RACKING SYSTEM	FIXED TILT 15°	
AZIMUTH	0°	
PANEL TILT ANGLE	15°	
ROW TO ROW SPACING	21' - 7"	
GROUND COVER RATIO	0.62 (TBC)	
FENCED IN AREA	AREA #1	APPROX. 4.6 ACRES
	AREA #2	APPROX. 13.26 ACRES
	AREA #3	APPROX. 22.04 ACRES
	AREA #4	APPROX. 9.16 ACRES
	AREA #5	APPROX. 7.79 ACRES
	TOTAL	APPROX. 56.23 ACRES

1. MODULES ARE POSITIONED TWO DEEP IN PORTRAIT ORIENTATION.

NOTE: EACH TRACKER CONTAINS (2) STRINGS OF (28) PV MODULES.

2 - TRACKER STRING DETAIL
SCALE: NONE

N
W E
S

SCALE: 1" = 200'
0 200' 400' FT

AES
Distributed Energy

AES Distributed Energy
282 Century Pl. Suite 2000
Louisville, CO 80027 USA

FDR SJ CONSULTING

SYSTEM DESCRIPTION

REVISIONS

REV	BY	DATE	DESCRIPTION

PE STAMP

OVERALL SITE PLAN
WEST OAHU SOLAR
AES DE
OAHU, HI

PROJECT NUMBER
19537
PHASE
ISSUED FOR REVIEW
MILESTONE
30% DESIGN
ELECTRICAL DESIGNER
STRUCTURAL DESIGNER
DATE
12-04-2019
SCALE
1"=200'
TITLE
DRAWING
C200

2. METHODOLOGY

2.1 Study Methodology

This study will address the following:

- Assess existing traffic operating conditions at key intersections during the weekday morning (AM) and afternoon (PM) peak hours of traffic within the study area.
- Traffic projections for Year 2021 without the Project including traffic generated by other known developments in the vicinity of the Project in addition to an ambient growth rate. These other known developments are projects that are currently under construction or known new/future developments that are anticipated to affect traffic demand and operations within the study area.
- Trip generation and traffic assignment characteristics during and after construction for the proposed Project.
- Traffic projections for Year 2021 during Project construction, which includes Year 2021 without Project traffic volumes in addition to traffic volumes generated during construction.
- Traffic projections for Year 2021 with the Project, which includes Year 2021 without Project traffic volumes in addition to traffic volumes generated by the Project.
- Recommendations as needed to mitigate any impacts resulting from Year 2021 conditions during construction or at Project completion.

2.2 Intersection Analysis

Level of Service (LOS) is a qualitative measure used to describe the conditions of traffic flow at intersections, with values ranging from free-flow conditions at LOS A to congested conditions at LOS F. The Highway Capacity Manual (HCM), 6th Edition, includes methods for calculating volume to capacity ratios, delays, and corresponding Levels of Service that were utilized in this study. LOS definitions for signalized and unsignalized intersections are provided in Appendix B.

Analyses for the study intersections were performed using the traffic analysis software Synchro, which is able to prepare reports based on the methodologies described in the HCM. These reports contain control delay results as based on intersection lane geometry, signal timing, and hourly traffic volumes. Based on the vehicular delay at each intersection, a LOS is assigned to each approach and intersection movement as a qualitative measure of performance. These results, as confirmed or refined by field observations, constitute the technical analysis that will form the basis of the recommendations outlined in this report.

2.3 Study Area Intersection Analysis

Intersection analysis within the Project's study area was performed on the following intersections due to their proximity to the Project:

- Palehua Road/H-1 Freeway Westbound on-/off-ramp (Signalized)
- Kualakai Parkway/H-1 Freeway Eastbound on-/off-ramp (Signalized)

3. EXISTING TRAFFIC CONDITIONS

The existing conditions scenario represents the traffic conditions within the Project area as it currently stands, with no build-out of the Project.

3.1 Roadway System

The following are brief descriptions of the studied roadways within the vicinity of the Project:

Palehua Road is generally a two-way, two-lane, undivided, east-west private roadway that begins at its intersection with the H-1 Westbound on-/off-ramps and terminates to the west as the entrance to Makakilo Quarry. The portion of the roadway nearest the Project Access serves as a haul road for Makakilo Quarry and is used exclusively by local traffic. Currently, there is no posted speed limit.

Kualakai Parkway is generally a two-way, 4-6 lane, divided, north-south State roadway that begins at its intersection with the H-1 Westbound on-/off-ramps and terminates to the south at its intersection with Kapolei Parkway. Kualakai Parkway provides regional access to and from locations such as Hoopili, Ka Makana Alii, and the Kroc Center. The posted speed limit is 35 miles per hour (mph).

H-1 Freeway is generally an east-west, two-way divided freeway which begins to the west in the vicinity of the Palailai Interchange then extends through Kapolei, Ewa, Waipahu, Airport Industrial Area and Central Honolulu before terminating to the east and continuing on as Kalanianaole Highway. The H-1 Freeway is approximately 27.1 miles long.

In the vicinity of the Project the H-1 Freeway is a two-way, six lane divided highway which provides three lanes in each direction with a posted speed limit of 60 miles per hour (mph).

3.2 Existing Traffic Volumes

Traffic data utilized in this report was collected on Thursday, October 24, 2019. Traffic count data is provided in Appendix A. Based on the traffic count data, the weekday AM and PM peak hours of traffic were determined to occur between 6:30 AM and 7:30 AM and between 3:45 PM to 4:45 PM, respectively.

3.3 Existing Observations and Intersection Analysis

Traffic along Kualakai Parkway is generally higher in the northbound direction during the AM peak hour and higher in the southbound direction during the PM peak hour largely due to commuter traffic.

Palehua Road & H-1 Freeway Westbound on-/off-ramp – The signalized intersection operates at LOS B or better during both AM and PM peak hours and does not experience significant delays or queuing during either peak period. All individual movements currently operate at LOS D or better during the AM and PM peak hours of traffic.

Kualakai Parkway & H-1 Freeway Eastbound on-/off-ramp – The signalized intersection operates at overall LOS A and does not experience significant delays or queuing during the AM or PM peak hours. All individual movements currently operate at LOS D or better during the AM and PM peak hours of traffic.

No pedestrians were observed during the AM or PM peak hours.

See Figure 3.1 for existing lane configuration, traffic volumes, and LOS for the study intersections. See Table 4.1 for a LOS comparison between Existing Conditions and Year 2021 without Project conditions.

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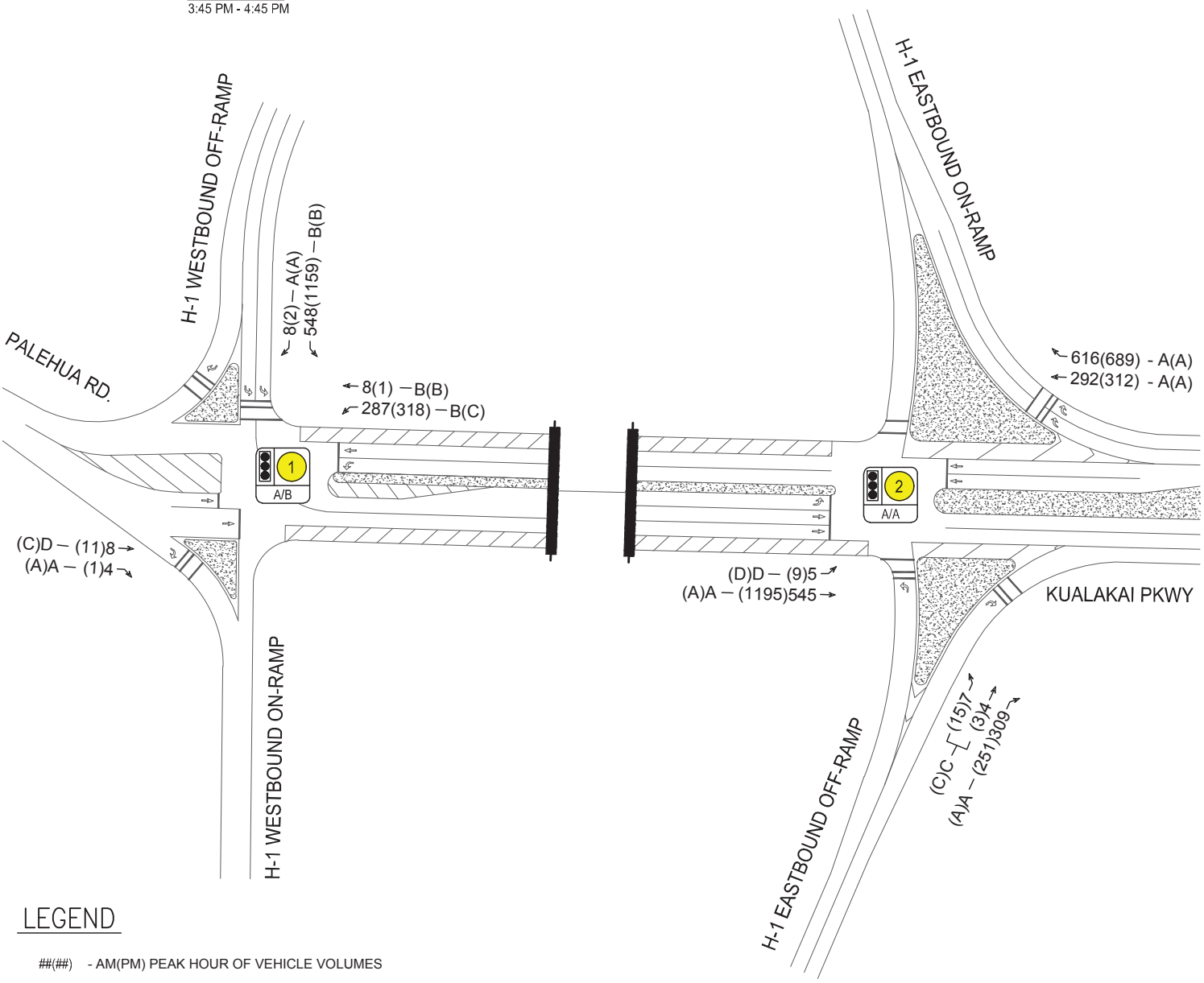
DATE OF COUNTS:
OCTOBER 24, 2019

AM PEAK HOUR:
6:30 AM - 7:30 AM

PM PEAK HOUR:
3:45 PM - 4:45 PM



LEGEND

##(##) - AM(PM) PEAK HOUR OF VEHICLE VOLUMES

Y
X/X
- SIGNALIZED INTERSECTION Y, OVERALL AM/PM LOS

X(X) - AM(PM) LOS

FIGURE 3.1

EXISTING CONDITIONS, LANE CONFIGURATIONS, TRAFFIC VOLUMES AND LOS

TABLE 3.1: LOS SUMMARY TABLE
EXISTING CONDITIONS

Intersection	Existing Conditions					
	AM			PM		
	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS
1. Kualakai Pkwy./Palehua Rd./H1 WB Ramps						
NB LT	15.8	0.75	B	27.8	0.84	C
NB TH	10.9	0.02	B	17.1	0.00	B
WB LT	12.8	0.65	B	15.8	0.82	B
WB RT	-	-	A	-	-	A
SB TH	30.2	0.41	C	39.9	0.45	D
SB RT	-	-	A	-	-	A
OVERALL	13.9	-	A	18.6	-	B
2. Kualakai Pkwy./H1 EB Ramps						
NB TH	7.9	0.36	A	5.6	0.20	A
NB RT	-	-	A	-	-	A
EB LT/TH	28.8	0.52	C	30.7	0.55	C
EB RT	-	-	A	-	-	A
SB LT	48.4	0.51	D	39.2	0.53	D
SB TH	3.8	0.33	A	3.7	0.56	A
OVERALL	5.8	-	A	4.6	-	A

Directions
NB = Northbound approach
SB = Southbound approach
EB = Eastbound approach
WB = Westbound approach

4. YEAR 2021 TRAFFIC CONDITIONS WITHOUT PROJECT

The Year 2021 was selected to reflect the Project completion year. The Base Year 2021 scenario represents the traffic conditions within the study area without the Project. Traffic projections were formulated by applying a defacto growth rate to the existing 2019 traffic count volumes as well as trips generated by known future developments in the vicinity of the Project.

4.1 Defacto Growth Rate

Projections for Year 2021 traffic were based upon the Hawaii Department of Transportation (HDOT) statewide annual count data and Hoopili TIAR, which was revised in 2014 by ATA. This defacto growth rate takes into account the continued development of the Ewa-Kapolei region, including Hoopili. By the Year 2021, Hoopili is anticipated to have completed Phase 1A and be in the process of finishing Phases 1B and 1C. These phases are anticipated to introduce over 3,000 new housing units including single-family housing, multi-family housing, and apartments, as well as neighborhood businesses, a new elementary school and a new high school.

- Kualakai Parkway – From 2014-2019 the annual growth rate was found to be 8% from the HDOT annual count data. This increase was likely due to the completion of Ka Makana Alii (2016), continued expansion of the University of Hawaii West Oahu, as well as other developments in the area. Traffic is anticipated to continue to grow at this rate as Hoopili and other developments are constructed.
- H-1 Eastbound & Westbound Freeway on-/off-ramps – Assumed the same annual growth rate of 8% as Kualakai Parkway during AM(PM) peak hours since all traffic going to and from the on-/off-ramps utilize Kualakai Parkway.

4.2 Planned Roadway Improvements

By Year 2021 without the Project, no major roadway improvements are planned to be constructed in the area. The following roadway improvements have been identified in the ORTP as future roadway improvements that may be constructed beyond Year 2021 and were therefore, not included in this TIAR.

Makakilo Drive Extension – In the vicinity of Palehua Road, Makakilo Drive is to be extended south to the Kualakai Interchange as a four-lane roadway, connecting Makakilo Drive to Kualakai Parkway between 2019-2029. At the time of this report, no information regarding the completion date of the Makakilo Drive Extension was available and was therefore not assumed to be completed prior to the Project.

Kualakai Parkway Extension – Kualakai Parkway is anticipated to be extended from Kapolei Parkway to Franklin D Roosevelt Avenue.

4.3 Year 2021 Analysis without Project

Palehua Road & H-1 Freeway Westbound on-/off-ramp – With the projection of the 8% annual growth rate from 2019 to 2021, the signalized intersection is anticipated to operate at an overall LOS B(C) during AM(PM) peak hours of traffic, respectively. Degradation of LOS from existing conditions can be attributed to background traffic growth in the region as a result of continued

development of West Oahu. However, all movements at the intersection are expected to continue operating at LOS D or better during the AM and PM peak hours of traffic.

Kualakai Parkway & H-1 Freeway Eastbound on-/off-ramp – The signalized intersection is anticipated to continue operating at overall LOS A during the AM and PM peak hours. In addition, all individual movement LOS are expected to remain the same as existing LOS with all approaches operating at LOS D or better during both AM and PM peak hours of traffic.

See Figure 4.1 for base year lane configuration, traffic volumes, and LOS for the study intersections. See Table 4.1 for a LOS comparison between Existing Conditions and Year 2021 without Project conditions.

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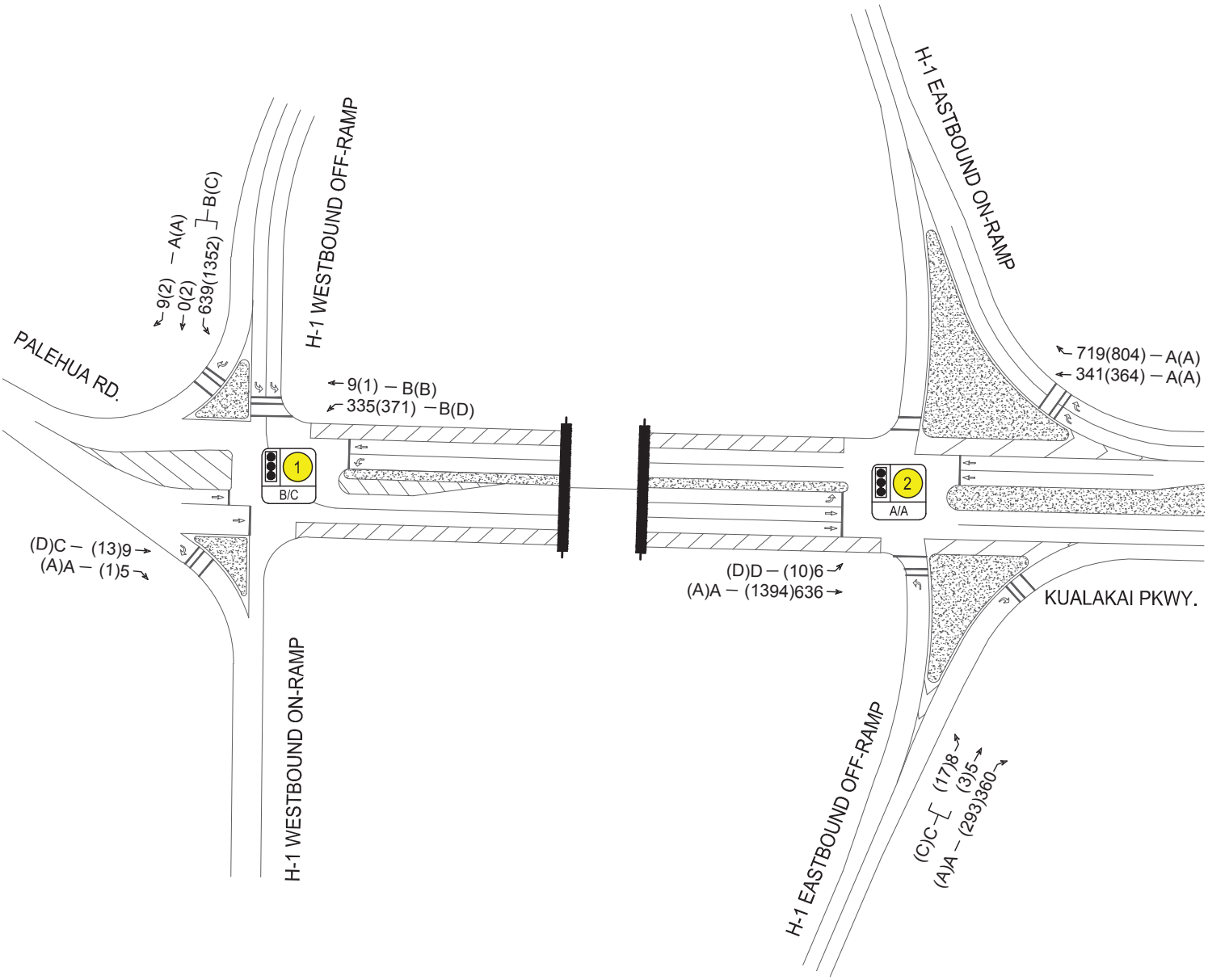

LEGEND

##(##) - AM(PM) PEAK HOUR OF VEHICLE VOLUMES

Y
X/X
- SIGNALIZED INTERSECTION Y, OVERALL AM/PM LOS

X(X) - AM(PM) LOS

FIGURE 4.1

YEAR 2021 WITHOUT PROJECT, LANE CONFIGURATIONS, TRAFFIC VOLUMES AND LOS

TABLE 4.1: LOS SUMMARY TABLE
EXISTING CONDITIONS VS YEAR 2021 WITHOUT PROJECT CONDITIONS

Intersection	Existing Conditions						Year 2021 without Project					
	AM			PM			AM			PM		
	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS
1. Kualakai Pkwy./Palehua Rd./H1 WB Ramps												
NB LT	15.8	0.75	B	27.8	0.84	C	17.0	0.78	B	42.3	0.90	D
NB TH	10.9	0.02	B	17.1	0.00	B	11.3	0.02	B	19.6	0.00	B
WB LT	12.8	0.65	B	15.8	0.82	B	13.9	0.70	B	22.6	0.90	C
WB RT	-	-	A	-	-	A	-	-	A	-	-	A
SB TH	30.2	0.41	C	39.9	0.45	D	32.0	0.43	C	45.9	0.48	D
SB RT	-	-	A	-	-	A	-	-	A	-	-	A
OVERALL	13.9	-	A	18.6	-	B	15.1	-	B	27.0	-	C
2. Kualakai Pkwy./H1 EB Ramps												
NB TH	7.9	0.36	A	5.6	0.20	A	7.8	0.38	A	4.9	0.20	A
NB RT	-	-	A	-	-	A	-	-	A	-	-	A
EB LT/TH	28.8	0.52	C	30.7	0.55	C	27.3	0.52	C	34.1	0.57	C
EB RT	-	-	A	-	-	A	-	-	A	-	-	A
SB LT	48.4	0.51	D	39.2	0.53	D	40.0	0.52	D	41.8	0.54	D
SB TH	3.8	0.33	A	3.7	0.56	A	3.9	0.38	A	3.6	0.61	A
OVERALL	5.8	-	A	4.6	-	A	5.7	-	A	4.4	-	A

Directions
NB = Northbound approach
SB = Southbound approach
EB = Eastbound approach
WB = Westbound approach

5. YEAR 2021 TRAFFIC CONDITIONS WITH PROJECT

The Year 2021 with project scenario represents the traffic conditions within the Project study area with the full build-out of the Project.

5.1 Background

The Project is envisioned to be a solar and battery storage facility on approximately 80 acres of land. The Project will consist of a 12.5 MW ground-mounted solar PV system with a 50 MW-hour battery energy storage system. The Project is planning to begin construction in late 2020 and complete construction by the end of 2021.

5.2 Trip Distribution

Trips generated during construction or by the Project were assigned throughout the study area generally based upon existing and projected Base Year 2021 travel patterns. The traffic generated by the Project was added to the forecast Base Year 2021 traffic volumes within the vicinity of the Project to constitute the traffic volumes for the Future Year 2021 traffic conditions.

5.3 Year 2021 During Project Construction Conditions

5.3.1 Trip Generation

Information provided by the Client indicates that during construction daily workers on site will range from 10 to 160 workers with an average of 55 daily workers throughout the anticipated 1-year construction schedule.

During construction, an estimated 500 tractor trailer loads (mixture of flat bed and enclosed) will make deliveries to the Project site over the course of the 1-year construction schedule. In addition to the typical tractor trailer loads, a single heavy and wide load delivery will need to be made to the Project site. Due to the size of trailer required as well as its impact to typical traffic patterns, it is assumed that this special transport will be done outside of daily peak hours of traffic and will have no effect on commuter traffic.

Due to the nature of trailer deliveries and its dependence on construction progression and manpower, a worst-case scenario was assumed for the purposes of this study. It is assumed that a maximum of 40 tractor trailers, 20 during both the AM and PM peak hours of traffic, will arrive, unload and depart the project site.

See Table 5.1 below for a summary of construction trip generation and Figure 5.1 for the assignment of construction-generated traffic.

Table 5.1: Construction Trip Generation

	Weekday AM Peak Hour		Weekday PM Peak Hour	
	Enter	Exit	Enter	Exit
Construction Workers	55	0	0	55
Tractor Trailers	20	20	20	20
Total	75	20	20	75

5.3.2 Year 2021 During Project Construction Analysis

Palehua Road & H-1 Freeway Westbound on-/off-ramp – Under worst-case assumptions as stated above, the intersection is expected to continue operating at LOS B(C) during the AM(PM) peak hours, respectively. In addition, all individual movements are expected to continue operating at LOS D or better.

Kualakai Parkway & H-1 Freeway Eastbound on-/off-ramp – The signalized intersection is anticipated to continue operating at overall LOS A during the AM and PM peak hours. In addition, all individual movement LOS are expected to remain the same as existing LOS with all approaches operating at LOS D or better during both AM and PM peak hours of traffic.

The Project site is approximately 80 acres with access off of Palehua Road (private). Due to the ample size of the property as well as the long driveway between Palehua Road and the Project site, it is not expected that any vehicle queues will spill back to the H-1 Westbound intersection and adversely affect traffic operations.

See Figure 5.2 for construction conditions lane configuration, traffic volumes, and LOS for the study intersections. See Table 5.2 for a LOS comparison between Year 2021 without Project conditions and Year 2021 During Project Construction conditions.

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Engineers & Surveyors

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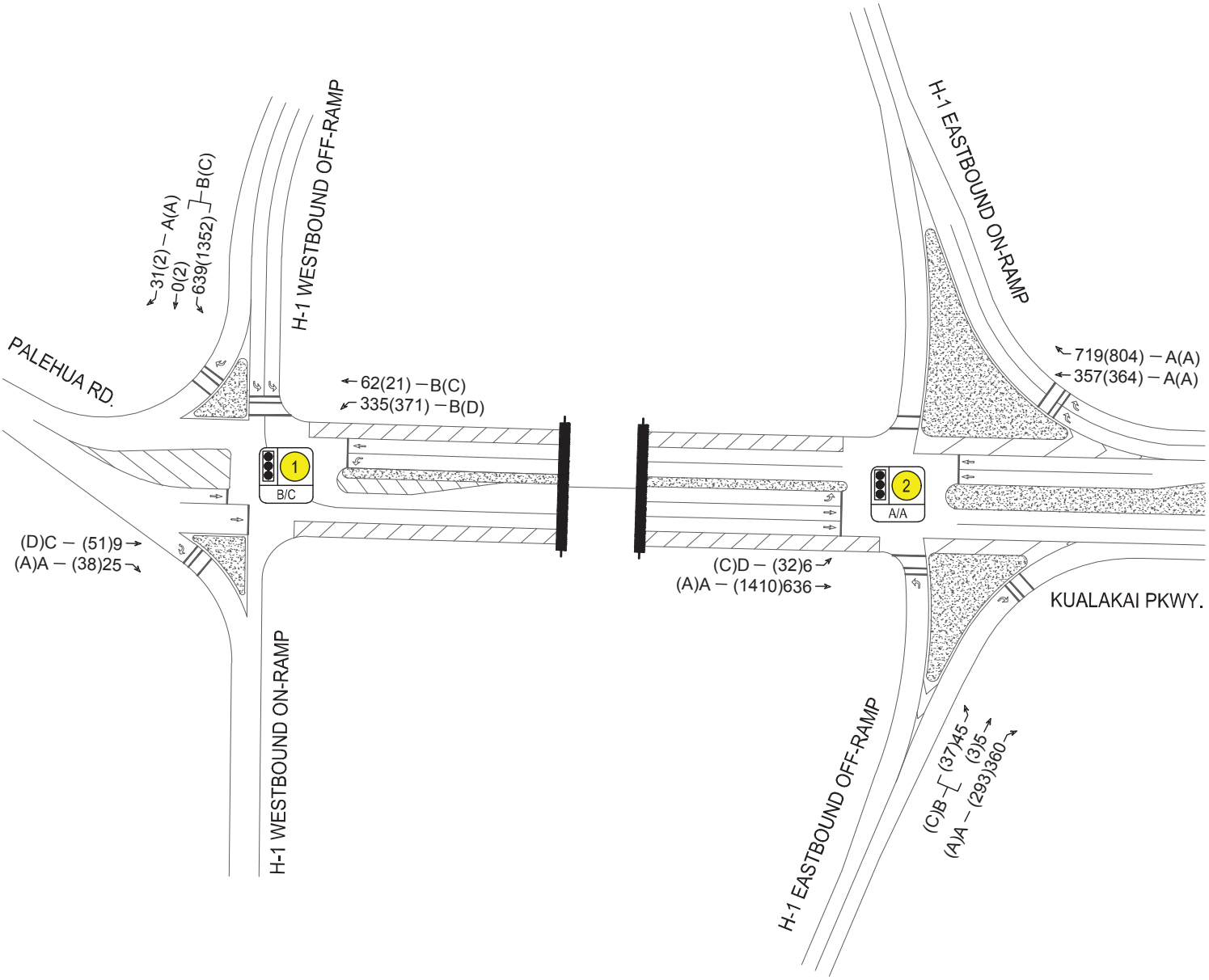

LEGEND

##(##) - AM(PM) PEAK HOUR OF VEHICLE VOLUMES

Y - SIGNALIZED INTERSECTION Y

FIGURE 5.1

YEAR 2021 CONSTRUCTION, LANE CONFIGURATIONS, TRAFFIC VOLUMES AND LOS

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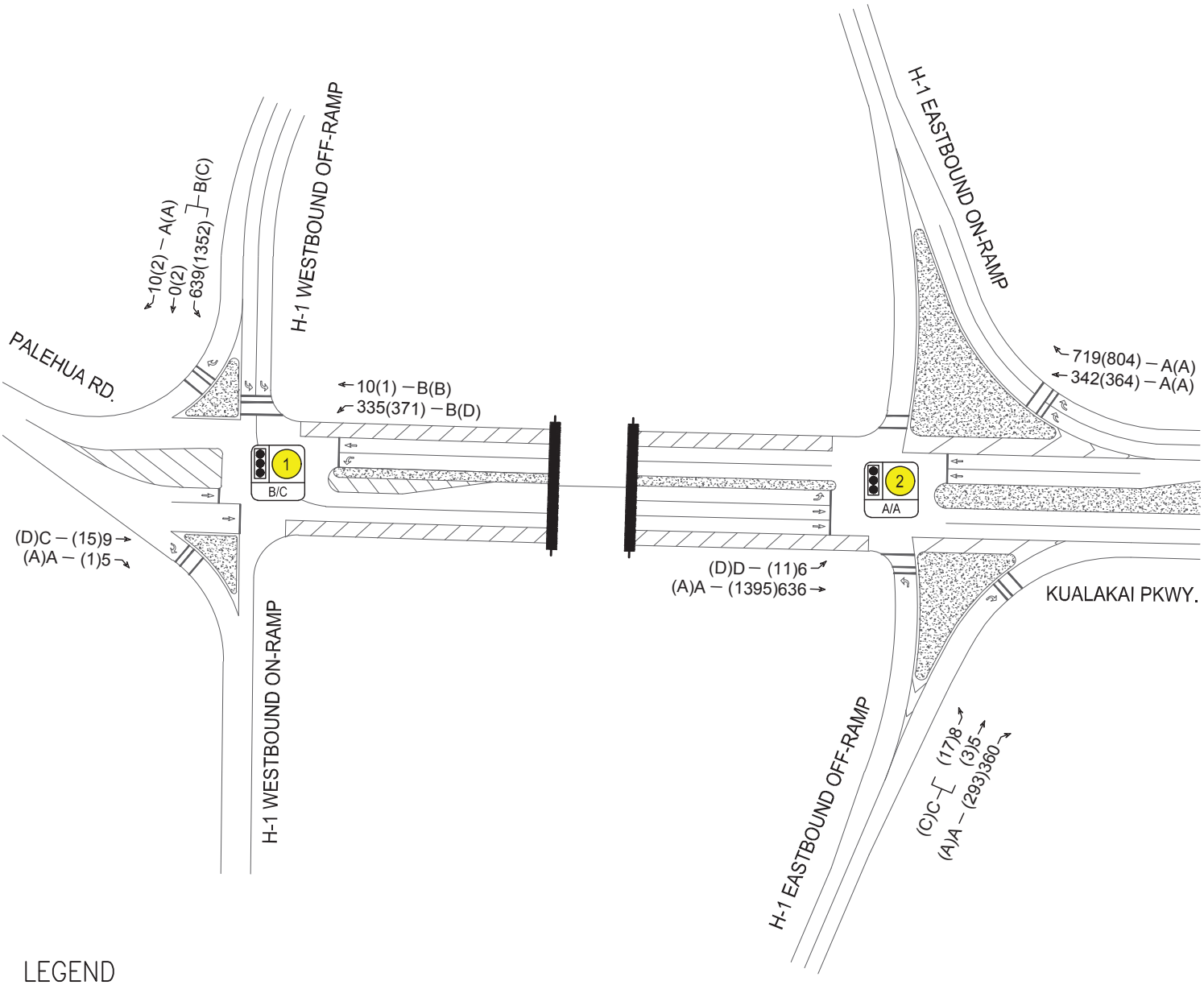

LEGEND

##(##) - AM(PM) PEAK HOUR OF VEHICLE VOLUMES

Y
X/X
- SIGNALIZED INTERSECTION Y, OVERALL AM/PM LOS

X(X) - AM(PM) LOS

FIGURE 5.2

YEAR 2021 WITH PROJECT, LANE CONFIGURATIONS, TRAFFIC VOLUMES AND LOS

5.4 Year 2021 with Project Conditions

5.4.1 Trip Generation

Based upon information provided by the client it is expected that during typical weekday operations of the Project, only two full-time employees will be on site during daytime hours. Therefore, the Project is forecast to only generate 2(2) trips during the AM(PM) peak hours of traffic.

5.4.2 Year 2021 with Project Analysis

Upon completion of the Project, with the inclusion of both the 8% annual growth rate from 2019 to 2021 and the new traffic as a result of the Project, all study intersections are projected to operate at the same overall and individual movement LOS as Year 2021 without Project traffic conditions during the AM and PM peak hours of traffic.

Palehua Road & H-1 Freeway Westbound on-/off-ramp –The signalized intersection is anticipated to operate at an overall LOS B(C) during AM(PM) peak hours of traffic, respectively. All movements at the intersection are expected to continue operating at LOS D or better during the AM and PM peak hours of traffic.

Kualakai Parkway & H-1 Freeway Eastbound on-/off-ramp – The signalized intersection is anticipated to continue operating at overall LOS A during the AM and PM peak hours. In addition, all individual movement LOS are expected to remain the same as existing LOS with all approaches operating at LOS D or better during both AM and PM peak hours of traffic.

See Figure 5.2 for Future Year 2021 with project lane configuration, traffic volumes, and LOS for the study intersections. See Table 5.3 for a LOS comparison between Year 2021 without Project conditions and Year 2021 with Project conditions

TABLE 5.2: LOS SUMMARY TABLE
YEAR 2021 WITHOUT PROJECT VS YEAR 2021 DURING PROJECT CONSTRUCTION CONDITIONS

Intersection	Year 2021 without Project						Year 2021 During Project Construction					
	AM			PM			AM			PM		
	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS
1. Kualakai Pkwy./Palehua Rd./H1 WB Ramps												
NB LT	17.0	0.78	B	42.3	0.90	D	16.6	0.76	B	46.5	0.90	D
NB TH	11.3	0.02	B	19.6	0.00	B	11.7	0.13	B	21.1	0.05	C
WB LT	13.9	0.70	B	22.6	0.90	C	14.2	0.70	B	25.9	0.91	C
WB RT	-	-	A	-	-	A	-	-	A	-	-	A
SB TH	32.0	0.43	C	45.9	0.48	D	32.3	0.43	C	47.1	0.72	D
SB RT	-	-	A	-	-	A	-	-	A	-	-	A
OVERALL	15.1	-	B	27.0	-	C	14.9	-	B	30.7	-	C
2. Kualakai Pkwy./H1 EB Ramps												
NB TH	7.8	0.38	A	4.9	0.20	A	8.3	0.40	A	5.6	0.21	A
NB RT	-	-	A	-	-	A	-	-	A	-	-	A
EB LT/TH	27.3	0.52	C	34.1	0.57	C	19.1	0.61	B	32.0	0.65	C
EB RT	-	-	A	-	-	A	-	-	A	-	-	A
SB LT	40.0	0.52	D	41.8	0.54	D	40.8	0.52	D	32.7	0.63	C
SB TH	3.9	0.38	A	3.6	0.61	A	4.2	0.39	A	3.9	0.62	A
OVERALL	5.7	-	A	4.4	-	A	6.5	-	A	5.3	-	A

Directions
NB = Northbound approach
SB = Southbound approach
EB = Eastbound approach
WB = Westbound approach

TABLE 5.3: LOS SUMMARY TABLE
YEAR 2021 WITHOU PROJECT VS YEAR 2021 WITH PROJECT CONDITIONS

Intersection	Year 2021 without Project						Year 2021 with Project					
	AM			PM			AM			PM		
	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS
1. Kualakai Pkwy./Palehua Rd./H1 WB Ramps												
NB LT	17.0	0.78	B	42.3	0.90	D	17.0	0.78	B	42.6	0.90	D
NB TH	11.3	0.02	B	19.6	0.00	B	11.3	0.02	B	19.7	0.00	B
WB LT	13.9	0.70	B	22.6	0.90	C	13.9	0.70	B	22.8	0.90	C
WB RT	-	-	A	-	-	A	-	-	A	-	-	A
SB TH	32.0	0.43	C	45.9	0.48	D	32.0	0.43	C	45.6	0.50	D
SB RT	-	-	A	-	-	A	-	-	A	-	-	A
OVERALL	15.1	-	B	27.0	-	C	15.1	-	B	27.0	-	C
2. Kualakai Pkwy./H1 EB Ramps												
NB TH	7.8	0.38	A	4.9	0.20	A	7.8	0.39	A	4.9	0.20	A
NB RT	-	-	A	-	-	A	-	-	A	-	-	A
EB LT/TH	27.3	0.52	C	34.1	0.57	C	27.3	0.52	C	34.2	0.57	C
EB RT	-	-	A	-	-	A	-	-	A	-	-	A
SB LT	40.0	0.52	D	41.8	0.54	D	40.0	0.52	D	40.5	0.54	D
SB TH	3.9	0.38	A	3.6	0.61	A	3.9	0.38	A	3.6	0.61	A
OVERALL	5.7	-	A	4.4	-	A	5.7	-	A	4.4	-	A

Directions
NB = Northbound approach
SB = Southbound approach
EB = Eastbound approach
WB = Westbound approach

6. CONCLUSIONS

The Project is envisioned to be a solar and battery storage facility within the currently undeveloped UH West Oahu mauka lands parcel in Kapolei. Vehicular access to the Project will be provided via Palehua Road at an existing gated entry located north of the Kualakai Parkway intersection with the H-1 westbound on- and off-ramps. The Project is anticipated to be completed by the end of Year 2021.

6.1 Existing Conditions

- Palehua Road & H-1 Westbound on-/off-ramp currently operates at LOS A(B) during the AM(PM) peak hours of traffic, respectively. Additionally, all individual movements currently operate at LOS D or better during the AM and PM peak hours of traffic.

- Kualakai Parkway & H-1 Eastbound on-/off-ramp currently operates at LOS A during both the AM and PM peak hours of traffic. Additionally, all individual movements currently operate at LOS D or better during the AM and PM peak hours of traffic.

6.2 Year 2021 without Project Conditions

Based upon HDOT annual traffic data, the Hoopili TIAR and Traffic Counts taken by ATA, the annual growth rate for the study roadways was determined to be 8%. This growth rate takes into account the continued development of the West Oahu including Hoopili and the University of Hawaii West Oahu campus as well as other developments.

With the inclusion of the 8% annual growth rate from 2019 to 2021,

- Palehua Road & H-1 Westbound on-/off-ramp intersection is projected to operate at LOS B(C) during the AM(PM) peak hours of traffic. Similar to existing conditions all individual movements currently operate at LOS D or better during the AM and PM peak hours of traffic.

- Kualakai Parkway & H-1 Eastbound on-/off-ramp intersection is projected to operate at LOS A during both AM and PM peak hours. Similar to existing conditions all individual movements currently operate at LOS D or better during the AM and PM peak hours of traffic.

6.3 Year 2021 During Project Construction Conditions

During construction, information provided by the client indicates that construction worker presence will vary from 10-160 daily workers with a daily average of 55 workers. In addition, tractor trailers will also be making deliveries to the Project site. A worst-case scenario was assumed for tractor trailer deliveries with 20 deliveries occurring in both the AM and PM peak hours of traffic.

With the inclusion of construction traffic into Year 2021 without Project volumes,

- Palehua Road & H-1 Westbound on-/off-ramp intersection is projected to operate at LOS B(C) during the AM(PM) peak hours of traffic. Similar to Year 2021 without Project

conditions all individual movements currently operate at LOS D or better during the AM and PM peak hours of traffic.

- Kualakai Parkway & H-1 Eastbound on-/off-ramp intersection is projected to operate at LOS A during both AM and PM peak hours. Similar to Year 2021 without Project conditions all individual movements currently operate at LOS D or better during the AM and PM peak hours of traffic.

Due to the large amount of on-site space and driveway length, it is not expected that vehicle queues will spill back to the H-1 Westbound intersection and adversely affect traffic operations.

6.4 Year 2021 with Project Conditions

Upon completion the Project will only have 2 full-time employees on site during typical weekday operations. Therefore, the Project is forecast to only generate 2(2) trips during the AM(PM) peak hours of traffic. These additional trips are anticipated to have no impact on Year 2021 without Project traffic. Therefore, upon completion of the Project, all study intersections are anticipated to operate with the same LOS as Year 2021 without Project traffic conditions.

With the inclusion of the 8% annual growth rate from 2019 to 2021,

- Palehua Road & H-1 Westbound on-/off-ramp intersection is projected to operate at LOS B(C) during the AM(PM) peak hours of traffic. Similar to Year 2021 without Project conditions all individual movements currently operate at LOS D or better during the AM and PM peak hours of traffic.

- Kualakai Parkway & H-1 Eastbound on-/off-ramp intersection is projected to operate at LOS A during both AM and PM peak hours. Similar to Year 2021 without Project conditions all individual movements currently operate at LOS D or better during the AM and PM peak hours of traffic.

As a result of this report, it is found that the Project during construction or upon completion will have no significant impact on the surrounding facilities.

7. REFERENCES

1. Austin Tsutsumi & Associates, Roadway Master Plan Report Hoopili, August 31, 2016.

2. Austin Tsutsumi & Associates, Traffic Impact Analysis Report Hoopili, Updated May 30, 2014.

APPENDICES

APPENDIX A

TRAFFIC COUNT DATA

Austin Tsutsumi & Associates

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File Name : Kualakai Pkwy - H-1 West On and Off-Ramp
Site Code : West Oahu Solar
Start Date : 10/24/2019

Groups Printed- Motorcycles - Cars & Light Goods - Buses - Unit Trucks - Articulated Trucks - Bicycles on Road - Bicycles on Crosswalk - Pedestrians

	KUALAKAI PKWY SOUTHBOUND				H-1 WEST OFF-RAMP WESTBOUND				KUALAKAI PKWY NORTHBOUND				H-1 WEST ON-RAMP EASTBOUND				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
06:00	0	0	0	0	137	0	4	0	31	5	0	0	0	0	0	0	177
06:15	0	0	0	0	131	0	5	0	48	4	0	0	0	0	0	0	188
06:30	0	0	1	0	160	0	4	0	65	3	0	0	0	0	0	0	233
06:45	0	3	0	0	149	0	1	0	74	3	0	0	0	0	0	0	230
Total	0	3	1	0	577	0	14	0	218	15	0	0	0	0	0	0	828
07:00	0	4	1	0	116	0	2	0	69	0	0	0	0	1	0	0	193
07:15	0	1	2	0	123	0	1	0	79	2	0	0	0	0	0	0	208
07:30	0	1	3	0	148	0	2	0	104	3	0	0	0	0	0	0	261
07:45	0	3	2	0	148	0	2	0	60	1	0	0	0	0	0	0	216
Total	0	9	8	0	535	0	7	0	312	6	0	0	0	1	0	0	878
08:00	0	1	2	0	140	0	1	0	76	1	0	0	0	0	0	0	221
08:15	0	1	2	0	129	0	2	0	53	3	0	0	0	0	0	0	190
08:30	0	3	2	0	133	0	3	0	46	3	0	0	0	0	0	0	190
08:45	0	3	5	0	119	1	3	0	32	4	0	0	0	0	0	0	167
Total	0	8	11	0	521	1	9	0	207	11	0	0	0	0	0	0	768
Grand Total	0	20	20	0	1633	1	30	0	737	32	0	0	0	1	0	0	2474
Apprch %	0	50	50	0	98.1	0.1	1.8	0	95.8	4.2	0	0	0	100	0	0	
Total %	0	0.8	0.8	0	66	0	1.2	0	29.8	1.3	0	0	0	0	0	0	
Motorcycles	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	2
% Motorcycles	0	0	0	0	0.1	0	0	0	0.1	0	0	0	0	0	0	0	0.1
Cars & Light Goods	0	3	5	0	1589	1	14	0	686	12	0	0	0	0	0	0	2310
% Cars & Light Goods	0	15	25	0	97.3	100	46.7	0	93.1	37.5	0	0	0	0	0	0	93.4
Buses	0	0	0	0	2	0	0	0	6	0	0	0	0	0	0	0	8
% Buses	0	0	0	0	0.1	0	0	0	0.8	0	0	0	0	0	0	0	0.3
Single-Unit Trucks	0	13	9	0	36	0	11	0	39	15	0	0	0	1	0	0	124
% Single-Unit Trucks	0	65	45	0	2.2	0	36.7	0	5.3	46.9	0	0	0	100	0	0	5
Articulated Trucks	0	3	6	0	5	0	5	0	5	5	0	0	0	0	0	0	29
% Articulated Trucks	0	15	30	0	0.3	0	16.7	0	0.7	15.6	0	0	0	0	0	0	1.2
Bicycles on Road	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
% Bicycles on Road	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bicycles on Crosswalk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bicycles on Crosswalk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pedestrians	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Pedestrians	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Austin Tsutsumi & Associates

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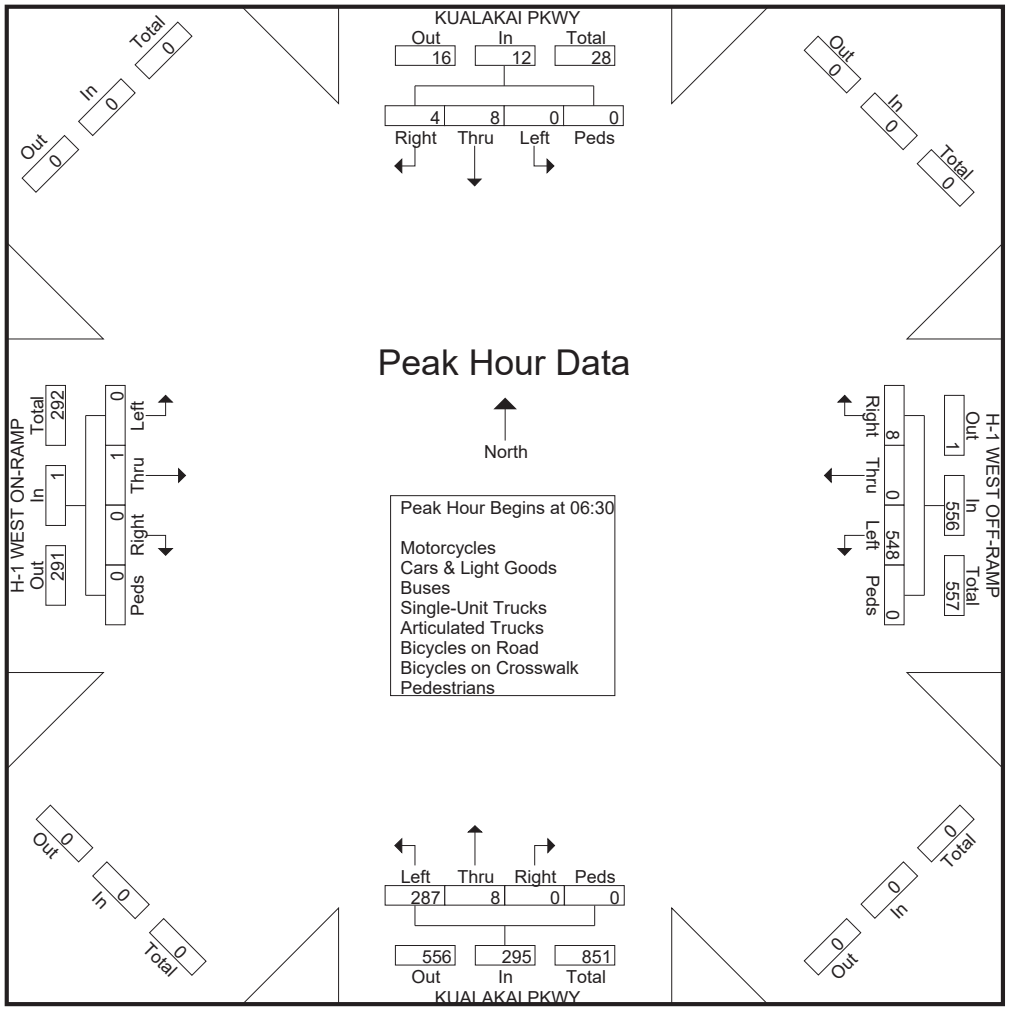
File Name : Kualakai Pkwy - H-1 West On and Off-Ramp
Site Code : West Oahu Solar
Start Date : 10/24/2019
Page No : 2

	KUALAKAI PKWY SOUTHBOUND					H-1 WEST OFF-RAMP WESTBOUND					KUALAKAI PKWY NORTHBOUND					H-1 WEST ON-RAMP EASTBOUND					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 06:30 to 07:15 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 06:30																					
06:30	0	0	1	0	1	**160**	0	**4**	0	**164**	65	**3**	0	0	68	0	0	0	0	0	**233**
06:45	0	3	0	0	3	149	0	1	0	150	74	3	0	0	77	0	0	0	0	0	230
07:00	0	**4**	1	0	**5**	116	0	2	0	118	69	0	0	0	69	0	**1**	0	0	**1**	193
07:15	0	1	**2**	0	3	123	0	1	0	124	**79**	2	0	0	**81**	0	0	0	0	0	208
Total Volume	0	8	4	0	12	548	0	8	0	556	287	8	0	0	295	0	1	0	0	1	864
% App. Total	0	66.7	33.3	0		98.6	0	1.4	0		97.3	2.7	0	0		0	100	0	0		
PHF	.000	.500	.500	.000	.600	.856	.000	.500	.000	.848	.908	.667	.000	.000	.910	.000	.250	.000	.000	.250	.927



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File Name : Kualakai Pkwy - H-1 West On and Off-Ramp
Site Code : West Oahu Solar
Start Date : 10/24/2019
Page No : 1

Groups Printed- Motorcycles - Cars & Light Goods - Buses - Unit Trucks - Articulated Trucks - Bicycles on Road - Bicycles on Crosswalk - Pedestrians

	KUALAKAI PKWY SOUTHBOUND				H-1 WEST OFF-RAMP WESTBOUND				KUALAKAI PKWY NORTHBOUND				H-1 WEST ON-RAMP EASTBOUND				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
15:00	0	6	7	0	212	1	1	0	76	0	0	0	0	0	0	0	303
15:15	0	2	1	0	234	1	0	0	66	2	0	0	0	0	0	0	306
15:30	0	3	0	0	267	1	1	0	80	0	0	0	0	0	0	0	352
15:45	0	4	0	0	300	0	0	0	112	0	0	0	0	0	0	0	416
Total	0	15	8	0	1013	3	2	0	334	2	0	0	0	0	0	0	1377
16:00	0	2	0	0	256	1	2	0	62	1	0	0	0	0	0	0	324
16:15	0	0	1	0	295	1	0	0	77	0	0	0	0	0	0	0	374
16:30	0	5	0	0	308	0	0	0	67	0	0	0	0	0	0	0	380
16:45	0	1	1	0	306	0	0	0	58	0	0	0	0	0	0	0	366
Total	0	8	2	0	1165	2	2	0	264	1	0	0	0	0	0	0	1444
17:00	0	2	1	0	293	1	0	0	59	0	0	0	0	0	0	0	356
17:15	0	0	0	0	299	0	0	0	68	0	0	0	0	0	0	0	367
17:30	0	0	0	0	298	1	0	0	54	0	0	0	0	0	0	0	353
17:45	0	1	1	0	279	0	0	0	46	0	0	0	0	1	0	0	328
Total	0	3	2	0	1169	2	0	0	227	0	0	0	0	1	0	0	1404
Grand Total	0	26	12	0	3347	7	4	0	825	3	0	0	0	1	0	0	4225
Apprch %	0	68.4	31.6	0	99.7	0.2	0.1	0	99.6	0.4	0	0	0	100	0	0	
Total %	0	0.6	0.3	0	79.2	0.2	0.1	0	19.5	0.1	0	0	0	0	0	0	
Motorcycles	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	17
% Motorcycles	0	0	0	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0.4
Cars & Light Goods	0	25	11	0	3306	6	3	0	808	3	0	0	0	1	0	0	4163
% Cars & Light Goods	0	96.2	91.7	0	98.8	85.7	75	0	97.9	100	0	0	0	100	0	0	98.5
Buses	0	0	0	0	5	0	0	0	4	0	0	0	0	0	0	0	9
% Buses	0	0	0	0	0.1	0	0	0	0.5	0	0	0	0	0	0	0	0.2
Single-Unit Trucks	0	1	1	0	18	0	1	0	7	0	0	0	0	0	0	0	28
% Single-Unit Trucks	0	3.8	8.3	0	0.5	0	25	0	0.8	0	0	0	0	0	0	0	0.7
Articulated Trucks	0	0	0	0	0	1	0	0	6	0	0	0	0	0	0	0	7
% Articulated Trucks	0	0	0	0	0	14.3	0	0	0.7	0	0	0	0	0	0	0	0.2
Bicycles on Road	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
% Bicycles on Road	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bicycles on Crosswalk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bicycles on Crosswalk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pedestrians	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Pedestrians	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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File Name : Kualakai Pkwy - H-1 West On and Off-Ramp
Site Code : West Oahu Solar
Start Date : 10/24/2019
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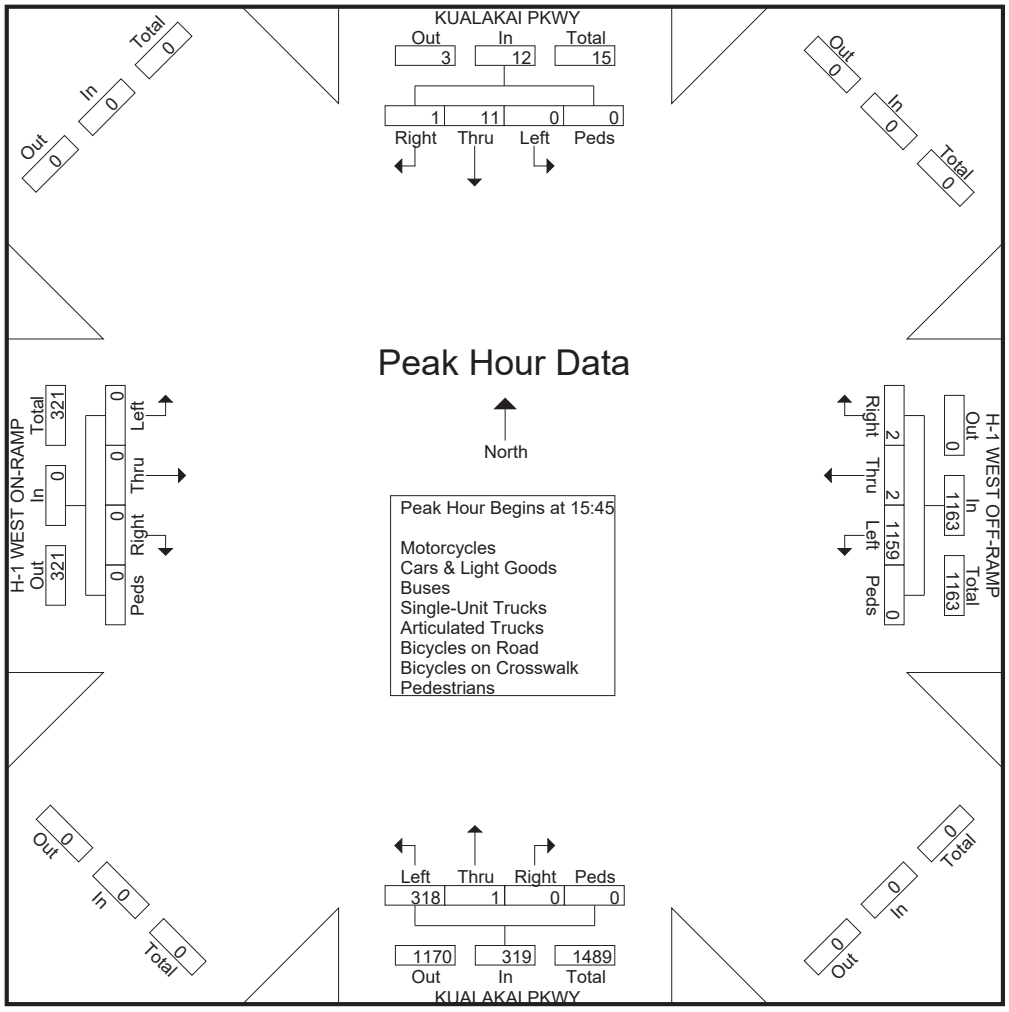
	KUALAKAI PKWY SOUTHBOUND					H-1 WEST OFF-RAMP WESTBOUND					KUALAKAI PKWY NORTHBOUND					H-1 WEST ON-RAMP EASTBOUND					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 15:00 to 17:45 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 15:45																					
15:45	0	4	0	0	4	300	0	0	0	300	**112**	0	0	0	**112**	0	0	0	0	0	**416**
16:00	0	2	0	0	2	256	**1**	**2**	0	259	62	**1**	0	0	63	0	0	0	0	0	324
16:15	0	0	**1**	0	1	295	1	0	0	296	77	0	0	0	77	0	0	0	0	0	374
16:30	0	**5**	0	0	**5**	**308**	0	0	0	**308**	67	0	0	0	67	0	0	0	0	0	380
Total Volume	0	11	1	0	12	1159	2	2	0	1163	318	1	0	0	319	0	0	0	0	0	1494
% App. Total	0	91.7	8.3	0		99.7	0.2	0.2	0		99.7	0.3	0	0		0	0	0	0		
PHF	.000	.550	.250	.000	.600	.941	.500	.250	.000	.944	.710	.250	.000	.000	.712	.000	.000	.000	.000	.000	.898



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File Name : Kualakai Pkwy - H-1 East On and Off-Ramp
Site Code : West Oahu Solar
Start Date : 10/24/2019

Groups Printed- Motorcycles - Cars & Light Goods - Buses - Unit Trucks - Articulated Trucks - Bicycles on Road - Bicycles on Crosswalk - Pedestrians

	KUALAKAI PKWY SOUTHBOUND				H-1 EAST ON-RAMP WESTBOUND				KUALAKAI PKWY NORTHBOUND				H-1 EAST OFF-RAMP EASTBOUND				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
06:00	0	138	0	0	0	0	0	0	0	29	223	0	5	0	46	0	441
06:15	0	134	0	0	0	0	0	0	0	50	181	0	3	2	66	0	436
06:30	0	158	0	0	0	0	0	0	0	73	174	0	3	1	91	0	500
06:45	1	156	0	0	0	0	0	0	0	66	166	0	3	1	74	0	467
Total	1	586	0	0	0	0	0	0	0	218	744	0	14	4	277	0	1844
07:00	4	108	0	0	0	0	0	0	0	69	110	0	0	1	65	0	357
07:15	0	123	0	0	0	0	0	0	0	84	166	0	1	1	79	0	454
07:30	1	149	0	0	0	0	0	0	0	102	137	0	3	0	69	0	461
07:45	4	148	0	0	0	0	0	0	0	61	138	0	1	0	61	0	413
Total	9	528	0	0	0	0	0	0	0	316	551	0	5	2	274	0	1685
08:00	1	131	0	0	0	0	0	0	0	75	170	0	3	0	62	0	442
08:15	4	135	0	0	0	0	0	0	0	51	167	0	3	0	47	0	407
08:30	3	135	0	0	0	0	0	0	0	45	132	0	6	0	34	0	355
08:45	3	122	0	0	0	0	0	0	0	32	121	0	5	0	42	0	325
Total	11	523	0	0	0	0	0	0	0	203	590	0	17	0	185	0	1529
Grand Total	21	1637	0	0	0	0	0	0	0	737	1885	0	36	6	736	0	5058
Apprch %	1.3	98.7	0	0	0	0	0	0	0	28.1	71.9	0	4.6	0.8	94.6	0	
Total %	0.4	32.4	0	0	0	0	0	0	0	14.6	37.3	0	0.7	0.1	14.6	0	
Motorcycles	0	1	0	0	0	0	0	0	0	4	8	0	0	0	0	0	13
% Motorcycles	0	0.1	0	0	0	0	0	0	0	0.5	0.4	0	0	0	0	0	0.3
Cars & Light Goods	9	1595	0	0	0	0	0	0	0	678	1851	0	20	4	697	0	4854
% Cars & Light Goods	42.9	97.4	0	0	0	0	0	0	0	92	98.2	0	55.6	66.7	94.7	0	96
Buses	0	2	0	0	0	0	0	0	0	6	8	0	0	0	7	0	23
% Buses	0	0.1	0	0	0	0	0	0	0	0.8	0.4	0	0	0	1	0	0.5
Single-Unit Trucks	9	32	0	0	0	0	0	0	0	42	16	0	13	0	29	0	141
% Single-Unit Trucks	42.9	2	0	0	0	0	0	0	0	5.7	0.8	0	36.1	0	3.9	0	2.8
Articulated Trucks	3	5	0	0	0	0	0	0	0	6	2	0	3	2	3	0	24
% Articulated Trucks	14.3	0.3	0	0	0	0	0	0	0	0.8	0.1	0	8.3	33.3	0.4	0	0.5
Bicycles on Road	0	2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	3
% Bicycles on Road	0	0.1	0	0	0	0	0	0	0	0.1	0	0	0	0	0	0	0.1
Bicycles on Crosswalk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bicycles on Crosswalk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pedestrians	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Pedestrians	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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File Name : Kualakai Pkwy - H-1 East On and Off-Ramp
Site Code : West Oahu Solar
Start Date : 10/24/2019
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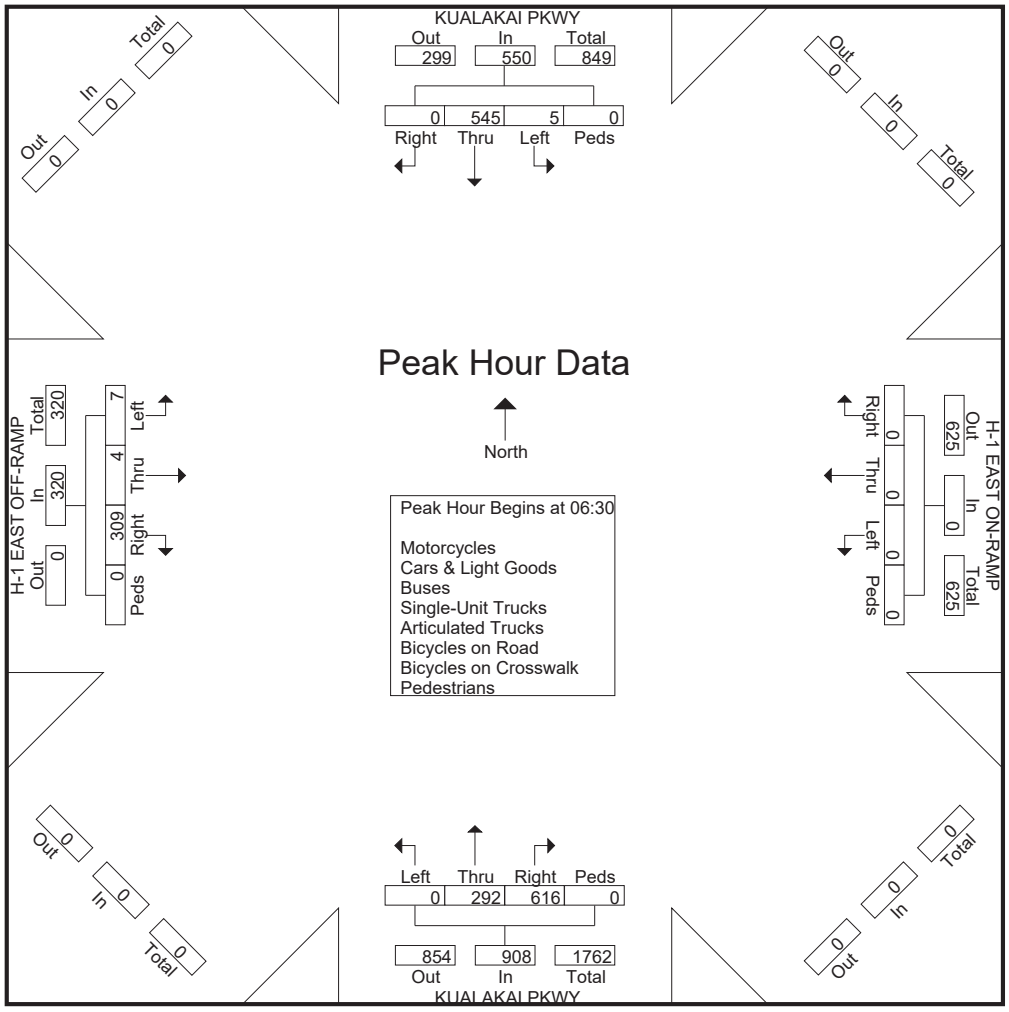
	KUALAKAI PKWY SOUTHBOUND					H-1 EAST ON-RAMP WESTBOUND					KUALAKAI PKWY NORTHBOUND					H-1 EAST OFF-RAMP EASTBOUND					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 06:30 to 07:15 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 06:30																					
06:30	0	**158**	0	0	**158**	0	0	0	0	0	0	73	**174**	0	247	**3**	**1**	**91**	0	**95**	**500**
06:45	1	156	0	0	157	0	0	0	0	0	0	66	166	0	232	3	1	74	0	78	467
07:00	**4**	108	0	0	112	0	0	0	0	0	0	69	110	0	179	0	1	65	0	66	357
07:15	0	123	0	0	123	0	0	0	0	0	0	**84**	166	0	**250**	1	1	79	0	81	454
Total Volume	5	545	0	0	550	0	0	0	0	0	0	292	616	0	908	7	4	309	0	320	1778
% App. Total	0.9	99.1	0	0		0	0	0	0		0	32.2	67.8	0		2.2	1.2	96.6	0		
PHF	.313	.862	.000	.000	.870	.000	.000	.000	.000	.000	.000	.869	.885	.000	.908	.583	1.00	.849	.000	.842	.889



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Start Date : 10/24/2019

Groups Printed- Motorcycles - Cars & Light Goods - Buses - Unit Trucks - Articulated Trucks - Bicycles on Road - Bicycles on Crosswalk - Pedestrians

	KUALAKAI PKWY SOUTHBOUND				H-1 EAST ON-RAMP WESTBOUND				KUALAKAI PKWY NORTHBOUND				H-1 EAST OFF-RAMP EASTBOUND				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
15:00	5	213	0	0	0	0	0	0	0	68	194	0	3	0	52	0	535
15:15	3	240	0	0	0	0	0	0	0	64	189	0	3	1	47	0	547
15:30	2	267	0	0	0	0	0	0	0	82	251	0	0	0	64	0	666
15:45	2	305	0	0	0	0	0	0	0	111	193	0	4	1	55	0	671
Total	12	1025	0	0	0	0	0	0	0	325	827	0	10	2	218	0	2419
16:00	2	263	0	0	0	0	0	0	0	59	161	0	4	0	59	0	548
16:15	0	302	0	0	0	0	0	0	0	72	165	0	2	2	60	0	603
16:30	5	325	0	0	0	0	0	0	0	70	170	0	5	0	77	0	652
16:45	1	314	0	0	0	0	0	0	0	51	157	0	2	0	74	0	599
Total	8	1204	0	0	0	0	0	0	0	252	653	0	13	2	270	0	2402
17:00	2	294	0	0	0	0	0	0	0	58	151	0	5	0	57	0	567
17:15	1	299	0	0	0	0	0	0	0	63	142	0	1	0	46	0	552
17:30	1	292	0	0	0	0	0	0	0	52	122	0	2	0	42	0	511
17:45	2	289	0	0	0	0	0	0	0	48	119	0	3	1	48	0	510
Total	6	1174	0	0	0	0	0	0	0	221	534	0	11	1	193	0	2140
Grand Total	26	3403	0	0	0	0	0	0	0	798	2014	0	34	5	681	0	6961
Apprch %	0.8	99.2	0	0	0	0	0	0	0	28.4	71.6	0	4.7	0.7	94.6	0	
Total %	0.4	48.9	0	0	0	0	0	0	0	11.5	28.9	0	0.5	0.1	9.8	0	
Motorcycles	0	19	0	0	0	0	0	0	0	0	2	0	0	0	4	0	25
% Motorcycles	0	0.6	0	0	0	0	0	0	0	0	0.1	0	0	0	0.6	0	0.4
Cars & Light Goods	24	3365	0	0	0	0	0	0	0	781	1980	0	33	5	673	0	6861
% Cars & Light Goods	92.3	98.9	0	0	0	0	0	0	0	97.9	98.3	0	97.1	100	98.8	0	98.6
Buses	1	4	0	0	0	0	0	0	0	4	2	0	0	0	1	0	12
% Buses	3.8	0.1	0	0	0	0	0	0	0	0.5	0.1	0	0	0	0.1	0	0.2
Single-Unit Trucks	1	14	0	0	0	0	0	0	0	8	24	0	1	0	3	0	51
% Single-Unit Trucks	3.8	0.4	0	0	0	0	0	0	0	1	1.2	0	2.9	0	0.4	0	0.7
Articulated Trucks	0	1	0	0	0	0	0	0	0	5	6	0	0	0	0	0	12
% Articulated Trucks	0	0	0	0	0	0	0	0	0	0.6	0.3	0	0	0	0	0	0.2
Bicycles on Road	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bicycles on Road	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bicycles on Crosswalk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bicycles on Crosswalk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pedestrians	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Pedestrians	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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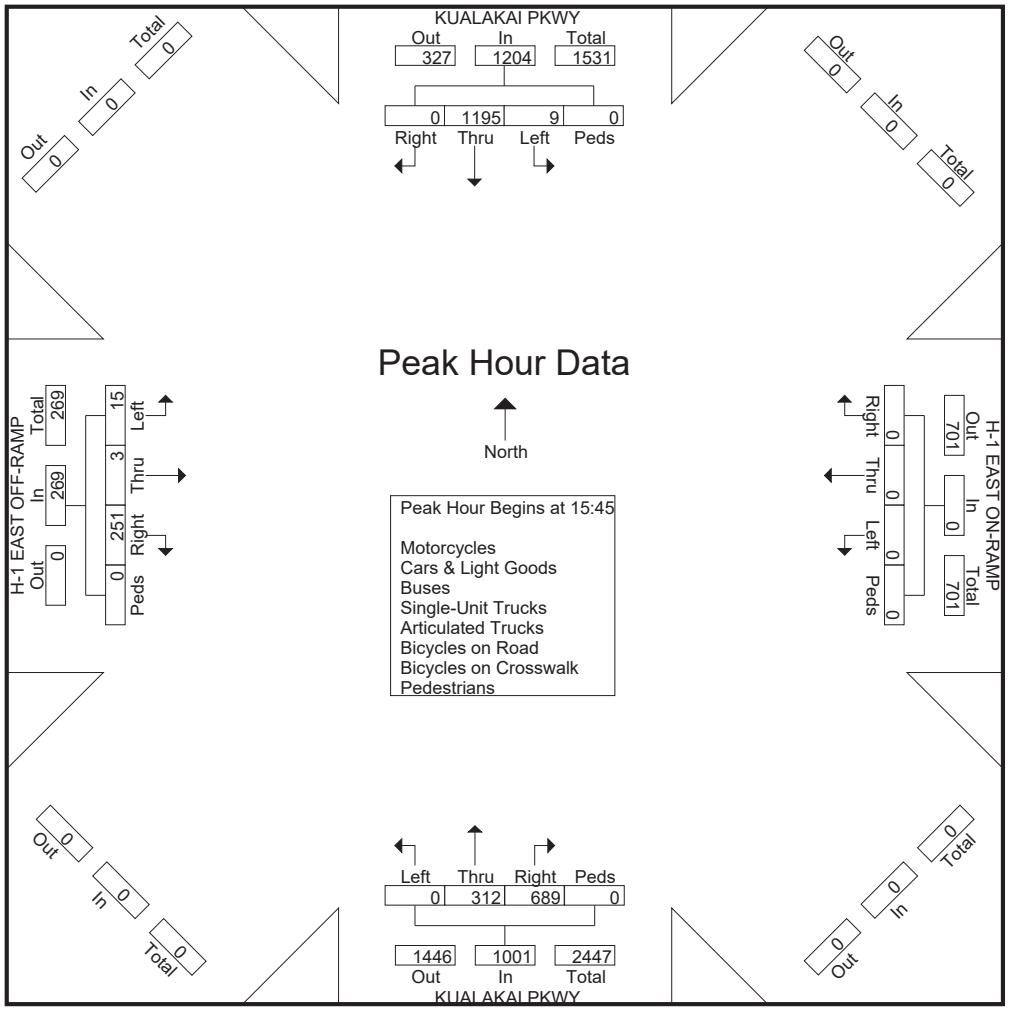
	KUALAKAI PKWY SOUTHBOUND					H-1 EAST ON-RAMP WESTBOUND					KUALAKAI PKWY NORTHBOUND					H-1 EAST OFF-RAMP EASTBOUND					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 15:45 to 16:30 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 15:45																					
15:45	2	305	0	0	307	0	0	0	0	0	0	**111**	**193**	0	**304**	4	1	55	0	60	**671**
16:00	2	263	0	0	265	0	0	0	0	0	0	59	161	0	220	4	0	59	0	63	548
16:15	0	302	0	0	302	0	0	0	0	0	0	72	165	0	237	2	**2**	60	0	64	603
16:30	**5**	**325**	0	0	**330**	0	0	0	0	0	0	70	170	0	240	**5**	0	**77**	0	**82**	652
Total Volume	9	1195	0	0	1204	0	0	0	0	0	0	312	689	0	1001	15	3	251	0	269	2474
% App. Total	0.7	99.3	0	0		0	0	0	0		0	31.2	68.8	0		5.6	1.1	93.3	0		
PHF	.450	.919	.000	.000	.912	.000	.000	.000	.000	.000	.000	.703	.892	.000	.823	.750	.375	.815	.000	.820	.922



APPENDIX B

LEVEL OF SERVICE CRITERIA

APPENDIX B – LEVEL OF SERVICE (LOS) CRITERIA

VEHICULAR LEVEL OF SERVICE FOR SIGNALIZED INTERSECTIONS (HCM 6th EDITION)

Level of service for vehicles at signalized intersections is directly related to delay values and is assigned on that basis. Level of Service is a measure of the acceptability of delay values to motorists at a given intersection. The criteria are given in the table below.

Level-of Service Criteria for Signalized Intersections

Level of Service	Control Delay per Vehicle (sec./veh.)
A	< 10.0
B	>10.0 and ≤ 20.0
C	>20.0 and ≤ 35.0
D	>35.0 and ≤ 55.0
E	>55.0 and ≤ 80.0
F	> 80.0

Delay is a complex measure, and is dependent on a number of variables, including the quality of progression, the cycle length, the green ratio, and the v/c ratio for the lane group or approach in question.

VEHICULAR LEVEL OF SERVICE CRITERIA FOR UNSIGNALIZED INTERSECTIONS (HCM 6th EDITION)

The level of service criteria for vehicles at unsignalized intersections is defined as the average control delay, in seconds per vehicle.

LOS delay threshold values are lower for two-way stop-controlled (TWSC) and all-way stop-controlled (AWSC) intersections than those of signalized intersections. This is because more vehicles pass through signalized intersections, and therefore, drivers expect and tolerate greater delays. While the criteria for level of service for TWSC and AWSC intersections are the same, procedures to calculate the average total delay may differ.

Level of Service Criteria for Two-Way Stop-Controlled Intersections

Level of Service	Average Control Delay (sec/veh)
A	≤ 10
B	>10 and ≤15
C	>15 and ≤25
D	>25 and ≤35
E	>35 and ≤50
F	> 50

PEDESTRIAN AND BICYCLE LEVEL OF SERVICE FOR SIGNALIZED INTERSECTIONS (HCM 6th EDITION)

Level of service for pedestrians and bicycles at signalized intersections is determined by calculating an LOS Score for each approach at a signalized intersection, and is assigned on that basis. Level of Service for non-automobile modes at signalized intersections is associated with a score value based on traveler perception research, considering factors of performance measures and intersection characteristics. The criteria are given in the table below.

Level-of Service Criteria for Signalized Intersections

Level of Service	LOS Score
A	< 1.50
B	>1.50 and ≤ 2.50
C	>2.50 and ≤ 3.50
D	>3.50 and ≤ 4.50
E	>4.50 and ≤ 5.50
F	> 5.50

PEDESTRIAN LEVEL OF SERVICE CRITERIA FOR UNCONTROLLED CROSSINGS (HCM 6th EDITION)

The level of service criteria for pedestrians at uncontrolled crossings is defined as the average control delay, in seconds per pedestrian.

LOS delay threshold values for two-way stop-controlled (TWSC) intersections are defined for pedestrians crossing a traffic stream not controlled by a STOP sign; it also applies to midblock pedestrian crossings and crossings at with special treatments such as flashing beacons and signage. Factors such as vehicle and pedestrian volumes, geometric conditions, motorist yield rates, and multiple-stage crossings affect the control delay for pedestrians.

Level of Service Criteria for Two-Way Stop-Controlled Intersections

Level of Service	Average Control Delay (sec/veh)
A	≤ 5
B	>5 and ≤10
C	>10 and ≤20
D	>20 and ≤30
E	>30 and ≤45
F	> 45

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

- Existing Conditions AM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	548	0	8	287	8	0	0	8	4
Future Volume (veh/h)	0	0	0	548	0	8	287	8	0	0	8	4
Initial Q (Qb), veh				0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)				1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj				1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach					No			No			No	
Adj Sat Flow, veh/h/ln				1870	0	1870	1870	1870	0	0	1870	1870
Adj Flow Rate, veh/h				596	0	0	312	9	0	0	9	0
Peak Hour Factor				0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %				2	0	2	2	2	0	0	2	2
Cap, veh/h				918	0		418	439	0	0	22	
Arrive On Green				0.27	0.00	0.00	0.23	0.23	0.00	0.00	0.01	0.00
Sat Flow, veh/h				3456	0	1585	1781	1870	0	0	1870	1585
Grp Volume(v), veh/h				596	0	0	312	9	0	0	9	0
Grp Sat Flow(s),veh/h/ln				1728	0	1585	1781	1870	0	0	1870	1585
Q Serve(g_s), s				5.6	0.0	0.0	6.0	0.1	0.0	0.0	0.2	0.0
Cycle Q Clear(g_c), s				5.6	0.0	0.0	6.0	0.1	0.0	0.0	0.2	0.0
Prop In Lane				1.00		1.00	1.00		0.00	0.00		1.00
Lane Grp Cap(c), veh/h				918	0		418	439	0	0	22	
V/C Ratio(X)				0.65	0.00		0.75	0.02	0.00	0.00	0.41	
Avail Cap(c_a), veh/h				2623	0		1400	1470	0	0	760	
HCM Platoon Ratio				1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)				1.00	0.00	0.00	1.00	1.00	0.00	0.00	1.00	0.00
Uniform Delay (d), s/veh				12.0	0.0	0.0	13.1	10.9	0.0	0.0	18.1	0.0
Incr Delay (d2), s/veh				0.8	0.0	0.0	2.7	0.0	0.0	0.0	12.1	0.0
Initial Q Delay(d3),s/veh				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln				1.8	0.0	0.0	2.2	0.0	0.0	0.0	0.1	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh				12.8	0.0	0.0	15.8	10.9	0.0	0.0	30.2	0.0
LnGrp LOS				B	A		B	B	A	A	C	
Approach Vol, veh/h					596	A		321			9	A
Approach Delay, s/veh					12.8			15.6			30.2	
Approach LOS					B			B			C	

Timer - Assigned Phs				4		6		8				
Phs Duration (G+Y+Rc), s				6.4		15.8		14.7				
Change Period (Y+Rc), s				6.0		6.0		6.0				
Max Green Setting (Gmax), s				15.0		28.0		29.0				
Max Q Clear Time (g_c+I1), s				2.2		7.6		8.0				
Green Ext Time (p_c), s				0.0		2.2		0.9				

Intersection Summary		
HCM 6th Ctrl Delay		13.9
HCM 6th LOS		B

Notes

Unsignalized Delay for [WBR, SBR] is excluded from calculations of the approach delay and intersection delay.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	7	4	309	0	0	0	0	292	616	5	545	0
Future Volume (veh/h)	7	4	309	0	0	0	0	292	616	5	545	0
Initial Q (Qb), veh	0	0	0				0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00				1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00				1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No						No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870				0	1870	1870	1870	1870	0
Adj Flow Rate, veh/h	8	4	0				0	317	0	5	592	0
Peak Hour Factor	0.92	0.92	0.92				0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2				0	2	2	2	2	0
Cap, veh/h	15	8					0	884		10	1772	0
Arrive On Green	0.01	0.01	0.00				0.00	0.25	0.00	0.01	0.50	0.00
Sat Flow, veh/h	1207	603	1585				0	3647	2790	1781	3647	0
Grp Volume(v), veh/h	12	0	0				0	317	0	5	592	0
Grp Sat Flow(s),veh/h/ln	1810	0	1585				0	1777	1395	1781	1777	0
Q Serve(g_s), s	0.2	0.0	0.0				0.0	1.8	0.0	0.1	2.5	0.0
Cycle Q Clear(g_c), s	0.2	0.0	0.0				0.0	1.8	0.0	0.1	2.5	0.0
Prop In Lane	0.67		1.00				0.00		1.00	1.00		0.00
Lane Grp Cap(c), veh/h	23	0					0	884		10	1772	0
V/C Ratio(X)	0.52	0.00					0.00	0.36		0.51	0.33	0.00
Avail Cap(c_a), veh/h	1106	0					0	6078		1088	9116	0
HCM Platoon Ratio	1.00	1.00	1.00				1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00				0.00	1.00	0.00	1.00	1.00	0.00
Uniform Delay (d), s/veh	12.0	0.0	0.0				0.0	7.6	0.0	12.2	3.7	0.0
Incr Delay (d2), s/veh	16.7	0.0	0.0				0.0	0.2	0.0	36.3	0.1	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0				0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.2	0.0	0.0				0.0	0.4	0.0	0.1	0.2	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	28.8	0.0	0.0				0.0	7.9	0.0	48.4	3.8	0.0
LnGrp LOS	C	A					A	A		D	A	A
Approach Vol, veh/h		12	A					317	A		597	
Approach Delay, s/veh		28.8						7.9			4.2	
Approach LOS		C						A			A	

Timer - Assigned Phs	1	2		4		6
Phs Duration (G+Y+Rc), s	6.1	12.1		6.3		18.2
Change Period (Y+Rc), s	6.0	6.0		6.0		6.0
Max Green Setting (Gmax), s	15.0	42.0		15.0		63.0
Max Q Clear Time (g_c+I1), s	2.1	3.8		2.2		4.5
Green Ext Time (p_c), s	0.0	2.3		0.0		4.7

Intersection Summary	
HCM 6th Ctrl Delay	5.8
HCM 6th LOS	A

Notes

User approved pedestrian interval to be less than phase max green.

Unsignalized Delay for [NBR, EBR] is excluded from calculations of the approach delay and intersection delay.

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

- Existing Conditions PM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	1159	0	2	318	1	0	0	11	1
Future Volume (veh/h)	0	0	0	1159	0	2	318	1	0	0	11	1
Initial Q (Qb), veh				0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)				1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj				1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach					No			No			No	
Adj Sat Flow, veh/h/ln				1870	0	1870	1870	1870	0	0	1870	1870
Adj Flow Rate, veh/h				1260	0	0	346	1	0	0	12	0
Peak Hour Factor				0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %				2	0	2	2	2	0	0	2	2
Cap, veh/h				1531	0		412	432	0	0	26	
Arrive On Green				0.44	0.00	0.00	0.23	0.23	0.00	0.00	0.01	0.00
Sat Flow, veh/h				3456	0	1585	1781	1870	0	0	1870	1585
Grp Volume(v), veh/h				1260	0	0	346	1	0	0	12	0
Grp Sat Flow(s),veh/h/ln				1728	0	1585	1781	1870	0	0	1870	1585
Q Serve(g_s), s				18.5	0.0	0.0	10.7	0.0	0.0	0.0	0.4	0.0
Cycle Q Clear(g_c), s				18.5	0.0	0.0	10.7	0.0	0.0	0.0	0.4	0.0
Prop In Lane				1.00		1.00	1.00		0.00	0.00		1.00
Lane Grp Cap(c), veh/h				1531	0		412	432	0	0	26	
V/C Ratio(X)				0.82	0.00		0.84	0.00	0.00	0.00	0.45	
Avail Cap(c_a), veh/h				2214	0		617	648	0	0	486	
HCM Platoon Ratio				1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)				1.00	0.00	0.00	1.00	1.00	0.00	0.00	1.00	0.00
Uniform Delay (d), s/veh				14.1	0.0	0.0	21.2	17.1	0.0	0.0	28.2	0.0
Incr Delay (d2), s/veh				1.7	0.0	0.0	6.6	0.0	0.0	0.0	11.6	0.0
Initial Q Delay(d3),s/veh				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln				6.4	0.0	0.0	4.8	0.0	0.0	0.0	0.2	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh				15.8	0.0	0.0	27.8	17.1	0.0	0.0	39.9	0.0
LnGrp LOS				B	A		C	B	A	A	D	
Approach Vol, veh/h					1260	A		347			12	A
Approach Delay, s/veh					15.8			27.7			39.9	
Approach LOS					B			C			D	

Timer - Assigned Phs				4		6		8				
Phs Duration (G+Y+Rc), s				6.8		31.6		19.4				
Change Period (Y+Rc), s				6.0		6.0		6.0				
Max Green Setting (Gmax), s				15.0		37.0		20.0				
Max Q Clear Time (g_c+I1), s				2.4		20.5		12.7				
Green Ext Time (p_c), s				0.0		5.1		0.7				

Intersection Summary		
HCM 6th Ctrl Delay	18.6	
HCM 6th LOS	B	

Notes

Unsignalized Delay for [WBR, SBR] is excluded from calculations of the approach delay and intersection delay.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	15	3	251	0	0	0	0	312	689	9	1195	0
Future Volume (veh/h)	15	3	251	0	0	0	0	312	689	9	1195	0
Initial Q (Qb), veh	0	0	0				0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00				1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00				1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No						No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870				0	1870	1870	1870	1870	0
Adj Flow Rate, veh/h	16	3	0				0	339	0	10	1299	0
Peak Hour Factor	0.92	0.92	0.92				0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2				0	2	2	2	2	0
Cap, veh/h	29	5					0	1689		19	2313	0
Arrive On Green	0.02	0.02	0.00				0.00	0.48	0.00	0.01	0.65	0.00
Sat Flow, veh/h	1511	283	1585				0	3647	2790	1781	3647	0
Grp Volume(v), veh/h	19	0	0				0	339	0	10	1299	0
Grp Sat Flow(s),veh/h/ln	1795	0	1585				0	1777	1395	1781	1777	0
Q Serve(g_s), s	0.4	0.0	0.0				0.0	2.0	0.0	0.2	7.3	0.0
Cycle Q Clear(g_c), s	0.4	0.0	0.0				0.0	2.0	0.0	0.2	7.3	0.0
Prop In Lane	0.84		1.00				0.00		1.00	1.00		0.00
Lane Grp Cap(c), veh/h	34	0					0	1689		19	2313	0
V/C Ratio(X)	0.55	0.00					0.00	0.20		0.53	0.56	0.00
Avail Cap(c_a), veh/h	740	0					0	4105		735	6157	0
HCM Platoon Ratio	1.00	1.00	1.00				1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00				0.00	1.00	0.00	1.00	1.00	0.00
Uniform Delay (d), s/veh	17.7	0.0	0.0				0.0	5.5	0.0	17.9	3.5	0.0
Incr Delay (d2), s/veh	13.0	0.0	0.0				0.0	0.1	0.0	21.3	0.2	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0				0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.3	0.0	0.0				0.0	0.5	0.0	0.2	0.7	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	30.7	0.0	0.0				0.0	5.6	0.0	39.2	3.7	0.0
LnGrp LOS	C	A					A	A		D	A	A
Approach Vol, veh/h		19	A					339	A		1309	
Approach Delay, s/veh		30.7						5.6			4.0	
Approach LOS		C						A			A	

Timer - Assigned Phs	1	2		4		6
Phs Duration (G+Y+Rc), s	6.4	23.3		6.7		29.7
Change Period (Y+Rc), s	6.0	6.0		6.0		6.0
Max Green Setting (Gmax), s	15.0	42.0		15.0		63.0
Max Q Clear Time (g_c+I1), s	2.2	4.0		2.4		9.3
Green Ext Time (p_c), s	0.0	2.4		0.0		14.3

Intersection Summary	
HCM 6th Ctrl Delay	4.6
HCM 6th LOS	A

Notes

Unsignalized Delay for [NBR, EBR] is excluded from calculations of the approach delay and intersection delay.

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

- Year 2021 Without Project Conditions AM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	639	0	9	335	9	0	0	9	5
Future Volume (veh/h)	0	0	0	639	0	9	335	9	0	0	9	5
Initial Q (Qb), veh				0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)				1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj				1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach					No			No			No	
Adj Sat Flow, veh/h/ln				1870	0	1870	1870	1870	0	0	1870	1870
Adj Flow Rate, veh/h				695	0	0	364	10	0	0	10	0
Peak Hour Factor				0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %				2	0	2	2	2	0	0	2	2
Cap, veh/h				1000	0		467	491	0	0	23	
Arrive On Green				0.29	0.00	0.00	0.26	0.26	0.00	0.00	0.01	0.00
Sat Flow, veh/h				3456	0	1585	1781	1870	0	0	1870	1585
Grp Volume(v), veh/h				695	0	0	364	10	0	0	10	0
Grp Sat Flow(s),veh/h/ln				1728	0	1585	1781	1870	0	0	1870	1585
Q Serve(g_s), s				7.4	0.0	0.0	7.8	0.2	0.0	0.0	0.2	0.0
Cycle Q Clear(g_c), s				7.4	0.0	0.0	7.8	0.2	0.0	0.0	0.2	0.0
Prop In Lane				1.00		1.00	1.00		0.00	0.00		1.00
Lane Grp Cap(c), veh/h				1000	0		467	491	0	0	23	
V/C Ratio(X)				0.70	0.00		0.78	0.02	0.00	0.00	0.43	
Avail Cap(c_a), veh/h				2343	0		1251	1313	0	0	679	
HCM Platoon Ratio				1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)				1.00	0.00	0.00	1.00	1.00	0.00	0.00	1.00	0.00
Uniform Delay (d), s/veh				13.1	0.0	0.0	14.1	11.3	0.0	0.0	20.2	0.0
Incr Delay (d2), s/veh				0.9	0.0	0.0	2.9	0.0	0.0	0.0	11.7	0.0
Initial Q Delay(d3),s/veh				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln				2.4	0.0	0.0	2.9	0.1	0.0	0.0	0.2	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh				13.9	0.0	0.0	17.0	11.3	0.0	0.0	32.0	0.0
LnGrp LOS				B	A		B	B	A	A	C	
Approach Vol, veh/h					695	A		374			10	A
Approach Delay, s/veh					13.9			16.8			32.0	
Approach LOS					B			B			C	

Timer - Assigned Phs	4	6	8
Phs Duration (G+Y+Rc), s	6.5	17.9	16.8
Change Period (Y+Rc), s	6.0	6.0	6.0
Max Green Setting (Gmax), s	15.0	28.0	29.0
Max Q Clear Time (g_c+I1), s	2.2	9.4	9.8
Green Ext Time (p_c), s	0.0	2.6	1.1

Intersection Summary	
HCM 6th Ctrl Delay	15.1
HCM 6th LOS	B

Notes

Unsignalized Delay for [WBR, SBR] is excluded from calculations of the approach delay and intersection delay.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	8	5	360	0	0	0	0	341	719	6	636	0
Future Volume (veh/h)	8	5	360	0	0	0	0	341	719	6	636	0
Initial Q (Qb), veh	0	0	0				0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00				1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00				1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No						No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870				0	1870	1870	1870	1870	0
Adj Flow Rate, veh/h	9	5	0				0	371	0	7	691	0
Peak Hour Factor	0.92	0.92	0.92				0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2				0	2	2	2	2	0
Cap, veh/h	17	10					0	964		14	1828	0
Arrive On Green	0.01	0.01	0.00				0.00	0.27	0.00	0.01	0.51	0.00
Sat Flow, veh/h	1165	647	1585				0	3647	2790	1781	3647	0
Grp Volume(v), veh/h	14	0	0				0	371	0	7	691	0
Grp Sat Flow(s),veh/h/ln	1812	0	1585				0	1777	1395	1781	1777	0
Q Serve(g_s), s	0.2	0.0	0.0				0.0	2.2	0.0	0.1	3.0	0.0
Cycle Q Clear(g_c), s	0.2	0.0	0.0				0.0	2.2	0.0	0.1	3.0	0.0
Prop In Lane	0.64		1.00				0.00		1.00	1.00		0.00
Lane Grp Cap(c), veh/h	27	0					0	964		14	1828	0
V/C Ratio(X)	0.52	0.00					0.00	0.38		0.52	0.38	0.00
Avail Cap(c_a), veh/h	995	0					0	6135		979	8924	0
HCM Platoon Ratio	1.00	1.00	1.00				1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00				0.00	1.00	0.00	1.00	1.00	0.00
Uniform Delay (d), s/veh	12.5	0.0	0.0				0.0	7.6	0.0	12.6	3.7	0.0
Incr Delay (d2), s/veh	14.8	0.0	0.0				0.0	0.3	0.0	27.4	0.1	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0				0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.2	0.0	0.0				0.0	0.5	0.0	0.1	0.3	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	27.3	0.0	0.0				0.0	7.8	0.0	40.0	3.9	0.0
LnGrp LOS	C	A					A	A		D	A	A
Approach Vol, veh/h		14	A					371	A		698	
Approach Delay, s/veh		27.3						7.8			4.2	
Approach LOS		C						A			A	

Timer - Assigned Phs	1	2		4		6
Phs Duration (G+Y+Rc), s	6.2	12.9		6.4		19.1
Change Period (Y+Rc), s	6.0	6.0		6.0		6.0
Max Green Setting (Gmax), s	14.0	44.0		14.0		64.0
Max Q Clear Time (g_c+I1), s	2.1	4.2		2.2		5.0
Green Ext Time (p_c), s	0.0	2.7		0.0		5.7

Intersection Summary	
HCM 6th Ctrl Delay	5.7
HCM 6th LOS	A

Notes

Unsignalized Delay for [NBR, EBR] is excluded from calculations of the approach delay and intersection delay.

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

- Year 2021 Without Project Conditions PM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	1352	0	2	371	1	0	0	13	1
Future Volume (veh/h)	0	0	0	1352	0	2	371	1	0	0	13	1
Initial Q (Qb), veh				0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)				1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj				1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach					No			No			No	
Adj Sat Flow, veh/h/ln				1870	0	1870	1870	1870	0	0	1870	1870
Adj Flow Rate, veh/h				1470	0	0	403	1	0	0	14	0
Peak Hour Factor				0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %				2	0	2	2	2	0	0	2	2
Cap, veh/h				1641	0		450	472	0	0	29	
Arrive On Green				0.47	0.00	0.00	0.25	0.25	0.00	0.00	0.02	0.00
Sat Flow, veh/h				3456	0	1585	1781	1870	0	0	1870	1585
Grp Volume(v), veh/h				1470	0	0	403	1	0	0	14	0
Grp Sat Flow(s),veh/h/ln				1728	0	1585	1781	1870	0	0	1870	1585
Q Serve(g_s), s				27.2	0.0	0.0	15.3	0.0	0.0	0.0	0.5	0.0
Cycle Q Clear(g_c), s				27.2	0.0	0.0	15.3	0.0	0.0	0.0	0.5	0.0
Prop In Lane				1.00		1.00	1.00		0.00	0.00		1.00
Lane Grp Cap(c), veh/h				1641	0		450	472	0	0	29	
V/C Ratio(X)				0.90	0.00		0.90	0.00	0.00	0.00	0.48	
Avail Cap(c_a), veh/h				1825	0		508	534	0	0	400	
HCM Platoon Ratio				1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)				1.00	0.00	0.00	1.00	1.00	0.00	0.00	1.00	0.00
Uniform Delay (d), s/veh				16.8	0.0	0.0	25.3	19.6	0.0	0.0	34.2	0.0
Incr Delay (d2), s/veh				5.8	0.0	0.0	17.0	0.0	0.0	0.0	11.7	0.0
Initial Q Delay(d3),s/veh				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln				10.7	0.0	0.0	8.2	0.0	0.0	0.0	0.3	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh				22.6	0.0	0.0	42.3	19.6	0.0	0.0	45.9	0.0
LnGrp LOS				C	A		D	B	A	A	D	
Approach Vol, veh/h					1470	A		404			14	A
Approach Delay, s/veh					22.6			42.3			45.9	
Approach LOS					C			D			D	

Timer - Assigned Phs				4		6		8				
Phs Duration (G+Y+Rc), s				7.1		39.3		23.7				
Change Period (Y+Rc), s				6.0		6.0		6.0				
Max Green Setting (Gmax), s				15.0		37.0		20.0				
Max Q Clear Time (g_c+I1), s				2.5		29.2		17.3				
Green Ext Time (p_c), s				0.0		4.0		0.4				

Intersection Summary		
HCM 6th Ctrl Delay		27.0
HCM 6th LOS		C

Notes

Unsignalized Delay for [WBR, SBR] is excluded from calculations of the approach delay and intersection delay.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	17	3	293	0	0	0	0	364	804	10	1394	0
Future Volume (veh/h)	17	3	293	0	0	0	0	364	804	10	1394	0
Initial Q (Qb), veh	0	0	0				0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00				1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00				1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No						No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870				0	1870	1870	1870	1870	0
Adj Flow Rate, veh/h	18	3	0				0	396	0	11	1515	0
Peak Hour Factor	0.92	0.92	0.92				0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2				0	2	2	2	2	0
Cap, veh/h	32	5					0	1972		20	2502	0
Arrive On Green	0.02	0.02	0.00				0.00	0.56	0.00	0.01	0.70	0.00
Sat Flow, veh/h	1537	256	1585				0	3647	2790	1781	3647	0
Grp Volume(v), veh/h	21	0	0				0	396	0	11	1515	0
Grp Sat Flow(s),veh/h/ln	1793	0	1585				0	1777	1395	1781	1777	0
Q Serve(g_s), s	0.5	0.0	0.0				0.0	2.4	0.0	0.3	9.6	0.0
Cycle Q Clear(g_c), s	0.5	0.0	0.0				0.0	2.4	0.0	0.3	9.6	0.0
Prop In Lane	0.86		1.00				0.00		1.00	1.00		0.00
Lane Grp Cap(c), veh/h	37	0					0	1972		20	2502	0
V/C Ratio(X)	0.57	0.00					0.00	0.20		0.54	0.61	0.00
Avail Cap(c_a), veh/h	370	0					0	4647		245	5625	0
HCM Platoon Ratio	1.00	1.00	1.00				1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00				0.00	1.00	0.00	1.00	1.00	0.00
Uniform Delay (d), s/veh	21.2	0.0	0.0				0.0	4.9	0.0	21.4	3.3	0.0
Incr Delay (d2), s/veh	13.0	0.0	0.0				0.0	0.0	0.0	20.4	0.2	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0				0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.3	0.0	0.0				0.0	0.6	0.0	0.2	1.0	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	34.1	0.0	0.0				0.0	4.9	0.0	41.8	3.6	0.0
LnGrp LOS	C	A					A	A		D	A	A
Approach Vol, veh/h		21	A					396	A		1526	
Approach Delay, s/veh		34.1						4.9			3.8	
Approach LOS		C						A			A	

Timer - Assigned Phs	1	2		4		6						
Phs Duration (G+Y+Rc), s	6.5	30.2		6.9		36.7						
Change Period (Y+Rc), s	6.0	6.0		6.0		6.0						
Max Green Setting (Gmax), s	6.0	57.0		9.0		69.0						
Max Q Clear Time (g_c+I1), s	2.3	4.4		2.5		11.6						
Green Ext Time (p_c), s	0.0	2.9		0.0		19.1						

Intersection Summary												
HCM 6th Ctrl Delay			4.4									
HCM 6th LOS			A									

Notes

User approved pedestrian interval to be less than phase max green.

Unsignalized Delay for [NBR, EBR] is excluded from calculations of the approach delay and intersection delay.

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

- Year 2021 During Project Construction Conditions AM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	639	0	31	335	62	0	0	9	25
Future Volume (veh/h)	0	0	0	639	0	31	335	62	0	0	9	25
Initial Q (Qb), veh				0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)				1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj				1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach					No			No			No	
Adj Sat Flow, veh/h/ln				1870	0	1870	1870	1870	0	0	1870	1870
Adj Flow Rate, veh/h				695	0	0	364	67	0	0	10	0
Peak Hour Factor				0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %				2	0	2	2	2	0	0	2	2
Cap, veh/h				996	0		479	503	0	0	23	
Arrive On Green				0.29	0.00	0.00	0.27	0.27	0.00	0.00	0.01	0.00
Sat Flow, veh/h				3456	0	1585	1781	1870	0	0	1870	1585
Grp Volume(v), veh/h				695	0	0	364	67	0	0	10	0
Grp Sat Flow(s),veh/h/ln				1728	0	1585	1781	1870	0	0	1870	1585
Q Serve(g_s), s				7.5	0.0	0.0	7.9	1.1	0.0	0.0	0.2	0.0
Cycle Q Clear(g_c), s				7.5	0.0	0.0	7.9	1.1	0.0	0.0	0.2	0.0
Prop In Lane				1.00		1.00	1.00		0.00	0.00		1.00
Lane Grp Cap(c), veh/h				996	0		479	503	0	0	23	
V/C Ratio(X)				0.70	0.00		0.76	0.13	0.00	0.00	0.43	
Avail Cap(c_a), veh/h				2314	0		1236	1297	0	0	671	
HCM Platoon Ratio				1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)				1.00	0.00	0.00	1.00	1.00	0.00	0.00	1.00	0.00
Uniform Delay (d), s/veh				13.3	0.0	0.0	14.0	11.6	0.0	0.0	20.5	0.0
Incr Delay (d2), s/veh				0.9	0.0	0.0	2.5	0.1	0.0	0.0	11.8	0.0
Initial Q Delay(d3),s/veh				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln				2.5	0.0	0.0	2.9	0.4	0.0	0.0	0.2	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh				14.2	0.0	0.0	16.6	11.7	0.0	0.0	32.3	0.0
LnGrp LOS				B	A		B	B	A	A	C	
Approach Vol, veh/h					695	A		431			10	A
Approach Delay, s/veh					14.2			15.8			32.3	
Approach LOS					B			B			C	

Timer - Assigned Phs				4		6		8				
Phs Duration (G+Y+Rc), s				6.5		18.0		17.2				
Change Period (Y+Rc), s				6.0		6.0		6.0				
Max Green Setting (Gmax), s				15.0		28.0		29.0				
Max Q Clear Time (g_c+I1), s				2.2		9.5		9.9				
Green Ext Time (p_c), s				0.0		2.6		1.4				

Intersection Summary		
HCM 6th Ctrl Delay		14.9
HCM 6th LOS		B

Notes

Unsignalized Delay for [WBR, SBR] is excluded from calculations of the approach delay and intersection delay.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	45	5	360	0	0	0	0	357	719	6	636	0
Future Volume (veh/h)	45	5	360	0	0	0	0	357	719	6	636	0
Initial Q (Qb), veh	0	0	0				0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00				1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00				1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No						No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870				0	1870	1870	1870	1870	0
Adj Flow Rate, veh/h	49	5	0				0	388	0	7	691	0
Peak Hour Factor	0.92	0.92	0.92				0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2				0	2	2	2	2	0
Cap, veh/h	80	8					0	965		13	1787	0
Arrive On Green	0.05	0.05	0.00				0.00	0.27	0.00	0.01	0.50	0.00
Sat Flow, veh/h	1624	166	1585				0	3647	2790	1781	3647	0
Grp Volume(v), veh/h	54	0	0				0	388	0	7	691	0
Grp Sat Flow(s),veh/h/ln	1789	0	1585				0	1777	1395	1781	1777	0
Q Serve(g_s), s	0.8	0.0	0.0				0.0	2.4	0.0	0.1	3.2	0.0
Cycle Q Clear(g_c), s	0.8	0.0	0.0				0.0	2.4	0.0	0.1	3.2	0.0
Prop In Lane	0.91		1.00				0.00		1.00	1.00		0.00
Lane Grp Cap(c), veh/h	88	0					0	965		13	1787	0
V/C Ratio(X)	0.61	0.00					0.00	0.40		0.52	0.39	0.00
Avail Cap(c_a), veh/h	934	0					0	5833		930	8484	0
HCM Platoon Ratio	1.00	1.00	1.00				1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00				0.00	1.00	0.00	1.00	1.00	0.00
Uniform Delay (d), s/veh	12.5	0.0	0.0				0.0	8.0	0.0	13.3	4.1	0.0
Incr Delay (d2), s/veh	6.7	0.0	0.0				0.0	0.3	0.0	27.5	0.1	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0				0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.4	0.0	0.0				0.0	0.6	0.0	0.1	0.4	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	19.1	0.0	0.0				0.0	8.3	0.0	40.8	4.2	0.0
LnGrp LOS	B	A					A	A		D	A	A
Approach Vol, veh/h		54	A					388	A		698	
Approach Delay, s/veh		19.1						8.3			4.6	
Approach LOS		B						A			A	

Timer - Assigned Phs	1	2		4		6
Phs Duration (G+Y+Rc), s	6.2	13.3		7.3		19.5
Change Period (Y+Rc), s	6.0	6.0		6.0		6.0
Max Green Setting (Gmax), s	14.0	44.0		14.0		64.0
Max Q Clear Time (g_c+I1), s	2.1	4.4		2.8		5.2
Green Ext Time (p_c), s	0.0	2.8		0.1		5.7

Intersection Summary		
HCM 6th Ctrl Delay		6.5
HCM 6th LOS		A

Notes

Unsignalized Delay for [NBR, EBR] is excluded from calculations of the approach delay and intersection delay.

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

- Year 2021 During Project Construction Conditions AM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	1352	0	2	371	21	0	0	51	38
Future Volume (veh/h)	0	0	0	1352	0	2	371	21	0	0	51	38
Initial Q (Qb), veh				0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)				1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj				1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach					No			No			No	
Adj Sat Flow, veh/h/ln				1870	0	1870	1870	1870	0	0	1870	1870
Adj Flow Rate, veh/h				1470	0	0	403	23	0	0	55	0
Peak Hour Factor				0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %				2	0	2	2	2	0	0	2	2
Cap, veh/h				1610	0		446	468	0	0	76	
Arrive On Green				0.47	0.00	0.00	0.25	0.25	0.00	0.00	0.04	0.00
Sat Flow, veh/h				3456	0	1585	1781	1870	0	0	1870	1585
Grp Volume(v), veh/h				1470	0	0	403	23	0	0	55	0
Grp Sat Flow(s),veh/h/ln				1728	0	1585	1781	1870	0	0	1870	1585
Q Serve(g_s), s				29.3	0.0	0.0	16.2	0.7	0.0	0.0	2.2	0.0
Cycle Q Clear(g_c), s				29.3	0.0	0.0	16.2	0.7	0.0	0.0	2.2	0.0
Prop In Lane				1.00		1.00	1.00		0.00	0.00		1.00
Lane Grp Cap(c), veh/h				1610	0		446	468	0	0	76	
V/C Ratio(X)				0.91	0.00		0.90	0.05	0.00	0.00	0.72	
Avail Cap(c_a), veh/h				1726	0		481	505	0	0	379	
HCM Platoon Ratio				1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)				1.00	0.00	0.00	1.00	1.00	0.00	0.00	1.00	0.00
Uniform Delay (d), s/veh				18.4	0.0	0.0	26.9	21.1	0.0	0.0	35.1	0.0
Incr Delay (d2), s/veh				7.5	0.0	0.0	19.6	0.0	0.0	0.0	12.0	0.0
Initial Q Delay(d3),s/veh				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln				12.1	0.0	0.0	9.0	0.3	0.0	0.0	1.2	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh				25.9	0.0	0.0	46.5	21.1	0.0	0.0	47.1	0.0
LnGrp LOS				C	A		D	C	A	A	D	
Approach Vol, veh/h					1470	A		426			55	A
Approach Delay, s/veh					25.9			45.1			47.1	
Approach LOS					C			D			D	

Timer - Assigned Phs				4		6		8				
Phs Duration (G+Y+Rc), s				9.0		40.5		24.5				
Change Period (Y+Rc), s				6.0		6.0		6.0				
Max Green Setting (Gmax), s				15.0		37.0		20.0				
Max Q Clear Time (g_c+I1), s				4.2		31.3		18.2				
Green Ext Time (p_c), s				0.1		3.2		0.3				

Intersection Summary		
HCM 6th Ctrl Delay		30.7
HCM 6th LOS		C

Notes

Unsignalized Delay for [WBR, SBR] is excluded from calculations of the approach delay and intersection delay.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	37	3	293	0	0	0	0	364	804	32	1410	0
Future Volume (veh/h)	37	3	293	0	0	0	0	364	804	32	1410	0
Initial Q (Qb), veh	0	0	0				0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00				1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00				1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No						No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870				0	1870	1870	1870	1870	0
Adj Flow Rate, veh/h	40	3	0				0	396	0	35	1533	0
Peak Hour Factor	0.92	0.92	0.92				0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2				0	2	2	2	2	0
Cap, veh/h	61	5					0	1906		56	2486	0
Arrive On Green	0.04	0.04	0.00				0.00	0.54	0.00	0.03	0.70	0.00
Sat Flow, veh/h	1663	125	1585				0	3647	2790	1781	3647	0
Grp Volume(v), veh/h	43	0	0				0	396	0	35	1533	0
Grp Sat Flow(s),veh/h/ln	1787	0	1585				0	1777	1395	1781	1777	0
Q Serve(g_s), s	1.1	0.0	0.0				0.0	2.6	0.0	0.9	10.4	0.0
Cycle Q Clear(g_c), s	1.1	0.0	0.0				0.0	2.6	0.0	0.9	10.4	0.0
Prop In Lane	0.93		1.00				0.00		1.00	1.00		0.00
Lane Grp Cap(c), veh/h	66	0					0	1906		56	2486	0
V/C Ratio(X)	0.65	0.00					0.00	0.21		0.63	0.62	0.00
Avail Cap(c_a), veh/h	353	0					0	4451		235	5388	0
HCM Platoon Ratio	1.00	1.00	1.00				1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00				0.00	1.00	0.00	1.00	1.00	0.00
Uniform Delay (d), s/veh	21.6	0.0	0.0				0.0	5.5	0.0	21.8	3.6	0.0
Incr Delay (d2), s/veh	10.4	0.0	0.0				0.0	0.1	0.0	10.9	0.3	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0				0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.6	0.0	0.0				0.0	0.7	0.0	0.5	1.3	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	32.0	0.0	0.0				0.0	5.6	0.0	32.7	3.9	0.0
LnGrp LOS	C	A					A	A		C	A	A
Approach Vol, veh/h		43	A					396	A		1568	
Approach Delay, s/veh		32.0						5.6			4.5	
Approach LOS		C						A			A	

Timer - Assigned Phs	1	2		4		6
Phs Duration (G+Y+Rc), s	7.4	30.4		7.7		37.8
Change Period (Y+Rc), s	6.0	6.0		6.0		6.0
Max Green Setting (Gmax), s	6.0	57.0		9.0		69.0
Max Q Clear Time (g_c+I1), s	2.9	4.6		3.1		12.4
Green Ext Time (p_c), s	0.0	2.9		0.1		19.5

Intersection Summary		
HCM 6th Ctrl Delay		5.3
HCM 6th LOS		A

Notes

Unsignalized Delay for [NBR, EBR] is excluded from calculations of the approach delay and intersection delay.

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

- Year 2021 With Project Conditions AM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	639	0	10	335	10	0	0	9	5
Future Volume (veh/h)	0	0	0	639	0	10	335	10	0	0	9	5
Initial Q (Qb), veh				0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)				1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj				1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach					No			No			No	
Adj Sat Flow, veh/h/ln				1870	0	1870	1870	1870	0	0	1870	1870
Adj Flow Rate, veh/h				695	0	0	364	11	0	0	10	0
Peak Hour Factor				0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %				2	0	2	2	2	0	0	2	2
Cap, veh/h				1000	0		467	491	0	0	23	
Arrive On Green				0.29	0.00	0.00	0.26	0.26	0.00	0.00	0.01	0.00
Sat Flow, veh/h				3456	0	1585	1781	1870	0	0	1870	1585
Grp Volume(v), veh/h				695	0	0	364	11	0	0	10	0
Grp Sat Flow(s),veh/h/ln				1728	0	1585	1781	1870	0	0	1870	1585
Q Serve(g_s), s				7.4	0.0	0.0	7.8	0.2	0.0	0.0	0.2	0.0
Cycle Q Clear(g_c), s				7.4	0.0	0.0	7.8	0.2	0.0	0.0	0.2	0.0
Prop In Lane				1.00		1.00	1.00		0.00	0.00		1.00
Lane Grp Cap(c), veh/h				1000	0		467	491	0	0	23	
V/C Ratio(X)				0.70	0.00		0.78	0.02	0.00	0.00	0.43	
Avail Cap(c_a), veh/h				2343	0		1251	1313	0	0	679	
HCM Platoon Ratio				1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)				1.00	0.00	0.00	1.00	1.00	0.00	0.00	1.00	0.00
Uniform Delay (d), s/veh				13.1	0.0	0.0	14.1	11.3	0.0	0.0	20.2	0.0
Incr Delay (d2), s/veh				0.9	0.0	0.0	2.8	0.0	0.0	0.0	11.7	0.0
Initial Q Delay(d3),s/veh				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln				2.4	0.0	0.0	2.9	0.1	0.0	0.0	0.2	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh				13.9	0.0	0.0	17.0	11.3	0.0	0.0	32.0	0.0
LnGrp LOS				B	A		B	B	A	A	C	
Approach Vol, veh/h					695	A		375			10	A
Approach Delay, s/veh					13.9			16.8			32.0	
Approach LOS					B			B			C	

Timer - Assigned Phs	4	6	8
Phs Duration (G+Y+Rc), s	6.5	17.9	16.8
Change Period (Y+Rc), s	6.0	6.0	6.0
Max Green Setting (Gmax), s	15.0	28.0	29.0
Max Q Clear Time (g_c+I1), s	2.2	9.4	9.8
Green Ext Time (p_c), s	0.0	2.6	1.1

Intersection Summary	
HCM 6th Ctrl Delay	15.1
HCM 6th LOS	B

Notes

Unsignalized Delay for [WBR, SBR] is excluded from calculations of the approach delay and intersection delay.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	8	5	360	0	0	0	0	342	719	6	636	0
Future Volume (veh/h)	8	5	360	0	0	0	0	342	719	6	636	0
Initial Q (Qb), veh	0	0	0				0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00				1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00				1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No						No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870				0	1870	1870	1870	1870	0
Adj Flow Rate, veh/h	9	5	0				0	372	0	7	691	0
Peak Hour Factor	0.92	0.92	0.92				0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2				0	2	2	2	2	0
Cap, veh/h	17	10					0	966		14	1829	0
Arrive On Green	0.01	0.01	0.00				0.00	0.27	0.00	0.01	0.51	0.00
Sat Flow, veh/h	1165	647	1585				0	3647	2790	1781	3647	0
Grp Volume(v), veh/h	14	0	0				0	372	0	7	691	0
Grp Sat Flow(s),veh/h/ln	1812	0	1585				0	1777	1395	1781	1777	0
Q Serve(g_s), s	0.2	0.0	0.0				0.0	2.2	0.0	0.1	3.0	0.0
Cycle Q Clear(g_c), s	0.2	0.0	0.0				0.0	2.2	0.0	0.1	3.0	0.0
Prop In Lane	0.64		1.00				0.00		1.00	1.00		0.00
Lane Grp Cap(c), veh/h	27	0					0	966		14	1829	0
V/C Ratio(X)	0.52	0.00					0.00	0.39		0.52	0.38	0.00
Avail Cap(c_a), veh/h	995	0					0	6132		978	8919	0
HCM Platoon Ratio	1.00	1.00	1.00				1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00				0.00	1.00	0.00	1.00	1.00	0.00
Uniform Delay (d), s/veh	12.5	0.0	0.0				0.0	7.6	0.0	12.6	3.7	0.0
Incr Delay (d2), s/veh	14.8	0.0	0.0				0.0	0.3	0.0	27.4	0.1	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0				0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.2	0.0	0.0				0.0	0.5	0.0	0.1	0.3	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	27.3	0.0	0.0				0.0	7.8	0.0	40.0	3.9	0.0
LnGrp LOS	C	A					A	A		D	A	A
Approach Vol, veh/h		14	A					372	A		698	
Approach Delay, s/veh		27.3						7.8			4.2	
Approach LOS		C						A			A	

Timer - Assigned Phs	1	2		4		6
Phs Duration (G+Y+Rc), s	6.2	12.9		6.4		19.1
Change Period (Y+Rc), s	6.0	6.0		6.0		6.0
Max Green Setting (Gmax), s	14.0	44.0		14.0		64.0
Max Q Clear Time (g_c+I1), s	2.1	4.2		2.2		5.0
Green Ext Time (p_c), s	0.0	2.7		0.0		5.7

Intersection Summary		
HCM 6th Ctrl Delay		5.7
HCM 6th LOS		A

Notes

Unsignalized Delay for [NBR, EBR] is excluded from calculations of the approach delay and intersection delay.

APPENDIX C

LEVEL OF SERVICE CALCULATIONS

- Year 2021 With Project Conditions PM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	1352	0	2	371	1	0	0	15	1
Future Volume (veh/h)	0	0	0	1352	0	2	371	1	0	0	15	1
Initial Q (Qb), veh				0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)				1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj				1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach					No			No			No	
Adj Sat Flow, veh/h/ln				1870	0	1870	1870	1870	0	0	1870	1870
Adj Flow Rate, veh/h				1470	0	0	403	1	0	0	16	0
Peak Hour Factor				0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %				2	0	2	2	2	0	0	2	2
Cap, veh/h				1639	0		450	472	0	0	32	
Arrive On Green				0.47	0.00	0.00	0.25	0.25	0.00	0.00	0.02	0.00
Sat Flow, veh/h				3456	0	1585	1781	1870	0	0	1870	1585
Grp Volume(v), veh/h				1470	0	0	403	1	0	0	16	0
Grp Sat Flow(s),veh/h/ln				1728	0	1585	1781	1870	0	0	1870	1585
Q Serve(g_s), s				27.4	0.0	0.0	15.4	0.0	0.0	0.0	0.6	0.0
Cycle Q Clear(g_c), s				27.4	0.0	0.0	15.4	0.0	0.0	0.0	0.6	0.0
Prop In Lane				1.00		1.00	1.00		0.00	0.00		1.00
Lane Grp Cap(c), veh/h				1639	0		450	472	0	0	32	
V/C Ratio(X)				0.90	0.00		0.90	0.00	0.00	0.00	0.50	
Avail Cap(c_a), veh/h				1818	0		507	532	0	0	399	
HCM Platoon Ratio				1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)				1.00	0.00	0.00	1.00	1.00	0.00	0.00	1.00	0.00
Uniform Delay (d), s/veh				16.9	0.0	0.0	25.4	19.7	0.0	0.0	34.3	0.0
Incr Delay (d2), s/veh				5.9	0.0	0.0	17.2	0.0	0.0	0.0	11.3	0.0
Initial Q Delay(d3),s/veh				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln				10.8	0.0	0.0	8.2	0.0	0.0	0.0	0.4	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh				22.8	0.0	0.0	42.6	19.7	0.0	0.0	45.6	0.0
LnGrp LOS				C	A		D	B	A	A	D	
Approach Vol, veh/h					1470	A		404			16	A
Approach Delay, s/veh					22.8			42.5			45.6	
Approach LOS					C			D			D	

Timer - Assigned Phs				4		6		8				
Phs Duration (G+Y+Rc), s				7.2		39.4		23.7				
Change Period (Y+Rc), s				6.0		6.0		6.0				
Max Green Setting (Gmax), s				15.0		37.0		20.0				
Max Q Clear Time (g_c+I1), s				2.6		29.4		17.4				
Green Ext Time (p_c), s				0.0		4.0		0.4				

Intersection Summary		
HCM 6th Ctrl Delay		27.2
HCM 6th LOS		C

Notes

Unsignalized Delay for [WBR, SBR] is excluded from calculations of the approach delay and intersection delay.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	17	3	293	0	0	0	0	364	804	11	1395	0
Future Volume (veh/h)	17	3	293	0	0	0	0	364	804	11	1395	0
Initial Q (Qb), veh	0	0	0				0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00				1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00				1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No						No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870				0	1870	1870	1870	1870	0
Adj Flow Rate, veh/h	18	3	0				0	396	0	12	1516	0
Peak Hour Factor	0.92	0.92	0.92				0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2				0	2	2	2	2	0
Cap, veh/h	32	5					0	1970		22	2503	0
Arrive On Green	0.02	0.02	0.00				0.00	0.55	0.00	0.01	0.70	0.00
Sat Flow, veh/h	1537	256	1585				0	3647	2790	1781	3647	0
Grp Volume(v), veh/h	21	0	0				0	396	0	12	1516	0
Grp Sat Flow(s),veh/h/ln	1793	0	1585				0	1777	1395	1781	1777	0
Q Serve(g_s), s	0.5	0.0	0.0				0.0	2.4	0.0	0.3	9.6	0.0
Cycle Q Clear(g_c), s	0.5	0.0	0.0				0.0	2.4	0.0	0.3	9.6	0.0
Prop In Lane	0.86		1.00				0.00		1.00	1.00		0.00
Lane Grp Cap(c), veh/h	37	0					0	1970		22	2503	0
V/C Ratio(X)	0.57	0.00					0.00	0.20		0.54	0.61	0.00
Avail Cap(c_a), veh/h	370	0					0	4643		245	5621	0
HCM Platoon Ratio	1.00	1.00	1.00				1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00				0.00	1.00	0.00	1.00	1.00	0.00
Uniform Delay (d), s/veh	21.2	0.0	0.0				0.0	4.9	0.0	21.4	3.3	0.0
Incr Delay (d2), s/veh	13.0	0.0	0.0				0.0	0.0	0.0	19.1	0.2	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0				0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.3	0.0	0.0				0.0	0.6	0.0	0.2	1.0	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	34.2	0.0	0.0				0.0	4.9	0.0	40.5	3.6	0.0
LnGrp LOS	C	A					A	A		D	A	A
Approach Vol, veh/h		21	A					396	A		1528	
Approach Delay, s/veh		34.2						4.9			3.9	
Approach LOS		C						A			A	

Timer - Assigned Phs	1	2		4		6
Phs Duration (G+Y+Rc), s	6.5	30.2		6.9		36.7
Change Period (Y+Rc), s	6.0	6.0		6.0		6.0
Max Green Setting (Gmax), s	6.0	57.0		9.0		69.0
Max Q Clear Time (g_c+I1), s	2.3	4.4		2.5		11.6
Green Ext Time (p_c), s	0.0	2.9		0.0		19.1

Intersection Summary		
HCM 6th Ctrl Delay		4.4
HCM 6th LOS		A

Notes

Unsignalized Delay for [NBR, EBR] is excluded from calculations of the approach delay and intersection delay.

October 22, 2020

Kathy Sokugawa, Director
c/o Mr. Raymond Young
City & County of Honolulu
Department of Planning and Permitting
650 South King Street, 7th Floor
Honolulu, HI 96813
Submitted via email: ksokugawa@honolulu.gov; rcsyoung@honolulu.gov

Subject: AES West O'ahu Solar, LLC State Special Use Permit No. 2020/SUP-6, TMK 9-2-002:007 (por.)

Dear Ms. Sokugawa:

As the authorized agent for AES West O'ahu Solar, LLC, we are transmitting information related to the State Special Use Permit (SUP) application for the West O'ahu Solar Plus Storage Project (Project) and respectfully request that this documentation be incorporated into the Project record. Specifically the information presented herein is related to (1) a slight reduction of the Project area, (2) the status of the historic preservation review process, and (3) an update regarding the easement(s) to secure land rights for the Project. Each of these topics is further discussed below.

Reduction of Project Area

Based on information shared by the Department of Planning and Permitting (DPP) and upon further investigation of the underlying data, it was determined that there was a translation error in the spatial data depicting the Land Study Bureau (LSB) soil classification that was used to develop the Project design and layout, resulting in a minor overlap of the Project area with land classified as LSB Class A soils. This issue has been resolved and minor adjustments have been made to the Project boundary to ensure that no LSB Class A soils occur within the Project area.

Based on the adjustments to the boundary, the overall Project area is approximately 96.353 acres, which is a slight reduction from the 96.846-acre Project area described in the SUP application. The adjusted Project area falls entirely within the limits of the original Project area described in the Final Environmental Assessment (EA) and SUP application. Table 5 in the SUP application provides the approximate acreage of each LSB soil class within the permanent footprint of the Project facilities, as well as the approximate acreage of each LSB soil class within the overall Project area. An updated version of this table per the adjusted Project area is provided below. As referenced in the table, the Project would not involve construction of any facilities on LSB Class A soils.

Project Acreage by LSB Soil Classification

Area	LSB Soil Class (acres)					Total Area (acres)
	A	B	C	D	E	
Permanent Footprint of Project Facilities[1,2]	0.0	2.01	0.0	0.17	0.004	2.2
Overall Project Area	0.0	45.9	0.0	36.7	13.8	96.4
Percentage of Project Area Occupied by Project Footprint	0.0%	4.4%	0.0%	0.5%	0.03%	2.3%

[1] Additional detail regarding calculation of the permanent project footprint is provided as part of Table 2 in the SUP application.

[2] The area occupied by the Project components are calculated based on a 60 percent level of design. The dimensions used for these calculations will be refined through the final design process; in particular, refinements are anticipated based on Hawaiian Electric's technical review and the equipment procurement process. Any refinements are expected to be relatively minor, such that the resulting calculations would not substantively differ from those reported above.

The site plan for the Project (provided as Attachment H in the SUP application) has been updated to reflect the corrected LSB classification data and the adjusted Project area boundary. In particular, Drawing C1 depicts the adjusted Project area boundary, including metes and bounds. Drawing C2 also presents this information along with the corrected LSB soil layer. The site plan (based on a 60-percent level of design) is shown in Drawings C2 and C3. The Project figures (provided as Attachment A in the SUP) have also been updated to reflect the adjusted Project area boundary. An additional figure (Figure 18), which shows the proximity of surrounding land uses relative to the adjusted Project area, has been included in the set of figures. Revised versions of Attachments A and H are enclosed as part of this submittal.

In light of the reduction in the Project area, each of the due diligence and supporting technical studies referenced in the SUP application was reviewed to determine whether this revision would have any bearing on the study results. Signed statements documenting that the reduction in the Project area would not materially affect the findings and conclusions of the studies are also enclosed.

Historic Preservation Review

As discussed in Section 2.7 of the SUP application, an archaeological inventory survey (AIS) was conducted by Cultural Surveys Hawai'i to identify, document and assess the significance of historic properties within the Project area. In accordance with Hawai'i Revised Statutes (HRS) § 6E and Hawai'i Administrative Rules (HAR) § 13-284, the AIS Report was submitted to the State of Hawai'i Historic Preservation Division (SHPD) on February 5, 2020. At the time the SUP application was submitted to DPP on August 31, 2020, SHPD had not yet provided a response regarding their review of the AIS Report and the effect determination for the Project. Subsequently, on September 15, 2020, SHPD contacted DPP to request a copy of the SUP application. It is understood that DPP provided SHPD with a link to the SUP application; in addition, Cultural Surveys Hawai'i also transmitted a link to the SUP application and receipt was acknowledged by SHPD. In addition, a meeting was held with SHPD staff September 25, 2020 to discuss the AIS Report. During this meeting, SHPD staff indicated that review comments on the AIS Report would be forthcoming. Copies of recent correspondence with SHPD regarding the historic preservation review process are contained in Attachment 3.

System Easement

As discussed in Section 1 of the SUP application, under an August 2019 option agreement with UH (as amended in May 2020), AES will enter into a Grant of System Easement under which AES will have the right to develop, construct, install, operate, maintain, repair, and replace the Project upon and/or remove the Project on a portion of the UH West O'ahu Mauka Lands property. The easements will include an exclusive easement for the Project facilities, a non-exclusive utility easement for Hawaiian Electric, and a non-exclusive access easement along existing shared-use access roads. As noted in the SUP application, it is anticipated that the area to be secured for the Project through the easement(s) required under the option agreement with UH will be a subset of the Project area, subject to a possible reduction of approximately 25-35 acres; the final area secured for Project use from UH will be based on the final design and engineering plans, subject to review and input by Hawaiian Electric. This area will be defined through the easement designation process, and submitted to the City and County of Honolulu and Land Court for approval. Any such reduction in the area secured for Project use from UH would not substantively change the size, scope, intensity, use, location or timing of the Project itself (as described in either the Final EA or the SUP application), nor would it change the area for which SUP approval is requested. The easements are currently being defined and it is anticipated that draft plans for the proposed easement designation areas may be provided as part of a supplemental filing for DPP's reference in advance of the formal decision making.

We appreciate your efforts in support of processing the SUP application for the West O'ahu Solar Plus Storage Project. If you have any questions regarding the information provided herein, please do not hesitate to contact me.

Sincerely,

Tetra Tech
Lisa Kettley
Agent for AES Distributed Energy

Enclosures:

- Attachment H (Revised)
- Attachment A (Revised)
- Signed Statements Regarding Supporting Technical Studies
- Correspondence with State Historic Preservation Division staff

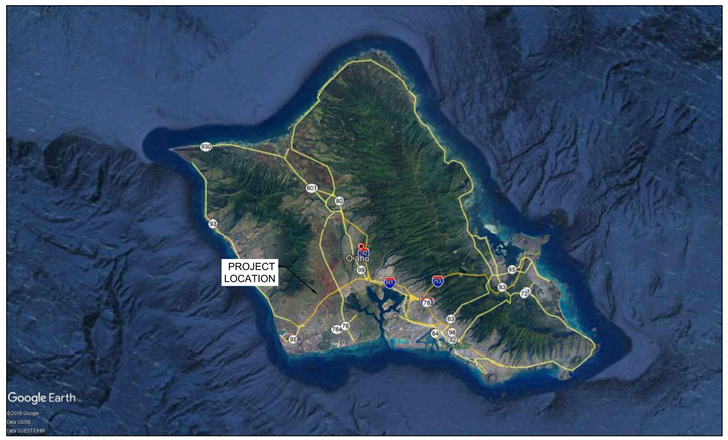
Cc: Nick Molinari, AES Distributed Energy (West O'ahu Solar, LLC)

WEST OAHU SOLAR PLUS STORAGE
12.5 MW AC COMBINED PV AND 50 MWh BESS

KAPOLEI, WEST OAHU, HAWAII

PREPARED FOR

CITY AND COUNTY OF HONOLULU DEPARTMENT OF PLANNING AND PERMITTING



VICINITY MAP

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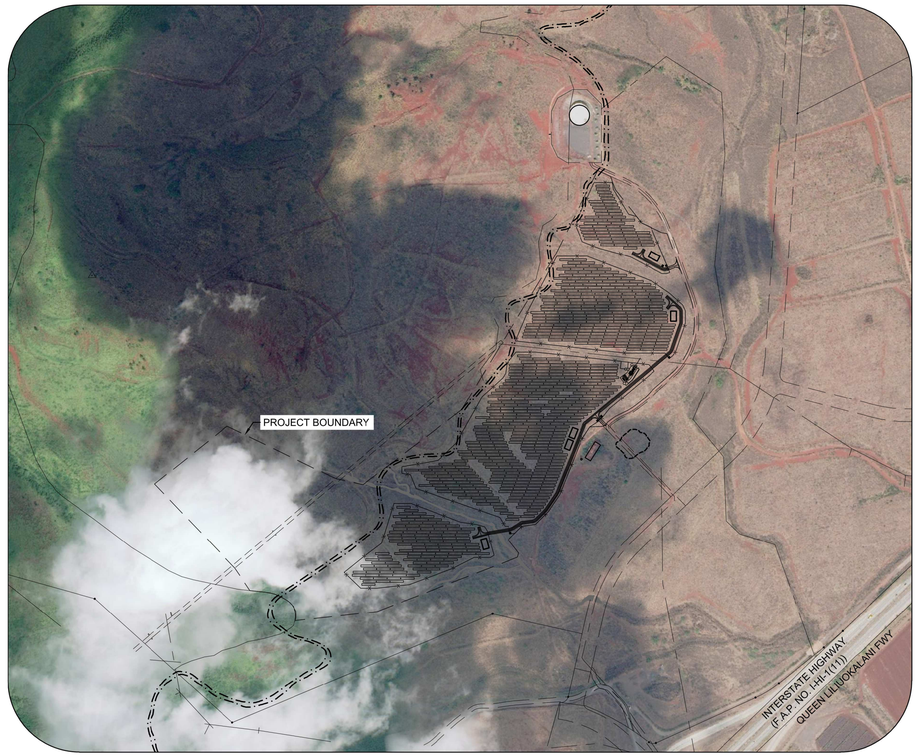

SITE MAP

1" = 500'

SCOPE OF WORK

THIS PACKAGE PROVIDES DRAWINGS FOR THE INSTALLATION OF 17.42 MW DC, 12.5 MW AC AT POI COMBINED PHOTOVOLTAIC AND BATTERY ENERGY STORAGE SYSTEM NEAR KAPOLEI, WEST OAHU, HAWAII.

PROJECT DEVELOPER

AES WEST OAHU SOLAR
282 CENTURY PL, SUITE 2000
LOUISVILLE, CO 80027

NICK MOLINARI
BUSINESS DEVELOPMENT
(303) 524-4368

CAMERON HAUGHEY
PROJECT MANAGER
(720) 450-4360

CIVIL ENGINEER

AARON MURPHY
3J CONSULTING
9600 SW NIMBUS AVE
BEAVERTON, OR 97008

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EXP. DATE - 04/30/22

STRUCTURAL ENGINEER

THOMAS HAMLIN
HDR, INC.
3200 EAST CAMELBACK ROAD
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ELECTRICAL ENGINEER

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EXP. DATE - 04/30/2022

SHEET INDEX

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A Murphy

SIGNATURE — 4/30/2022 LIC. EXP. DATE

Oct 22 2020 7:01 PM DocuSign

AES Distributed Energy

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282 Century Pl. Suite 2000
Louisville, CO 80027 USA

HDR / 3J CONSULTING
CIVIL ENGINEERING
WATER RESOURCES
COMMUNITY PLANNING
9600 SW NIMBUS AVE, SUITE 100, BEAVERTON, OR 97008

SYSTEM DESCRIPTION

REVISIONS

REV	BY	DATE	DESCRIPTION

PE STAMP

AARON J MURPHY
LICENSED PROFESSIONAL ENGINEER
No. 18696-C
HAWAII U.S.A.

AES WEST OAHU SOLAR
OAHU, HI

PROJECT NUMBER
19537
PHASE
LAND USE
MILESTONE
60% DESIGN

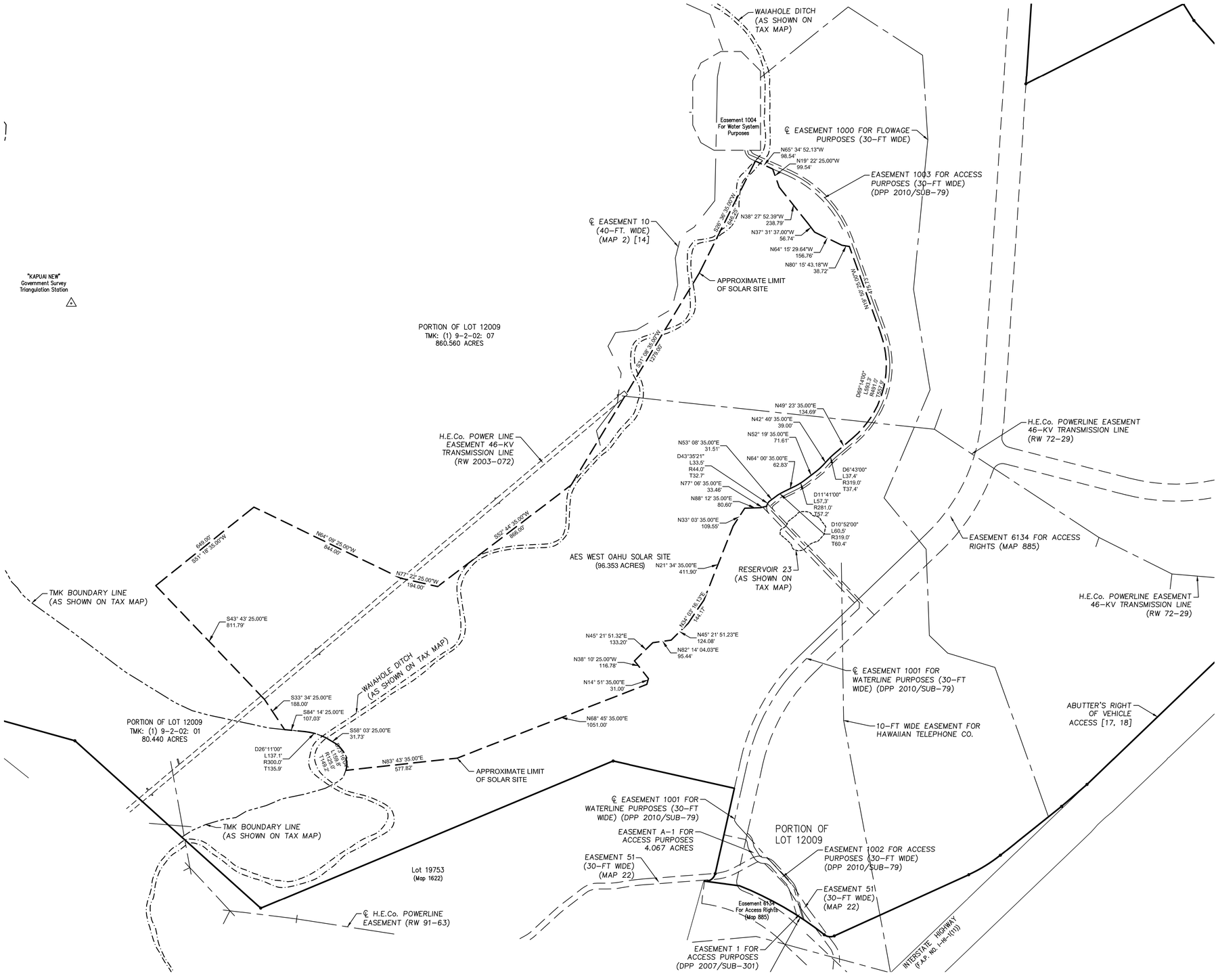
ELECTRICAL DESIGNER

STRUCTURAL DESIGNER

DATE	SCALE
10-07-2020	N/A

TITLE
COVER SHEET

DRAWING
C0



LEGEND

- BOUNDARY FOR LOT 12009
- TMK BOUNDARY
- WAIAHOLE DITCH (PER TAX MAP)
- RESERVOIR (PER TAX MAP)
- EXISTING ROW LINE
- EXISTING EASEMENT LINE
- EXISTING EASEMENT CENTER LINE
- APPROXIMATE LIMIT OF SOLAR SITE

N
W E
S

SCALE: 1" = 250'
0 250 500 FT

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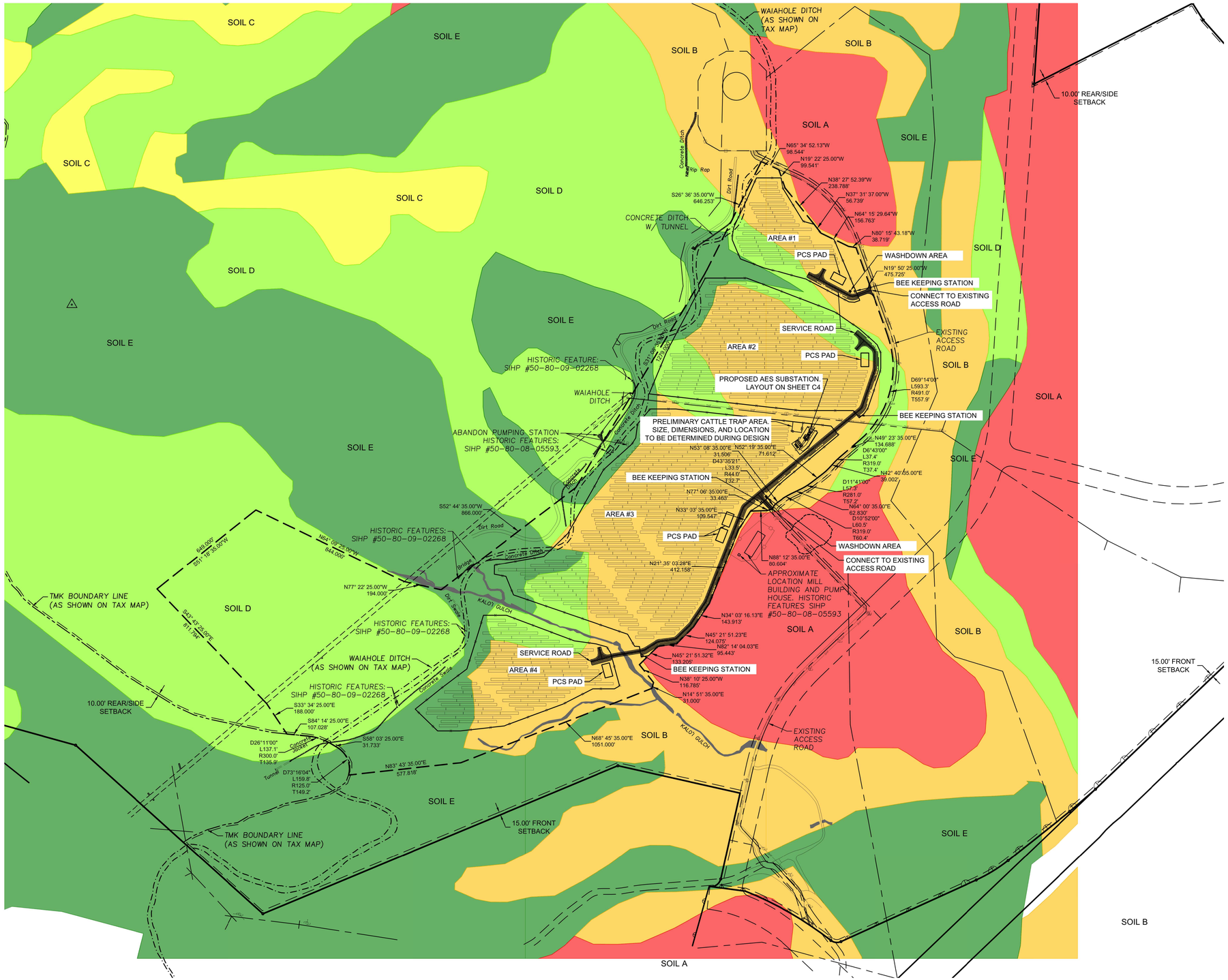
ELECTRICAL DESIGNER

STRUCTURAL DESIGNER

DATE 10-07-2020
SCALE 1" = 250'

TITLE
TMK PLAN

DRAWING
C1



LAND STUDY BUREAU (LSB) SOIL CLASSES

- LSB CLASS A
- LSB CLASS B
- LSB CLASS C
- LSB CLASS D
- LSB CLASS E

N

W E

S

SCALE: 1" = 250'

0 250 500 FT

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SYSTEM DESCRIPTION

REVISIONS

REV	BY	DATE	DESCRIPTION

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19537
PHASE
LAND USE
MILESTONE
60% DESIGN

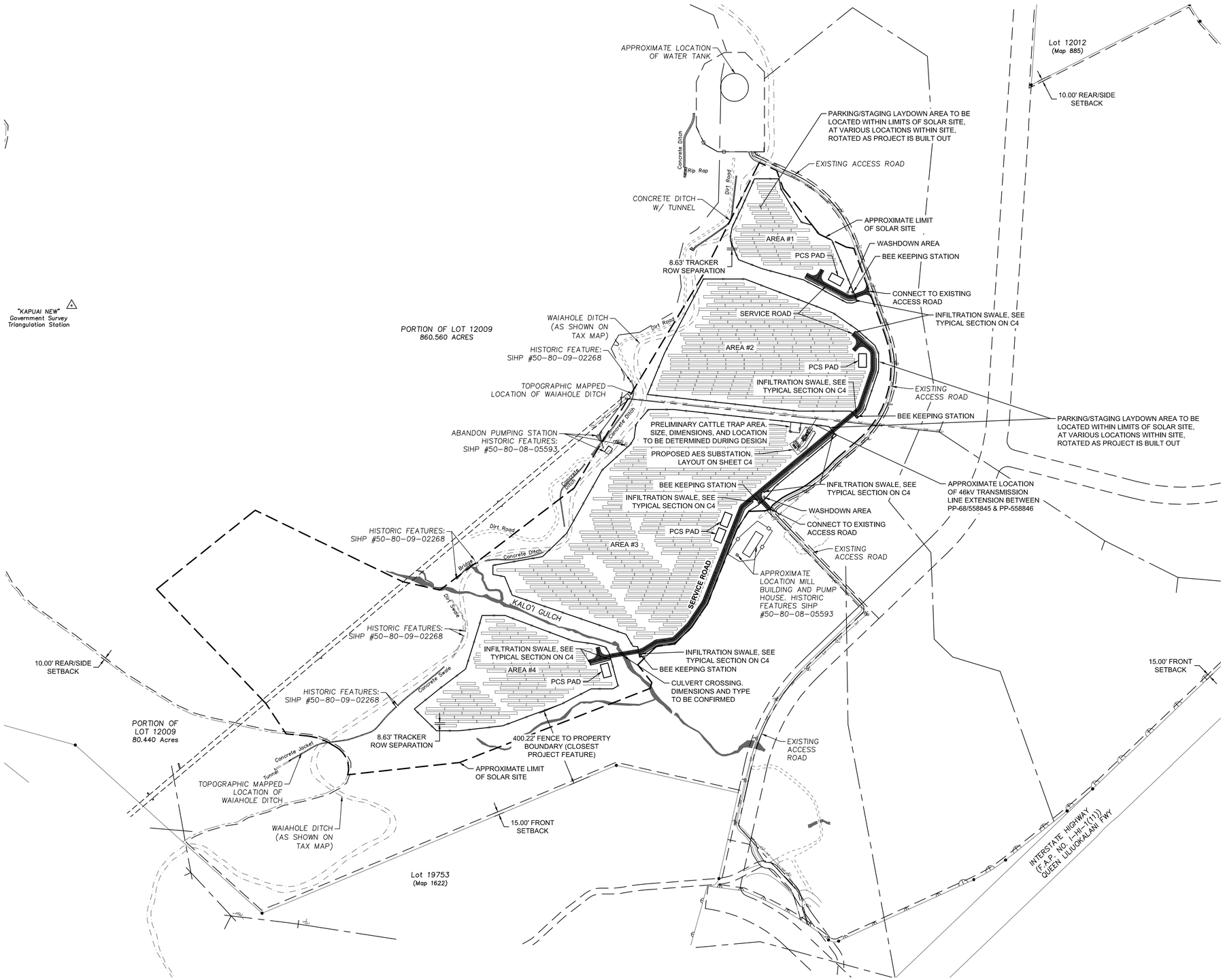
ELECTRICAL DESIGNER

STRUCTURAL DESIGNER

DATE 10-07-2020
SCALE 1" = 250'

TITLE
LSB SOIL UNDERLAY

DRAWING
C2



LEGEND

- BOUNDARY FOR LOT 12009
- TMK BOUNDARY
- WAIAHOLE DITCH (PER TAX MAP)
- RESERVOIR (PER TAX MAP)
- EXISTING ROW LINE
- EXISTING EASEMENT CENTER LINE
- EXISTING EASEMENT LINE
- EXISTING ASPHALT
- EXISTING DIRT ROAD
- EXISTING CONCRETE DITCH
- EXISTING FENCE
- OHP — EXISTING OVERHEAD POWER
- EXISTING TRANSMISSION LINE POLE
- PROPOSED ACCESS ROAD, SEE TYPICAL SECTION ON SHEET C4
- PROPOSED PROPERTY BOUNDARY SETBACK
- PROPOSED 7' TALL STEEL FABRIC MESH SECURITY FENCE. SEE DETAIL ON SHEET C9.1
- PROPOSED PCS (POWER CONVERSION STATION) FOUNDATION AND EQUIPMENT PAD. SEE SCHEMATIC ON C4
- PROPOSED WASHDOWN AREA
- APPROXIMATE LIMIT OF SOLAR SITE

N
W E
S

SCALE: 1" = 250'
0 250 500 FT

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A. Murphy

4/30/2022

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OAHU, HI

PROJECT NUMBER
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PHASE
LAND USE
MILESTONE
60% DESIGN

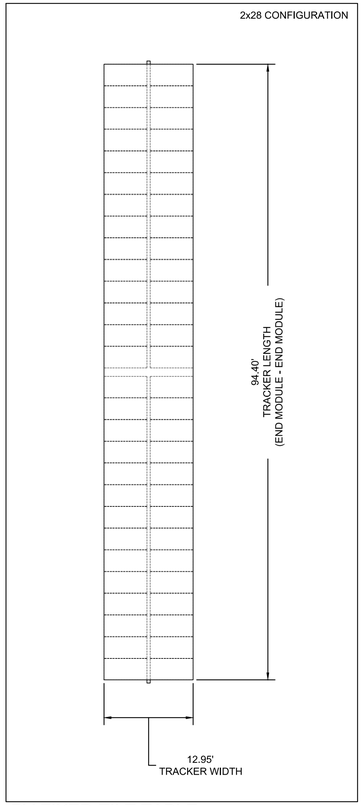
ELECTRICAL DESIGNER

STRUCTURAL DESIGNER

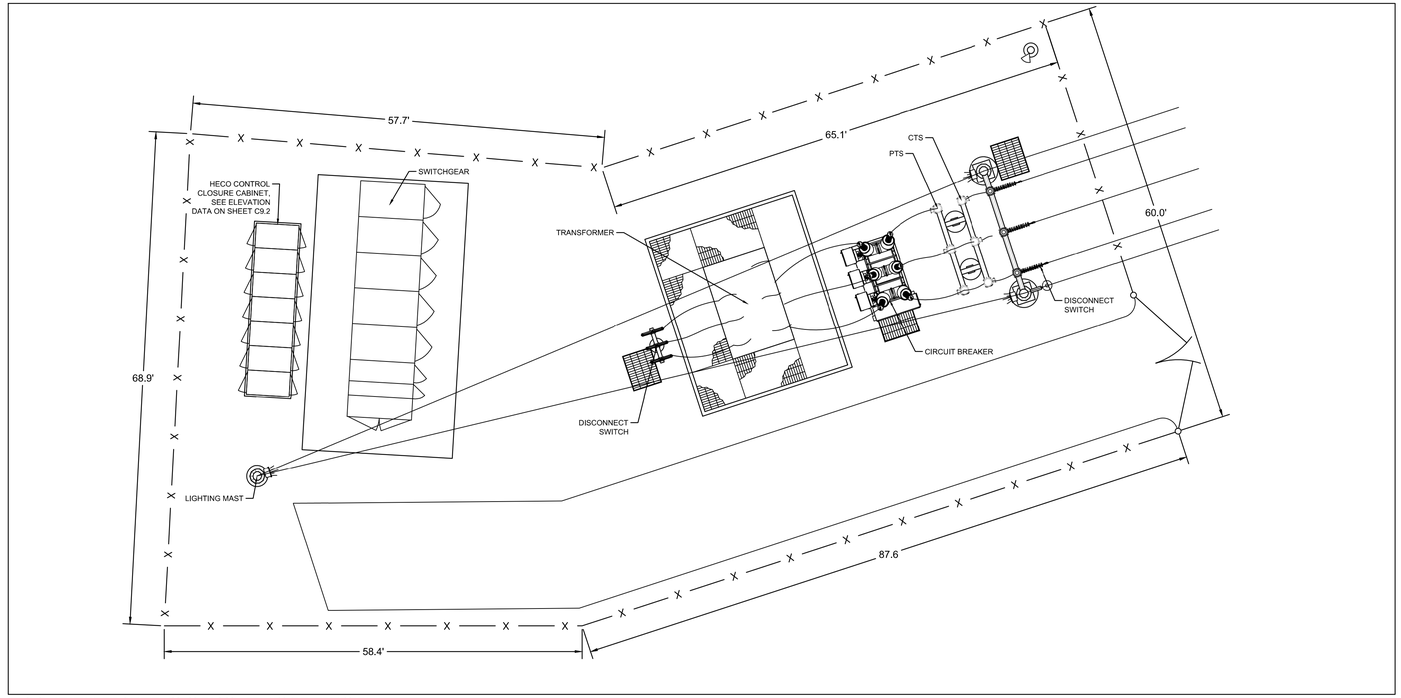
DATE 10-07-2020
SCALE 1" = 250'

TITLE
OVERALL SITE PLAN

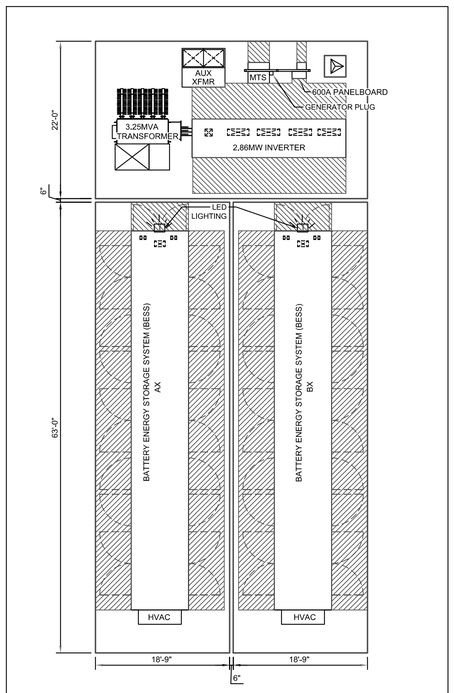
DRAWING
C3



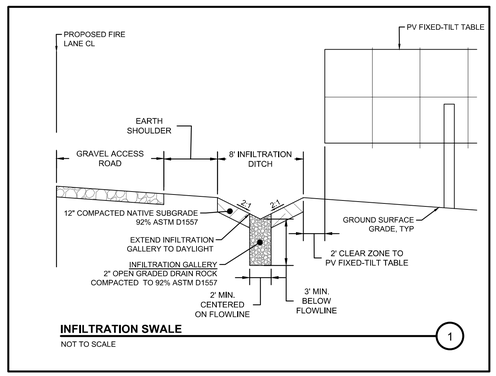
PV FIXED-TILT TABLE -
SEE ELEVATION DATA ON SHEET C9.2



PRELIMINARY AES SUBSTATION LAYOUT -
SEE ELEVATION DATA ON SHEET C9.2



POWER CONVERSION STATION (PCS) PAD LAYOUT -
SEE ELEVATION DATA ON SHEET C9.2



INFILTRATION SWALE
NOT TO SCALE
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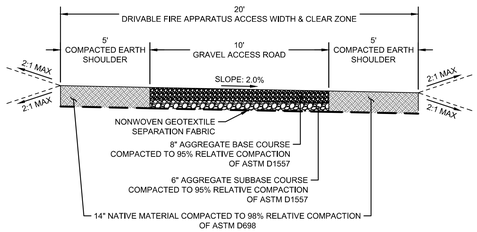

TYPICAL SECTION
GRAVEL SERVICE ROAD
NOT TO SCALE
1

AES
Distributed Energy

AES Distributed Energy
282 Century Pl. Suite 2000
Louisville, CO 80027 USA

HDR
3J CONSULTING
CIVIL ENGINEERING
WATER RESOURCES
COMMUNITY PLANNING
9600 SW NIMBUS AVE, SUITE 100, BEAVERTON, OR 97008

SYSTEM DESCRIPTION

REVISIONS

REV	BY	DATE	DESCRIPTION

PE STAMP

AARON J MURPHY
LICENSED PROFESSIONAL ENGINEER
No. 18696-C
HAWAII U.S.A.

AES WEST OAHU SOLAR
OAHU, HI

PROJECT NUMBER
19537
PHASE
LAND USE
MILESTONE
60% DESIGN

ELECTRICAL DESIGNER

STRUCTURAL DESIGNER

DATE
10-07-2020
SCALE
N/A

TITLE
SITE PLAN SCHEMATICS

N
W E
S

SCALE: 1" = 250'
0 250 500 FT

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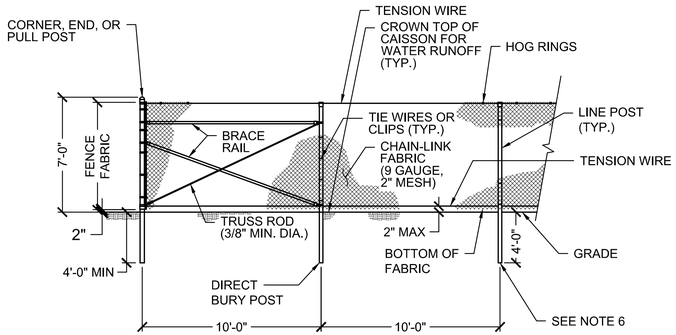
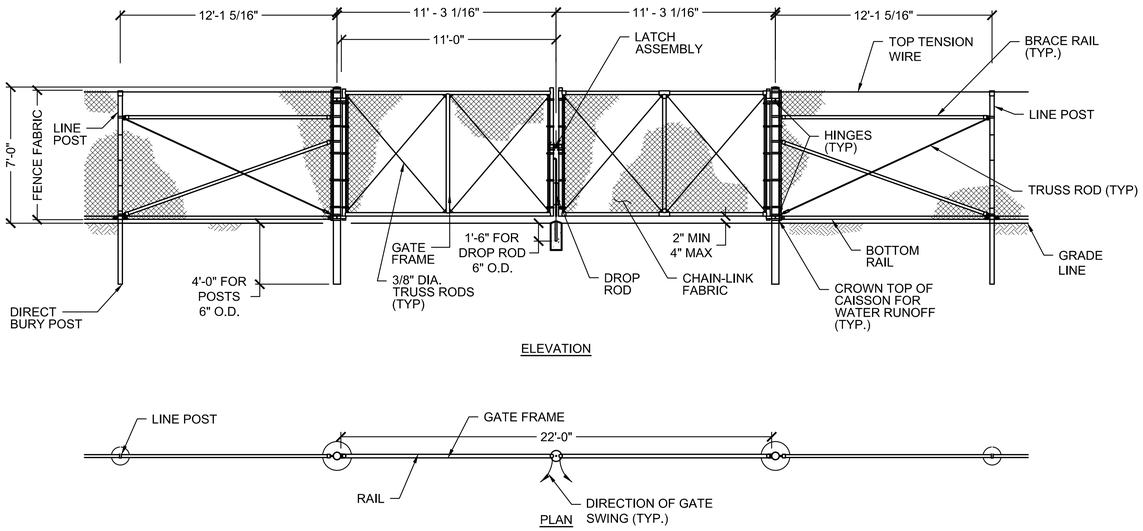
A Murphy
SIGNATURE
Oct 22 2020 7:01 PM DocuSign
4/30/2022
LIC. EXP. DATE

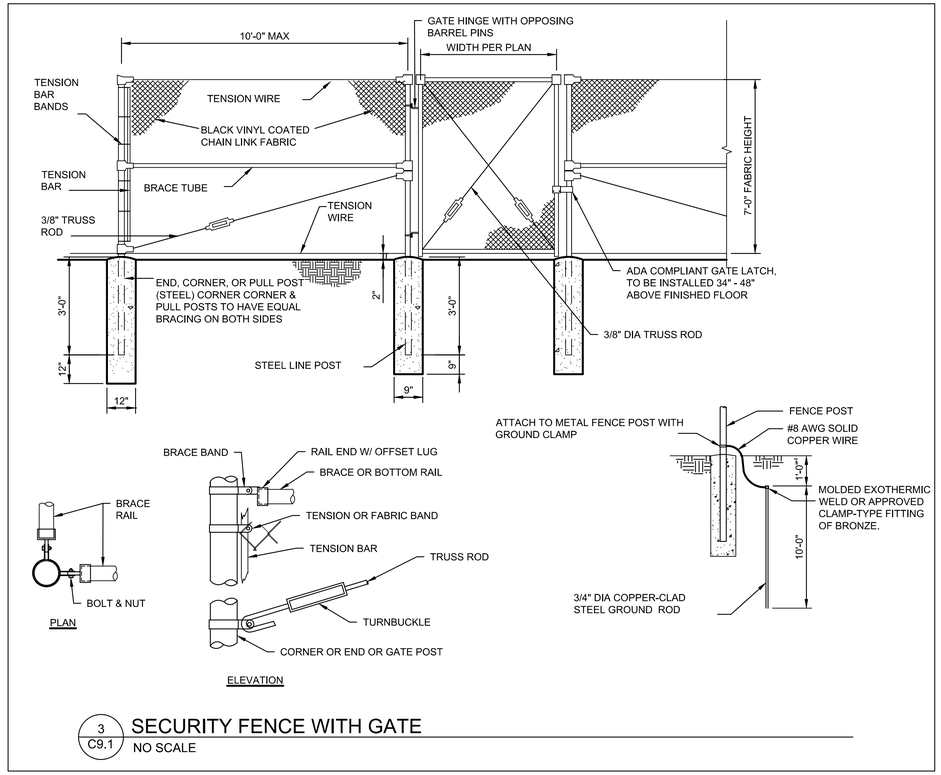
DRAWING
C4



1 C9.1 PERIMETER FENCE ELEVATION



2 C9.1 TYPICAL ACCESS GATE



3 C9.1 SECURITY FENCE WITH GATE
NO SCALE

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A. Murphy

4/30/2022

SIGNATURE Oct 23 2020 7:01 PM DocuSigned by: LIC. EXP. DATE

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Louisville, CO 80027 USA

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WATER RESOURCES
COMMUNITY PLANNING
9600 SW NIMBUS AVE, SUITE 100, BEAVERTON, OR 97008

SYSTEM DESCRIPTION

REVISIONS

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MILESTONE
60% DESIGN

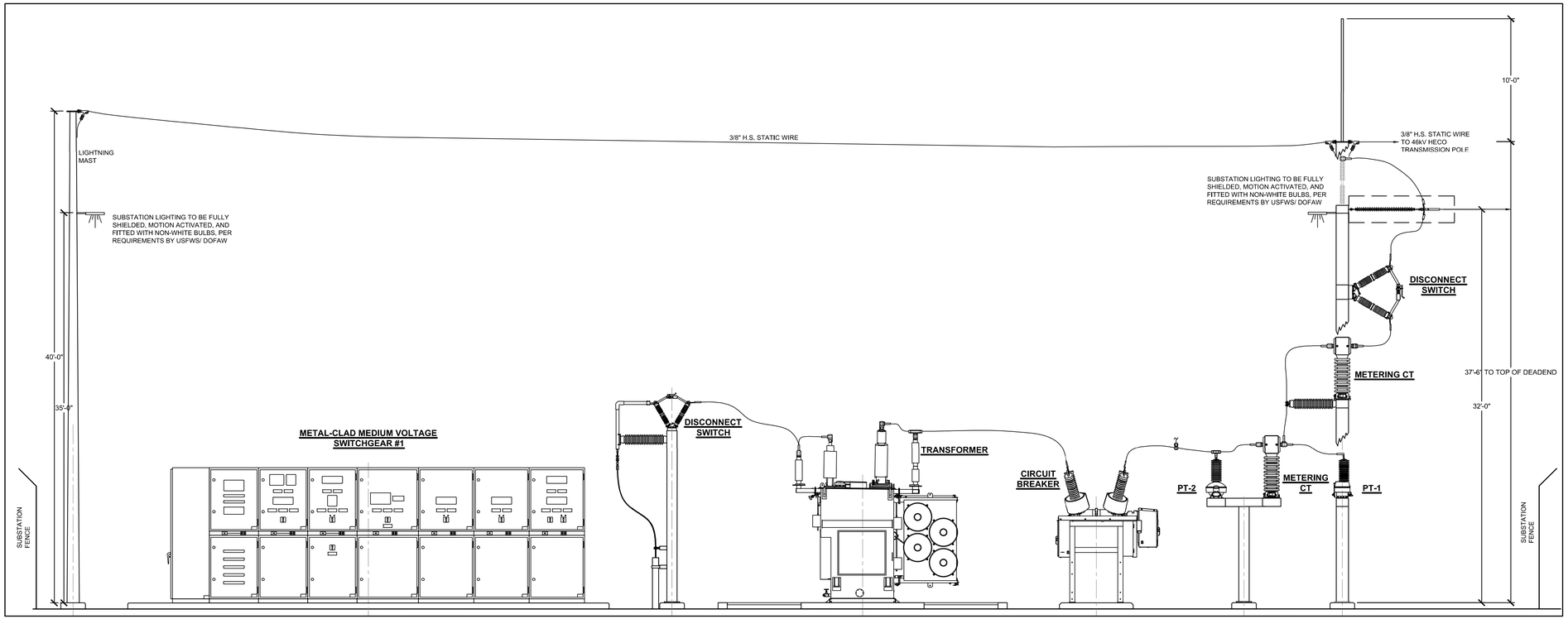
ELECTRICAL DESIGNER

STRUCTURAL DESIGNER

DATE 10-07-2020
SCALE N/A

TITLE
CIVIL DETAIL 1

DRAWING
C9.1



1 C9.2 PRELIMINARY SUBSTATION ELEVATION
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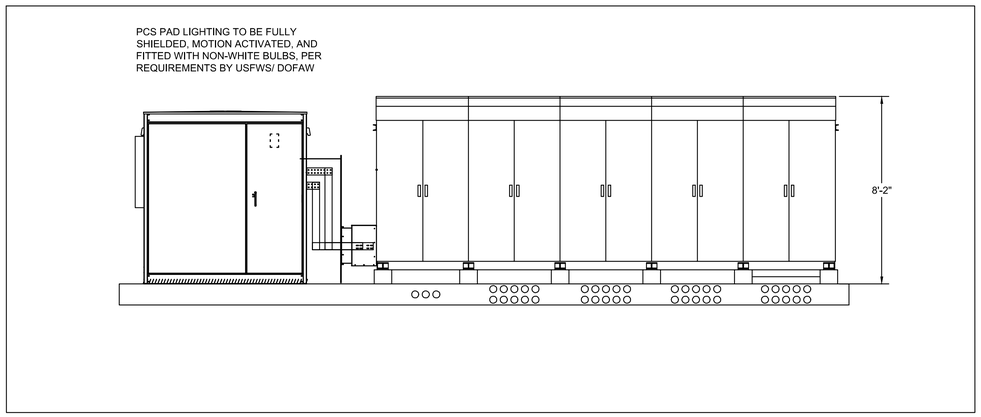

2 C9.2 POWER CONVERSION STATION (PCS) PAD INVERTER AND TRANSFORMER FRONT ELEVATION
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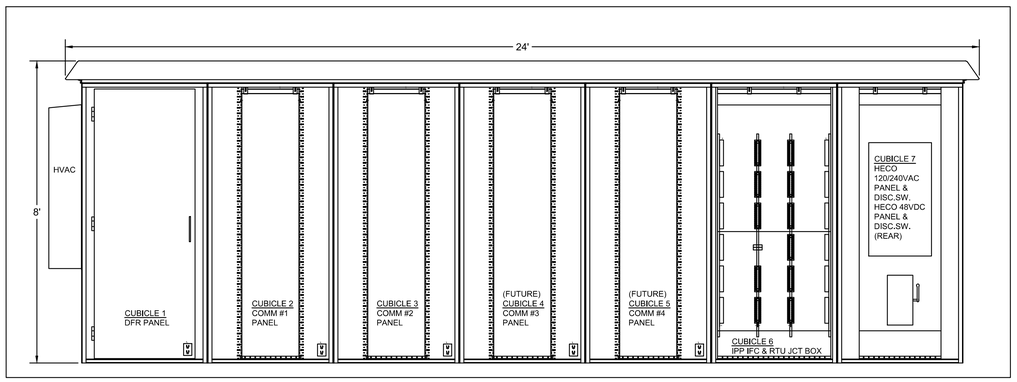
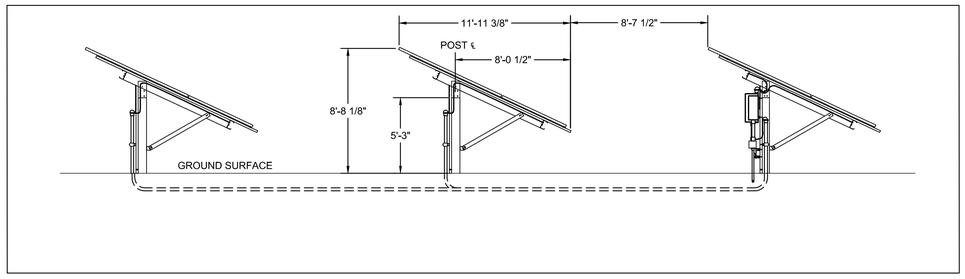


3 C9.2 HECO CONTROL CLOSURE CABINET ELEVATION
N.T.S.



4 C9.2 PV FIXED-TILT TABLE ELEVATION
N.T.S.

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A Murphy

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4/30/2022
LIC. EXP. DATE

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HDR
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OAHU, HI

PROJECT NUMBER
19537
PHASE
LAND USE
MILESTONE
60% DESIGN

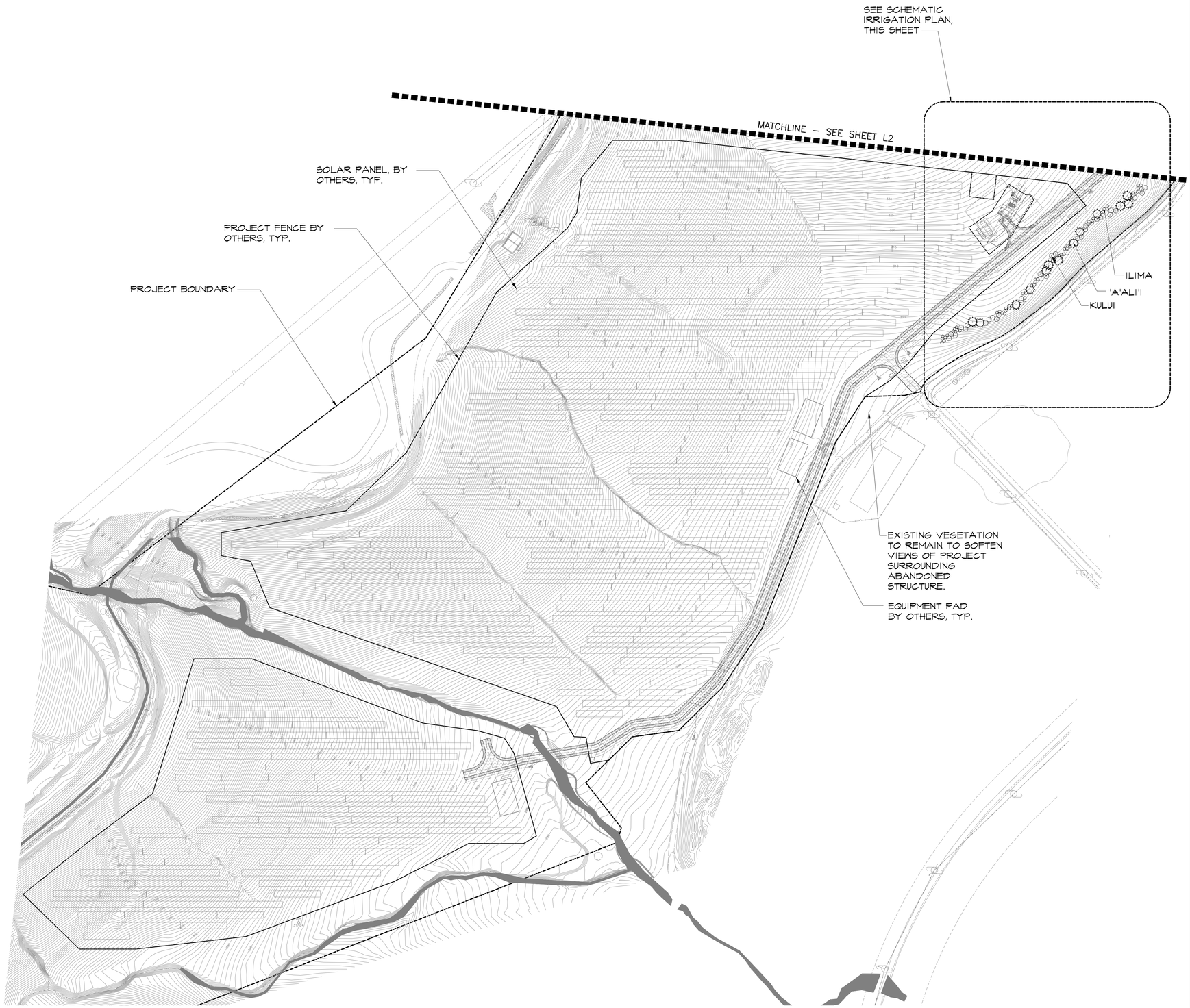
ELECTRICAL DESIGNER

STRUCTURAL DESIGNER

DATE 10-07-2020
SCALE N/A

TITLE
CIVIL DETAIL 2

DRAWING
C9.2



NORTH **LANDSCAPE PLAN**
SCALE: 1" = 100'-0"

100' 0 100'

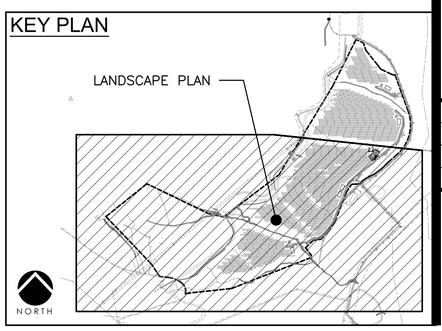
NOTE: SEE PLANT LEGEND ON SHEET L3 FOR PLANT NAMES, SIZES, QUANTITIES AND OTHER INFORMATION.

NOTE: SEE IRRIGATION EQUIPMENT LIST ON SHEET L3 FOR MORE INFORMATION.

NORTH **SCHEMATIC IRRIGATION PLAN**
SCALE: 1" = 80'-0"

80' 0 80'

KEY PLAN



REVISION	DATE	BY
REVISION 1		
REVISION 2		
REVISION 3		
REVISION 4		
REVISION 5		
REVISION 6		

MAILELANI DESIGN
1241 ALA AMOAMO ST
HONOLULU, HI 96819

VIVIAN L. ARITA
LICENSED PROFESSIONAL LANDSCAPE ARCHITECT
No. 18181
HAWAII, U.S.A.

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SIGNATURE 4/30/22 EXPIRATION DATE

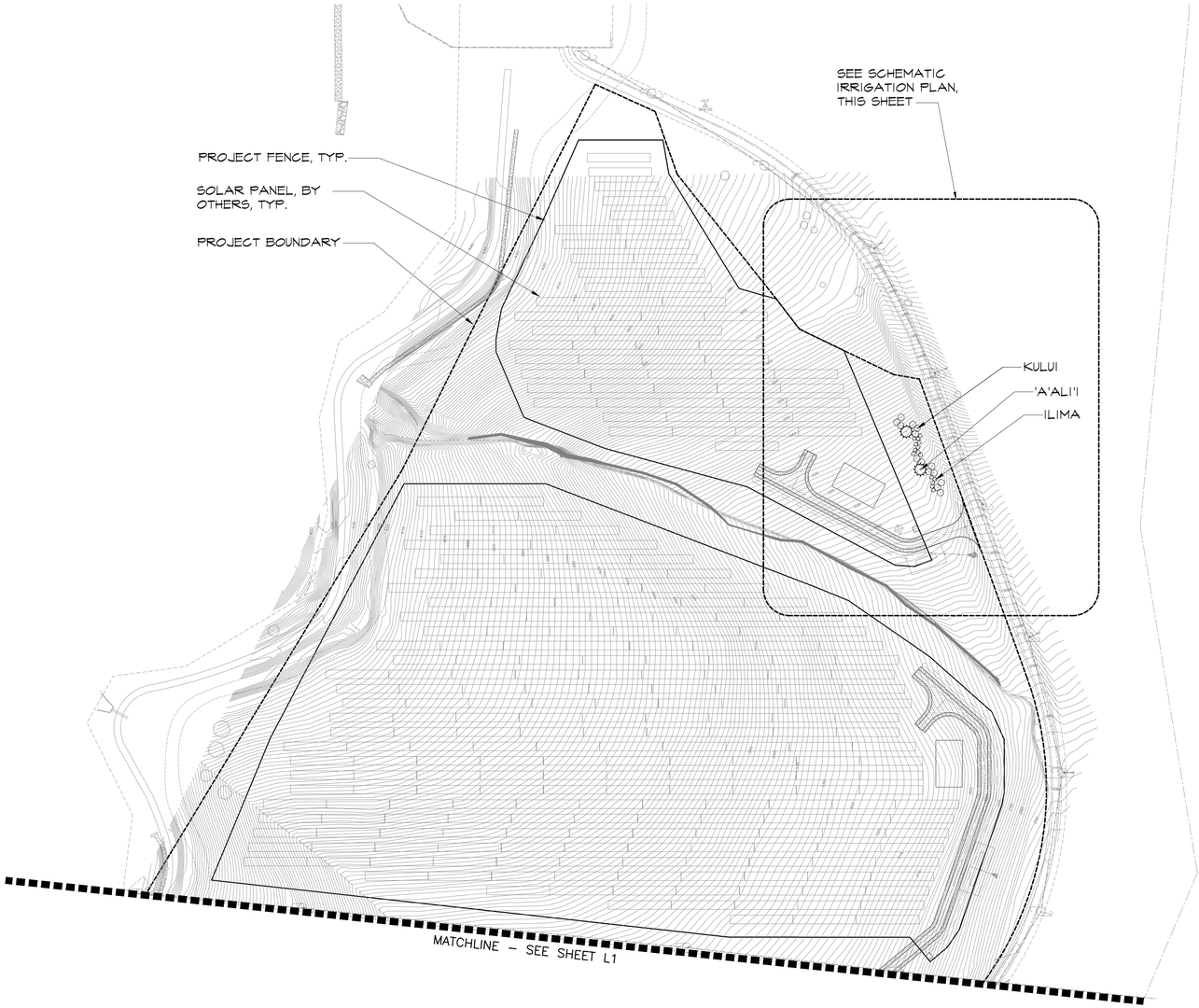
AES WEST O'AHU SOLAR PLUS STORAGE PROJECT
TMK: 9-2-002:007, Hono'uli'uli, 'Ewa, O'ahu, Hawai'i

LANDSCAPE PLAN AND SCHEMATIC IRRIGATION PLAN

DATE:	JUNE 2019
SCALE:	AS NOTED
DRAWN BY:	VA
MD JOB NO.:	2007

L1

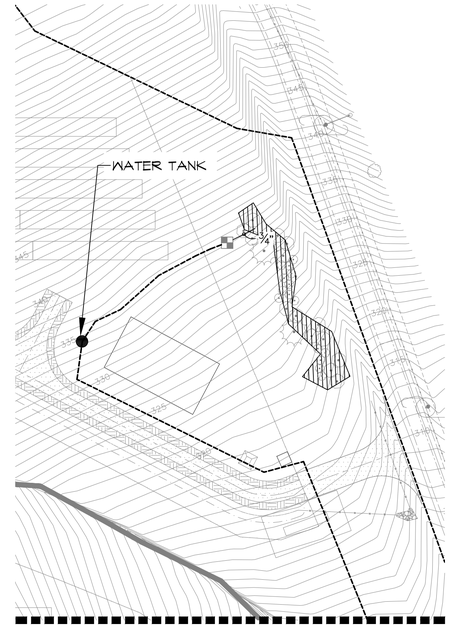
1 OF 3 SHEETS



NORTH **LANDSCAPE PLAN**
SCALE: 1" = 100'-0"

100' 0 100'

NOTE: SEE PLANT LEGEND ON SHEET L3 FOR PLANT NAMES, SIZES, QUANTITIES AND OTHER INFORMATION.

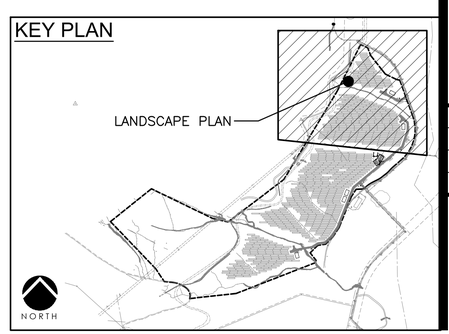


NOTE: SEE IRRIGATION EQUIPMENT LIST ON SHEET L3 FOR MORE INFORMATION.

NORTH **SCHEMATIC IRRIGATION PLAN**
SCALE: 1" = 50'-0"

50' 0 50'

KEY PLAN



REVISION	DATE	BY
REVISION 1		
REVISION 2		
REVISION 3		
REVISION 4		
REVISION 5		
REVISION 6		

MAILELANI DESIGN
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HONOLULU, HI 96819

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SIGNATURE 04/30/22 EXPIRATION DATE

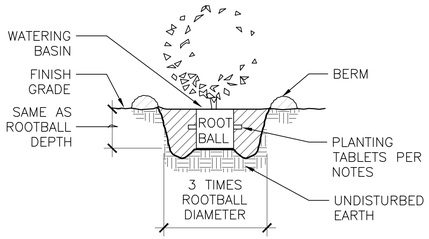
AES WEST O'AHU SOLAR PLUS STORAGE PROJECT

TMK: 9-2-002:007, Hono'uli'uli, 'Ewa, O'ahu, Hawai'i

LANDSCAPE PLAN AND SCHEMATIC IRRIGATION PLAN

DATE:	JUNE 2019
SCALE:	AS NOTED
DRAWN BY:	VA
MD JOB NO.:	2007

L2



1 SHRUB PLANTING DETAIL

NOT TO SCALE

PLANTING NOTES:

1. THE LANDSCAPE CONTRACTOR SHALL VERIFY ALL EXISTING UTILITY LOCATIONS WITHIN THE PROJECT SITE PRIOR TO BEGINNING LANDSCAPE CONSTRUCTION ACTIVITIES.
2. PRIOR TO THE INSTALLATION OF ALL NEW SHRUBS, THE CONTRACTOR SHALL CLEAR AND GRUB EXISTING VEGETATION WITHIN A 10' DIAMETER FOR EACH NEW PLANTING.
3. ANY DAMAGE DONE TO UTILITIES BY THE LANDSCAPE CONTRACTOR DURING LANDSCAPE INSTALLATION ACTIVITIES SHALL BE REPAIRED/RESTORED TO ORIGINAL CONDITION AT NO EXPENSE TO THE OWNER
4. REFER TO "LANDSCAPE SPECIFICATIONS" SECTION 02480 PRIOR TO THE START OF WORK. CONTRACTOR SHALL BE HELD RESPONSIBLE FOR ALL MATERIALS, SCHEDULING, PRODUCTS, WARRANTIES AND METHODS FOR EXECUTION OF WORK WHICH MAY NOT BE INDICATED WITHIN THE DRAWINGS.
5. BACKFILL MIX SHALL CONSIST OF THREE (3) PARTS AMENDED IMPORTED PLANTING SOIL TO ONE (1) PART ORGANIC SOIL CONDITIONER (SEE SPECIFICATIONS). ADD ONE (1) POUND OF 10-30-10 FERTILIZER TO ONE (1) CUBIC YARD OF BACKFILL MIX. MIX THOROUGHLY ON PROJECT SITE PRIOR TO ANY PLANTING OPERATIONS.
6. PLANTING TABLETS FOR SHRUBS SHALL BE AS FOLLOWS:

   A) 5 GALLON 3 TABLETS
   B) 3 GALLON 2 TABLETS

   USE SLOW RELEASE FERTILIZER TABLETS 20-10-5, 21 GRAM SIZE.
7. QUANTITIES SHOWN ON PLANT SCHEDULE ARE FOR REFERENCE ONLY. VERIFY ACTUAL QUANTITIES AS SHOWN ON PLAN TO PROVIDE FULL AND EVEN COVERAGE OF PLANTING AREAS.

PLANT SCHEDULE

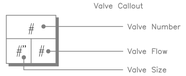
SHRUBS	QTY	COMMON NAME	BOTANICAL NAME	SIZE	HEIGHT	SPREAD	REMARKS
	48	KULU'I	NOTOTRICHIUM SANDWICENSE	5 GAL	3'-4'	2'-3'	MATURE HT: 6'
	15	'A'ALI'I	DODONAEA VISCOSA	5 GAL	3'-4'	2'-3'	MATURE HT: 20'
	69	'ILIMA	SIDA FALLAX	3 GAL	2'-3'	1'-2'	MATURE HT: 6'-8'

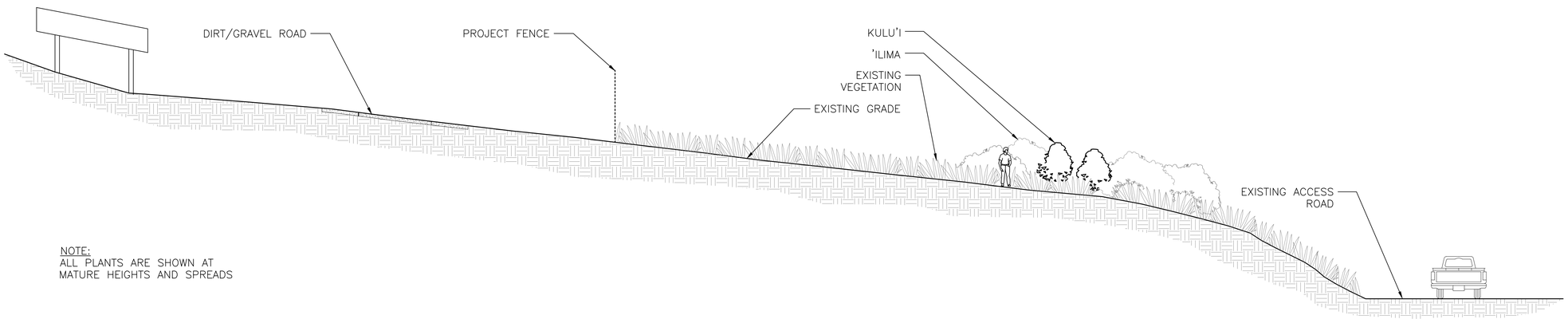
IRRIGATION SCHEDULE

SYMBOL	MANUFACTURER/MODEL/DESCRIPTION
	HUNTER ICZ-101-25 DRIP CONTROL ZONE KIT. 1" ICV GLOBE VALVE WITH 1" HY100 FILTER SYSTEM. PRESSURE REGULATION: 25PSI. FLOW RANGE: 2 GPM TO 20 GPM. 150 MESH STAINLESS STEEL SCREEN. CONTROLLERS SHALL HAVE SOLAR TIMERS.
	AREA TO RECEIVE DRIPLINE NETAFIM TLCV-04-18 TECHLINE PRESSURE COMPENSATING LANDSCAPE DRIPLINE WITH CHECK VALVE. 0.4 GPH EMITTERS AT 18" O.C. DRIPLINE LATERALS SPACED AT 18" APART, WITH EMITTERS OFFSET FOR TRIANGULAR PATTERN. 17MM.
	1000 GALLON ABOVE GROUND VERTICAL WATER STORAGE TANK. FDA APPROVED HIGH DENSITY LINEAR POLYETHYLENE, IMPACT, UV AND CORROSION RESISTANT.

SYMBOL	MANUFACTURER/MODEL/DESCRIPTION
	IRRIGATION LATERAL LINE: PVC SCHEDULE 40-NP
	IRRIGATION MAINLINE: HDPE PE3408 DR 11-NP

Valve Callout





NOTE:
ALL PLANTS ARE SHOWN AT MATURE HEIGHTS AND SPREADS

2 SECTION THROUGH EAST SLOPE, SHRUBS AND EXISTING ACCESS ROAD

NOT TO SCALE

REVISION	DATE	BY
REVISION 1		
REVISION 2		
REVISION 3		
REVISION 4		
REVISION 5		
REVISION 6		

MAILELANI DESIGN
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SIGNATURE 4/30/22 EXPIRATION DATE

AES WEST O'AHU SOLAR PLUS STORAGE PROJECT
TMK: 9-2-002:007, Hono'uli'uli, 'Ewa, O'ahu, Hawai'i

LANDSCAPE DETAIL, SECTION, PLANT LIST, NOTES AND IRRIGATION EQUIPMENT LIST

DATE:	JUNE 2019
SCALE:	AS NOTED
DRAWN BY:	VA
MD JOB NO.:	2007

L3

3 OF 3 SHEETS

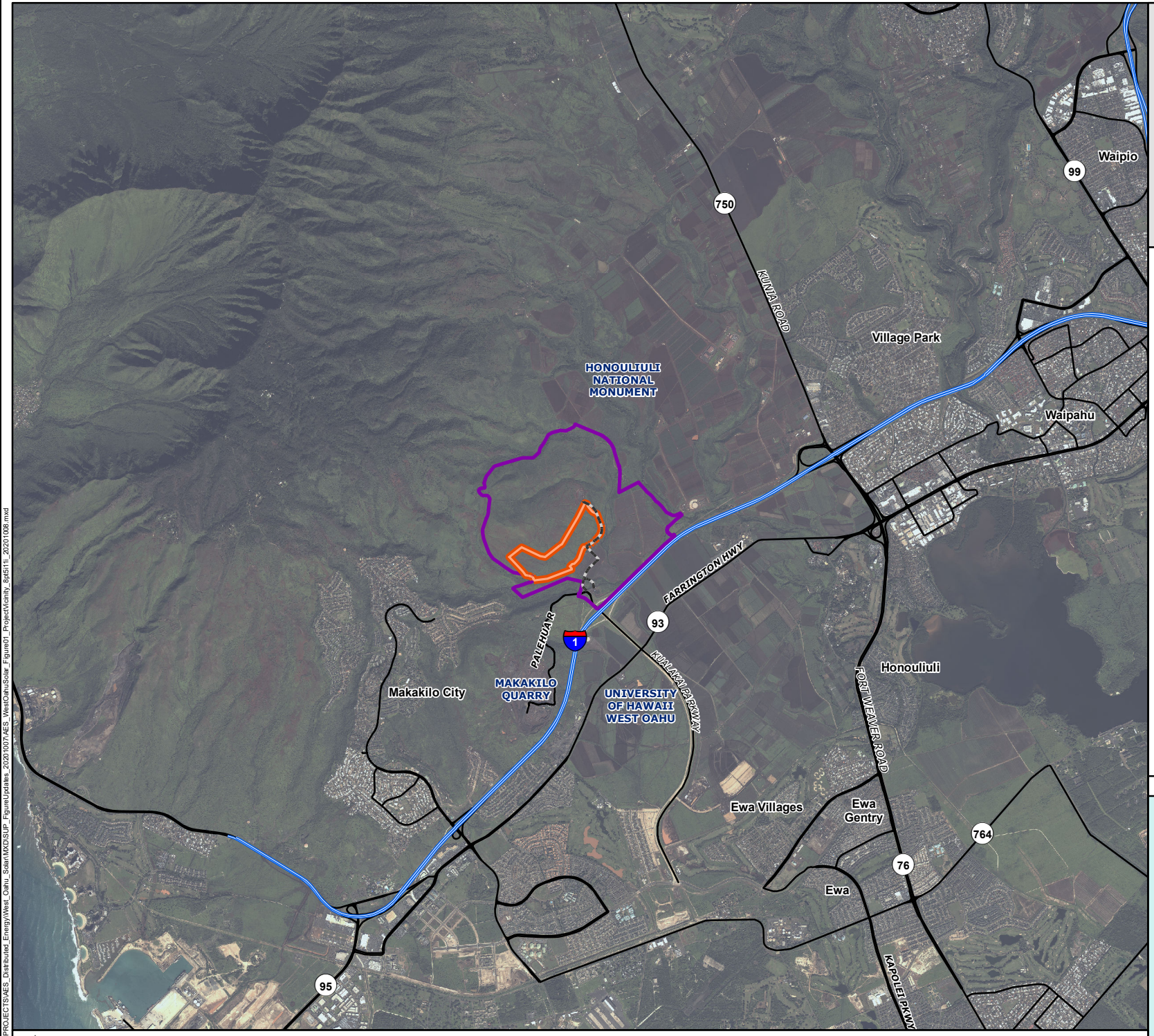

Figure 1

West Oahu Solar Plus Storage Project

AES Distributed Energy

Project Vicinity

HONOLULU COUNTY, HI

- Project Area
- Property Boundary
- Existing Access Road
- Interstate Highway
- Roadway

TETRA TECH

Reference Map

1:65,000 WGS 1984 UTM Zone 4N

0 0.5 1 2 3 Miles

NOT FOR CONSTRUCTION

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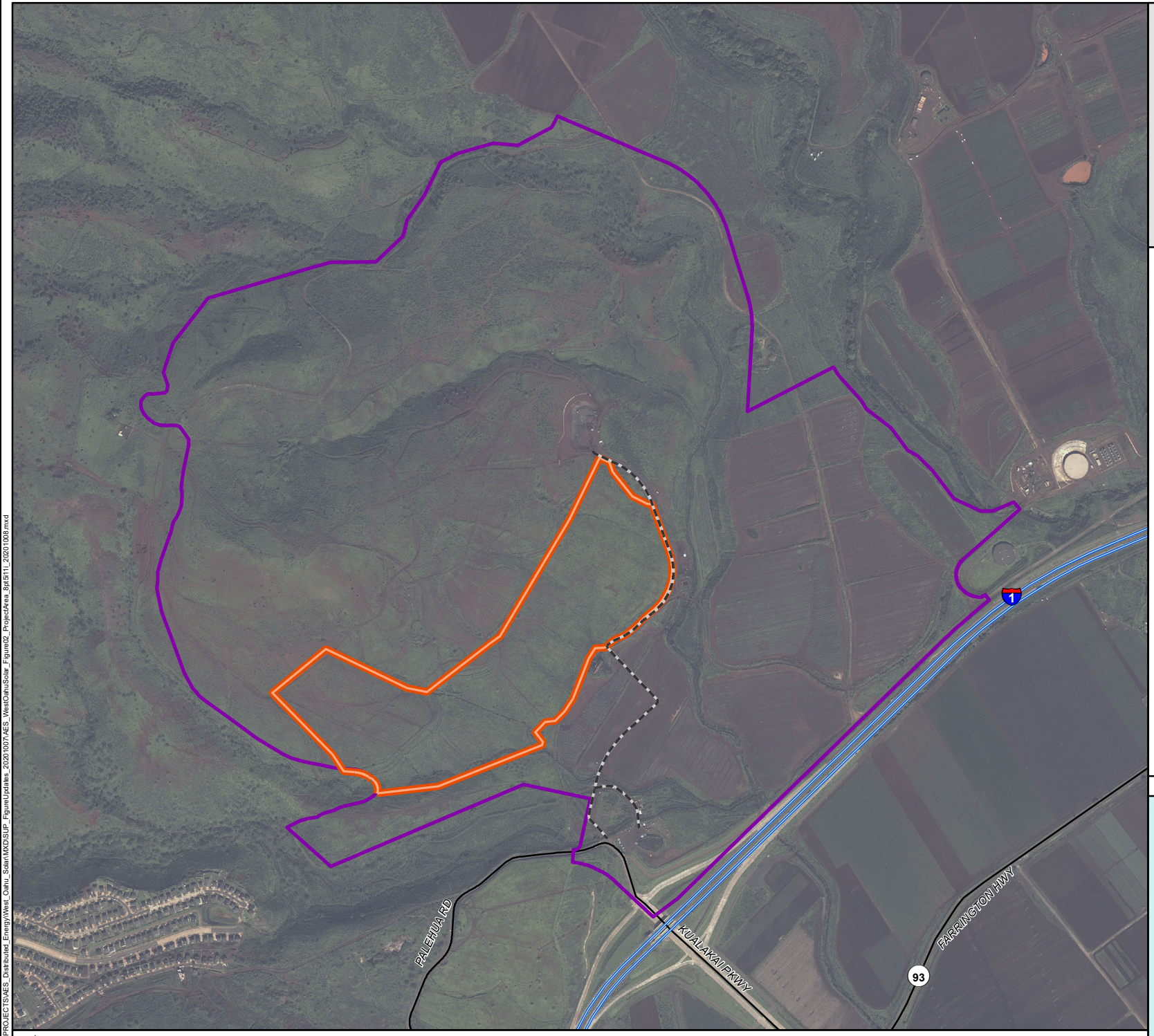

Figure 2

West Oahu Solar Plus Storage Project

AES Distributed Energy

Project Area

HONOLULU COUNTY, HI

- Project Area
- Property Boundary
- Existing Access Road
- Interstate Highway
- Roadway

TETRA TECH

Reference Map

1:15,000 WGS 1984 UTM Zone 4N

0 0.25 0.5 1 Miles

NOT FOR CONSTRUCTION

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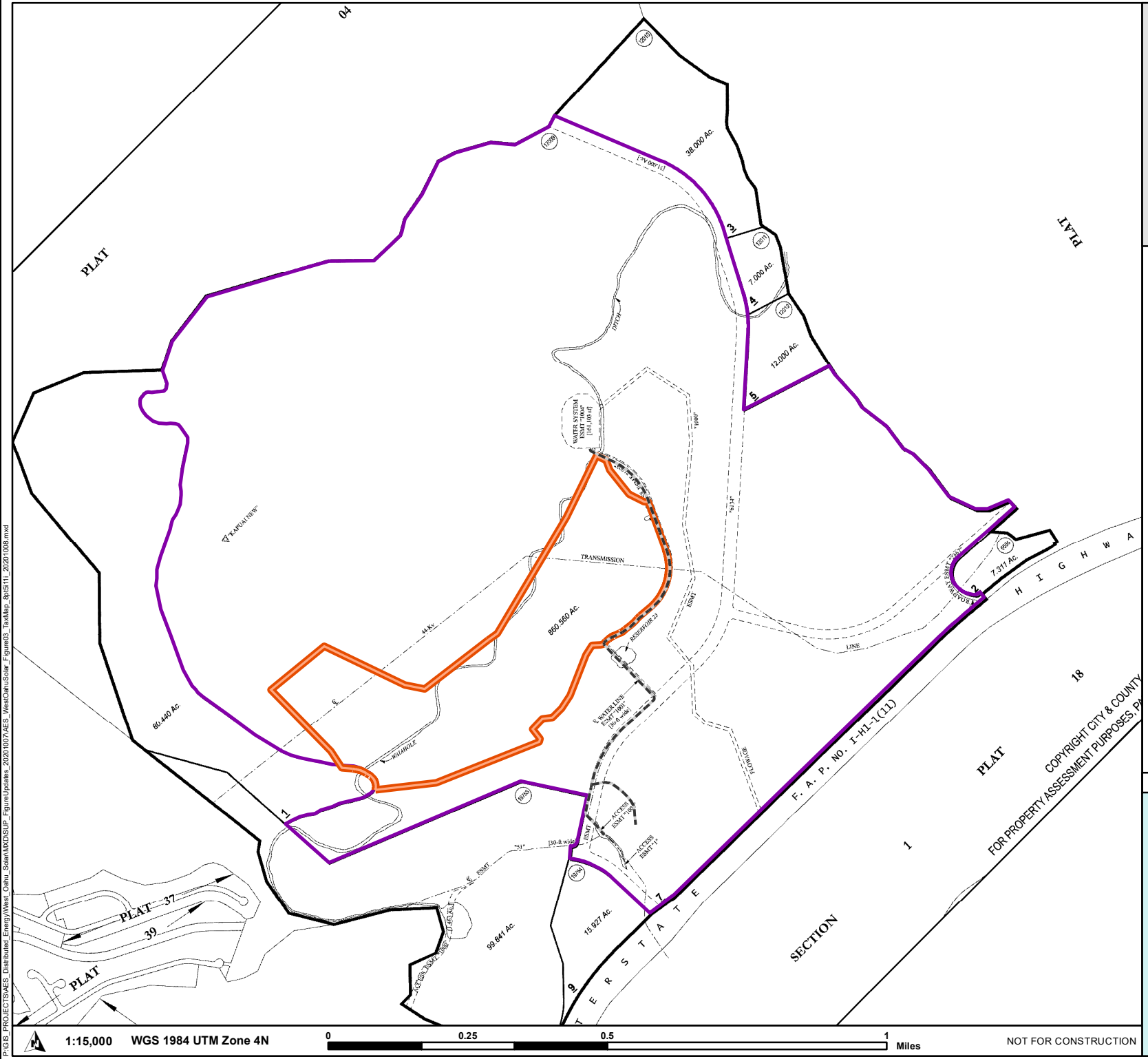


Figure 3

West Oahu Solar Plus Storage Project

AES Distributed Energy

Tax Map

HONOLULU COUNTY, HI

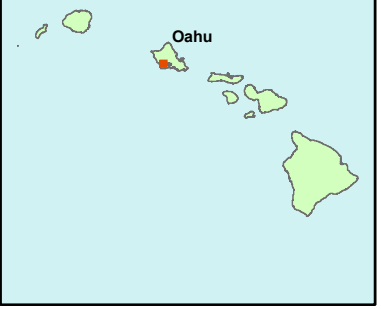
- Project Area
- Property Boundary
- Existing Access Road

Source:
City and County of Honolulu

Zone 9, Section 2, Plat 002

TETRA TECH

Reference Map



1:15,000 WGS 1984 UTM Zone 4N

0 0.25 0.5 1 Miles

NOT FOR CONSTRUCTION

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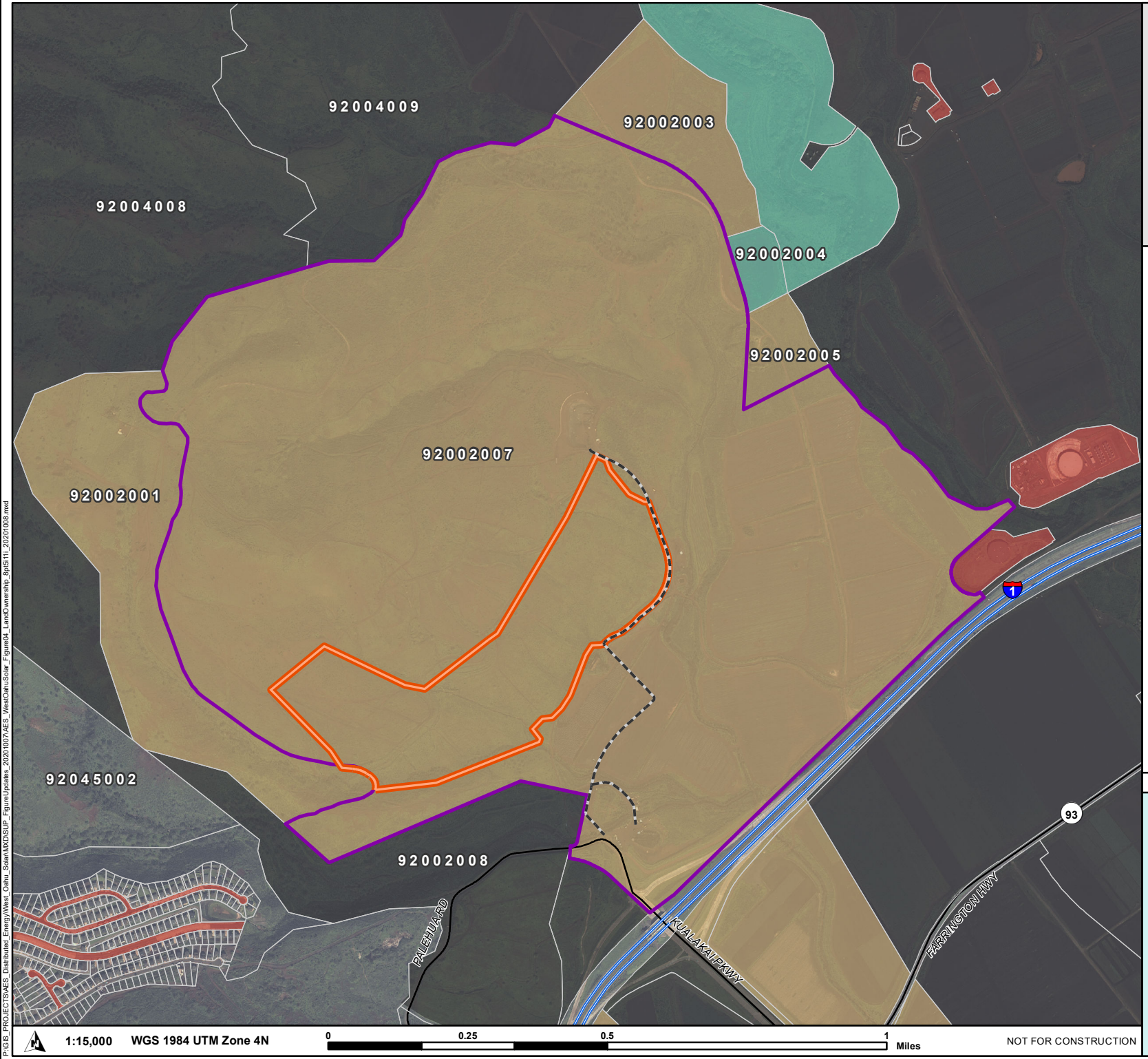


Figure 4

West Oahu Solar Plus Storage Project

AES Distributed Energy

Land Ownership

HONOLULU COUNTY, HI

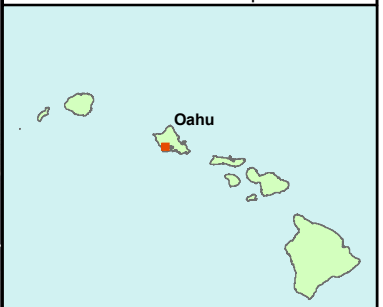
- Project Area
- Property Boundary
- Existing Access Road
- TMK Boundary
- Interstate Highway
- Roadway

Land Ownership

- County
- Federal
- State
- Private (Large Land Owner)
- Private (Other)

TETRA TECH

Reference Map



1:15,000 WGS 1984 UTM Zone 4N

0 0.25 0.5 1 Miles

NOT FOR CONSTRUCTION

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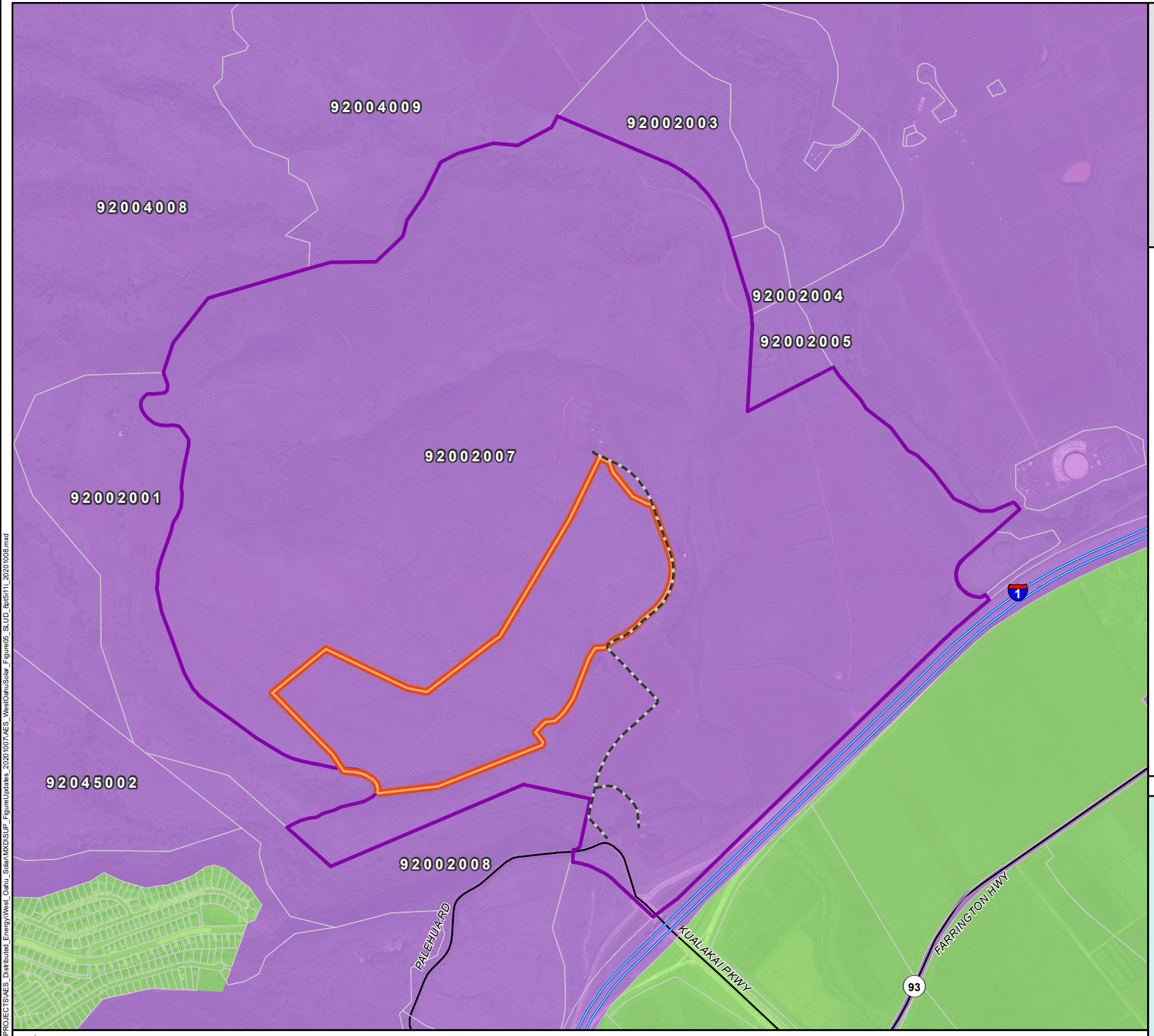

Figure 5

West Oahu Solar Plus Storage Project

AES Distributed Energy

State Land Use Districts

HONOLULU COUNTY, HI

- Project Area
- Property Boundary
- Existing Access Road
- TMK Boundary
- Interstate Highway
- Roadway

State Land Use

- Agricultural Land Use District
- Urban Land Use District

TETRA TECH

Reference Map

1:15,000 WGS 1984 UTM Zone 4N

0 0.25 0.5 1 Miles

NOT FOR CONSTRUCTION

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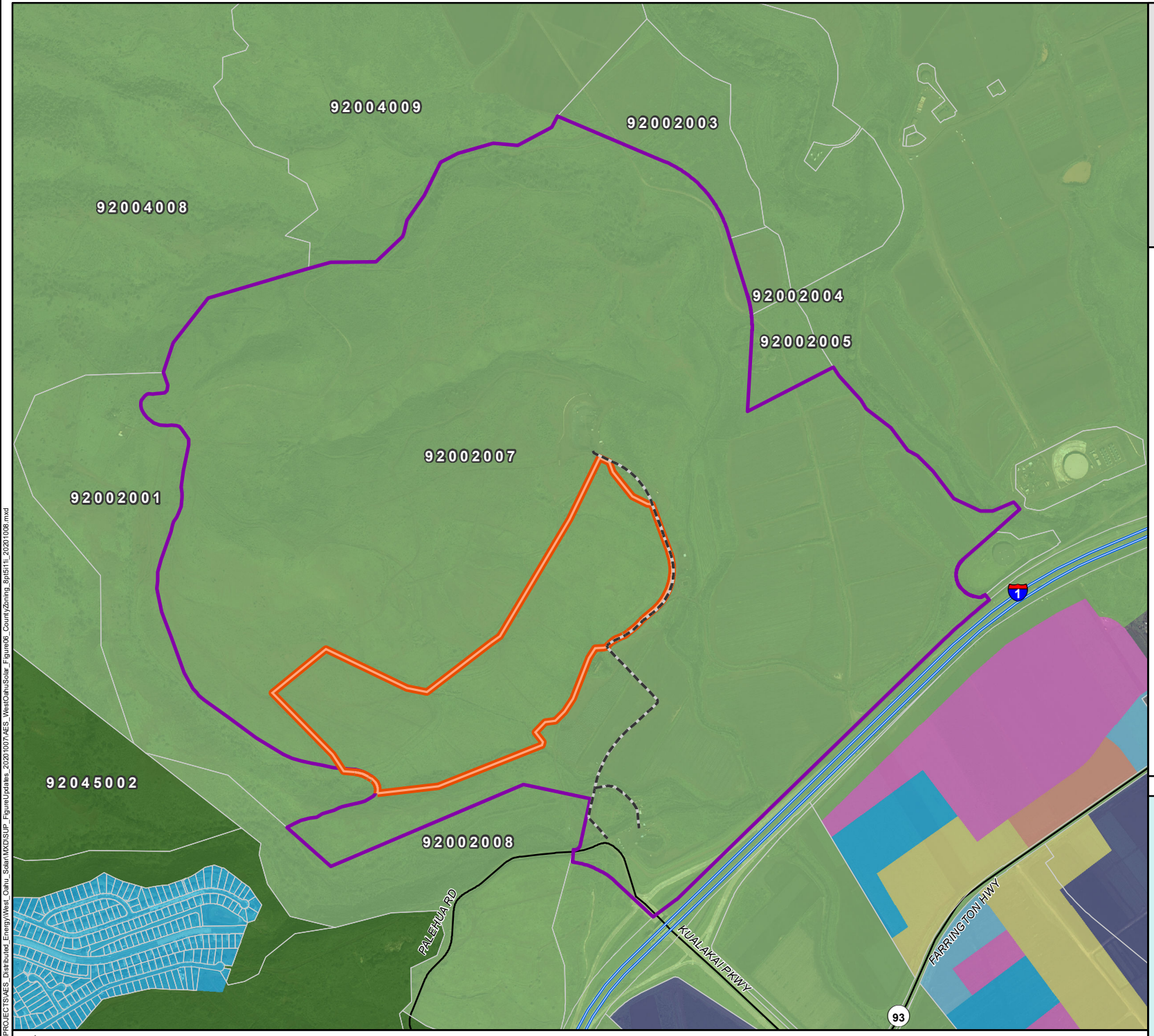

Figure 6

West Oahu Solar Plus Storage Project

AES Distributed Energy

County Zoning

HONOLULU COUNTY, HI

- Project Area
- Property Boundary
- Existing Access Road
- TMK Boundary
- Interstate Highway
- Roadway

Zoning Classes

- Low- and Medium-Density Apartment District
- Restricted Agriculture District
- General Agriculture District
- Medium-density Apartment Mixed Use District
- Neighborhood Business District
- Community Business/ Community Business Mixed Use District
- General Preservation District
- Residential District

TETRA TECH

Reference Map

1:15,000 WGS 1984 UTM Zone 4N

0 0.25 0.5 1 Miles

NOT FOR CONSTRUCTION

P:\GIS_PROJECTS\AES_Distributed_Energy\West_Oahu_Solar\MXD\SUP_FigureUpdates_20201007\AES_WestOahuSolar_Figure06_CountyZoning_8x51l1_20201008.mxd

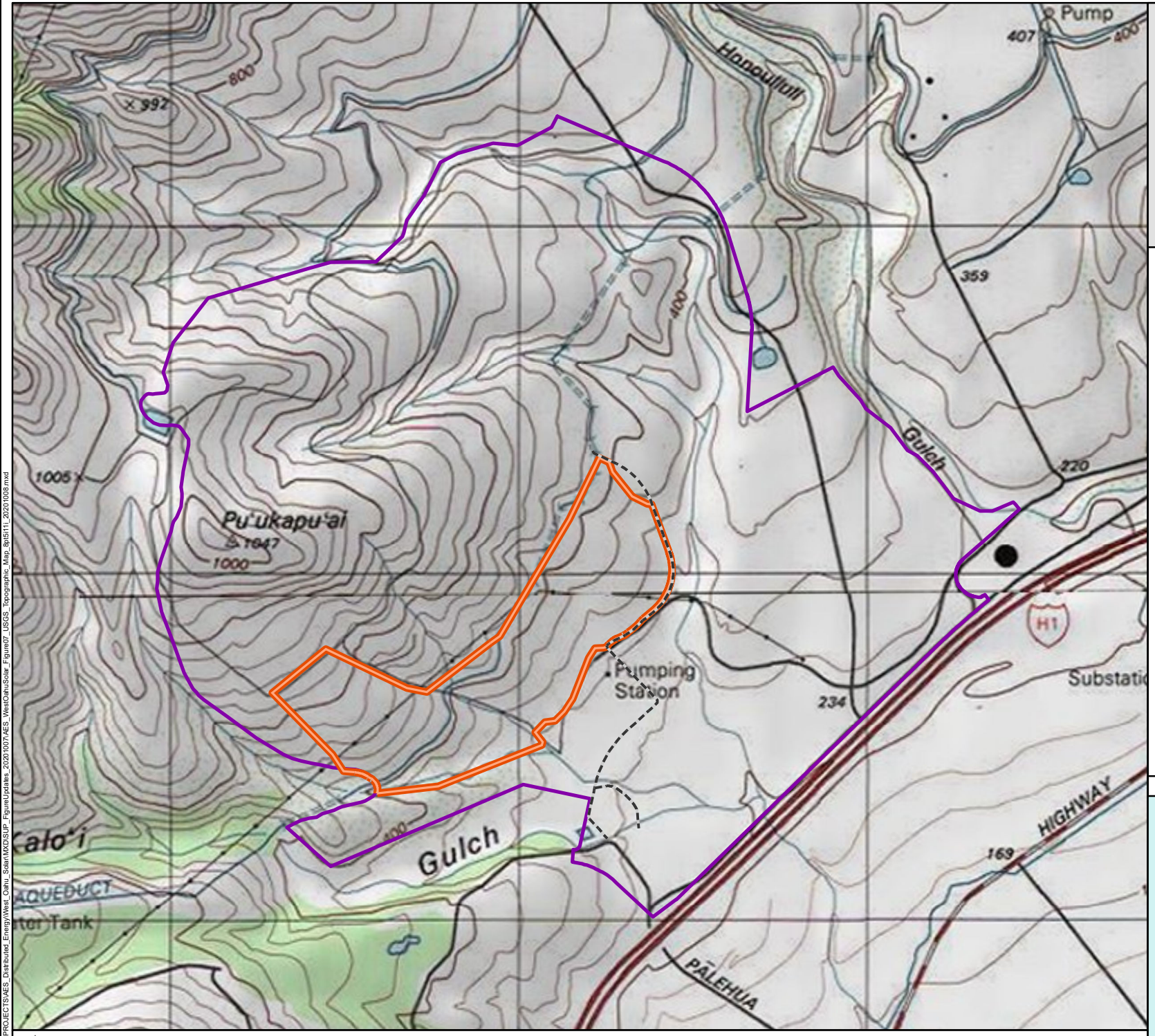

Figure 7

West Oahu Solar Plus Storage Project

AES Distributed Energy

USGS Topographic Map

HONOLULU COUNTY, HI

Project Area
Property Boundary
Existing Access Road

TETRA TECH

Reference Map

1:15,000 WGS 1984 UTM Zone 4N

0 0.25 0.5 1 Miles

NOT FOR CONSTRUCTION

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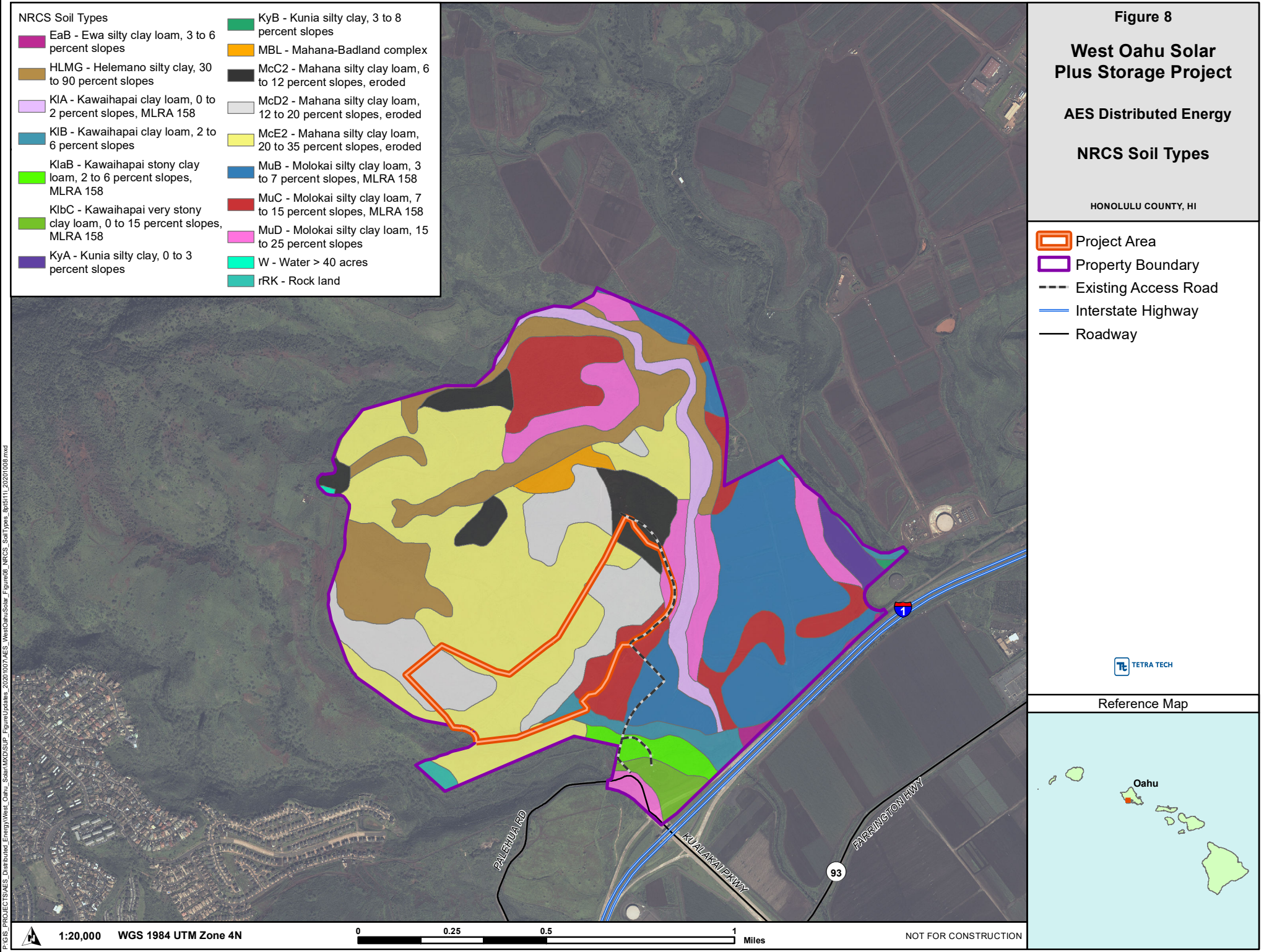


Figure 8

West Oahu Solar Plus Storage Project

AES Distributed Energy

NRCS Soil Types

HONOLULU COUNTY, HI

- Project Area
- Property Boundary
- Existing Access Road
- Interstate Highway
- Roadway

TETRA TECH

Reference Map

P:\GIS_PROJECTS\AES_Distributed_Energy\West_Oahu_Solar\MXD\SUP_FigureUpdates_20201007\AES_WestOahuSolar_Figure08_NRCS_SoilTypes_8p5l11_20201008.mxd

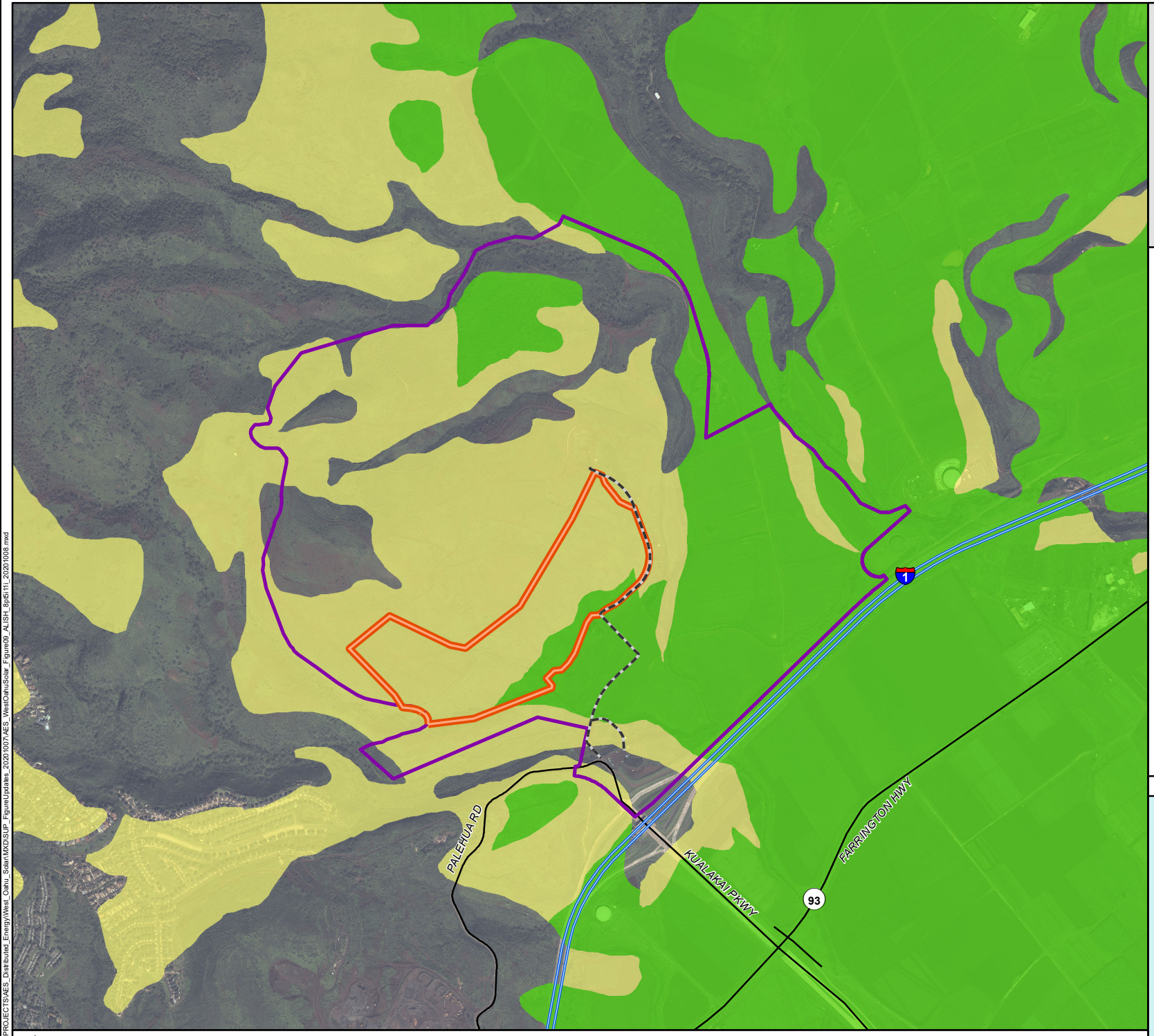


Figure 9

West Oahu Solar Plus Storage Project

AES Distributed Energy

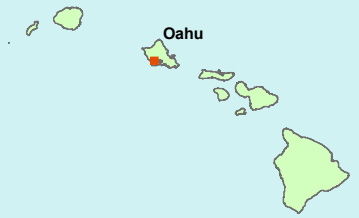
Agricultural Lands of Statewide Importance

HONOLULU COUNTY, HI

- Project Area
- Property Boundary
- Existing Access Road
- Interstate Highway
- Roadway
- Prime Lands
- Other Lands

TETRA TECH

Reference Map



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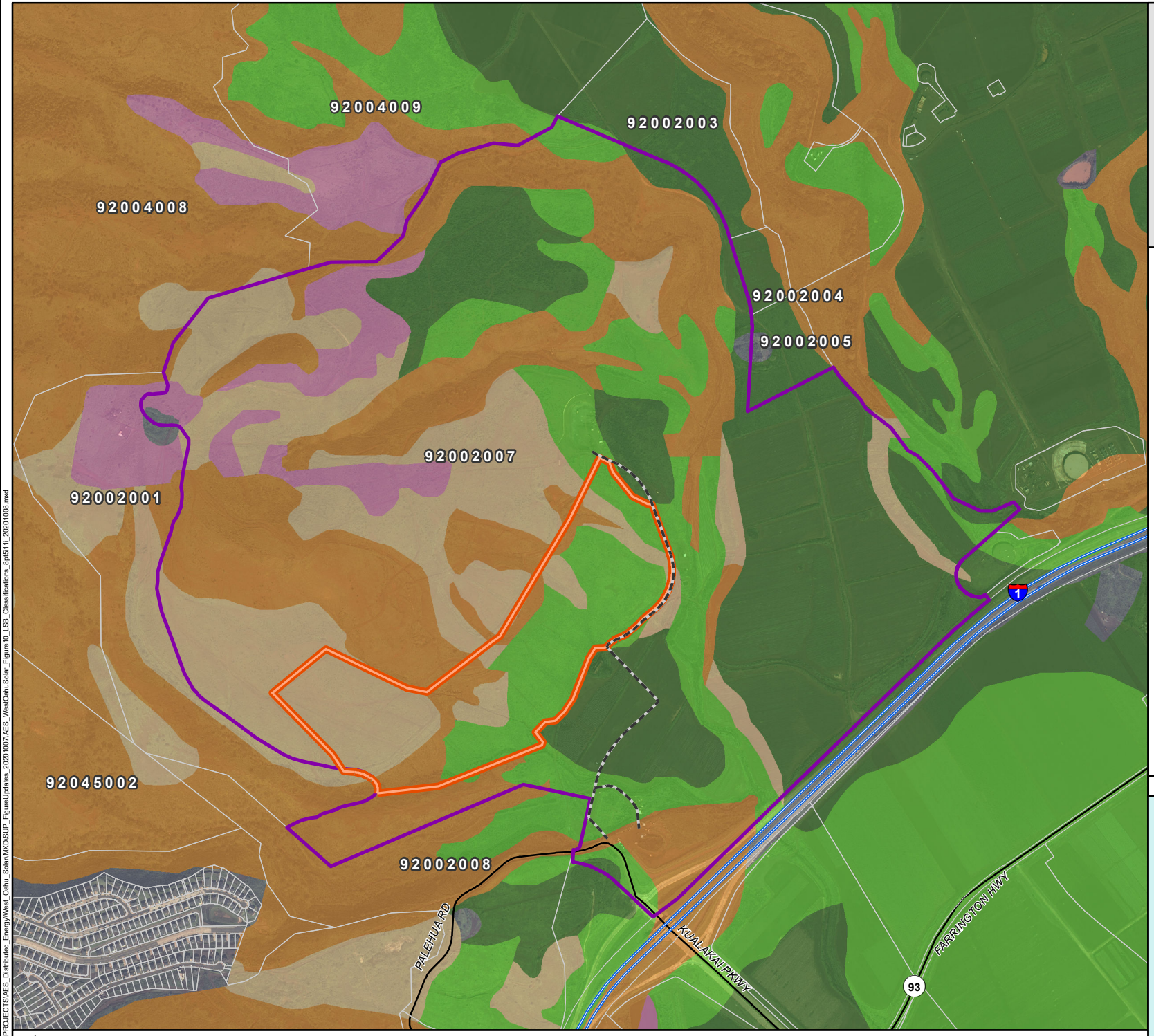

Figure 10

West Oahu Solar Plus Storage Project

AES Distributed Energy

Land Study Bureau Classification

HONOLULU COUNTY, HI

- Project Area
- Property Boundary
- Existing Access Road
- TMK Boundary
- Interstate Highway
- Roadway

Land Study Bureau Classes

- A
- B
- C
- D
- E

TETRA TECH

Reference Map

1:15,000 WGS 1984 UTM Zone 4N

0 0.25 0.5 1 Miles

NOT FOR CONSTRUCTION

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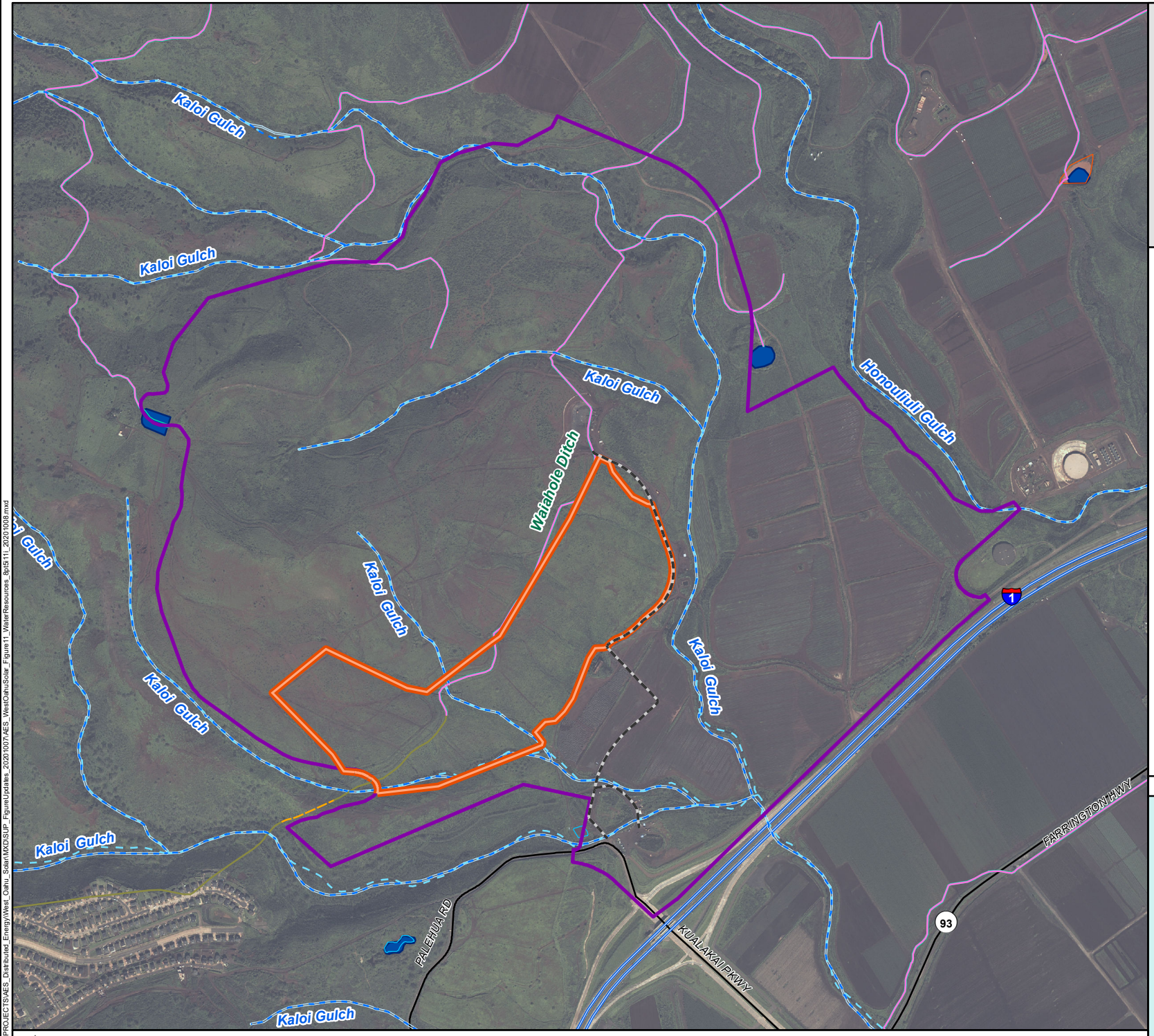


Figure 11

West Oahu Solar Plus Storage Project

AES Distributed Energy

Water Resources

HONOLULU COUNTY, HI

- Project Area
- Property Boundary
- Existing Access Road
- Interstate Highway
- Roadway
- Non-Perennial Stream (State of Hawaii Division of Aquatic Resources)

National Wetland Inventory

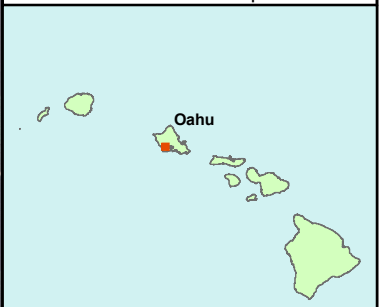
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Riverine

National Hydrography Dataset

- Waterbody
- Canal/Ditch
- Pipeline (Surface Aqueduct)
- Pipeline (Underground Aqueduct)
- Intermittent Stream

TETRA TECH

Reference Map



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0 0.25 0.5 1 Miles

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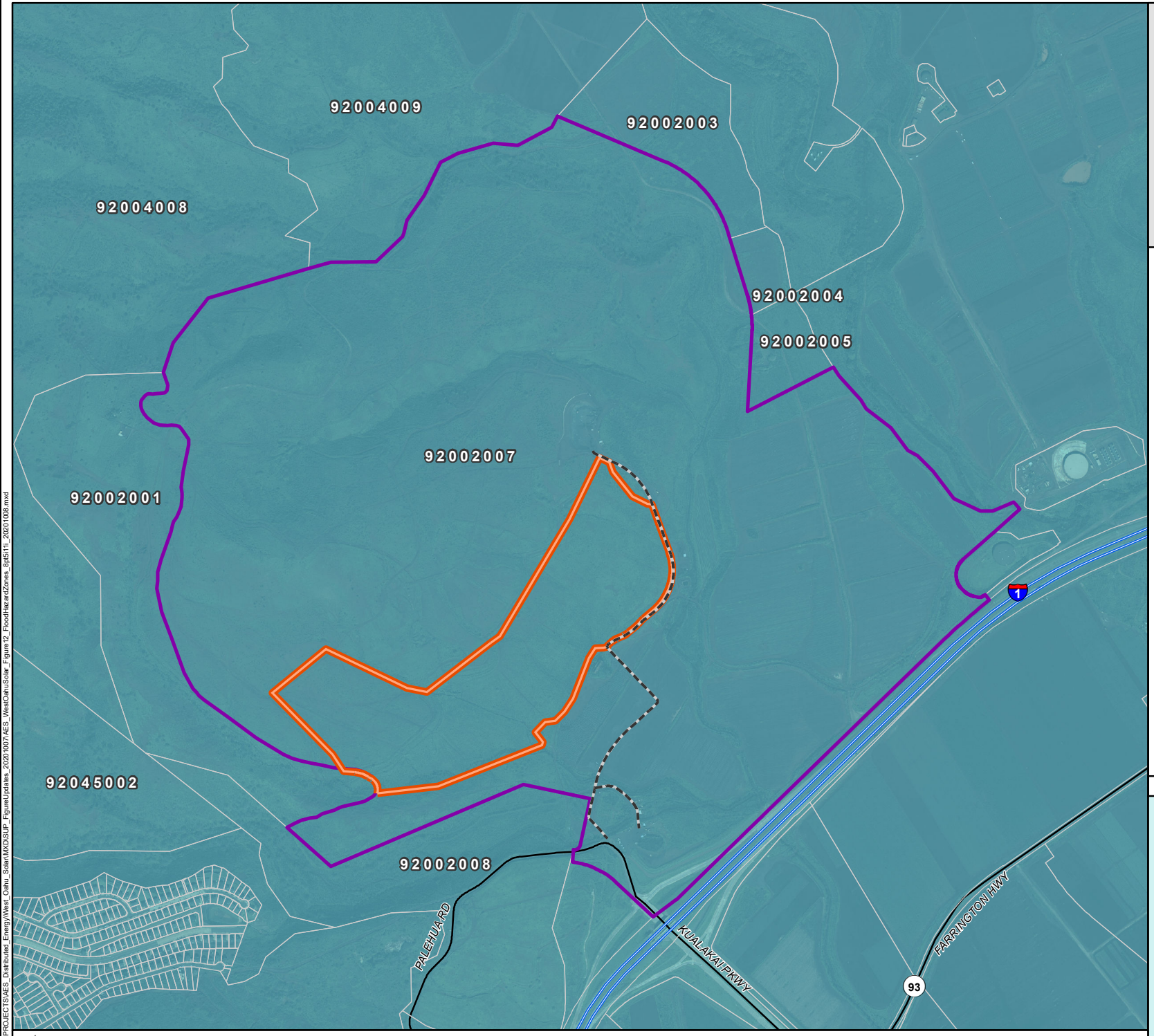


Figure 12

West Oahu Solar Plus Storage Project

AES Distributed Energy

Flood Hazard Zones

HONOLULU COUNTY, HI

- Project Area
- Property Boundary
- Existing Access
- TMK Boundary
- Interstate Highway
- Roadway
- Flood Hazard Zone D (FEMA)

TETRA TECH

Reference Map

1:15,000 WGS 1984 UTM Zone 4N

0 0.25 0.5 1 Miles

NOT FOR CONSTRUCTION

P:\GIS_PROJECTS\AES_Distributed_Energy\West_Oahu_Solar\MXD\SUP_FigureUpdates_20201007\AES_WestOahuSolar_Figure12_FloodHazardZones_8pt5i11i_20201008.mxd

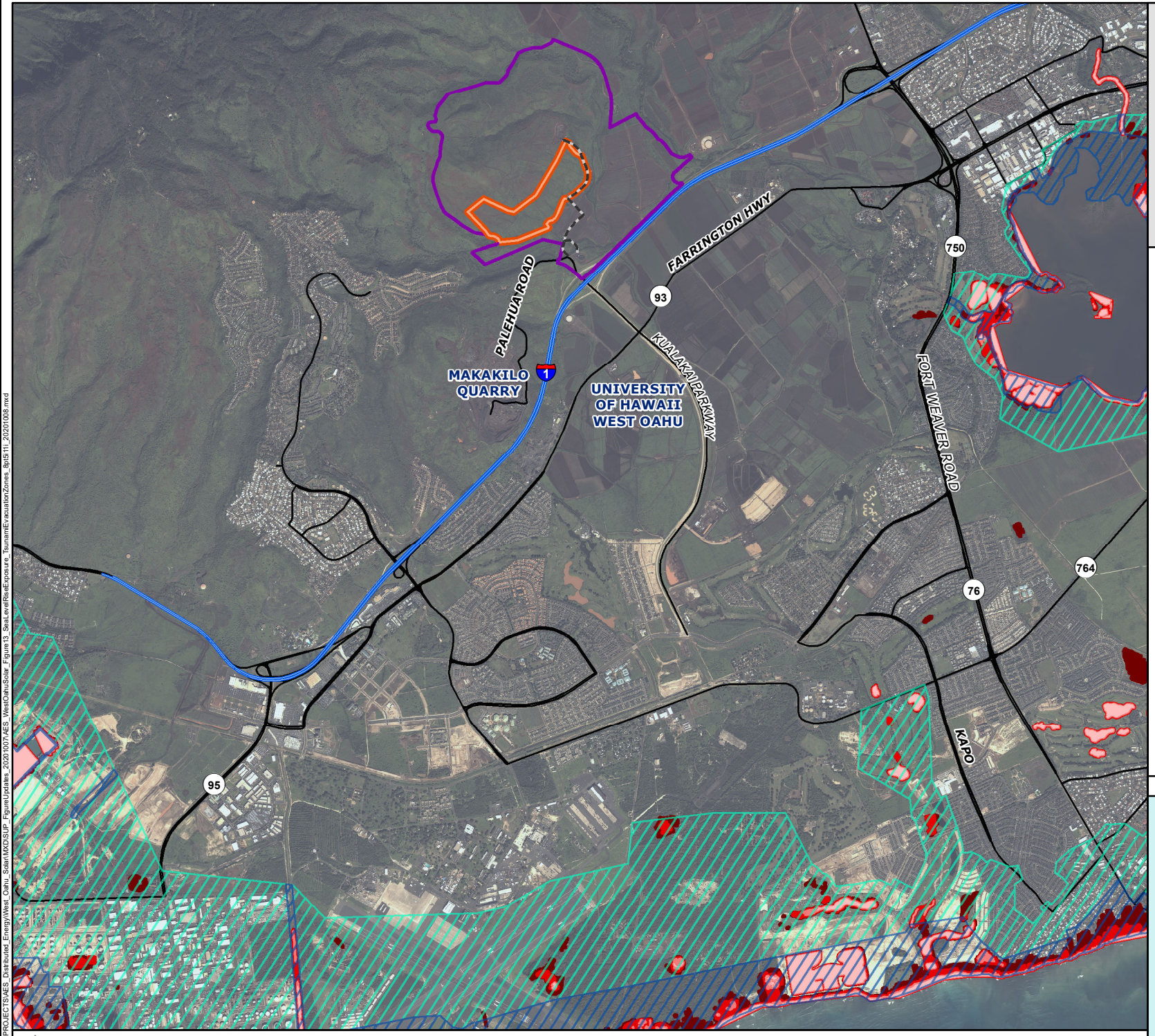


Figure 13

West Oahu Solar Plus Storage Project

AES Distributed Energy

Sea Level Rise Exposure and Tsunami Evacuation Zones

HONOLULU COUNTY, HI

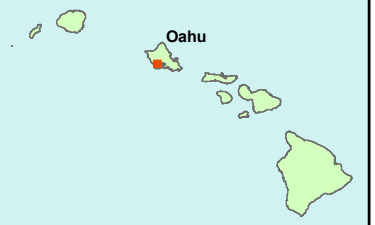
- Project Area
- Property Boundary
- Existing Access Road
- Interstate Highway
- Roadway
- Extreme Tsunami Evacuation Zone
- Tsunami Evacuation Zone

Sea Level Rise Exposure Areas

- 0.5 feet
- 1.1 feet
- 2.0 feet
- 3.2 feet

TETRA TECH

Reference Map



1:50,000 WGS 1984 UTM Zone 4N

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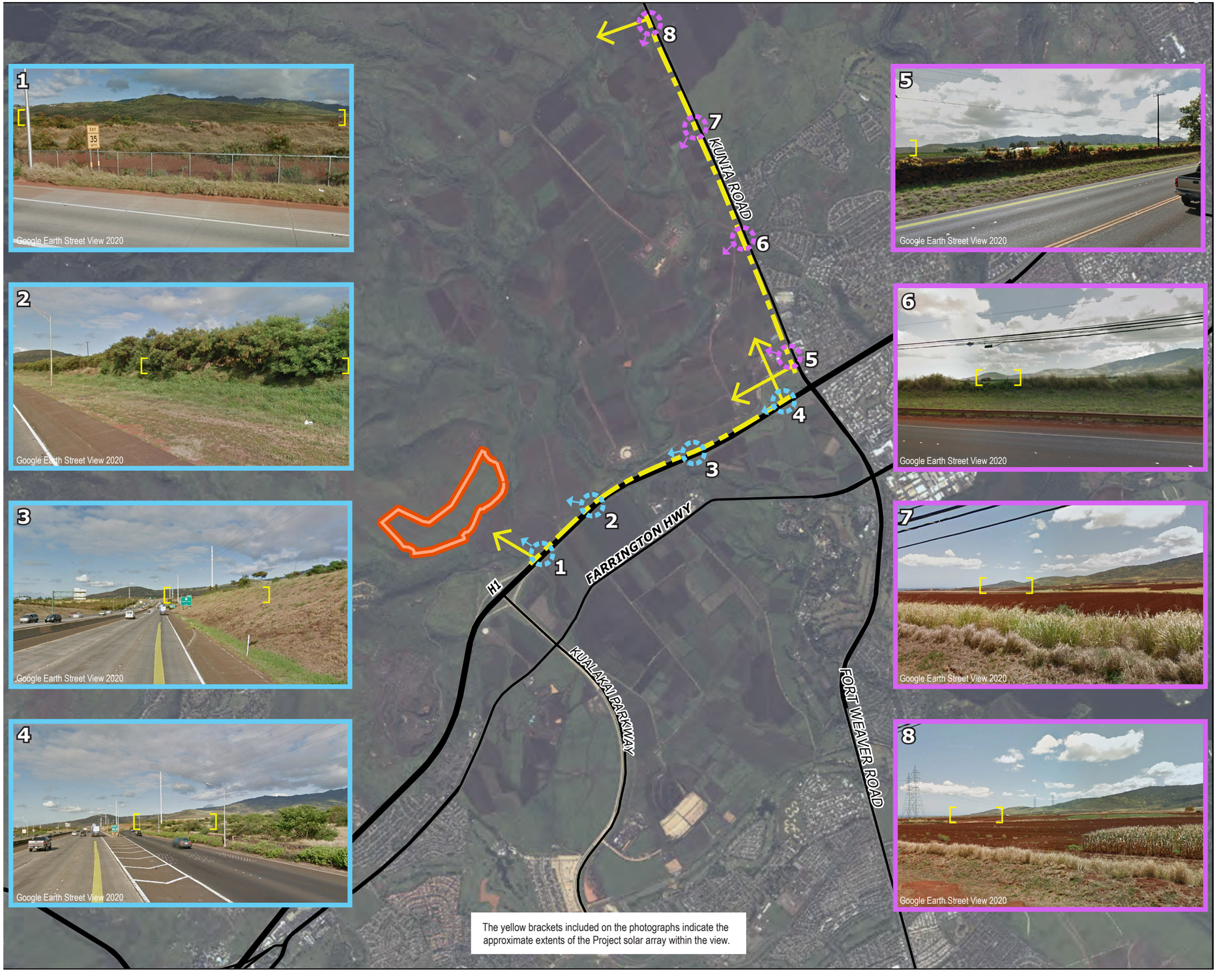
Figure 14

West Oahu Solar Plus Storage Project

AES Distributed Energy

Representative Views from Identified Viewplanes

HONOLULU COUNTY, HI



Project Area

Identified Viewplane in Ewa Development Plan

TETRA TECH

Reference Map

1:200,000 WGS 1984 UTM Zone 4N

0 0.5 1 2 3 4 Miles

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FIGURE 15

West O'ahu Solar Plus Storage Project

PANORAMIC PHOTO SIMULATION

Representative Viewpoint 01

Farrington Highway

Existing Conditions

Simulated Conditions

VICINITY MAP

Photograph Information

Time of photograph: 8:40 a.m.
Date of photograph: 11/15/2019
Weather condition: Partly Cloudy
Viewing direction: Northwest
Latitude: 21.368050° N
Longitude: -158.050300° W
Photo Location: The photo was taken from along Farrington Highway approximately 4500 feet southeast of the Project.

AES

FIGURE 15

West O'ahu Solar Plus Storage Project

PANORAMIC PHOTO SIMULATION

Representative Viewpoint 02

Kualakai Parkway

Mile Marker 1.5

Existing Conditions

Simulated Conditions

VICINITY MAP

Photograph Information

Time of photograph: 9:45 a.m.
Date of photograph: 11/15/2019
Weather condition: Partly Cloudy
Viewing direction: Northwest
Latitude: 21.355490° N
Longitude: -158.050200° W
Photo Location: The photo was taken from along Kualakai Parkway approximately 7250 feet southeast of the Project.

AES

FIGURE 15

West O'ahu Solar Plus Storage Project

PANORAMIC PHOTO SIMULATION

Representative Viewpoint 03

Kualakai Parkway

Mile Marker 0.5

Existing Conditions

Simulated Conditions

VICINITY MAP

Photograph Information

Time of photograph: 5:15 p.m.
Date of photograph: 11/15/2019
Weather condition: Mostly Cloudy
Viewing direction: North northeast
Latitude: 21.343980° N
Longitude: -158.052700° W
Photo Location: The photo was taken from along Kualakai Parkway approximately 2 miles southeast of the Project.

AES

FIGURE 15

West O'ahu Solar Plus Storage Project

PANORAMIC PHOTO SIMULATION

Representative Viewpoint 04

Geiger Community Park

Existing Conditions

Simulated Conditions

VICINITY MAP

Photograph Information

Time of photograph: 11:00 a.m.
Date of photograph: 11/15/2019
Weather condition: Partly Cloudy
Viewing direction: Northwest
Latitude: 21.332410° N
Longitude: -158.026900° W
Photo Location: The photo was taken from Geiger Community Park approximately 3.5 miles southeast of the Project.

AES

FIGURE 15

West O'ahu Solar Plus Storage Project

PANORAMIC PHOTO SIMULATION

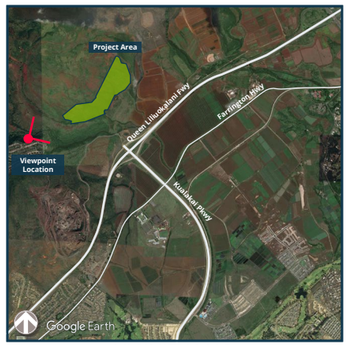
Representative Viewpoint 05

Makakilo Neighborhood

Near Luawainui Street and Punawainui Street

Existing Conditions

Simulated Conditions



VICINITY MAP

Photograph Information

Time of photograph: 3:05 p.m.
Date of photograph: 11/15/2019
Weather condition: Partly Cloudy
Viewing direction: Northeast
Latitude: 21.367980° N
Longitude: -158.074300° W
Photo Location: The photo was taken from the Makakilo neighborhood approximately 2200 feet southwest of the Project.

AES

FIGURE 15

West O'ahu Solar Plus Storage Project

PANORAMIC PHOTO SIMULATION

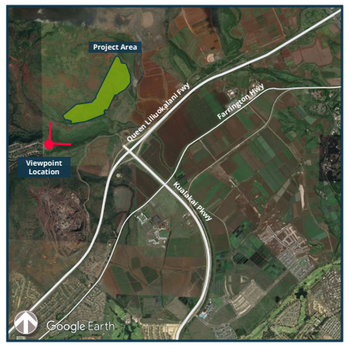
Existing Conditions

Simulated Conditions

Representative Viewpoint 06

Makakilo Neighborhood

Near End of Punawainui Street



VICINITY MAP

Photograph Information

Time of photograph: 3:15 p.m.
Date of photograph: 11/15/2019
Weather condition: Partly Cloudy
Viewing direction: Northeast
Latitude: 21.366740° N
Longitude: -158.071300° W
Photo Location: The photo was taken from the Makakilo neighborhood approximately 1600 feet southwest of the Project.

AES

FIGURE 15

West O'ahu Solar Plus Storage Project

PANORAMIC PHOTO SIMULATION

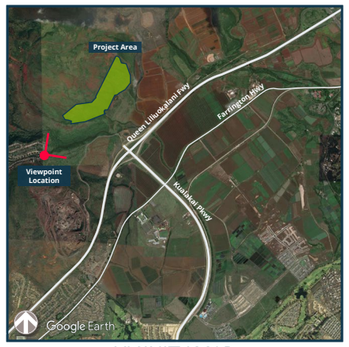
Representative Viewpoint 07

Makakilo Neighborhood

Near End of Pueonani Street

Existing Conditions

Simulated Conditions



VICINITY MAP

Photograph Information

Time of photograph: 3:10 p.m.
Date of photograph: 11/15/2019
Weather condition: Partly Cloudy
Viewing direction: Northeast
Latitude: 21.365770° N
Longitude: -158.072000° W
Photo Location: The photo was taken from the Makakilo neighborhood approximately 2000 feet southwest of the Project.

AES

Existing Conditions

Simulated Conditions

FIGURE 15

West O'ahu Solar Plus Storage Project

PHOTO SIMULATION

Representative Viewpoint 08

Makakilo Neighborhood

Mauka End of Makakilo Drive

VICINITY MAP

Photograph Information

Time of photograph: 10:20 a.m.
Date of photograph: 05/22/2020
Weather condition: Partly Cloudy
Viewing direction: Northwest
Latitude: 21.366237° N
Longitude: -158.071975° W
Photo Location: The photo was taken 1800 feet southwest of the Project.
Photograph provided by City & County of Honolulu Department of Planning and Permitting.

AES

Existing Conditions

Simulated Conditions

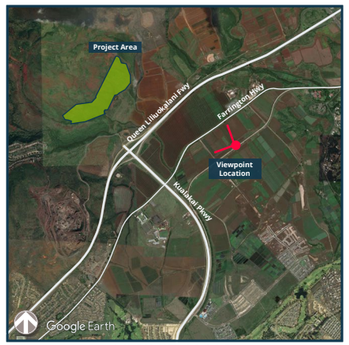
FIGURE 15

West O'ahu Solar Plus Storage Project

PHOTO SIMULATION

Representative Viewpoint 09

Honouliuli Transit Station



VICINITY MAP

Photograph Information

Time of photograph: 9:10 a.m.
Date of photograph: 05/21/2020
Weather condition: Partly Cloudy
Viewing direction: Northwest
Latitude: 21.367001° N
Longitude: -158.045514° W
Photo Location: The photo was taken from the Honouliuli Transit Station approximately 1 mile southeast of the Project. Photograph provided by City & County of Honolulu Department of Planning and Permitting.

AES

FIGURE 15

West O'ahu Solar Plus Storage Project

PHOTO SIMULATION

Representative Viewpoint 10

Pedestrian Bridge at Keone'ae Transit Station

Existing Conditions

Simulated Conditions

VICINITY MAP

Photograph Information

Time of photograph: 8:10 a.m.
Date of photograph: 05/22/2020
Weather condition: Clear
Viewing direction: Northwest
Latitude: 21.358494° N
Longitude: -158.051338° W
Photo Location: The photo was taken from the pedestrian bridge over Kualakai Parkway approximately 1 mile southeast of the Project.
Photograph provided by City & County of Honolulu Department of Planning and Permitting.

AES

Existing Conditions

Simulated Conditions

FIGURE 15

West O'ahu Solar Plus Storage Project

PHOTO SIMULATION

Representative Viewpoint 11

Kualakai Parkway & Farrington Highway

VICINITY MAP

Photograph Information

Time of photograph: 7:22 a.m.
Date of photograph: 05/22/2020
Weather condition: Clear
Viewing direction: Northwest
Latitude: 21.361916° N
Longitude: -158.055321° W
Photo Location: The photo was taken from along Kualakai Parkway approximately 4600 feet southeast of the Project. Photograph provided by City & County of Honolulu Department of Planning and Permitting.

AES

FIGURE 15

West O'ahu Solar Plus Storage Project

PHOTO SIMULATION

Representative Viewpoint 12

Kualakai Parkway
Mile Marker 2.3

Existing Conditions

Simulated Conditions

VICINITY MAP

Photograph Information

Time of photograph: 7:40 a.m.
Date of photograph: 05/22/2020
Weather condition: Clear
Viewing direction: Northwest
Latitude: 21.364071° N
Longitude: -158.057414° W
Photo Location: The photo was taken from along Kualakai Parkway approximately 3500 feet southeast of the Project. Photograph provided by City & County of Honolulu Department of Planning and Permitting.

AES

FIGURE 15

West O'ahu Solar Plus Storage Project

PHOTO SIMULATION

Representative Viewpoint 13

H-1 Freeway at Kualakai Parkway

Existing Conditions

Simulated Conditions

VICINITY MAP

Photograph Information

Time of photograph: 7:50 a.m.
Date of photograph: 05/22/2020
Weather condition: Partly Cloudy
Viewing direction: North-northwest
Latitude: 21.366336° N
Longitude: -158.060247° W
Photo Location: The photo was taken from the H-1 Freeway bridge over Kualakai Parkway approximately 2000 feet southeast of the Project. Photograph provided by City & County of Honolulu Department of Planning and Permitting.

AES

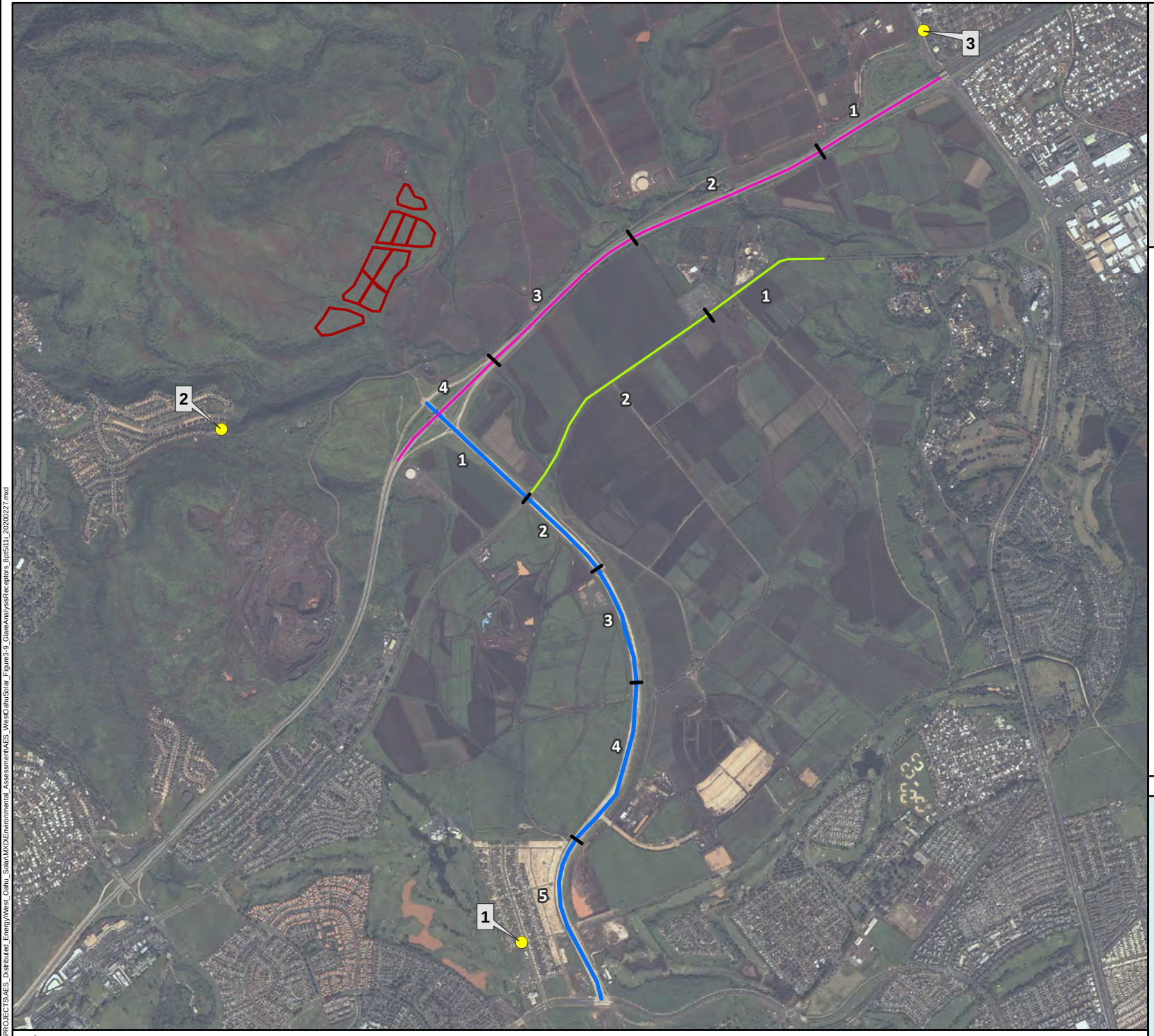


Figure 16

West Oahu Solar Plus Storage Project

AES Distributed Energy

Glare Analysis Receptors

HONOLULU COUNTY, HI

Project Layout (Solar Arrays)

Observation Point

Road Segments

Farrington Highway

H-1 Freeway

Kualakai Parkway

TETRA TECH

Reference Map

1:30,000 WGS 1984 UTM Zone 4N

0 0.25 0.5 1 Miles

NOT FOR CONSTRUCTION

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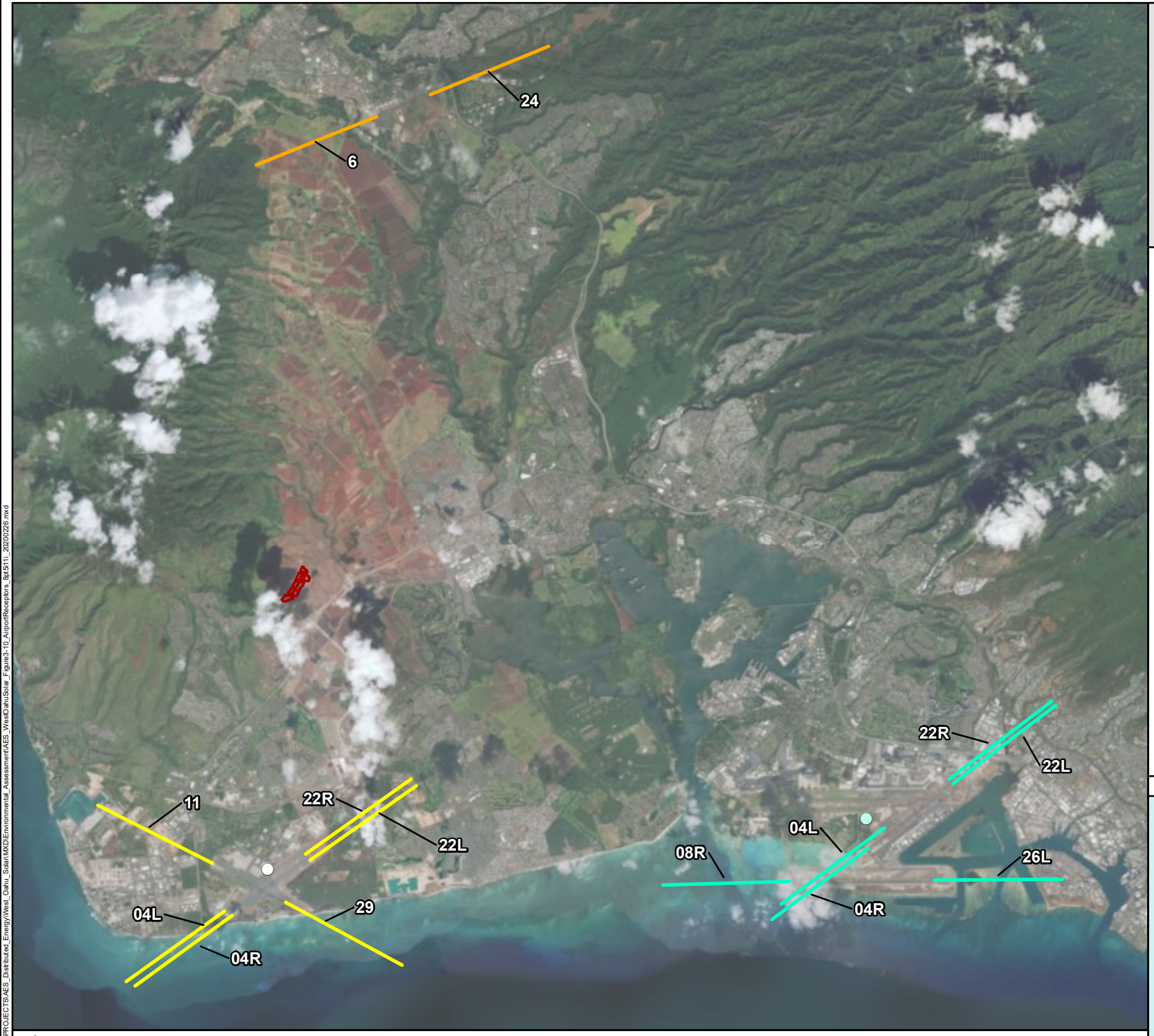

Figure 17

West Oahu Solar Plus Storage Project

AES Distributed Energy

Airport Receptors

HONOLULU COUNTY, HI

Project Layout (Solar Arrays)

Honolulu International Airport (HNL)

Final Approach

Air Traffic Control Tower

Kalaeloa Airport (JRF)

Final Approach

Air Traffic Control Tower

Wheeler Army Airfield

Final Approach

TETRA TECH

Reference Map

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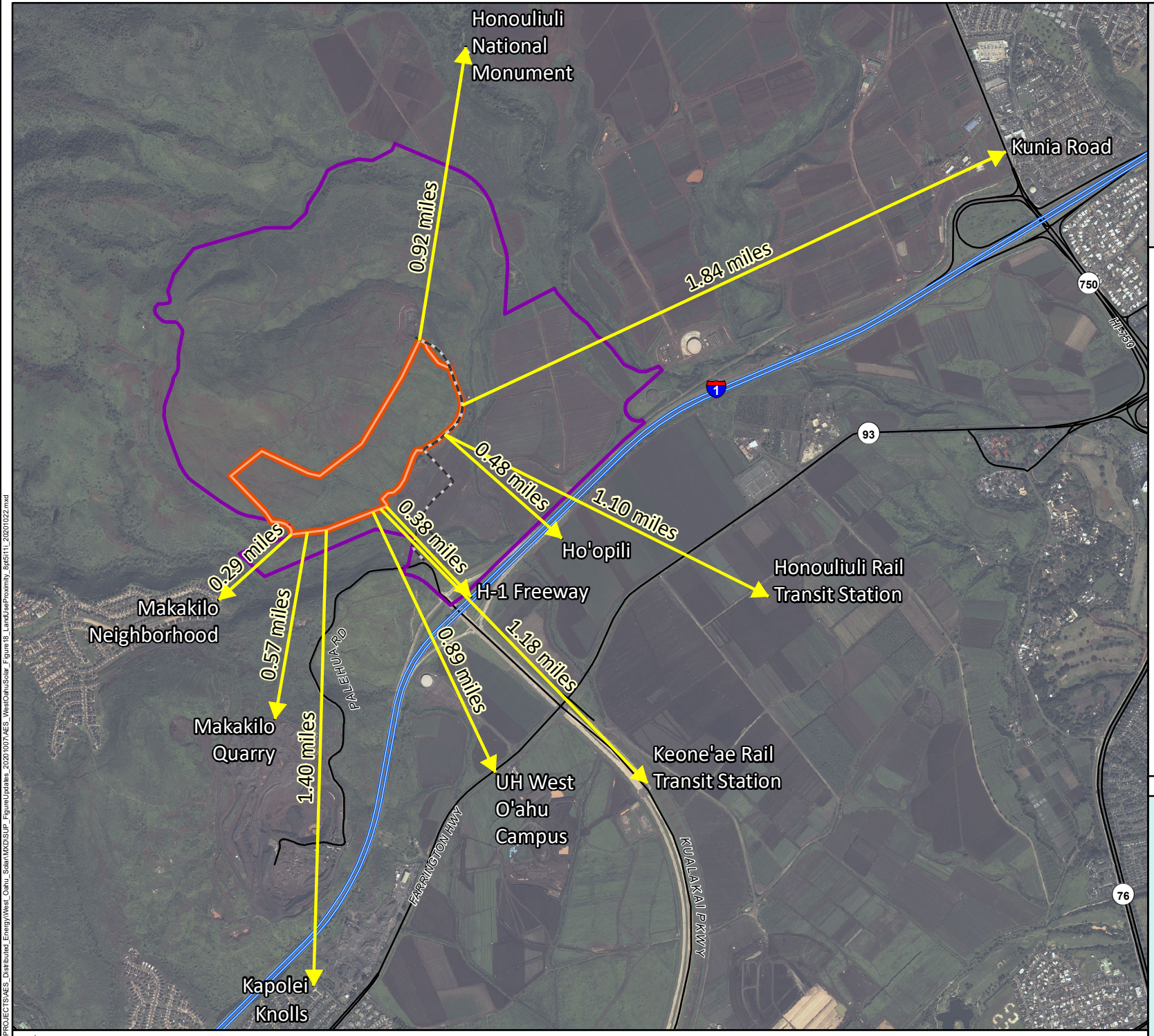

Figure 18

West Oahu Solar Plus Storage Project

AES Distributed Energy

Proximity to Surrounding Land Uses

HONOLULU COUNTY, HI

- Project Area
- Property Boundary
- Existing Access Road
- Interstate Highway
- Roadway
- Approximate Distance to Surrounding Land Uses from Project Area

TETRA TECH

Reference Map

1:26,000 WGS 1984 UTM Zone 4N

0 0.25 0.5 1 Miles

NOT FOR CONSTRUCTION

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TETRA TECH

October 14, 2020

Kathy Sokugawa, Director
c/o Mr. Raymond Young
City & County of Honolulu
Department of Planning and Permitting
650 South King Street, 7th Floor
Honolulu, HI 96813

Subject: General Biological Resource and Pueo Surveys for the West O'ahu Solar Plus Storage Project, Special Use Permit No. 2020/SUP-6

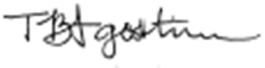
Dear Ms. Sokugawa:

At the request of AES West Oahu Solar, LLC (AES), Tetra Tech, Inc. conducted a biological survey for the West O'ahu Solar Plus Storage Project (Project). The purpose of the survey was to characterize the existing habitat and assess the potential for state or federally listed threatened, endangered, or otherwise rare plants or animals to occur within the Project area. As discussed in the Special Use Permit (SUP) application, the biological survey was conducted on January 31, 2019 and February 5, 2019; a follow-up survey was conducted on November 14, 2019 to confirm the findings relative to an adjustment in the Project area boundary. As part of the general biological survey, a focused survey specifically intended to detect pueo or Hawaiian short-eared owl (*Asio flammeus sandwichensis*) was conducted within the Project area. To increase detectability, three additional pueo surveys were conducted in September, November, and December 2019. The results of these surveys are summarized in the SUP application, with additional detail in the Biological Resource Survey and Supplemental Pueo Survey Reports (Attachment E).

It is understood that AES recently adjusted the Project boundary resulting in an approximately 0.5-acre reduction of the Project area. This reduction of the Project area does not affect the findings and conclusions of the biological resource and pueo surveys, and the discussion of biological resources presented in the SUP application remains valid for the revised 96.353-acre Project area.

If you have any questions regarding the information provided herein, please contact me at Tiffany.Agostini@tetratech.com.

Sincerely,



Tetra Tech, Inc.
Tiffany Agostini
Senior Biologist

CULTURAL SURVEYS HAWAI'I
ARCHAEOLOGICAL, CULTURAL, AND HISTORICAL DOCUMENTATION SERVICES — SINCE 1982

13 October 2020

Kathy Sokugawa, Director
c/o Mr. Raymond Young
City & County of Honolulu
Department of Planning and Permitting
650 South King Street, 7th Floor
Honolulu, HI 96813

Subject: Archaeological Inventory Survey (AIS) for the West O'ahu Solar Plus Storage Project, Special Use Permit No. 2020/SUP-6

Dear Ms. Sokugawa:

At the request of AES West Oahu Solar, LLC (AES), Cultural Surveys Hawai'i conducted an archaeological inventory survey (AIS) for the West O'ahu Solar Plus Storage Project (Project). The purpose of the survey was to identify, document and assess the significance of historic properties within the Project area. As discussed in the Special Use Permit (SUP) application, the AIS included background research (with sources including archival documents, historic maps, Land Commission Awards [LCAs], and previous archaeological reports) to construct a history of land use and to determine if historic properties have been previously recorded in or near the Project area, as well as to formulate a predictive model of the types and locations of historic properties that would be expected to occur. The field component included a 100 percent pedestrian inspection of the Project area to identify any potential historic properties within the Project area. The results of the AIS are summarized in the SUP application, with additional detail in the AIS Report (Attachment F).

It is understood that AES recently adjusted the Project boundary resulting in an approximately 0.5-acre reduction of the Project area. This reduction of the Project area does not affect the findings and conclusions of the AIS, and the discussion of historic properties presented in the SUP application remains valid for the revised 96.353-acre Project area.

If you have any questions regarding the information provided herein, please contact me at 808-262-9972.

Sincerely,

David W. Shideler
Cultural Surveys Hawai'i, Inc.
dshideler@culturalsurveys.com
Cell-(808) 753-0785

CULTURAL SURVEYS HAWAI'I
ARCHAEOLOGICAL, CULTURAL, AND HISTORICAL DOCUMENTATION SERVICES — SINCE 1982

13 October 2020

Kathy Sokugawa, Director
c/o Mr. Raymond Young
City & County of Honolulu
Department of Planning and Permitting
650 South King Street, 7th Floor
Honolulu, HI 96813

Subject: Cultural Impact Assessment (CIA) for the West O'ahu Solar Plus Storage Project, Special Use Permit No. 2020/SUP-6

Dear Ms. Sokugawa:

At the request of AES West Oahu Solar, LLC (AES), Cultural Surveys Hawai'i conducted a cultural impact assessment (CIA) for the West O'ahu Solar Plus Storage Project (Project). The purpose of the CIA was to evaluate the potential effect of the Project on cultural beliefs, practices, and resources, including traditional cultural properties. As discussed in the Special Use Permit (SUP) application, the assessment included archival and background research, as well as community consultation to obtain input from knowledgeable individuals regarding present and past uses, cultural sites, traditional gathering practices, cultural association and any associated cultural concerns. The results of the CIA are summarized in the SUP application, with additional detail in the CIA Report (Attachment G).

It is understood that AES recently adjusted the Project boundary resulting in an approximately 0.5-acre reduction of the Project area. This reduction of the Project area does not affect the findings and conclusions of the CIA, and the discussion of cultural resources presented in the SUP application remains valid for the revised 96.353-acre Project area.

If you have any questions regarding the information provided herein, please contact me at 808-262-9972.

Sincerely,

David W. Shideler
Cultural Surveys Hawai'i, Inc.
dshideler@culturalsurveys.com
Cell (808) 753-0785

MAILELANI
DESIGN

October 13, 2020

Kathy Sokugawa, Director
c/o Mr. Raymond Young
City & County of Honolulu
Department of Planning and Permitting
650 South King Street, 7th Floor
Honolulu, HI 96813

Subject: Landscape Plan for the West O'ahu Solar Plus Storage Project, Special Use Permit No. 2020/SUP-6

Dear Ms. Sokugawa:

At the request of AES West Oahu Solar, LLC (AES), Mailelani Design developed a landscape plan for the West O'ahu Solar Plus Storage Project (Project). The landscape plan is summarized in the Special Use Permit (SUP) application, with further detail in Landscape Narrative (Attachment K) and Sheets L1, L2, L3 of the drawing set (Attachment H).

It is understood that AES recently adjusted the Project boundary resulting in an approximately 0.5-acre reduction of the Project area. Sheets L1, L2, L3 have been updated to reflect the revised Project area. The reduction in the Project area had no effect on the location of any of the landscape components. The landscape approach and plan presented in the SUP application remains valid for the revised 96.353-acre Project area.

If you have any questions regarding the information provided herein, please contact me at Vivian@mailelanidesign.com.

Sincerely,

Mailelani Design

Vivian Arita, PLA, ASLA, LEED® AP

October 13, 2020

Kathy Sokugawa, Director
c/o Mr. Raymond Young
City & County of Honolulu
Department of Planning and Permitting
650 South King Street, 7th Floor
Honolulu, HI 96813

Subject: Decommissioning Plan for the West O'ahu Solar Plus Storage Project, Special Use Permit No. 2020/SUP-6

Dear Ms. Sokugawa:

In March 2020, HDR developed a decommissioning plan for the West O'ahu Solar Plus Storage Project (Project). The decommissioning plan describes the general measures and procedures that should be developed and implemented to decommission and restore the site and safely dispose of or recycle Project materials. A discussion of the decommissioning plan is included in the Special Use Permit (SUP) application, with additional detail in the Decommissioning Plan (Attachment L).

It is understood that AES recently adjusted the Project boundary resulting in an approximately 0.5-acre reduction of the Project area. This reduction of the Project area does not affect the recommendations for decommissioning, and the Decommissioning Plan presented in the SUP application remains valid for the revised 96.353-acre Project area.

If you have any questions regarding the information provided herein, please contact me at David.phillips@hdrinc.com.

Sincerely,

HDR Engineering, Inc.
Dave Phillips
Power Delivery Renewables Lead

3J CONSULTING
9600 SW NIMBUS AVENUE, SUITE 100
BEAVERTON, OREGON 97008
PH: (503) 946.9365
WWW.3JCONSULTING.COM

October 14, 2020

Kathy Sokugawa, Director
c/o Mr. Raymond Young
City & County of Honolulu
Department of Planning and Permitting
650 South King Street, 7th Floor
Honolulu, HI 96813

Subject: Stormwater Management Plan for the West O'ahu Solar Plus Storage Project, Special Use Permit No. 2020/SUP-6

Dear Ms. Sokugawa,

In January 2020, 3J Consulting on behalf of HDR Engineering, Inc. developed a 60% Stormwater Management Plan for the West O'ahu Solar Plus Storage Project (Project). The memorandum discusses methodologies used in quantifying stormwater runoff for the affected areas and sizing the required stormwater management best management practices (BMPs). The design and analysis of onsite BMPs are based on the County of Honolulu's "Rules Relating to Storm Drainage Standards", "Post-Construction Water Quality Requirements" and "Storm Water BMP Guide for New and Redevelopment". The results of the analysis are described in the Special Use Permit (SUP) application, with additional detail in the 60% Stormwater Management Design Memo (Attachment N).

It is understood that AES recently adjusted the Project boundary resulting in an approximately 0.5-acre reduction of the Project area. This reduction of the Project area does not affect the findings and conclusions of the Stormwater Management Design Memo, and the discussion of Stormwater Management Design presented in the SUP application remains valid for the revised 96.353-acre Project area.

If you have any questions regarding the information provided herein, please contact me at aaron.murphy@3j-consulting.com.

Sincerely,

Aaron Murphy, PE
Sr. Project Manager
3J Consulting, Inc.

copy: File

TETRA TECH

October 14, 2020

Kathy Sokugawa, Director
c/o Mr. Raymond Young
City & County of Honolulu
Department of Planning and Permitting
650 South King Street, 7th Floor
Honolulu, HI 96813

Subject: Glare Analysis for the West O'ahu Solar Plus Storage Project, Special Use Permit No. 2020/SUP-6

Dear Ms. Sokugawa:

At the request of AES West Oahu Solar, LLC (AES), Tetra Tech conducted a glare analysis for the West O'ahu Solar Plus Storage Project (Project). As discussed in the Special Use Permit (SUP) application, the glare analysis was conducted using the Solar Glare Hazard Analysis Tool (SGHAT) software through an online tool (GlareGauge) developed by Sandia National Laboratories and hosted by ForgeSolar. The analysis included three segmented traffic routes (H-1 Freeway, Farrington Highway, and Kualaka'i Parkway), three observation points from the surrounding community (to the west, south and east), as well as the various final approach flight paths and air traffic control towers associated with Kalaeloa Airport, Daniel K. Inouye International Airport and Wheeler Army Airfield. The results of the glare analysis are summarized in the SUP application, with additional detail in the Glare Analysis Report (Attachment P).

It is understood that AES recently adjusted the Project boundary resulting in an approximately 0.5-acre reduction of the Project area. This reduction of the Project area does not affect the findings and conclusions of the glare analysis, and the discussion of potential glare impacts presented in the SUP application remains valid for the revised 96.353-acre Project area.

If you have any questions regarding the information provided herein, please contact me at Joshua.Burdett@tetratech.com.

Sincerely,

Tetra Tech
Josh Burdett
Lead Glare Analyst

AUSTIN, TSUTSUMI & ASSOCIATES, INC. CIVIL ENGINEERS • SURVEYORS
CONTINUING THE ENGINEERING PRACTICE FOUNDED BY H. A. R. AUSTIN IN 1934

TERRANCE S. ARASHIRO, P.E.
ADRIENNE W.L.H. WONG, P.E., LEED AP
DEANNA M.R. HAYASHI, P.E.
PAUL K. ARITA, P.E.
ERIK S. KANESHIRO, L.P.L.S., LEED AP
MATT K. NAKAMOTO, P.E.
GARRETT K. TOKUOKA, P.E.

October 14, 2020

Kathy Sokugawa, Director
c/o Mr. Raymond Young
City & County of Honolulu
Department of Planning and Permitting
650 South King Street, 7th Floor
Honolulu, HI 96813

Subject: Traffic Impact Analysis Report for the West O'ahu Solar Plus Storage Project, Special Use Permit No. 2020/SUP-6

Dear Ms. Sokugawa:

In February 2020, Austin, Tsutsumi & Associates Inc. conducted a Traffic Impact Analysis Report (TIAR) for the West O'ahu Solar Plus Storage Project (Project). The purpose of the report was to document the findings of the traffic study and to evaluate impacts resulting from the proposed Project. The results of the findings are summarized in the Special Use Permit (SUP) application, with additional detail in the Traffic Impact Analysis Report (Attachment Q).

It is understood that AES recently adjusted the Project boundary resulting in an approximately 0.5-acre reduction of the Project area. This reduction of the Project area does not affect the findings and conclusions of TIAR, and the discussion of traffic impacts presented in the SUP application remains valid for the revised 96.353-acre Project area.

If you have any questions regarding the information provided herein, please contact me at eimada@atahawaii.com.

Sincerely,

Austin, Tsutsumi & Associates Inc.
Eric Imada, P.E.
Project Manager

REPLY TO:
501 SUMNER STREET, SUITE 521 • HONOLULU, HAWAII 96817-5031
PHONE (808) 533-3646 • FAX (808) 526-1267
EMAIL : alahni@atahawaii.com

OFFICES IN:
HONOLULU, HAWAII
WAILUKU, MAUI, HAWAII
HILO, HAWAII

TETRA TECH

October 14, 2020

Kathy Sokugawa, Director
c/o Mr. Raymond Young
City & County of Honolulu
Department of Planning and Permitting
650 South King Street, 7th Floor
Honolulu, HI 96813

Subject: Economic Assessment for the West O'ahu Solar Plus Storage Project, Special Use Permit No. 2020/SUP-6

Dear Ms. Sokugawa:

At the request of AES West Oahu Solar, LLC (AES), Tetra Tech conducted an economic assessment for the West O'ahu Solar Plus Storage Project (Project). As discussed in the Special Use Permit (SUP) application, the economic activity associated with the Project was modeled using IMPLAN, a commercially available economic modeling package widely used to assess the economic impacts of renewable energy and many other types of projects. Economic impacts were assessed in terms of employment, labor income, and economic output, with separate analyses presented for the construction and operation phases. The results of the economic assessment are summarized in Section 6.13 of the SUP application.

It is understood that AES recently adjusted the Project boundary resulting in an approximately 0.5-acre reduction of the Project area. This reduction of the Project area does not affect the findings and conclusions of the economic assessment, and the discussion of economic impacts presented in the SUP application remains valid for the revised 96.353-acre Project area.

If you have any questions regarding the information provided herein, please contact me at Matt.Dadswell@tetratech.com.

Sincerely,

Tetra Tech
Matt Dadswell
Senior Economic Analyst

David Shideler

From: David Shideler
Sent: Wednesday, September 16, 2020 2:42 PM
To: 'Susan.A.Lebo@hawaii.gov'
Subject: RE: AES West O'ahu Solar Project, Honouliuli Ahupua'a, 'Ewa District, O'ahu, TMK: [1] 9-2-002:007 Responding to SHPD Question by supplying the SUP application

Aloha Susan:

In the context of our draft *Archaeological Inventory Survey Report for the AES West O'ahu Solar Project, Honouliuli Ahupua'a, 'Ewa District, O'ahu, TMK: [1] 9-2-002:007 (por.)* (assigned SHPD review LOG # 2020.00290 on Feb 6, 2020), we understand from DPP that SHPD has inquired about a copy of the SUP application, so are following up with a link to the document (below) which we very much hope suffices as a "Trigger" for review of the AIS.

SUP Application

I remain unclear on when "supplemental information pertaining to a prior submittal should be submitted to DLNR.Intake.SHPD. There have been recent cases where that elicited another Log No. that seemingly proved problematic.

Sooo…. Please advise if I should submit this SUP Application.

Mahalo for all you do.

Aloha.

David Shideler
Cultural Surveys Hawai'i
PO Box 1114
Kailua, HI 96734
PH: (808) 262-9972
Cell: (808) 753-0785
Fax: (808) 262-4950
dshideler@culturalsurveys.com

David Shideler

From: Lebo, Susan A <susan.a.lebo@hawaii.gov>
Sent: Wednesday, September 16, 2020 3:55 PM
To: David Shideler
Subject: Re: AES West O'ahu Solar Project, Honouliuli Ahupua'a, 'Ewa District, O'ahu, TMK: [1] 9-2-002:007 Responding to SHPD Question by supplying the SUP application

got it to open!

David Shideler

From:	David Shideler
Sent:	Monday, October 5, 2020 3:32 PM
To:	'Susan.A.Lebo@hawaii.gov'
Cc:	alan.s.downer@hawaii.gov
Subject:	Mahalo for the Friday September 25, 2020 teleconference regarding the AES West O'ahu Solar Project AIS and notification DPP is issuing their acceptance determination for the SUP application

Aloha Dr. Susan Lebo and Dr. Alan Downer:

Thank you for the zoom meeting discussion on Friday September 25, 2020 regarding the AES West O'ahu Solar Project, Honouliuli Ahupua'a, 'Ewa District, O'ahu, TMK: [1] 9-2-002:007 (por.) and the associated archaeological inventory survey (AIS) presently under SHPD review.

We appreciate your input to the discussion and look forward to receiving any comments you may have on the Draft AIS.

We understand that the City and County Department of Planning and Permitting (DPP) is issuing their acceptance determination for the application, thus starting the clock on the statutory timelines for the State Special Use Permit (SUP) process. If there is anything that we can do to further support your review, please do not hesitate to ask.

Aloha.

David Shideler
Cultural Surveys Hawai'i
PO Box 1114
Kailua, HI 96734
PH: (808) 262-9972
Cell: (808) 753-0785
Fax: (808) 262-4950
dshideler@culturalsurveys.com

November 16, 2020

Kathy Sokugawa, Director
c/o Mr. Raymond Young
City & County of Honolulu
Department of Planning and Permitting
650 South King Street, 7th Floor
Honolulu, HI 96813
Submitted via email: ksokugawa@honolulu.gov; rcsyoung@honolulu.gov

Subject: AES West O'ahu Solar, LLC State Special Use Permit No. 2020/SUP-6, TMK 9-2-002:007 (por.)

Dear Ms. Sokugawa:

As the authorized agent for AES West O'ahu Solar, LLC (AES), we are transmitting information related to the State Special Use Permit (SUP) application for the West O'ahu Solar Plus Storage Project (Project) and respectfully request that this documentation be incorporated into the Project record. As indicated in our previous letter dated October 22, 2020, the purpose of this submittal is to provide the Department of Planning and Permitting (DPP) with updated information regarding the easement(s) that will be executed to secure land rights for the Project in advance of the formal easement designation process.

As discussed in Section 1 of the SUP application, under an August 2019 option agreement with the University of Hawaii (UH), as amended in May 2020, AES will enter into a Grant of System Easement under which they will be granted the right to develop, construct, install, operate, maintain, repair, and replace the Project upon and/or remove the Project on a portion of the UH West O'ahu Mauka Lands property. The easements will include (1) an exclusive easement for the Project facilities, (2) a non-exclusive utility easement for Hawaiian Electric Company, and (3) a non-exclusive access easement along existing shared-use access roads.

AES is currently in the process of defining the easement areas in preparation for the formal easement designation process, which will involve submittal of the easement documentation to the City and County of Honolulu and Land Court for approval. The proposed boundaries of the exclusive easement for the Project facilities and non-exclusive utility easement (based on the current level of design) are shown in the attached map. In total, the exclusive easement area comprises approximately 65.783 acres and the non-exclusive utility easement comprises approximately 0.24 acres; both of these easement areas would be entirely within the overall 96.353-acre Project area. As noted in the SUP application, the reduction in the area secured for Project use from UH does not substantively change the size, scope, intensity, use, location or timing of the Project itself (as described in either the Final Environmental Assessment or the

SUP application), nor does it change the area for which SUP approval is requested. The non-exclusive access easement, which will include existing shared-use access roads extending from Pālehua Road to the Project area, is being coordinated with the University of Hawaii as the landowner.

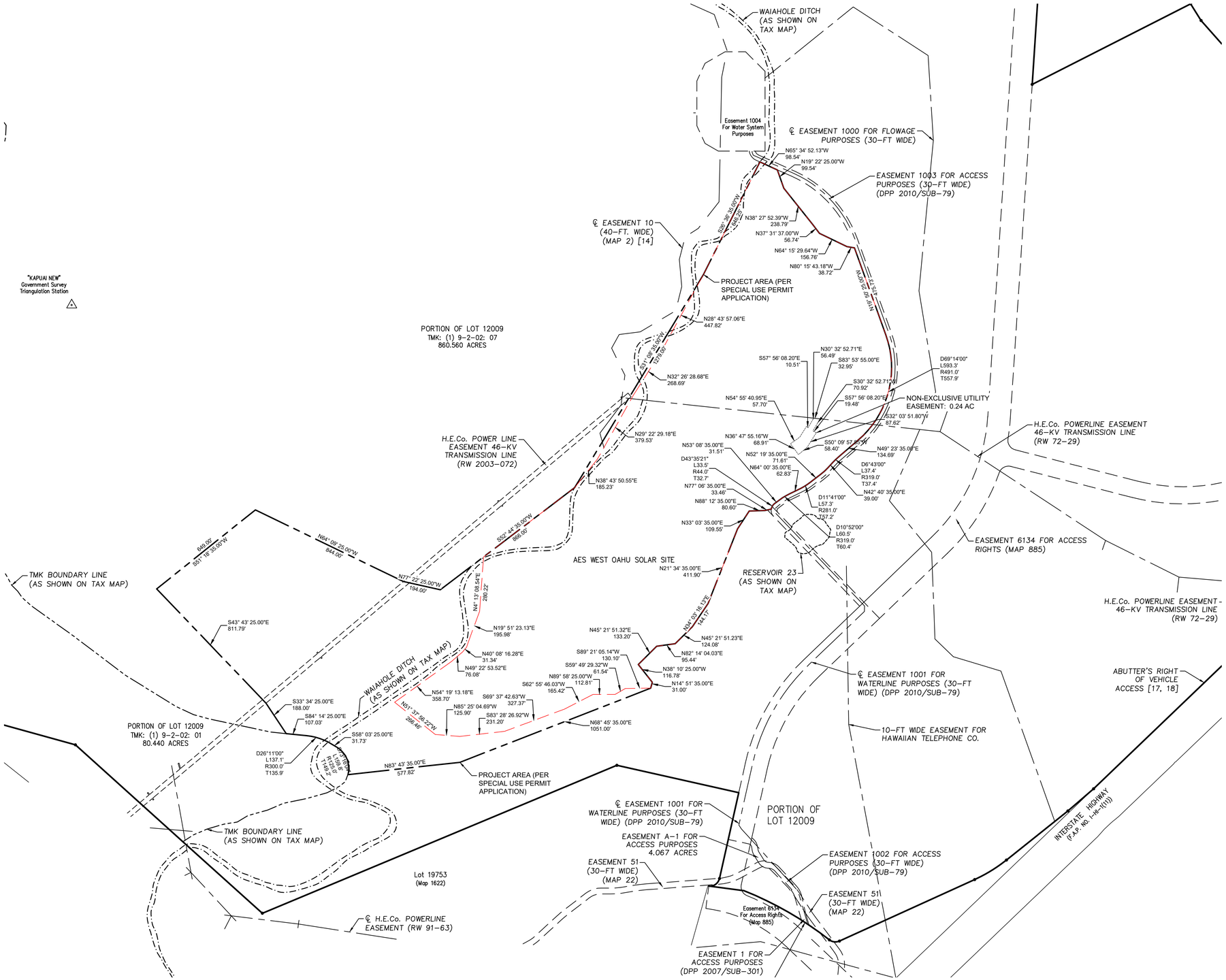
We appreciate DPP's efforts in support of processing the SUP application for the West O'ahu Solar Plus Storage Project. If you have any questions regarding the information provided herein, please do not hesitate to contact me.

Sincerely,

Tetra Tech
Lisa Kettley
Agent for AES West O'ahu Solar, LLC

Enclosures:
Draft Easement Plan

Cc: Nick Molinari, AES Distributed Energy (West O'ahu Solar, LLC)



LEGEND

- BOUNDARY FOR LOT 12009
- TMK BOUNDARY
- WAIAHOLE DITCH (PER TAX MAP)
- RESERVOIR (PER TAX MAP)
- EXISTING ROW LINE
- EXISTING EASEMENT LINE
- EXISTING EASEMENT CENTER LINE
- PROJECT AREA (PER SPECIAL USE PERMIT APPLCATION)
- PROJECT EASEMENT BOUNDARY
- NON-EXCLUSIVE UTILITY EASEMENT

PROJECT BOUNDARY ACREAGE

PROJECT AREA (PER SPECIAL USE PERMIT APPLICATION)	96.353 ACRES
PROJECT EASEMENT BOUNDARY	65.783 ACRES

N
W E
S

SCALE: 1" = 250'
0 250 500 FT

AES
Distributed Energy
AES Distributed Energy
282 Century Pl. Suite 2000
Louisville, CO 80027 USA
HDR
3J CONSULTING
CIVIL ENGINEERING
WATER RESOURCES
COMMUNITY PLANNING
9600 SW NIMBUS AVE, SUITE 100, BEAVERTON, OR 97008

SYSTEM DESCRIPTION

REVISIONS

REV	BY	DATE	DESCRIPTION

PE STAMP

AES WEST OAHU SOLAR
OAHU, HI

PROJECT NUMBER
19537
PHASE
ISSUED FOR REVIEW
MILESTONE
90% DESIGN

ELECTRICAL DESIGNER

STRUCTURAL DESIGNER

DATE
11-16-2020
SCALE
1" = 250'

TITLE

DRAWING
DRAFT
EASEMENT PLAN

WRITTEN DIRECT TESTIMONY OF PAUL T. MATSUDA, P.E.
(Civil Engineering)

1. Please state your name and business address for the record.

Paul T. Matsuda, 111 S. King Street, Suite 170, Honolulu, Hawai'i 96813

2. What is your current occupation?

I am a Principal and the Director of Civil Engineering at Group 70 International, Inc.

3. How long have you worked as a civil engineer?

Over 28 years.

4. Did you provide a copy of your resume for these proceedings?

Yes, a copy of my resume was provided as ***Exhibit 17***.

5. Please briefly describe your educational background.

I have a Bachelor of Science in Civil Engineering from the University of Washington. I am a licensed professional civil engineer in Hawai'i, Oregon, and Washington. I am also a U.S. Green Building Council LEED accredited professional.

6. To what professional organizations do you belong?

I am a member of the American Society of Civil Engineers, Hawai'i Section; the American Council of Engineering Companies Hawai'i, the American Water Works Association, Hawai'i Section; and the U.S. Green Building Council, Hawai'i Chapter. I served as a board member and Building Committee Chair for Honolulu Habitat for Humanity and was awarded the Fran Brossy Lifetime Achievement Award in 2011. I am also a member of Pacific Business News' Forty under 40 Class of 2009.

7. Do you specialize in any particular Area?

I specialize in civil engineering, primarily site development, transportation, and utility infrastructure projects.

8. Have you ever been qualified as an expert witness in civil engineering before the Planning Commission, Lane Use Commission, or in any other proceeding?

Yes. I was qualified as an expert witness in land and use planning before the State of Hawai'i Land Use Commission in October 2014 for a 50-megawatt ("***MW***") utility scale solar project on Oahu.

9. What is your role in the proposed Mahi Solar Project (the "*Project*")?

I am the civil engineering designer of record for the project.

10. Describe the details of the proposed Project.

The 620-acre Project is projected to generate a total of 120 MW of energy, which is enough to power approximately 37,000 Oʻahu homes or 4 percent of the island's electricity annually and the project is estimated to avert the consumption of 11,111,800 barrels of oil and save Oʻahu consumers $175 million over a 25-year lifespan.

11. Briefly describe the proposed location of the Project.

The project is located in on five portions of TMKs (1) 9-2-001:020 and (1) 9-2-004: 003, 006, 010, and 012 in Kunia, Oʻahu, Hawaiʻi and totals approximately 620 acres. The site will be developed in five areas identified as Areas 1, 2, 3, 4A, 4B, 4C, and 5, across the five TMK parcels. The site lies within the traditional moku of ʻEwa and the ahupuaʻa of Honouliuli.

The project is situated on lands designed as Agricultural by the State of Hawaiʻi Land Use Commission.

12. How is the Project area zoned?

The project area is zoned as AG-1 Restricted Agricultural District by the City and County of Honolulu's Land Use Ordinance and is planned for "Agriculture Preservation" uses within both the City and County of Honolulu Central Oʻahu Sustainable Communities Plan and Ewa Development Plan.

13. Does the Project's propose use of the agricultural zoned lands for the solar farm an allowable use?

Yes, it would be an allowable use with approval of the State of Hawaii Special Use Permit and City and County of Honolulu (minor).

14. What are the past and current uses of the property?

The property was historically used for the commercial agriculture that included sugarcane and pineapple.

Today, the project site currently consists of actively farmed areas, undeveloped and fallow agricultural land, and overgrown vegetation.

15. What are the anticipated permits and approvals required for this Project?

For the State of Hawai'i the following permits are required: (i) SUP; (ii) National Pollutant Discharge Elimination System Permit, Form C for Construction Activities; (iii) Community Noise Permit; and (iv) Historic Preservation Review.

For the City and County of Honolulu the following permits are required: (i) Conditional Use Permit Minor for Utility Installation, Type B; (ii) Zoning Waiver Permit; (iii) Building Permit; (iv) Grading, Grubbing and Stockpiling Permit; and (v) Erosion and Sediment Control Plan, Storm Water Pollution Prevention Plan, Post-Construction Best Management Practices Plan.

16. What are the flood zones of the property?

The property is located in Flood Zone D, areas undetermined flood hazard.

17. Are wastewater facilities required for this Project?

No wastewater facilities are required as occupied facilities will not be located on the site.

18. How is water provided to the Project area?

Kunia Water Association provides agricultural water service to the site and surrounding agricultural lands.

19. Are domestic and fire protection water service required for the Project area?

No because the facility is unmanned and there are no occupied buildings planned for the project.

20. Will the on-site water demand be minimal?

Onsite water demand is anticipated to be minimal and limited to a drip irrigation system or the use of water trucks to provide start up irrigation for screening plants and will be designed into the solar farm to ensure compatibility with the operation and maintenance activities.

21. What is the storm drainage system in the Project area?

There is no City and County of Honolulu storm drainage system in the project vicinity. State of Hawaii storm drainage systems in the vicinity are limited to concrete culverts crossing Kunia Road. There is no subsurface drainage system on the project property.

Existing drainage infrastructure on the property is comprised of agricultural drainage ways and culverts that convey water from mauka areas through the property and to

downstream properties and across Kunia Road. Stormwater eventually flows into the various tributaries of Honouliuli Stream.

22. Will water resources be affected by the project design?

No adverse effect to water resources, including Honouliuli Stream or its tributaries is anticipated.

23. How will stormwater runoff be addressed?

Stormwater runoff will be appropriately addressed through design features that incorporate temporary erosion controls and post-construction BMPs to minimize the quantity and water quality impacts of the runoff.

24. How will BMP's be identified?

In compliance with DOH's NPDES permit and DPP's Water Quality Rules, BMPs will be identified as part of a Temporary Erosion and Sediment Control Plan and Permanent Post-Construction BMP Plan.

25. Is the stormwater runoff expected to be minimal?

Yes, given the relatively short duration of construction and with the implementation of BMP's, the potential for sedimentation or increased pollutants in stormwater runoff is expected to be minimal.

26. Will the construction and operation of the project generate a significant amount of waste?

No.

27. How will the Project be developed?

The project will be developed as a Utility Installation, Type B and will provide 120 MW of solar electricity and 480 Megawatt-hours ("***MWh***") of battery storage.

28. Please explain the Project Components.

The project includes ground-mounted, single-axis tracking photovoltaic ("***PV***") arrays, a 480 MWh BESS, and a 34.5 kilovolt ("***kV***")/138 kV substation. The project will interconnect through a new 138 kV switchyard, also called a "switching station" adjacent to the existing Kahe-Waiau 138 kV transmission circuit west of Kunia Road. The 138kV transmission line is not currently serving other renewable projects, and no additional easements or rights of way are required.

29. Please explain the type of solar panels that will be installed.

Each panel is approximately 48 inches wide and 79 inches long, dark in color, and stands approximately 6 to 8 feet above ground level when flat (0-degree tilt). At maximum rotation or 50-degree tilt, the height of the panel reaches approximately 9 to 12 feet high and is approximately 1 to 3 feet off of the ground. Each PV panel is made up of thin-film Cadmium Telluride ("***CdTe***") semiconductor cells or equivalent. The cells are linked together and function as a single unit.

30. How will the solar panels be installed?

The PV panels will be installed on single-axis trackers aligned north-south which will vary in length. The trackers will rotate the panels to follow the sun during the day to maximize solar exposure to the face of the module. Trackers are supported by steel pile foundations at intervals. The PV panels may be mounted in either a portrait or landscape orientation, in single or double combination. Based on the preliminary design criteria for the project, there will be approximately one foundation for every eight-to-ten panels. Foundation spacing will be dependent upon the final chosen panel orientation. The array will have approximately 370,000 ground mounted PV panels, for a combined capacity of 120MW (AC).

31. Please explain how the panels will be mounted.

PV panels will be mounted on a rack with steel and aluminum construction and will be designed with a wind resistance to meet wind loading requirements per the adopted building code. There will be an approximately 9-foot-wide aisle between adjacent arrays of panels when they are in the horizontal position or 0-degree tilt.

32. How will the panels be connected?

The project's PV panels will be connected in series, referred to as a "string". The maximum string size is limited by a maximum system voltage of 1,500 volts direct current ("***VDC***"). For this project's design, a string is a DC circuit of approximately 6 panels each. Each string is connected to a combiner box with a fused disconnect. Typically, a group of approximately 16-30 strings will be connected at the combiner boxes and are limited by the 400A fuse size. A group of approximately 20-30 combiner boxes are connected via DC feeders into a DC/alternating current ("***AC***") inverter which connects to the AC power system.

33. What does the AC power system consist of?

The AC power system consists of pad-mounted equipment, including the inverters, step up transformer and communication equipment, which increases the power from 400-600 volts to a medium voltage of approximately 34.5 kV. Each pad will tie into the 34.5 kV

collector system which terminates at the high-voltage AC substation, whereby the voltage will be increased to 138 kV.

34. Will the substation connect to a switchyard?

Yes, the substation connects to a new adjacent 138 kV switchyard. The new 138 kV switchyard will connect to the existing HECO utility line at the property.

35. Do the inverters contain a safety protocol?

Yes, the inverters contain a safety protocol that automatically shuts off the PV facilities in the event the HECO grid loses power. This prevents adverse effects on grid operation, and electricity from leaving the PV facilities and injuring utility line workers who may be working on a nearby power line.

36. What protective devises and safety protocols will be implemented at the PV facility?

The PV facility will integrate protective devices for safe operation, and a Supervisory Control and Data Acquisition ("***SCADA***") which includes a central system controller, generating station protocols, and sensors to perform plant control and system operation. The SCADA system will allow for remote monitoring and control of select facility functions.

37. Will the PV systems be interconnected with a substation?

Yes, the PV systems will be interconnected with a substation located in Area 3 at the southwest corner of the project area.

38. When will electrical power be produced?

Electrical power from the PV system will be produced during daylight hours.

39. Where will electrical power be stored?

Power from the PV system may be stored in the BESS and may be discharged from the BESS at any time of day or night.

40. Where will the BESS be located?

The BESS will be located in Area 3 of the Project.

41. Please explain the BESS system.

The BESS system provides a four-hour discharge duration and storage capacity of 120 MW/480 MWh. The BESS consists of lithium-ion battery cells that are connected in series

into a battery module or array. The battery modules are typically stacked and connected into vertical racks containing several modules. The racks are then collected via cables and fed into DC to AC converters that feeds into the Battery Energy Storage inverter. The battery energy storage transformer steps up the voltage from the BESS inverter from 400–600V to 34.5kV. The battery energy system will typically come equipped with controls and communications systems that integrate into the plant's SCADA, including a battery management system to monitor battery state of health and operations. The battery racks will be stored in cabinets/enclosures and laid on top of a gravel pad. The enclosures will contain an internal thermal management system and/or HVAC units to support battery temperature management. The battery enclosures are also rated for outdoor use. Each BESS container is approximately 15 feet high.

42. What type of operational support facilities will the project consist of?

The operational support facilities will consist of an outdoor electrical substation, switchyard, and two control enclosures. The support facilities will be located in Area 3.

43. What will be the medium voltage AC output from the solar project?

At the substation, the medium voltage AC output from the solar project 138 kV and interconnected to the new HECO-owned switchyard.

44. Please explain the control enclosures.

There will be two control enclosures, each with an area of approximately 798 square feet, and a height of approximately 13 feet. The control enclosures will house the PV and BESS plant control systems, HECO remote terminal units, communications equipment, and relays and meters. Within the control enclosures, there will be a small battery system to serve as a back-up power system for data collection.

45. Please explain an inverter station.

The project will also include 32 PV inverter stations. The inverter stations will be located within the PV solar array field and include inverters and medium voltage transformers. Inverters rated at 3.95-4.2 MW-AC will be used to convert the DC electricity from the PV modules to AC. The AC electricity will be stepped up with a medium voltage transformer at the inverter station and connected to the substation by an underground or overhead medium voltage line.

46. What is the total building area for the facilities and equipment at the project site?

The total building area or lot coverage of the facilities and equipment at the project site will be approximately 6,495,188 square feet (approximately 149.1acres).

47. Are the structures and equipment governed by AG-1 Restricted Agricultural District development requirements?

Yes, the structures and equipment will be governed by AG-1 Restricted Agricultural District development requirements such as lot coverage, setbacks, and height restrictions.

48. How will the project be integrated into HECO's grid?

The project will be interconnected to HECO's Kahe-Waiau 138 kV transmission circuit located west of Kunia Road. The medium voltage collection system will transmit generation from the solar array inverters to the BESS and substation along overhead lines to be installed as part of the project.

49. How will the collector lines be installed?

The collector lines will be installed on new wooden structures along existing roadways, where required to comply with existing land use regulations, and then will cross the existing 138 kV lines underground to the BESS yard and project substation.

50. How will the BESS and substation be connected to the HECO switchyard?

The BESS and substation will be connected to the HECO-owned switchyard via an overhead bus structure. A short extension of the adjacent Kahe-Waiau circuit will extend both transmission lines into a proposed ring bus in the switchyard.

51. Will the Kahe-Waiau circuit be the primary Point of Interconnection ("*POI*")?

The Kahe-Waiau circuit is expected to be the primary POI since the 138 kV line located in the vicinity can accommodate the full output of the project without requiring a more elaborate interconnection scheme.

52. Is an alternative generation tie line ("*gen-tie*") route being considered for the Project?

Yes, at the request of HECO, an alternative gen-tie route and substation/switchyard/ BESS location is being considered for the project. The alternative would require the substation and BESS yard to be relocated to the southwest corner of Area 3. The same number of panels would be included in the project and shifted from Area 3 to Area 5. The alternative route would interconnect to a HECO switchyard proposed at the Hoʻohana Solar project site, located directly across Kunia Road to the southeast of the project.

53. Are gen-tie poles permitted use within the AG-1 Restricted Agricultural Zoning District?

Yes, gen-tie poles permitted use within the AG-1 Restricted Agricultural Zoning District

54. Is the design of the site, structures and fire access for the project based on applicable requirements of the State of Hawaii Fire Code.

Yes. Appropriate clear areas are incorporated throughout the site. Fencing will be provided around the perimeter of the PV panel areas, at the project substation, HECO switchyard, and BESS area. Batteries will be installed in self-contained enclosures that are constructed across an open-air gravel pad. The self-contained enclosures are remotely monitored and are intended to contain/suppress fires with no active fire response necessary from the Honolulu Fire Department ("***HFD***"). Coordination with the HFD will occur throughout the project design and permit process to ensure adequate access and fire code requirements are met.

55. Will the Project area need to be cleared and graded?

Minimal clearing and grading will need to be done in the project area for the access roads and leveling of uneven terrain.

56. Describe the landscaping proposed for the project site.

Minimal landscaping will be done with primary concentration on the eastern boundary of the project site along Kunia Road. Landscaping will include plants suitable for the Kunia climate and will include native Hawaiian or Polynesian-introduced species.

57. What type of irrigation system will be used?

A drip irrigation system or watering via water trucks will be used to irrigate the required screening plants thereby minimizing runoff and soil erosion as low volumes of water will be directed at individual plants near the soil surface.

Respectfully submitted,

_____

PAUL T. MATSUDA, P.E.

DATED: Honolulu, Hawai'i, _____, 2021.

Deron Lawrence

Education

M.A., Environmental Philosophy, Saint Louis University
Passing Orals with Great Distinction
M.S., Ecology, Idaho State University
B.S., Ecology, Idaho State University

Biographical Sketch

I have focused my career on energy development, construction, and operational compliance. My approach to permitting is to propose innovative solutions to solve challenging issues by relying on a robust technical and legal basis. I conduct thorough research to propose solutions with scientific merit and ability to implement within project economic and scheduling constraints. This approach is effective with regulatory staff at all levels to negotiate feasible solutions.

Summary of Qualifications

- 20+ years of project management, permitting, and applied environmental research.
- Comprehensive permitting experience in energy development, construction, and operation (wind, solar, and geothermal).
- Operational compliance management: MBTA, BGEPA, NPDES, BLM implementation, HSSE, County CUP/SUP, and others.
- US Agency experience: FWS, BLM, USFS, NPS, state agencies, and local permitting.
- Large project NEPA experience on BLM-administered lands.
- International pre-acquisition development pipeline and operating project review in Central/South America, China, Japan, Australia, Turkey, France, Norway.
- IFC, Equator Principles experience negotiating with sellers, lenders, and IE reviewers.
- Convened and led ad-hoc group of wind and solar companies to effect positive changes to BLM's competitive leasing rule impacting rents and bonding on federally leased land – working relationships with HQ staff in WDC at BLM, DOI, and FWS.

Deron Lawrence

Select Project Experience

Renewable Energy

- *Longroad Energy team.* Since company inception in 2016, have started construction on 1.3GW of solar and 654 MW of wind energy (~2 GW) in Texas, Utah, Minnesota, California, Alabama, & Maine. Currently developing ~2 GW for 2021-2022. Built legal and consulting teams for permitting each project, successfully financed externally.
- *Weaver Wind*, Maine. 72 MW wind project, state initially recommended denial in 2015. Project acquired in 2016, I led permit very difficult negotiations, permit issued in 2019; COD anticipated October 2020.
- *Milford Wind*, Utah. 304 MW wind project. Implemented cutting edge technology to eliminate eagle incidents; negotiated settlement agreement with USFWS Office of Law Enforcement.
- *Sunflower Wind*. Led environmental team of consultants to support revised layout permitting updates (extensive) in compressed timeline to meet FNTP. Addressed difficult challenges with state PSC and acquired support from native tribe which could have stopped project (from the same tribe that has recently stopped oil pipeline construction in ND). Supported construction compliance. Project operational.
- *Alta East Wind Project*, California**.** Completed development of an Eagle Conservation Plan (ECP), a Bird and Bat Conservation Strategy (BBCS), and Environmental Assessment (EA) led by the U.S. Fish and Wildlife Service (USFWS), to acquire a programmatic eagle take permit. Third permit issued in US.

International Renewable Energy

- *International Project Diligence*, 2015-2016. International pre-acquisition development pipeline & operating project due diligence in Honduras, Costa Rica, Chile, Nicaragua, Peru, Mexico, Africa, China, Japan, Australia, Turkey, France, Norway. Identified consulting and law firms to support project assessment of risks to development or operational environmental compliance. Worked closely with development team to monetize risks. Total of > 3 GW of assets reviewed for advancement or rejected.

Latin American Renewable Energy

- *Durango Wind*, Mexico. Initiated permitting and agency coordination with SEMARNAT for mountaintop wind farm with 36-mile gen-tie transmission line.

- *La Bufa Wind*, Mexico. Initiated environmental and social site diligence, agency coordination with SEMARNAT, and development of environmental, social, and cultural resource plans to address local concerns.

- *Eolo Wind*, Nicaragua. {SunEdison was looking to buy this operating asset.} Operating project in Year III when a high bat fatality rate of protected species was discovered. I designed study and negotiated in partnership with project owners the protocol with MARENA. Additionally, I performed due diligence of permit file and found significant gaps. I worked with owners during diligence to develop project environmental, cultural, and social plan to complete permitting while operating.

- *PESRL, Orosi, Alisios Wind Farms*, Costa Rica. {SunEdison was looking to buy these operating assets.} I performed due diligence of permit file and found significant gaps. I

worked with owners during diligence to develop project environmental, cultural, and social plan to complete permitting while operating in coordination with SETENA.

- *Cerro de Hula I/II Wind Farms*, Honduras. {SunEdison was looking to buy these operating assets.} I performed due diligence of permit file and found significant gaps. I worked with owners during diligence to develop project environmental, cultural, and social plan to complete permitting while operating.

- *Parqua, Tolpan I/II Wind Farms*, Chile. Early permitting development, I conducted due diligence, initial agency outreach (MMA), risk assessment, and schedule. Developed wildlife and vegetation plans to address local concerns.

- *Portfolio of 19 operating wind, solar, and hydro projects*, Peru & Chile. SunEdison purchased these operating assets. I performed project diligence of permit files to on-board projects into internal operating portfolio to meet environmental, cultural, and social compliance requirements of Equator Principles lending institutions. Coordinated with federal agencies in Peru (MINAM) and Chile (MMA) regarding implementation plans.

Geothermal Energy

- *Geothermal Project Permitting and Field Surveys, Oregon*
  Completed field surveys for eagles, other raptors, and greater sage-grouse at a proposed geothermal exploration location on BLM lands in central Oregon. During the survey, the team identified a new grouse lek that was within the proposed core area for grouse in Oregon. Completed the field studies for protected plant and wildlife resources and supported permitting efforts with the BLM. The project included over 20 locations for geothermal testing and review of the proposed infrastructure plan.

Electrical Transmission

- *BLM Burns District Echanis Transmission Line 3P EIS, Oregon*
  Led the analysis and writing for the wetlands, wildlife, and threatened and endangered species resource reports of a third-party BLM EIS for a 46-mile-long transmission line proposed to cross BLM and USFWS national wildlife refuge lands in Harney County, Oregon. The project analysis included, but was not limited to, raptors (including golden eagle), greater sage-grouse, migratory birds, big game and non-game wildlife, and jurisdictional wetlands.

USACE Individual Permit

- *Reservoir Permitting, Little River Plantation, Florida*
  Negotiated two district, one state, and one USACE individual permit for creation of an unprecedented 40-acre lake. Four year permitting effort, took over where two prior project managers had not succeeded. Mitigation includes 2 miles of stream restoration with 3-year monitoring program, preservation of site tributaries and bottomlands, 10-acre wetland restoration, and protection of the lake buffer zone. Directed the ecological assessment of the streams and wetlands and developed the mitigation and restoration plan.

State Water Quality Monitoring

- *Surface Water Monitoring Services, Department of Environmental Protection, Florida*

  Formed a team of 7 consulting firms (who previously were going to compete with our company) to win a competitive-bid $4.8 million water quality study of 350 stations located

throughout Florida. Study included the following: habitat assessments, Stream Condition Index evaluation, benthic macro-invertebrate taxonomy, phytoplankton taxonomy, periphyton taxonomy, water chemistry sampling, remote deployments of multi-probe sonde units, and development and implementation of a PDA data collection system linked to a real-time web page. Study supported revision of State of Florida Water Quality Standards.

Select Recent Presentations

- Native and Pollinator Species at Solar Energy Facilities. May 2021. Invited. E2Tech: Environmental and Energy Technology Council of Maine. Online Webinar.
- Eagle Conservation Plan and the NEPA Environmental Assessment: Permitting Nexus of Adaptive Management and Mitigation. March 2015. Conference on Wind Energy and Wildlife Impacts. Berlin, Germany.
- Eagle Take Permit NEPA Process: A Case Study in Tehachapi. September 2014. Invited. Raptor Research Foundation. Corpus Christi, Texas.

Professional Organizations/Affiliations

Solar Energy Industries Association (SEIA)

National Wind Coordinating Collaborative (NWCC) - abstract reviewer

American Wind and Wildlife Institute (AWWI) - managing research host site

Employment History

Longroad Energy, Director Natural Resources Permitting & Policy, current

SunEdison, Environmental Permitting Manager

CH2M HILL, Project Manager, Senior Ecologist, Eagle technical discipline leader

Cardno ENTRIX, Project Manager, Senior Ecologist

Biological Research Associates, Senior Ecologist/Senior Water Resource Analyst

Saint Louis University, Teaching Assistant, Adjunct Faculty (Philosophy, Ecology, Statistics)

WRITTEN DIRECT TESTIMONY OF DERON LAWRENCE
(Environmental)

1. Please state your name and business address for the record.

Deron Lawrence, 735 Montgomery St, Suite 400, San Francisco, CA 94111.

2. What is your current occupation?

I am an ecologist and project developer for Longroad Energy.

3. How long have you worked in the environmental field?

I have more than 20 years of experience working as an ecologist.

4. Did you provide a copy of your biography and or resume for these proceedings?

A brief biography and/or resume was filed as Exhibit 19.

5. Do you specialize in any particular area?

I specialize in renewable energy development, which requires expertise in wetland protection, endangered species act species, state protected species, and general wildlife assessments. I work closely with agencies in many states in the US, as well as environmental organizations and research groups who are conducting studies regarding the interaction between renewable energy and natural resources, especially protected (listed) wildlife species.

6. Can you describe the Mahi Solar Project ("*Project*") that is the subject of the SUP application?

Mahi Solar is proposing to construct a 120-megawatt solar project, a Battery Energy Storage System ("***BESS***"), and other associated appurtenances including fencing, roads, and electrical infrastructure on roughly 620 acres of agriculture-zoned land.

7. What is your role with this Project?

I am the Longroad Energy lead person for permitting.

8. Was a biological resource assessment done for the Project?

Yes, SWCA Environmental Consultants ("***SWCA***") provided Biological Resource Assessments for the Project. In 2018 SWCA did a survey to determine the potential for federal and state listed species to occur at the Project area and to identify critical issues related to natural resources permitted. In 2020, SWCA conducted suitable habitat surveys for special-plants, O'ahu 'elepaio and Hawaiian short-eared owl to determine the likelihood of their presence in the Project area.

9. Are any endangered or threatened plants located with the Project area?

With respect to flora, no threatened, endangered, or special species were seen in the Project area. Because the habitat observed was transformed by previous land use it is either dominated by non-native invasive species or used for cultivation of crops.

10. Are any endangered or threatened animal species located within the Project area?

Within the Project area, there are three state listed and federally listed species that could be found foraging or using the site for breeding habitat. The Hawaiian hoary bat, 'elepaio, and Hawaiian short-eared owl (pueo) are known to be present adjacent to or at times within the site. While other state and federally listed species are present on O'ahu, none require implementation of specific study or mitigation measures.

11. How would the identified animal species be impacted as a result of the Project?

Longroad Energy has completed desktop and field studies for the three listed species and coordinated with the state (DOFAW) and federal (USFWS) agencies to review the results. Based on Longroad's implementation of recommended guidelines and best management practices, the agencies concurred that no impacts were likely to occur to these species.

12. Would the Project result in avian fatalities?

Avian species are highly mobile and generally able to avoid impacts during construction and operation of solar sites. While there is always the potential for avian species to occur in or fly through the Project area, studies have not found that bird strikes are common at solar facilities. Longroad Energy will implement its corporate Downed Wildlife Observation Program ("***DWOP***") which will document all fatalities that do occur at the project site. The program includes annual staff training to identify and document all found wildlife carcasses and fatalities of species covered by the MBTA, the Endangered Species Act and HRS Chapter 195D. Where listed species may be found, reporting to the appropriate agency will occur within 24 hours of a find.

13. What mitigation measures will be implemented to minimize the potential for avian electrocutions.

To minimize the potential for avian electrocutions, Longroad Energy will implement best management recommendations as follows:

- Energized and/or grounded structures will be isolated through adequate spacing, as recommended by the Avian Power Line Interaction Committee ("***APLIC***").
- Energized and/or grounded features will be insulated.
- Perch discouragers and ribbons that alert birds to change flight course will be deployed if deemed necessary.

14. Explain the avoidance and minimization measures that will be implemented to protect the flora from invasive species.

To avoid the unintentional introduction or transport of new terrestrial invasive species to O'ahu, all construction equipment and vehicles arriving from outside O'ahu will be washed and inspected prior to entering the site. In addition, construction materials arriving from outside O'ahu will also be washed and/or visually inspected (as appropriate) for excessive debris, plant materials, and invasive or harmful non-native species (plants, amphibians, reptiles, and insects). When possible, raw materials (gravel, rock, and soil) will be purchased from a local supplier on O'ahu to avoid introducing non-native species on the island.

15. Explain the avoidance and minimization measures that will be implemented to protect the fauna.

To minimize the potential impacts to fauna, the following measures will be implemented:

- Regular on-site staff will be trained to identify special-status species with potential to occur on-site and should know the appropriate measures to be taken if they are present.

- Within 3 days before tree removal, a qualified biologist should conduct a nest search for the MBTA-protected species in order to protect nests until the chicks fledge.

- If tree clearing occurs within 305 m (1,000 feet) of O'ahu 'elepaio critical habitat from January through July, a qualified biologist will survey the tree clearing area. If a nest is found, the USFWS and DLNR will be contacted.

- If a Hawaiian goose, Hawaiian stilt, Hawaiian coot, Hawaiian short-eared owl, or Hawaiian hoary bat is observed in the area during construction activities, all activities within 30 m (100 feet) of the individual will cease, and work will not continue until the individual leaves the area on its own accord.

- If a Hawaiian goose nest is discovered, all activities within 46 m (150 feet) of the nest should cease, and the USFWS will be contacted. Work will not resume until directed by the USFWS.

- Hawaiian short-eared owl surveys will be conducted before vegetation clearing where suitable habitat for owl nesting is present within the project area. If a Hawaiian short-eared owl nest is discovered, all activities within 46 m (150 feet) of the nest will cease, and the DLNR will be contacted. Work will not resume until directed by the DLNR.

- If tree removal occurs during the bat breeding season, direct impacts could occur to juvenile bats that are too small to fly but too large to be carried by a parent. To

minimize this impact, no trees taller than 15 feet (4.6 m) will be trimmed or removed between June 1 and September 15.

- All fence construction will be barbless top-strand wire.

To minimize potential impacts to seabirds, the following measures will be followed:

- Construction activity will be restricted to daylight hours as much as practicable during the seabird peak fallout period (September 15–December 15) to avoid the use of nighttime lighting that could attract seabirds.
- All outdoor lights will be downward shielded to prevent light from radiating upward.
- Outside lights not needed for security and safety will be turned off from dusk through dawn during the fledgling fallout period (September 15–December 15).

16. Is there federally designated critical habitat in the Project area?

No.

17. Are there jurisdictional waters within the Project area?

No.

18. Are there any wetlands within the Project area?

No.

Respectfully submitted,

DERON LAWRENCE

DATED: Honolulu, Hawai'i, 11 JUNE, 2021.

Robert B. Rechtman, Ph.D.
Chief Executive Officer, ASM Affiliates

Total Years of Experience: 42

ASM affiliates
Archaeology • History • Ethnography • Architectural History

Education

Ph.D.	1992/Anthropology/University of California, Los Angeles
M.A.	1985/Anthropology/University of California, Los Angeles
B.A.	1983/Anthropology/University of California, Los Angeles

Professional Profile

Robert B. Rechtman, Ph.D. is currently the Chief Executive Officer and a Principal Archaeologist with ASM Affiliates (ASM). Prior to joining ASM in 2013, Dr. Rechtman founded and was the Principal Archaeologist of Rechtman Consulting, LLC, a cultural resources management firm (founded in 2000). Since 2000 has successfully completed more than 1,300 cultural resources management projects throughout the State of Hawai‘i. The range of projects included Section 106 Compliance, Cultural Impact Assessments, Archaeological Assessments, Reconnaissance Surveys, Inventory Surveys, Site Testing, Data Recovery, Preservation Planning, Burial Treatment Planning, and Archaeological Monitoring. These projects were been conducted for private landowners and developers, and county, state, and federal agencies. Before forming Rechtman Consulting, LLC, Dr. Rechtman was a Senior Archaeologist with PHRI for three years, where among other responsibilities was a Principal Investigator for a portion of an IDIQ contract with the U.S. Navy, Pacific Division. And before that, from 1995 to 1997, Dr. Rechtman served as the Cultural Resources Manager for the U.S. Army’s National Training Center at Fort Irwin; for which he received the Secretary of the Army Environmental Award. Collateral responsibilities included lead cultural resources person for the Mojave Ecosystem National Performance Review Project, for which he received a National Performance Review Award. As a result of his work with the U.S. Army, Dr. Rechtman has gained substantial expertise in federal contracting and regulatory compliance activities. Dr. Rechtman’s 42 years of professional archaeological experience includes work on archaeological projects in the Hawaiian Islands dating back to 1989.

Training, Honors & Awards

Section 106 Training. Advisory Council on Historic Preservation (1995)
Advanced Training: Agreement Documents under Section 106. Heritage Resource Management Program (1996)
Archaeological Resources Protection Training. Federal Law Enforcement Training Center (1996)
Secretary of the Army Environmental Award. Pentagon (1999)
National Performance Review Award. White House (1997)
National Science Foundation Grant (1991)
Fulbright Fellowship, Institute of International Education/U.S. Information Service (1989/90)

Professional Memberships

Society for Hawaiian Archaeology
Society for American Archaeology

Certified Expert Witness Testimony

Hawai‘i State Land Use Commission
Hawai‘i State Board of Land and Natural Resource
Hawai‘i County Planning Commission

WRITTEN DIRECT TESTIMONY OF ROBERT B. RECHTMAN, Ph.D.
(Archaeology)

1. Please state your name and business address for the record.

Robert B. Rechtman, 820 Mililani Street, Suite 700, Honolulu, Hawaii 96813

2. What is your current occupation?

I am the Chief Executive Officer and a Principal Archaeologists with ASM Affiliates.

3. What is ASM Affiliates?

ASM Affiliates is a Cultural Resources Management firm that provides archaeological, cultural, historical, and architectural history services to local, state, and federal agencies, as well as to private developers.

4. How long have you worked for ASM Affiliates?

I have been employed as a Principal Archaeologist with ASM Affiliates for the past 8 years.

5. Where did you work and in what capacity prior to ASM Affiliates?

Between 2000 and 2013, I was the Principal Archaeologist with Rechtman Consulting, LLC, a company I founded after leaving the employment of PHRI, where I worked between 1997 and 2000 as a Senior Archaeologist and Director of Hawaii Operations.

6. Did you provide a copy of your biography and or resume for these proceedings?

A copy of my resume was filed as ***Exhibit 21.***

7. Do you specialize in any particular area?

I have specialized in Pacific Islands archaeology since 1985 and have worked on over 1,000 projects in the Hawaiian Islands beginning in 1989.

8. Can you describe the Mahi Solar Project ("Project") that is the subject of the SUP application?

Mahi Solar is proposing to construct a 120-megawatt solar project, a Battery Energy Storage System (BESS), and other associated appurtenances including fencing, roads, and electrical infrastructure on roughly 600 acres of agriculture-zoned land that includes portions of Tax Map Keys (1) 9-2-001:001; 9-2-004:003, 006, 009, 010, 011, 012, and 013; 9-04-003:0001.

9. What is your role with this Project?

ASM Affiliates, with myself as the Principal Archaeologist, completed an Archaeological Inventory Survey (AIS) for the project area in compliance with HRS Chapter 6E-42.

10. When was the AIS completed?

Fieldwork for the AIS was carried out between August 2020 and January 2021 and the report was completed in April 2021.

11. Was the AIS submitted to SHPD?

Yes, the AIS was submitted to SHPD on 4/6/2021. To date, we have not yet received a response.

12. Describe the fieldwork conducted for the survey.

Fieldwork consisted of a surface survey of the entire project area, with field personnel walking parallel transects spaced between 5 and 20 meters depending on terrain and vegetation cover.

13. Was subsurface testing conducted?

No.

14. What were the results of the field survey?

As a result of the fieldwork effort two sites were defined, SIHP Site 2268 (Waiāhole Ditch) and SIHP Site 7346 (Oahu Sugar Company Irrigation features). The Waiāhole Ditch has been previously documented in other portions of O'ahu, and was built between 1913 and 1916 by the Waiahole Water Company, a subsidiary of the Oahu Sugar Company. Site 7346, a feature of which was previously recorded to the west of the current project area, is described in the AIS as a collection of Plantation-era irrigation infrastructure features associated with commercial cultivation of the project area likely beginning after 1916, a date marking the availability of water in the project brought by the Waiāhole Ditch.

Research and consultation was also conducted regarding the Pohakea Trail. No physical evidence of the Trail is evident in the Project Area as it appears it was superseded by a roadway that runs along and outside the boundaries of the Project Area.

15. How were the sites evaluated in the AIS and were there treatment recommendations offered?

SIHP Site 2268 (Waiāhole Ditch) was evaluated as significant under Criterion a and Criterion c, the significance of this site with respect to both its engineering aspects and its

effects on Oʻahu's physical and political landscapes cannot be overstated. As the Waiāhole Ditch continues to be a functioning water source for irrigation and other purposes, and as it will remain beyond the footprint of any Mahi Solar ground lease areas, per HAR §13-284-8 (a)(1)(A) the recommended treatment for this site with respect to the current project was "avoidance and protection" during development activities.

SIHP Site 7346 (Oahu Sugar Company Irrigation infrastructure) was evaluated as significant under Criterion a as the agricultural fields that this infrastructure supported were significant in Hawaii's plantation history; and, as the study of this site (both archaeologically and cartographically) has yield information on twentieth century land use practices, Site 7436 was also evaluated as significant under Criterion d. While it was the contention of the AIS that the archaeological research potential for Site 7436 within the current project area had likely been exhausted, the possibility (albeit remote) remains that as of yet significant undiscovered aspects of this site, or archaeological resources that predate this site, could be encountered within the current project area; therefore, per HAR §13-284-8 (a)(1)(C) the recommended treatment for this site with respect to the current project was "monitoring" during development activities.

As evidence indicates that the Pohakea Trail passes outside the Project Area, no recommendations were made with respect to that resource.

Respectfully submitted,

ROBERT B. RECHTMAN, Ph.D.

DATED: Hilo, Hawaiʻi, June 10, 2021.

Lokelani M.P. Brandt, M.A.
Senior Archaeologist & Cultural Specialist, ASM Affiliates

ASM affiliates
Archaeology • History • Ethnography • Architectural History

Education

M.A.	2017/ Cultural Heritage Management/ University of Hawai‘i at Hilo
B.A.	2012/ Anthropology & Hawaiian Studies/ University of Hawai‘i at Hilo
A.A.	2011/ Liberal Arts/ Hawai‘i Community College
A.A.S	2011/ Hawai‘i Life Styles/ Hawai‘i Community College

Employment History

2017-Present	Senior Archaeologist, ASM Affiliates, Hilo, Hawai‘i
2013-2017	Lecturer, Hawai‘i Community College, Hilo, Hawai‘i
2015-2017	Field Technician/Researcher, Nohopapa Hawai‘i, LLC, Kailua, Hawai‘i
2013-2017	Communications Director, Huliauapa‘a 501c3, Kailua, Hawai‘i
2012-2014	Keala Pono Archaeological Consulting, LLC, Kane‘ohe, Hawai‘i
2011-2012	Federal Hālaulani Cooperative Agreement Development Grant, Hilo, Hawai‘i
2007-2011	Hale Kuamo‘o Hawaiian Language Center, Hilo, Hawai‘i

Professional Profile

Lokelani Brandt is a Senior Archaeologist & Cultural Specialist with ASM's Hilo Office. Since 2012, she has worked on multiple Cultural Resources Management projects on Kaua‘i, O‘ahu, Maui, Moloka‘i, and Hawai‘i Island. In addition to consultation work, she has successfully led and organized several community-based cultural heritage management programs on Hawai‘i Island geared towards training local communities on the identification and protection of their tangible and intangible heritage. In 2017, Lokelani earned her M.A. degree in Cultural Heritage Management from the University of Hawai‘i at Hilo. Her Master's thesis focused on the recovery of the nearly forgotten Hawaiian cultural history of a small land division known as Pi‘opi‘o, located in Waiākea, Hilo, Hawai‘i. She drew on ethnohistorical accounts written in the Hawaiian and English language, archaeology, all while engaging with the local community. Lokelani has experience in the technical aspects of archaeology including, but not limited to inventory and reconnaissance surveys, site testing, excavation, artifact identification and cataloging, site recordation, community consultation, record searches, Hawaiian language translation, historical background research, and technical report writing.

Awards/ Honors

Graduated with High Honors, University of Hawai‘i at Hilo (2012).

Graduated with High Honors, Hawai‘i Community College (2011).

Professional Memberships

Society for Hawaiian Archaeology
Native American and Indigenous Studies Association

Selected Technical Reports

2021 A Historic Properties Study in Compliance with Section 106 of the National Historic Preservation Act for the Central Section of Ke Ala Kahawai O Waimea Trail Project, Portions of TMK(s): (3) 6-5-003:004, 005, 044; (3) 6-6-003:006, 007, and 013, Lālāmilo Ahupua‘a, South Kohala District, Island of Hawai‘i. ASM Project Number 34650. Prepared for Cardno GS, Inc., Kamuela.

2021 A *Ka Pa‘akai O Ka ‘Āina* Analysis for the Lili‘uokalani Trust LT Ranch in Pu‘ukapu, TMK: (3) 6-4-018:095, Pu‘ukapu Ahupua‘a, South Kohala District, Island of Hawai‘i.

2020 A Cultural Impact Assessment for the Proposed Single-Family Development of the Holcomb Family Trust Parcel, Mālamalamaiki 1st and 2nd Ahupua‘a, South Hilo District, Island of Hawai‘i. ASM Project Number 35400. Prepared for Carlsmith Ball, LLP, Hilo.

2020 A Cultural Impact Assessment for the Waimea Roadway Improvements Project, TMK(s): (3) 6-5-003:005 (por.), 6-5-004:027 (por.), 6-5-005:021 (por.) and 025 (por.), and 6-5-007:001 (por.), Lālāmilo Ahupua‘a, South Kohala District, Island of Hawai‘i. ASM Project Number 34580. Prepared for SSFm International, Inc. Hilo.

2019 An Archaeological Reconnaissance Survey of 300 Acres of Kamehameha Schools' Land in Coastal Punalu‘u Ahupua‘a, TMK: (3) 9-6-006:006 por., Punalu‘u Ahupua‘a, Ka‘ū District, Island of Hawai‘i. ASM Project Number 28870. Prepared for Kamehameha Schools, Honolulu.

2019 A Cultural Impact Assessment for the Proposed Statewide Release of a Wasp Paraditoid (*Aprostocetus nitens*) as Biocontrol for the Erythrina Gall Wasp (Quadradstichus erythrinae), State of Hawai‘i. ASM Project Number 31270. Prepared for the Department of Land and Natural Resources, Division of Forestry and Wildlife.

2018 An Archaeological Reconnaissance Survey of 209 Acres of Kamehameha Schools' Land in Maui Ku‘ia and ‘Auwai o Pi‘ilani, Ku‘ia Ahupua‘a, TMK: (2) 4-6-018:003, Ku‘ia Ahupua‘a, Lahaina District, Island of Maui.

2018 A Cultural Impact Assessment for the Ou Community Correctional Center Replacement Project, TMKs: (1) 1-2-013:002; (1) 4-2-003:004, 024, 025, 026; (1) 9-5-046:041 and 042; (1) 9-9-010:006, 031 por., 046 por., 054, 055, 057, and 058, Hālawa, Kalihi, Waikele, and Kailua Ahupua‘a, ‘Ewa, Kona, and Ko‘olaupoko Districts, Island of O‘ahu.

2018 A Cultural Impact Assessment for the Paniolo Tonewoods Kapoaula Koa Forest Management Project, Kapoaula Ahupua‘a, Hāmākua District, Island of Hawai‘i. ASM Project Number 31870. Prepared for Geometrician Associates, LLC, Hilo.

2017 A Cultural Impact Assessment in Support of an HRS Chapter 343 Environmental Planning Process for the HELCO Waiau Hydro Repowering Project on Wailuku River, Hilo District, Island of Hawai‘i. ASM Project Number 26930. Prepared for Jennifer Scheffel, SSFM International, Honolulu, HI.

Projects with Other Firms

2016 "Pi‘opi‘o, He ‘Āina Ali‘i Mai Kahiko Mai." Prepared for Kamehameha Schools. Directed a field crew in the survey of the property and the recordation of archaeological features located therein. Conducted historical research at various local archives and repositories, and was the primary author responsible for report preparation.

2015 "Hāmākua I Nā Pali Lele Koa‘e." Prepared for Kamehameha Schools. Directed a field crew in the survey of the property in east Hāmāua and the recordation of archaeological features located therein. Conducted historical research at various local archives and repositories, and was one of two authors responsible for report preparation.

2013 "Ethno-historical Study of the Kalāhuipua‘a Fishponds, Waikoloa Ahupua‘a, South Kohala District, Island of Hawai‘i." Prepared for Group 70 International. Conducted multiple interviews with various community members, transcribed audio recordings of the interviews, and prepared documents for the community consultation portion of the project.

2013 "Ethno-historical study of the Wao Kele O Puna Forest Reserve." Prepared for the Office of Hawaiian Affairs, (OHA). Conducted ethnohistorical research at various repositories in East Hawai‘i, and completed the post-contact background research.

Academic Publication

2013 "Is Hawaiian Archaeology Really Hawaiian" *The Society for American Archaeology Archaeological Record*. January, Vol. 13, No. 1:31-32.

2017 Paired geochemical and technological analyses of basalt adze debitage at the Hālawa Dune Site, Moloka‘i Island, Hawai‘i. *Archaeology in Oceania*. Vol. 53, No. 2:77-135.

References

Robert B. Rechtman, ASM Affiliates, (808) 969-6066
Kathleen Kawelu, University of Hawai‘i at Hilo Anthropology Department, (808) 333-6717
Peter Mills, University of Hawai‘i at Hilo Anthropology Department, (808) 932-7268
Sean Naleimaile, DLNR State Historic Preservation Division, (808) 640-5699
Noe Noe Wong-Wilson, University of Hawai‘i at Hilo, (808) 938-2884

WRITTEN DIRECT TESTIMONY OF
LOKELANI BRANDT, M.A.
(Cultural Resources / Ka Pa`akai Analysis)

1. Please state your name and business address for the record.

Lokelani Brandt
507-A E. Lanikaula Street
Hilo, HI 96720

2. What is your current occupation?

Senior Archaeologist with ASM Affiliates

3. How long have you worked in that position?

I have been employed with ASM Affiliates since June 2017. I started as an Associate Archaeologist and within a year was promoted to Senior Archaeologist.

4. Did you provide a copy of your biography and or resume for these proceedings?

A copy of my resume was filed as ***Exhibit 23***.

5. Do you specialize in any particular area?

My specialization is in preparing Cultural Impact Assessment studies, Ka Paʻakai O Ka ʻĀina studies, Burial Treatment Plans, Archaeological Reconnaissance and Inventory Survey reports, community consultation, Archaeological Site Preservation Plans, and Section 106 consultation and report preparation.

6. Can you describe the Mahi Solar Project ("*Project*") that is the subject of the SUP application?

Mahi Solar, LLC is proposing to construct a 120-megawatt solar project, a Battery Energy Storage System ("***BESS***"), and other associated appurtenances including fencing, roads, and electrical infrastructure on roughly 600 acres of agriculture-zoned land that includes portions of Tax Map Keys (1) 9-2-001:001; 9-2-004:003, 006, 009, 010, 011, 012, and 013; 9-04-003:0001.

7. What is your role with this Project?

I, along with Halena Kapuni-Reynolds, M.A., prepared the Ka Pa`akai O Ka `Āina Cultural Practices and Resources Analysis ("***Cultural Practices Analysis***") for the Project and said analysis is attached to the SUP Application as Appendix E. The Cultural Practices Analysis is intended to aid Mahi Solar and the State of Hawaiʻi and its associated agencies with

addressing preservation and protection of traditional and customary rights with respect to the Project. The Cultural Practices Analysis assesses the following:

1. The identity and scope of "valued cultural, historical, or natural resources" in the petition area, including the extent to which traditional and customary native Hawaiian rights are exercised in the petition area;

2. The extent to which those resources—including traditional and customary native Hawaiian rights—will be affected or impaired by the proposed action; and

3. The feasible action, if any, to be taken by the State Land Use Commission to reasonably protect native Hawaiian rights if they are found to exist.

8. <u>What sources did you rely upon to prepare the Cultural Practices Analysis?</u>

The Cultural Practices Analysis relies on historical archival sources, prior cultural and archaeological studies, and consultation with community members who have genealogical ties and long-standing residency to the proposed Project area to identify whether any valued cultural, historical, or natural resources are present within said area.

9. <u>Who did you consult with to identify customary and traditional cultural practices associated with the Project area?</u>

Five community members: Thomas Lenchanko, Dietrix Ulukoa Duhaylonsod, Douglas "McD" Philpotts, Glen Kila and Christopher Oliveira. Each identified customary and traditional cultural practices associated with the Project area that included the Pohakea Trail and a *heiau.*

Lead staff from the Department of Land and Natural Resources who opined that no specific information can be identified with respect to known archaeological or cultural resources in the Project area.

Lead compliance staff from the Office of Hawaiian Affairs, Kai Markell, who had no information about traditional cultural traditions and practices specific to the Project area but had identified individuals with whom we should contact to obtain such information

10. <u>Identify whether any valued cultural, historical, or natural resources are present within the Project area, and identify the extent to which traditional and customary Native Hawaiian rights are exercised.</u>

The following have been identified as traditional customary practices that formerly took place within the general Project area vicinity:

Pohakea Trail:

The Pohakea Trail is a trail that connects the lands of Honouliuli (ʻEwa) and Lualualei (Waiʻanae) via the Waiʻanae Mountains and it is referenced in both traditional literature and by consulted parties. The trail has been described as passing near the northern section of the Project area. The portion of the trial in the vicinity of the Project area is shown as a road that runs along and outside the boundary of the Project Area. As the road ascends the Waiʻanae Mountains, the road is shown as a foot trail. All of the consulted parties identified Pohakea trail as a valued cultural resource and noted that access to the trail impacts their ability to carry out their traditional customary rights.

Traditional Hawaiian Agricultural Practices and Endemic Plant References and Uses:

Historical literature identified agricultural practices that included *ʻuala* (sweet potato) and *loʻi kalo*. The following native plant regimes were referenced throughout Honouliuli: *maʻo* (Gossypium tomentosum) blossoms, *ʻilima* (Sida fallax), *ōhai* (Sesbania tomentosa), *koaiʻa* (Acacia koaia), *kukui* (Aleurites moluccanus), *wiliwili* (Erythrina sandwicensis), *nohu* (Tribulus cistoides), *ʻōhiʻa lehua* (Metrosideros polymorpha), and *kaunoʻa* (Cuscuta sandwichiana), *red pilipili grass* (Chrysopogon aciculatus). Historical accounts also describe the presence of "extensive stands" of ʻ*iliahi* (sandalwood); however, these forests were destroyed by the sandalwood industry and subsequent sugar and pineapple industries, resulting in the barren landscapes that are seen today. The results from consultation suggest that no traditional agricultural practices nor traditional gathering of plant resources is currently taking place in the Project area. The fact that such customary practices are not being carried out is a result of decades of restricted access that has prevented community members and practitioners from accessing the uplands to gather plant resources for cultural purposes.

Aliʻi Battle Sites:

Warfare took place in Honouliuli over centuries as warring chiefs from inter-island polities sought more land and political prestige. While warfare in the Project area has not taken place for many generations, the consulted individuals recognize the area as an important aspect of Oʻahu's Hawaiian history and heritage.

Cultural Sites and Resources in the Vicinity of Puʻu Kuʻua:

The southwestern portion of the Project area is situated at the base of Puʻu Kuʻua and was known for its extensive stands of sandalwood. Consultants describe a *heiau* atop Puʻu Kuʻua as being culturally significant. Astronomical observations also occurred in Puʻu Kuʻua and a population of *kauā* once lived in Puʻu Kuʻua. However, by the early 19th century, Puʻu Kuʻua and the surrounding area was sparsely populated and nearly abandoned.

Possibility of Remnant Cultural Sites in Gulches, Ravines and Along Ridgelines:

All of the consulted parties acknowledged the history of intensive agriculture practices and its resulting impacts on the natural and cultural resources once located in the Project area. However, since historical agricultural practices, such as sugarcane and pineapple cultivation, were often not conducted in gulches, ravines, and ridgelines there is a possibility of finding remnant cultural sites in those areas. There is also the possibility of finding remnant subsurface features in formerly cultivated areas.

Freshwater and the Waiāhole Ditch:

Freshwater can be found along the base of the Waiʻanae Mountains as well as the gulches and ravines. Portions of the Waiāhole Ditch can be found extending through portions of the Project area as well as along portions of the Project area boundaries.

11. <u>Identify the extent to which those resources and rights will be affected or impaired by the proposed Project.</u>

The proposed Project has the potential to impact all of the identified resources and associated practices to a degree if proper mitigative measures are not thoughtfully considered and implemented. Concerning Pohakea trail, if access remains obstructed, it infringes upon customary access rights and any concomitant resources and traditional customary practices (i.e., gathering of plant resources for cultural purposes) that would otherwise occur along this trail. However, the access is currently blocked by a gate that is outside the Project area and controlled by other parties, not the Applicant.

With respect to plant resources, while the majority of the Project area is dominated by non-native species, a biological survey of the Project area resulted in the identification of several native species including scattered individuals of ʻ*iliahialoʻe* (Santalum ellipticum), scattered individuals of *wiliwili* (Erythrina sandwicensis) in the dry lower gulches, and *ʻuhaloa* (Waltheria indica) found in fallow fields and roadsides). The former two plant species were noted in historical literature and traditional accounts. If the proposed Project footprint extends into native plant habitat, then such resources would be adversely impacted. Conversely, if the Project footprint does not extend into native plant habitat, then there would be no impact on such resources.

Concerning potential impacts to the battle site based on the available information it is difficult to ascertain the exact location of the battle site. Historical records indicate that the battle occurred on the plains of Keahumoa which is located to the area north of the Project area. It is unlikely the proposed Project would have any direct adverse impacts to the battle site.

A substantial portion of the Project area is within formerly cultivated and existing fields which are devoid of any surface archaeological sites and features. Although surface features may not be present within these extensively plowed areas, encountering subsurface features, although unlikely, remain a possibility. Additionally, in locations

where the Project area footprint extends into gulches, ravines, and previously undisturbed areas, the possibility of encountering archaeological and cultural resources increases substantially and thus the proposed Project has the potential of impacting such resources. Portions of the proposed Project appear to cross over at least four natural waterways as well as small segments of the historic Waiāhole Ditch. The proposed Project does not appear to alter, modify, or redirect the existing flow of freshwater nor the Waiāhole Ditch, thus no apparent impacts to water resources or to the Waiāhole Ditch are anticipated.

12. <u>Specify any mitigative actions to be taken to reasonable protect Native Hawaiian Rights if they are found to exist.</u>

Concerning the Pohakea Trail, further research and consultation has indicated that there is no physical evidence of the Trail in the Project area. Instead, there is evidence that the Trail was superseded by a roadway that runs along and outside the boundaries of the Project area. Concerning plant resources, efforts should be made to avoid all native plant species and their associated habitat. Such areas should be identified and avoided. Similarly, archaeological resources should also be identified and avoided. If the above-described recommendations are considered and implemented, impacts to traditional and customary practices would be mitigated.

Respectfully submitted,

LOKELANI BRANDT, M.A.

DATED: Honolulu, Hawai‘i, June 10, 2021.

ANDY STEPHENS –VISUALIZATION SPECIALIST III

VISUAL ANALYSIS/SIMULATION/ANIMATION

YEARS OF EXPERIENCE

12

EDUCATION

> B.S., Virtual Technology & Design, University of Idaho, 2008

AREAS OF EXPERTISE

> Visualization Development
> Visual Analysis
> Glint and Glare Analysis
> Photo Simulations
> 3D Animations

CERTIFICATION

> Autodesk Certified Professional 3ds Max
> FAA Certified Remote UAS Pilot

EXPERIENCE SUMMARY

Andy Stephens is part of POWER's Visualization and Visual Resources Department. Andy has a degree in virtual technology and design and has over 12 years of visualization experience with an emphasis in visual analysis and solar technology. Andy got his start as a designer for Hewlett Packard in 2009, developing marketing and training visuals for the small business sector. Andy was recruited by POWER in 2011 and focused his career on the use and application of visualization technology to qualify visual analysis methods and results. He found that visualization technology was one of the best tools to design, analyze and present information. While at POWER, he has tailored his skillset to the analysis and visualization of solar technologies and continues to excel at simplifying complex problems in an ever changing industry.

Brawley Solar Project, Ormat Solar, Solar Glare Analysis and Visual Simulation

Visualization Specialist providing Entitlement and Conditional Use Permit support for a new 40 MW solar farm with a 1.6 mile gen-tie line to an existing substation and geothermal plant. Responsible for production and oversite of a glare analysis to determine potential impacts of the proposed projects to the nearby airports, motorists and residences. Analysis includes technical write-up and supporting graphics. Also responsible for development of Visual Simulations to assist in visual analysis of the project. POWER was the third-party contractor for Ormat Solar and Chambers Group.

Group 70 International, Solar Glare Analysis

Visualization Specialist responsible for production and oversite of a glare analysis to determine potential impacts of the proposed projects to the nearby airports, motorists and residences. Analysis includes technical write-up and supporting graphics. POWER was the third-party contractor for Group 70 International Inc.

Rancho Seco Solar II, Sacramento Municipal Utility District, Visual Simulation & Video

Visualization Specialist providing CEQA support for a new 90 MW solar facility. Responsible for development and oversite of photo simulations, video simulations and drone operations to assist in visual analysis of the project.

Renewable Resources Group, Blythe Mesa Solar EIR and EA, California

Visualization Specialist supporting preparation of a joint EIR and EA (CEQA and NEPA) for a new 485 MW photovoltaic solar project. Responsible for production of a glare analysis to determine potential impacts of the project to the nearby airport. POWER was the third-party contractor for the Renewable Resources Group, Riverside County, and the BLM California Desert District, to prepare a joint EIR and EA (CEQA and NEPA) document for this 485 MW photovoltaic solar project. In addition to the PV solar panels, the project will include up to three substations, up to two O&M buildings and an approximate 4.8-mile, 230 kV transmission line. POWER provided assistance in all phases of the environmental process, including the Notice of Preparation, scoping meetings, technical studies, and preparation of EIR/EA.

RECENT SOLAR GLARE PROJECT EXAMPLES:

- **JVR Energy Park Solar Project 2021**
- **Rugged Solar Project 2021**
- **Brawley Solar Project 2021**
- **G70 Mahi Solar Project 2020**
- **G70 Pulehu Solar Project 2020**
- **G70 Longroad Energy Solar Project 2020**
- **Mohawk Solar Project 2019**
- **Inyokern Phase II Solar Project 2019**
- **Prairie Solar Project 2018**
- **JVR Solar Project 2018**
- **RB Inyokern Solar Project 2018**
- **Drew Solar Project 2017**
- **G70 Aloha Solar II Solar Project 2017**
- **G70 Kona Airport Solar Project 2017**
- **SMUD Solar Simulations 2017**
- **Thousand Palms Solar Project 2016**
- **G70 Oahu Solar Farm 2016**
- **North Star Solar Project 2015**
- **EPD Hemet Solar Field 2015**
- **G70 Kalaeloa Solar Project – 2014**
- **G70 Kahului Airport Project – 2014**
- **Westwood Maxton, Solar Project – 2014**
- **Cabrillo Solar Project – 2014**
- **EPD Sunedison Project – 2014**
- **Hemet Solar Project – 2014**
- **San Diego Ballpark Village 2013, 2014**
- **8 Minute Energy, Calexico – 2013**
- **Soitec Boulevard Project – 2013**
- **G70 Aloha Solar Energy, Kalaeloa Solar Project – 2013**
- **Ocotillo Wells Solar, Gildred Co – 2013**
- **G70 East Kapolei Solar Project, Aloha Solar – 2013**
- **Beechwood Builder Green Solutions – 2013**
- **Laurinburg Solar Project – 2013, 2014**
- **Soitec Desert Green Solar Project – 2013**
- **Westwood Skyfuel Project – 2013**
- **SunPower, Inc C7, Solar Study – 2012**
- **MEMC Kuala Lumpur Int. Airport Solar Project – 2012**

- **Palo Verde Mesa Solar Project, RRG – 2012**
- **Blythe Mesa Solar Project, RRG – 2011,12**
- **Calico Solar Project, Calico LLC – 2012**
- **Silverado Solar Project, 20, 200kV project Animations – 2011**

ASM affiliates
Archaeology • History • Ethnography • Architectural History

ASM Project 29450.04

December 13, 2020

Deron Lawrence
Longroad Energy Management, LLC
1 Longroad Boston
330 Congress Street, 6th Floor
Boston, MA 22101
mailto:deron.lawrence@longroadenergy.com *via email*

Subject: Archaeological Reconnaissance for the Mahi Solar Project

Dear Deron:

ASM Affiliates (ASM) has completed our initial archaeological reconnaissance for the Mahi Solar project located on multiple parcels (TMKs: (1) 9-2-004:003, 006, 010, 012; (1) 9-2-001:001; (1) 9-4-003:001). The study area is shown on Figure 1. Fieldwork was conducted under the supervision of Robert B. Rechtman, Ph.D. (Principal Investigator). Background research conducted prior to the fieldwork suggested much of the study area has been previously disturbed associated with nearly a century of intensive cultivation. Figures 2, 3, and 4 depict the current study area overlain on a series of aerial photographs showing the past agricultural uses. This letter report was prepared to accompany the City and County of Oʻahu Special Use Permit Application prepared for the project. Presented below are a summary of the fieldwork completed, our preliminary findings, and anticipated treatment recommendations for the identified archaeological sites.

Archaeological Reconnaissance Survey Findings

An archaeological reconnaissance surface survey of the entire roughly 690-acre study area was conducted between August 14 and September 4, 2020. The field personnel included Teresa Gotay, M.A., Kimberly Lauko, B.A., and Daina Avila, B.A. Fieldwork consisted of a surface survey of the entire study area, with field personnel walking parallel transects spaced between 10 and 25 meters apart (spacing based on surface visibility). No subsurface testing was conducted. As a result of the reconnaissance, numerous Historic Period plantation infrastructural elements (concrete "Waialua" flume segments (Figure 5), metal pipes (Figure 6), concrete reinforced masonry structures (Figure 7), etc.) were found primarily in Area 5, and to a lesser degree in the peripheral portion of Area 1 (see Figure 1). These elements were found in both undisturbed and disturbed (Figure 8) contexts.

A section of the Waiāhole Ditch (Figure 9; SHIP Site 50-80-09-2268) was also identified meandering between the solar array areas and crossing the access and transmission line corridors (see Figure 1). The construction of the massive Waiahole Ditch project, which included twenty-seven tunnels that connected to thirty-seven stream intakes on the Koʻolau mountains with the main tunnel reaching Waiāhole Valley, was completed in 1916 by the Waiahole Water Company, a subsidiary of Oahu Sugar Company. Extending for 21.9 miles, this construction, with some modifications, is still in use today.

Lastly, one site of seemingly Precontact origins (Temp Site 2) was observed in the vicinity of the proposed Substation/BESS interconnection facility (see Figure 1). This site is a constructed stone platform (Figure 10) that appears to have been protected throughout the years of agricultural use by the placement of a large boulder barrier surrounding the site (Figure 11). More research and consultation will be conducted with respect to the nature of this platform and its seemingly protected status.

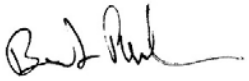
Conclusion and Recommendations

All of the historic resources identified during this reconnaissance study will be further documented in an Archaeological Inventory Survey (AIS) in compliance with Hawaii Revised Statutes (HRS) Chapter 6E-42 and in accordance with Hawaii Administrative Rules (HAR) §13-284 and 276. The AIS will contain a culture-historical context sufficient to support significance assessments for the documented sites. Treatment recommendations for each of the sites will also be made along with a project effects determination.

Specifically, the plantation infrastructural elements will be fully documented as part of the AIS with a likely recommended treatment of "No Further Work." Site 2268 (Waiāhole Ditch), portions of which have been previously documented outside of the current study area, will be fully recorded during the AIS where it extends through the current study area. The recommended treatment for this site will be avoidance and protection. Site T-2 (traditional platform) will also be fully documented as a part of the AIS with a likely recommended treatment of "Preservation."

Should you have any question or concerns, please do not hesitate to contact me directly.

Sincerely,



Robert B. Rechtman, Ph.D.

Principal Archaeologist

Figures

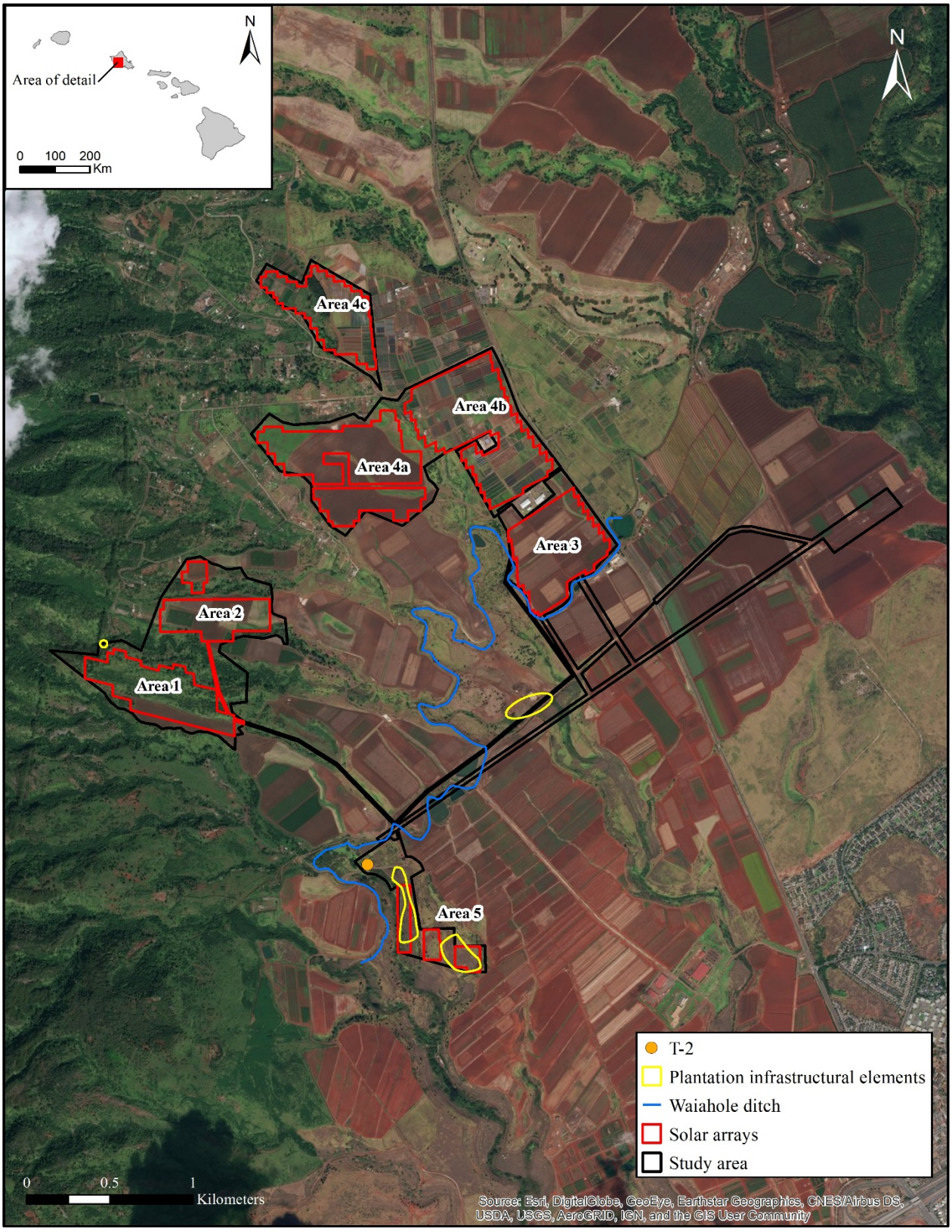


Figure 1. Study area location, project layout, and recorded sites locations.

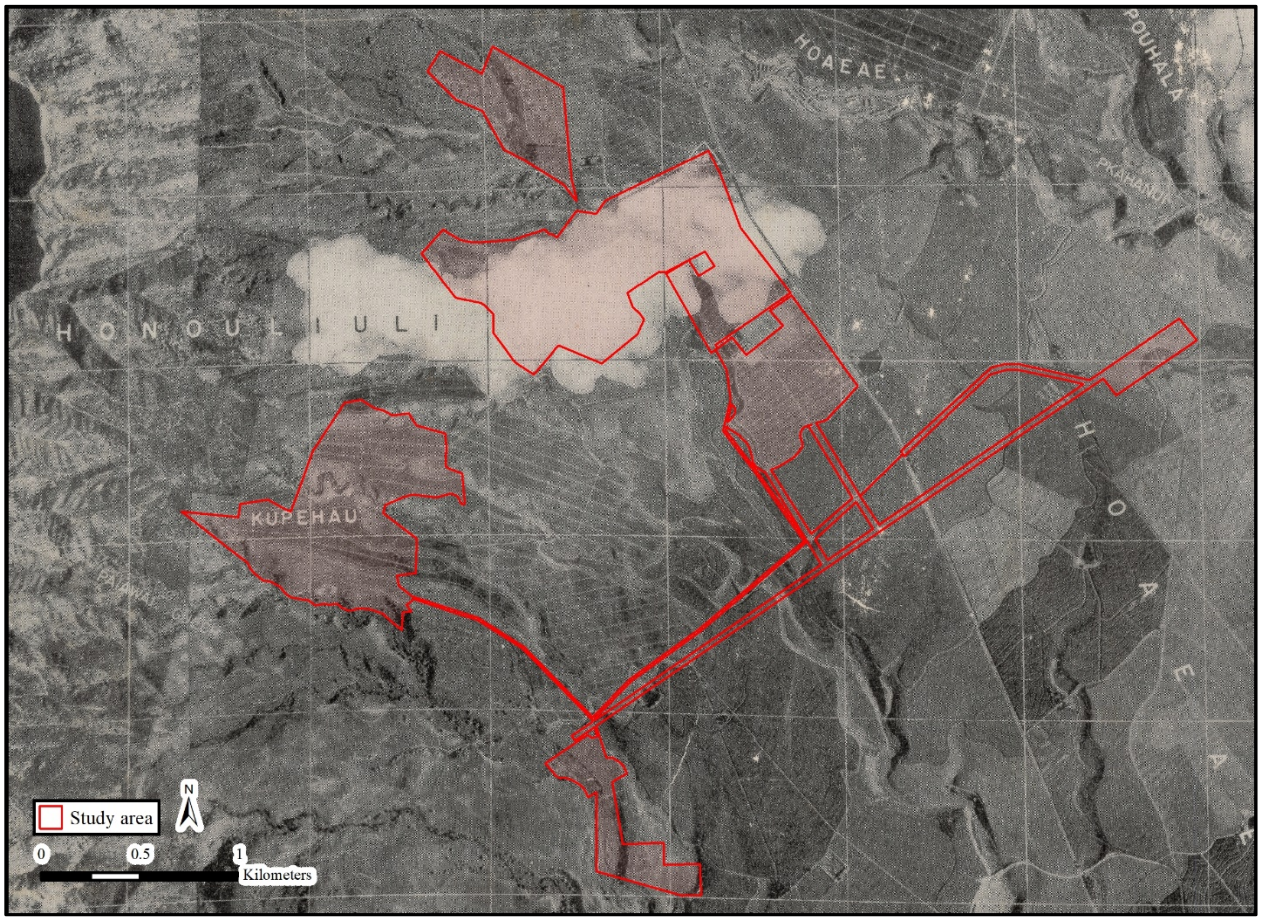


Figure 2. 1944 aerial image with study area location superimposed.

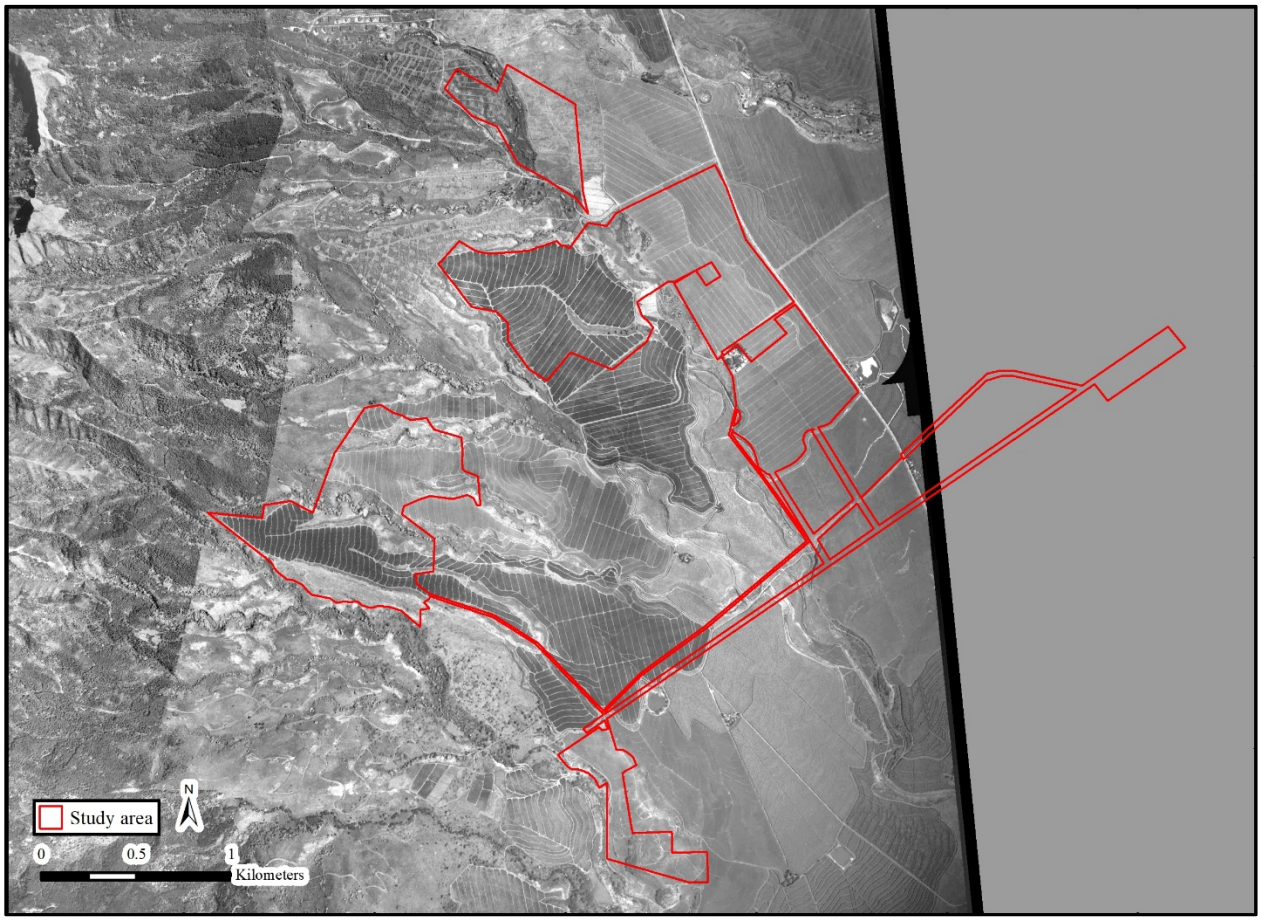


Figure 3. 1952 aerial image with study area location superimposed.

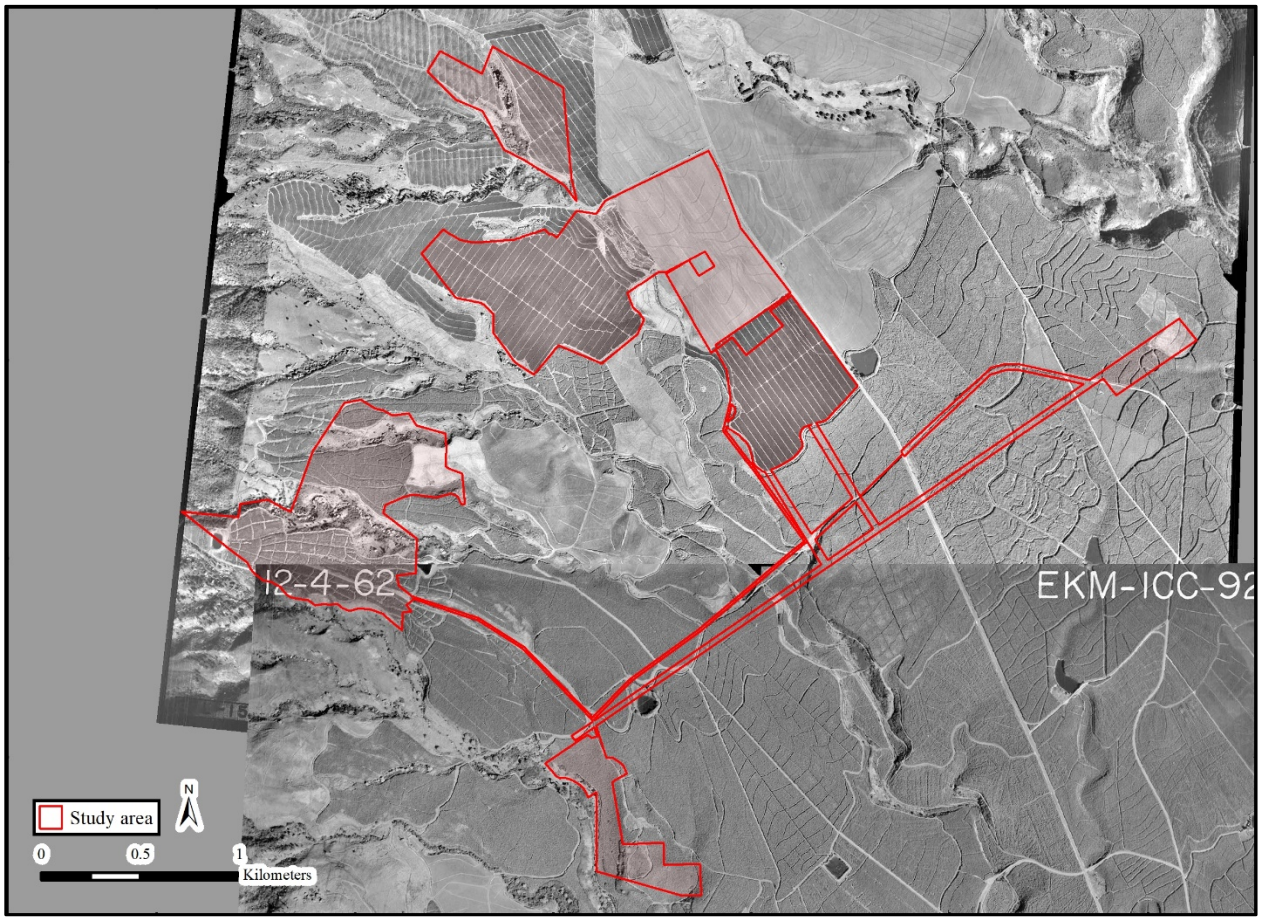


Figure 4. 1962 aerial image with study area location superimposed.

Figure 5. Example of intact section of “Waialua flume.”

Figure 6. Example of metal pipe.

Figure 7. Example of CRM construction.

Figure 8. Example of jumbled plantation infrastructural elements.

Figure 9. Waiāhole Ditch.

Figure 10. Site T-2 platform.

Figure 11. Large boulders surrounding Site T-2 platform.

DAVID Y. IGE
GOVERNOR

JADE T. BUTAY
DIRECTOR

Deputy Directors
LYNN A.S. ARAKI-REGAN
DEREK J. CHOW
ROSS M. HIGASHI
EDWIN H. SNIFFEN

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

IN REPLY REFER TO:
DIR 0365
STP 8.3162

May 4, 2021

Mr. Dean Uchida
Director
Department of Planning and Permitting
City and County of Honolulu
650 South King Street, 7th Floor
Honolulu, Hawaii 96813

Attention: Mr. Raymond Young

Dear Mr. Uchida:

Subject: Special Use Permit (SUP) Application No. 2020/SUP-7
Mahi Solar Project
Ewa, Oahu, Hawaii
Tax Map Keys: Portions of (1) 9-2-001: 020 and 9-2-004: 003, 006, 010, 012

Thank you for your letter dated April 9, 2021, requesting the State of Hawaii Department of Transportation's (HDOT) review and comment on the subject SUP application. HDOT understands that Mahi Solar, LLC is proposing a 120-megawatt (MW) photovoltaic (PV) energy generation system, a 480-megawatt hour battery storage system, and other supporting facilities on approximately 620 acres of land in Kunia.

Access to the project will be via Kunia Road (State Route 750) at three existing unsignalized, stop-controlled intersections with private roads as follows: Palawai Road, Plantation Road, and an unnamed road to the Monsanto Technology LLC parcel.

HDOT has the following comments:

Airports Division (HDOT-A)

1. The subject solar project is located just outside the transitional airspace for the Daniel K. Inouye International Airport. PV systems that are located in or near the protected approach and departure air space can create a hazardous condition for pilots because of possible glint and glare reflected from the PV array. If glint or glare from the PV array creates a hazardous condition for pilots, the owner of the PV system shall be prepared to immediately mitigate the hazard upon notification by the HDOT-A and/or Federal Aviation Administration (FAA).

   PV systems have also been known to emit radio frequency interference (RFI) to aviation-dedicated radio signals, thereby disrupting the reliability of air-to-ground communications. Again, the owner of the PV system shall be prepared to immediately mitigate the RFI hazard upon notification by the HDOT-A and/or FAA.

2. Thick smoke from uncontrolled fires are potential obstruction hazards to flight operations. Therefore, the energy or battery storage facility for the solar project shall have sufficient firefighting/fire suppressant ability to prevent hazardous smoke in the protected air space.

Highways Division (HDOT-HWY)

The HDOT-HWY reviewed the application, including Appendix J, Draft Mahi Solar Construction Traffic Assessment (CTA), dated September 2020 and have the following comments relevant to State highways:

1. We note that the site plan includes a 30-foot easement from Kunia Road along a segment of the frontage. Verify with the landowner that the easement was designated in anticipation of future Kunia Road widening.

2. Agricultural crossing points and cane haul roads may not be considered legal access to HDOT highways. Although the CTA did not identify operations-phase traffic impacts to Kunia Road, verify with HDOT-HWY Oahu District that these driveways meet current standards for the proposed use.

3. The CTA included the following assumptions and findings:

    a. The heavy truck access route is likely to originate at Sand Island, and travel east on Interstate H-1 to the Kunia Road Exit. All three project access driveways on Kunia Road would be used by construction vehicles.

    b. Eight intersections, including the three project access driveways were included in the analysis. Baseline 2020 Level of Service (LOS) is unacceptable (LOS D or E) during AM and/or PM peak traffic hours at the following intersections: 1) Kunia Road/H-1 eastbound ramp (AM only), 2) Site Access: Kunia and Plantation Road (AM and PM), and 3) Site Access: Kunia Road and Palawai Road (AM only). The through traffic on Kunia Road is uncontrolled and operates at a LOS A. The unacceptable LOS at the site access driveways is associated with the traffic delays on the private roads.

    c. Year 2022 was projected to be the horizon year for peak project construction. The cumulative effect of concurrent construction of two other planned solar farms (i.e., Hoohana, Kupehau) in the vicinity was included in the 2022 horizon year; however, it is unlikely the construction schedules would overlap.

    d. The project-related peak construction workforce is estimated at 340 workers and the number of vehicles was adjusted to 227, based on carpooling assumptions. The scenario assumes all construction personnel trips would occur during peak traffic hours and 50 percent would be to/from Honolulu.

    e. In 2022, the LOS at all three site access intersections with Kunia Road was projected to be unacceptable. The Kunia Road/H-1 ramp would remain at an unacceptable LOS. The Kunia Road and Anonui Road intersection would degrade to LOS E during PM peak traffic conditions.

    f. The heavy truck traffic was assumed to occur outside of peak traffic hours.

    g. The construction-related impacts would be temporary and largely attributed to the assumed concurrent construction of three solar projects. No capacity-building recommendations are warranted or proposed to mitigate the regional traffic impacts.

h. The report recommends specific elements be included in the Construction Traffic Management Plan (TMP) to improve safety at the three site access intersections.

4. The HDOT-HWY shares the CTA concern for construction-phase traffic safety at the three access intersections and supports the CTA recommendations for specific elements to be included in the Construction TMP. Submit the Construction TMP to HDOT-HWY Oahu District for review and acceptance. Access improvements may be required to accommodate heavy and oversized vehicles.

5. HDOT-HWY agrees the impact of the solar farm operations on State highways would be negligible; however, the operational analysis should describe the anticipated trips generated by the farming activities within the project lease area as well as landowner land use plans for the parcel areas outside of the lease areas, with respect to each of the three access intersections with Kunia Road. The application suggests more land area within the project lease area would be in production relative to existing conditions and the number of farming operations within the project lease area would increase. Describe the existing and future operational access control at the intersections. Identify recommendations, as warranted, for safety improvements to address the additional operational traffic.

6. No additional discharge of surface water run-off onto Kunia Road right-of-way (ROW) is permitted. This includes the use of the existing State drainage culverts and channels. All additional stormwater runoff from the project site shall be managed and mitigated onsite.

7. No work appears to be proposed within the State ROW. Note that any work within the State ROW requires a Permit to Perform Work Upon State Highways and a TMP. Construction plans prepared by a Hawaii licensed engineer shall be submitted to the HDOT-HWY Oahu District for review and approval prior to applying for a permit to perform work.

If there are any questions, please contact Mr. Blayne Nikaido of the HDOT Statewide Transportation Planning Office at (808) 831-7979 or via email at blayne.h.nikaido@hawaii.gov.

Sincerely,

JADE T. BUTAY
Director of Transportation

HISTORIC HAWAIʻI FOUNDATION

680 Iwilei Road Suite 690, Honolulu HI 96817 • (808) 523-2900 • preservation@historichawaii.org • www.historichawaii.org

May 10, 2021

Raymond Young, Acting Branch Chief
Community Planning Branch
Department of Planning and Permitting
City and County of Honolulu
650 South King Street, Seventh Floor
Honolulu, Hawaii 96813

Re: Special Use Permit (SUP) Application No. 2020/SUP-7
Mahi Solar Project
Honouliuli, ʻEwa, Island of Oʻahu
TMKs: (1) 9-2-01:020 portion, 9-2-004:003 portion, 9-2-004:006 portion, 9-2-004:010 portion, 9-2-004:012 portion

Dear Mr. Young:

Historic Hawaiʻi Foundation received notice and request for comments from the Department of Planning and Permitting, City & County of Honolulu on a Special Use Permit (SUP) for the proposed photo-voltaic energy gereration system, accessory battery storage system, and ancillary support facilities. Thank you for the opportunity to comment.

Interests of Historic Hawaiʻi Foundation

Historic Hawaiʻi Foundation (HHF) is a statewide nonprofit organization established in 1974 to encourage the preservation of sites, buildings, structures, objects and districts that are significant to the history of Hawaiʻi. HHF is providing these comments as an organization that is concerned with the effect of the project on historic properties.

Project Summary

The Mahi Solar project is a 120-megawatt alternating current solar and energy storage facility located in Kunia, Oʻahu. The site will be developed in five areas identified as Areas 1, 2A/2B/2C, 3, 4A/4B/4C, and 5, across portions of five TMK parcels. The total project area is approximately 620 acres, while the project parcels total approximately 2,952.3 acres.

The project will be interconnected to HECO's Kahe-Waiʻau 138 kV transmission circuit located west of Kunia Road. The medium voltage collection system will transmit generation from the solar array inverters to the BESS and substation along overhead lines to be installed as part of the project.

Project Context

The SUP Application notes that "the Kunia lands are some of the best agricultural sites in Hawaiʻi with deep soil, excellent sunlight and available water. As such, it is vital that agricultural operations be included as an important part of the solar project providing both energy and food products." Specifically, Area 5 and part of Area 1 are categorized as "Important Agricultural Lands."

Numerous historic properties and features are located in the project area, with a cluster of sites and objects in Area 5 (SIHP 50-80-12-7346). The Waiāhole Ditch system (SIHP 50-80-09-2268), which is exceptionally significant, also has numerous contributing features in the project area.

Summary of HHF Comments and Concerns

Historic Hawaiʻi Foundation does not have significant concerns with the PV development in Areas 1-4 (except for the portion designated as Important Agricultural Lands) subject to review and conditions as determined in consultation with the State Historic Preservation Division of the Department of Land and Natural Resources.

However, HHF is very concerned with the proposed industrial development in Area 5 and recommends that this portion of the proposed project be eliminated from the development.

HHF's concerns include:

1. The majority of the historic sites identified and described in the Archaeological Inventory Survey lie within Area 5 (SUP Appendix F, Figure 39 on page 67). It would be prudent to avoid that area if at all possible. Otherwise, a detailed preservation plan to avoid specific features and to mitigate for the effect overall will be needed.
2. The southern boundary of Area 5 is adjacent to the Honouliuli National Historic Site, which is listed on the National Register of Historic Places and is a unit of the National Park system. The areas adjacent and surrounding this historic property need to be treated with extreme sensitivity and care to avoid adverse effects to the setting, location and feeling of the site. With the National Park Service currently engaging in long-range planning with the intent to open the historic park in the coming years, the City and adjacent landowners should avoid inflicting any significant impacts or irreversible development that could irreparably harm this national historic resource.
3. Area 5, and a portion of Area 1, are designated as Important Agricultural Lands and should be available for high level agricultural use. In addition to the importance for food production, the rural and agricultural context of this area is also part of its historic character. While some level of new development is expected, Important Agricultural Lands are inappropriate locations for intense energy or industrial development. A more harmonious use that is compatible with the rural and agricultural history of the area would be more appropriate.

Historic Property Mitigation Commitments

The SUP application outlines proposed mitigation commitments to address effects to the historic properties. HHF recommends additional mitigation, which should enhance and continue documentation of the Waiāhole Ditch System that has been required for other projects (including PV development) for parcels that affected other segments of the historic irrigation system. For example, the features should be added to the Historic American Engineering Report (HAER) and an update or amendment to the "Waiāhole Ditch Context Study" (Mason Architects, 2018) may be needed.

If the existing documentation is deemed complete and sufficient, then additional mitigation would be appropriate. For example, public history and educational materials could be developed using the source materials from the technical studies.

Thank you for the opportunity to comment. Please let me know if you have any questions or would like to discuss these recommendations.

Very truly yours,

Kiersten Faulkner

Kiersten Faulkner, AICP
Executive Director

Copies via email:

Hawai'i State Historic Preservation Division

- Susan Lebo [Susan.A.Lebo@hawaii.gov]
- Stephanie Hacker [stephanie.hacker@hawaii.gov]
- Julia Flauaus [julia.flauaus@hawaii.gov]

MAKAKILO/ KAPOLEI/ HONOKAI HALE NEIGHBORHOOD BOARD NO. 34

c/o NEIGHBORHOOD COMMISSION • 925 DILLINGHAM BOULEVARD, SUITE 160 • HONOLULU, HAWAII 96817
TEL: (808) 768-3710 • FAX: (808) 768-3711 • INTERNET: http://www.honolulu.gov/nco

REGULAR MEETING AGENDA
WEDNESDAY, MAY 26, 2021
7:00 P.M. – 9:45 P.M.

Meeting link: https://cchnl.webex.com/cchnl/j.php?MTID=m5c82c5cc01432e4636da5be39051b6ec
Meeting number: 187 537 4361
Password: NB34 (6234 from phones and video systems)
Join by video system: Dial 1875374361@cchnl.webex.com
Join by phone: +1-408-418-9388 United States Toll

MEETING POLICIES

RULES OF SPEAKING: Makakilo/Kapolei/Honokai Hale Neighborhood Board No. 34 asks if anyone wishing to speak is asked to raise their hand, and when recognized by the Chair to address comments to the Chair. §2-14-117 Order and decorum. (a) All board members shall promote and preserve the order and decorum of the commission's proceedings. Time allowances will prevail at the noted limits and anyone wanting to comment on multiple items will be allowed to do so with the same time limit allowed per issue/item when the issue/item is called. All speakers are asked to be first recognized by the Chair, and address comments through the Chair. Speakers (community and Board), must keep their comments under one (1) minute (adopted December 5, 2005), and those giving **reports are urged to keep their reports under three (3) minutes unless otherwise noted. Written reports, flyers, information pertinent to reports are to be handed out PRIOR to presentation/discussion. Please silence all electronic devices. Please adhere to time limits.**

NOTE: The Board may take action on any agenda item. As required by the State Sunshine Law (HRS 92), specific issues not noted on this agenda cannot be voted on unless added to the agenda.

ORDER AND DECORUM: Our meetings are intended to act with fairness and order, and according to the 2008 Neighborhood Plan. Everyone is asked to treat each speaker with respect and keep their comments on **agenda subjects** within the time allowed. Your kokua is appreciated to avoid delays or timely adjournment of the meeting. Rules of decorum will be strictly enforced.

WELCOME

I. CALL TO ORDER

II. ROLL CALL – Neighborhood Board Assistant

III. CITY MONTHLY REPORTS

1. Honolulu Fire Department (HFD) – Duty Officer
2. Honolulu Police Department (HPD) – Duty Officer
3. Board of Water Supply - Rian Adachi
4. Mayor Rick Blangiardi Representative - Jerry Pupillo
5. Councilmember Andria Tupola and/or Representative - Louis Galdeira
6. OMPO Report- Frank Genadio

IV. APPROVAL OF MINUTES FROM THE APRIL 28, 2021 BOARD MEETING

V. COMMUNITY/BOARD CONCERNS & ANNOUNCEMENTS (Limited to one (1) minute each per person in totality. Issues concerning and/or needing elected official's or agency input/comments and related issues are to be discussed at the relative portion of the agenda. Issues and concerns not listed elsewhere on the Board's agenda may be raised, but HRS Chapter 92 ("Sunshine Law") prohibits Board action from being taken during this meeting.)

VI. STATE MONTHLY REPORTS – (Limited to two (2) minutes each, unless otherwise requested) ***If there are any printed reports and/or flyers that need to be disseminated, please do so before start of meeting (or as early as possible) so Board members have adequate time to brief themselves with your material and information.***

1. U.S. Congressman Ed Case - Nestor Garcia
2. U.S. Congressman Kai Kahele and/or Representative

3. Governor David Ige's Representative – Robert Yu, Department of Budget and Finance
4. Highways Division, DOT - Karen Chun, Design Branch Head
5. State Senator Mike Gabbard or designated office representative
6. State Senator Maile Shimabukuro or designated office representative
7. State Representative Sharon Har or designated office representative
8. State Representative Ty Cullen or designated office representative
9. State Representative Stacelynn K.M. Eli or designated office representative
10. Hawaii Community Development Authority (HCDA) - Tesha Malama

VII. BOARD BUSINESS (10 minutes limit unless otherwise noted) Discussion and Action

1. Element Hotel Project- Jim Stone and Tracy Camuno (G70)
2. Mahi Solar Project- Wren Wescoatt (Longroad Energy)
3. Install Removal School Crossing Sign at School Crosswalk- Pastor Mel Corpuz
4. VA Clinic Project Update: Tony Gaston (Hunt Companies)

VIII. TREASURER'S REPORT

IX. COMMITTEE REPORTS – (Limited to two (2) minutes each)

X. ANNOUNCEMENTS

- Next Scheduled Meeting – The Makakilo/Kapolei/Honokai Hale Neighborhood Board No.34's next scheduled meeting- Wednesday, June 23, 2021.

XI. ADJOURNMENT

'Olelo Community Television Cablecast of Board Meetings: The Makakilo/Kapolei/Honokai Hale Neighborhood Board regular meetings are video recorded and later on `Olelo Community Television Channel 49 at 9:00 p.m. on the second Friday of the month and on Channel 49 with a schedule of the 1st and 3rd Saturday of the month at 12:00 p.m. determined by 'Olelo. There may be a week or two (2) delay after a meeting date before the first cablecast of that meeting's video. The 'Olelo program schedule is posted at http://www.olelo.org/programming/default.html

A mailing list is maintained for interested persons and agencies to receive this board's agenda and minutes. Additions, corrections, and deletions to the mailing list may be directed to the Neighborhood Commission Office (NCO) at Kapalama Hale, 925 Dillingham Boulevard, Suite 160 Honolulu, Hawaii 96817; Telephone (808) 768-3710 Fax (808) 768-3711. Agendas and minutes are also available on the internet at www.honolulu.gov/nco.

All written testimony must be received in the Neighborhood Commission Office 48 hours prior to the meeting. If within 48 hours, written and/or oral testimony may be submitted directly to the board at the meeting. If submitting written testimony, please note the board and agenda item(s) your testimony concerns. Send to: Neighborhood Commission Office, 925 Dillingham Boulevard, Suite 160 Honolulu, Hawaii 96817. Fax: (808) 768-3711. Email: nbtestimony@honolulu.gov.

If you require special assistance, auxiliary aid and/or service to participate in this event (i.e. sign language interpreter; interpreter for language other than English, or wheelchair accessibility), please contact the NCO at (808) 768-3710 or email your request to nco@honolulu.gov at least three (3) business days prior to the meeting.

MILILANI/ WAIPIO/ MELEMANU NEIGHBORHOOD BOARD NO. 25

c/o NEIGHBORHOOD COMMISSION • 925 DILINGHAM BOULEVARD SUITE 160• HONOLULU, HAWAII, 96813
PHONE (808) 768-3710 • FAX (808) 768-3711 • INTERNET: http://www.honolulu.gov

DRAFT- REGULAR MEETING MINUTES
WEDNESDAY, MARCH 24, 2021
WAIPAHU FILIPINO COMMUNITY CENTER

CALL TO ORDER – Chair Dick Poirier called the meeting to order at 7:30 p.m., quorum established with **14 members present.** Pledge of Allegiance performed and present board members introduced. Note: This 23-member Board requires 12 members to establish quorum and to take official Board action. Chair Poirier led the Pledge of Allegiance and asked Board members to introduce themselves.

Members Present: Dick Poirier, Marion Poirier, Michael Dau, Trevor Nagamine, Leslie Among, Danielle Bass, Sabrina Gustafson, Darsha Lee, Marylin Lee, Karen Loomis, Rodney Park, Mary Smart, Emil Svrcina, and Sharon Williams.

Members Absent: Pauline Arellano, Elise Carmody, Ann Freed, Rojo Herrera, Kurumi Kaapana, Trish La Chica, Bernie Marcos Jr., Joy A. Marshall, and Carole Siegel.

Guests: Tracy Kubota (Mayor Kirk Caldwell's Representative); and Partner Akiona (Neighborhood Commission Office). **Note: name was not included if not legible or on the guest attendance sheet.**

FILLING OF VACANCY: No volunteers.

APPROVAL OF REGULAR MEETING MINUTES OF WEDNESDAY, FEBRUARY 26, 2021:
PAGE 3:

- Microchip Identification: The name Josie Kanahele should be spelled "Josie Kaanehe."

Hearing no further amendments or omissions the board APPROVED the motion by UNANIMOUS consent 14-0-0. **(**Poirier, Poirier, Dau, Nagamine, Among, Bass, Gustafson, Lee, Lee, Loomis, Park, Smart, Svrcina, Williams - **Aye;** n/a **Nay;** n/a **Abstain) (14-0-0)**

COMMUNITY FORUM
Honolulu Fire Department (HFD): No representative present. No report given.
Honolulu Police Department (HPD): No representative present. No report given.
Military 25th Infantry Division: Colonel Garcia reports the following:

- COVID: Army has transitioned to small group training sessions due to COVID guidelines and requirements. Also, it is voluntary, not required, for military personnel to receive the vaccine.
- Noise Complaint: One (1) reported noise complaint in Mililani as of November 2020. Complaint has been addressed and Colonel Garcia ensured the board his unit are proactive in reducing the possibility of future noise complaints.
- Women's History Month: March is Women's History Month, the military will be honoring Amelia Earhart for her accomplishments.

Questions, comments, concerns followed:

- ❖ Military Presence: Member Gustafson asked if the relocation of military personnel to Hawaii will increase or decrease due to COVID-19.
- ❖ Army Property: Member Dau informs Colonel Garcia of a residentially challenged encampment in Waiahole Ditch next to Kamehameha Highway due to the area being considered Army property.
- ❖ Equal Pay: Member Lee inquires about equal pay within the military between men and women.

Board of Water Supply (BWS): No representative present. No report given.

ALEA Bridge: Marilyn Lee, ALEA Bridge Board of Directors member, reported the following:

- Year: The previous year was difficult due to COVID-19 and reorganization.
- Notices: Complaints have been received regarding residentially challenged individuals residing at Mililani Library and other locations.
- Services: Even with the difficult previous calendar year, they are looking to expand services to housing entities.
- Members: The board currently has two vacancies. If anyone is interested please contact Marilyn.

- Contact: For more details and for a link to sign-up to volunteer and/or donate, please contact Liko at lcabanting@gmail.com or visit our website at www.aleabridge.org.

Questions, comments, concerns followed:

- ❖ Partnership: Member Among announced the organization Surfing the Nations is located in Wahiawa and he will look into the possibility of the organization joining with ALEA Bridge to join and offer other services such as food, showers, and other services.

Other Community Concerns:

- Virtual Meetings: Member Bass asks Chair Poirier why the board has not looked into having virtual meetings and if there was a board vote that she may have missed regarding this topic. Chair Poirier identifies that this topic is not on the agenda and will address it at another time. A discussion between Bass and Poirier followed regarding when it would be appropriate to discuss this topic.
  - o Requests: Member Bass respectfully requests the topic of virtual meetings be placed onto the April meeting agenda, that the April meeting be held virtually, and a cost comparison between holding an in person meeting as opposed to a virtual meeting be presented at the April meeting. Chair Poirier addressed the requests by informing all in attendance that the board will not hold a virtual meeting, but there is a possibility of holding a hybrid meeting once a permanent meeting place is established. Once that statement was made Chair Poirier ruled Member Bass out of order.
  - o Information: Member Bass asks the NA to provide information to the board regarding virtual meeting experiences from other board meetings. The NA gave a general breakdown of virtual meeting participation during the pandemic. Once again Chair Poirier ruled Bass out of order.

PUBLIC FORUM

Mahi Solar Project: Presentation given by Wren Wescoatt regarding the proposed solar project in Kunia. (This item was not on the agenda for this meeting.)

Questions, comments, concerns followed:

- ❖ Cost: Member Svrcina asks about cost to HECO for the electricity provided from this project.
- ❖ Replacement: Member Gustafson asks if this project and others like this will replace HECO.
- ❖ Dual Occupancy: Member Among comments on the proposal of having farming happen concurrently with the solar project.
- ❖ Heat: Member Dau asks about the radiant heat measurement for this project.

REPORTS OF PUBLIC OFFICALS

Councilmember Tulba: Councilmember Augie Tulba introduces himself, his staff, and addresses the board. Also, he covered a few key issues from his bulletin.

Questions, comments, concerns followed:

- ❖ Residentially Challenged: Member Lee inquires if Director Krucky could attend the next board meeting.
- ❖ Surfing with the Nations: Member Among mentions the Surfing the Nations meeting tomorrow night and will disburse Councilmember Tulba's contact info at that meeting.
- ❖ HART: Member Poirier asks about the money that has gone into HART that has been wasted.
- ❖ Vote: Member Svrcina commends Councilmember Tulba on voting "no" to the Rail Tax.
- ❖ Reso 21-44: Member Nagamine voiced his concerns regarding the Councilmember's vote on resolution 21-44.

Governor David Ige's Representative - Keith Kawaoka reported the following:

- COVID: Deputy Director Kawaoka gave information regarding how the State of Hawaii is handling COVID-19 vaccine disbursement.

Questions, comments, concerns followed:

- ❖ Department of Health: Member Lee asks if the Department of Health will be absorbing the Hawaii Health Corps.
- ❖ Powers: Member Svrcina asks about the Governor's "lawful lockdowns" passed the emergency proclamation 60 day allowance.
- ❖ Percentages: Member Smart asks what criteria is needed for COVID-19 to be a pandemic. Also, due to the pandemic label she is concerned with people having mental health issues.
- ❖ Effectiveness: Member Among inquires about the risk of a mass spread of COVID-19 even after being vaccinated.

Mayor Rick Blangiardi's Representative – Tracy Kubota reported the following:

- Graffiti: The graffiti and grass issue in Waena Park is a multijurisdictional issue. These jurisdictions being the Mililani Town Association and DPR.
- Meheulu Parkway: This area is maintained by the state and the issue has been passed to the State Homeless Coordinator. The City and County of Honolulu Department of Housing has been contacted for outreach services.
- Tree Trimming: The Department of Urban Forestry, under the Department of Parks and Recreation, assessed the area in August and determined the tree is sufficiently maintained and poses no safety issues.

Questions, comments, concerns followed:

- ❖ Bus Routes: Member Nagamine inquires about the 501 Bus Route. Also, he requested that the Department of Transportation Services monitor ridership.
- ❖ Residentially Challenged: Member Lee comments that the feeling from residents is the Honolulu Police Department are not concerned with these individuals.
- ❖ Potholes: Member Poirier thanks Deputy Director Kubota for her pothole hotline.
- ❖ Activities: Member Gustafson asks about what specific activities are allowed in city parks and if there are a website the board can be directed to for information.
- ❖ Response: Member Svrcina asks about Mayor Blangiardi's dismissiveness regarding the brutal arrest of a peaceful protestor who was with her children at an event this past Saturday.
- ❖ Trade: Chair Poirier requests that an agreement be made between the City and County of Honolulu and the State to reopen schools for public use since the City and County of Honolulu reopened parks for DOE students.

Representative Ryan Yamane: No representative present, but would have attended virtually of the option was available.

Senator Michelle Kidani: Trevor Nagamine reported on items covered in Senator Kidani's newsletter. Her newsletter can be viewed at this link:
https://www.capitol.hawaii.gov/MemberFiles/Senate/kidani/Newsletters/Kidani_NBR_2021-03.pdf.

Questions, comments, concerns followed:

- ❖ Turns: Member Gustafson thanks Senator Kidani's office for the work order regarding drivers making illegal turns out of the Koa Ridge Development. However, the work order has not been completed.

Representative Lauren Matsumoto: No representative present, but would have attended virtually of the option was available. For more information go to www.repmatsumoto.com

Representative Val Okimoto: No representative present, but would have attended virtually of the option was available.

COMMITTEE AND OTHER REPORTS

- Harrassment: Member Among informs the board of a harassment incident at Wahiawa Gardens. A report has been filed with HPD and will keep the board informed as information becomes available.
- Chair's Report: Chair Poirier is pleased with the venue and board member turnout for this meeting.
- Zoom: Member Svrcina volunteers to set up a Zoom account for the board to have virtual meetings.
- Venue: Member Nagamine asks if the Chair will make a public announcement as to why the board has not met for over a year.
- Elections: Member Gustafson inquires of elections are still happening.
- Meetings: Member Bass restates her formal request for the board to place the topic of virtual meetings be placed onto the April meeting agenda, that the April meeting be held virtually, and a cost comparison between holding an in person meeting as opposed to a virtual meeting be presented at the April meeting. Request noted by Chair Poirier.

'Olelo Broadcasting: The videotaping of Board meetings are scheduled to be shown on 'Olelo Focus 49 every second Thursday at 9:00 a.m. and every first and third Saturday at 9:00 a.m.

ADJOURNMENT – The meeting adjourned at 9:32 p.m.

Submitted by: Partner Akiona, Neighborhood Assistant
Reviewed by:
Final Review by:

WAIPAHU NEIGHBORHOOD BOARD NO. 22
c/o NEIGHBORHOOD COMMISSION • 925 DILLINGHAM BOULEVARD SUITE 106 • HONOLULU, HAWAII, 96817
TELEPHONE: (808) 768-3710 • FAX: (808) 768-3711 • INTERNET: http://www.honolulu.gov/nco

REGULAR MEETING AGENDA
THURSDAY, MAY 27, 2021 7:00 P.M.
FIL-COM CENTER
94-428 MOKUOLA STREET

Rules of Speaking: Anyone wishing to speak is asked to raise their hand, and when recognized by the Chair, to address comments to the Chair. Speakers are encouraged to keep their comments under three (3) minutes, and those giving reports are urged to keep their reports under three (3) minutes. Please silence all electronic devices.

Note: The Board may take action on any agenda item. As required by the State Sunshine Law (HRS 92), specific issues not noted on this agenda cannot be voted on, unless added to the agenda. A two-thirds (2/3) vote (13) of this 19-member Board is needed to add an item to the agenda. Items may not be added if they are of major importance and will affect a significant number of people.

I. CALL TO ORDER – Chair Cory Chun

II. INTRODUCTION OF BOARD MEMBERS

III. VACANCY
3.1 Filling of one (1) At-Large Vacancy

IV. FIRST RESPONDER REPORTS - Limit to three (3) minutes each**.**
4.1. Honolulu Fire Department (HFD)
4.2. Honolulu Police Department (HPD)
4.3. Military Services

V. RESIDENT AND COMMUNITY CONCERNS - Limited to three (3) minutes each.

VI. ELECTED OFFICIALS - Limit to three (3) minutes each
6.1. Mayor Rick Blangiardi's Representative – Roger Babcock, Director, Department of Facility Maintenance – (DFM)
6.2. Councilmember - Brandon Elefante
6.3. Councilmember - Augie Tulba
6.4. Governor David Ige's Representative: Morris Atta, Deputy Director, Hawaii State Department of Agriculture (HDOA)
6.5. Senator Mike Gabbard
6.6. Senator Michelle Kidani
6.7. Senator Clarence Nishihara
6.8. Representative Henry Aquino
6.9. Representative Ty Cullen
6.10. Representative Roy Takumi
6.11. Representative Ryan Yamane
6.12. U.S. Representative Ed Case – Nestor Garcia, Director of Communications
6.13. U.S. Representative Kai Kahele - Ikaika Mahoe, Deputy Chief of Staff

VII. REPORTS - Limit to three (3) minutes each.
7.1. Board of Water Supply
7.2. Honolulu High-Capacity Transit Project: Johnny Reid
7.3. Patsy T. Mink Central Oahu Regional Park/Waipio Soccer Complex: Marty Burke
7.4. Waipahu Community Foundation: Marty Burke

7.5. Oahu Metropolitan Planning Organization, Citizens Advisory Committee (OMPO-CAC): Matthew Weyer
7.6. Storm water Utility Project: Matthew Weyer
7.7. Reports of Board Members Attendance at other Meetings.

VIII. BOARD BUSINESS
8.1. Approval of the Thursday, April 22, 2021 Regular Meeting Minutes
8.2. Treasurer's Report
8.3. Chair's Report
8.4 Notice of three (3) absences: Ruffalynne Villanueva, Nelson Sua and Dionisio Guillermo

IX. PRESENTATIONS
9.1. Mahi Solar Project, Kunia – Wren Wescoatt, Longroad Energy

X. ANNOUNCEMENTS
The next Regular meeting of the Waipahu Neighborhood Board No. 22 is on Thursday, June 24, 2021 at 7:00 p.m. at Fil-Com Center.

XI. ADJOURNMENT

A mailing list is maintained for interested persons and agencies to receive this board's agenda and minutes. Additions, corrections, and deletions to the mailing list may be directed to the Neighborhood Commission Office (NCO) at Kapālama Hale, 925 Dillingham Boulevard, Suite 160 Honolulu, Hawaii 96817; Telephone (808) 768-3710 Fax (808) 768-3711; or call Neighborhood Assistant Naomi Hanohano at (808) 768-3718 or e-mail Naomi.hanohano@honolulu.gov. Agendas and minutes are also available on the internet at www.honolulu.gov/nco.

All written testimony must be received in the Neighborhood Commission Office 48 hours prior to the meeting. If within 48 hours, written and/or oral testimony may be submitted directly to the board at the meeting. If submitting written testimony, please note the board and agenda item(s) your testimony concerns. Send to: Neighborhood Commission Office, 925 Dillingham Boulevard, Suite 160 Honolulu, Hawaii 96817. Fax: (808) 768-3711. Email: nbtestimony@honolulu.gov.

If you require special assistance, auxiliary aid and/or service to participate in this event (i.e. sign language interpreter; interpreter for language other than English, or wheelchair accessibility), please contact the NCO at (808) 768-3710 or email your request to nco@honolulu.gov at least three (3) business days prior to the meeting.

Randall F. Sakumoto

From: Kraintz, Franz <fkraintz@honolulu.gov>
Sent: Tuesday, May 18, 2021 1:07 PM
To: Noelle Besa Wright
Subject: RE: HHF Comments: 2020/SUP-7 Mahi Solar Project

Thank you. A chain-link fence is not going to block any views. But I think we are adding that there should be a landscape treatment on that side of Area 5 (it is missing from the landscape plans) or set back farther if necessary to prevent views.

We're just doing some polishing of the document. When it is signed, I will send you a copy.

Btw, thanks for sending over the copies. They're here I know, I just haven't picked them up from the front yet.

From: Noelle Besa Wright [mailto:noellew@g70.design]
Sent: Tuesday, May 18, 2021 11:40 AM
To: Kraintz, Franz <fkraintz@honolulu.gov>
Cc: Tracy Camuso <tracyc@g70.design>
Subject: HHF Comments: 2020/SUP-7 Mahi Solar Project

Hi Franz,

Please see responses to HHF's comments, below:

1. The archaeological features identified and documented in Area 5 of the Mahi Solar Project are remnant elements of twentieth-century agricultural irrigation infrastructure, and while they have been evaluated as significant in the context of HRS Chapter 6E they do not rise to a level of significance that would warrant preservation or protection.

2. Area 5 of the Mahi Solar Project will not encroach on the Honouliuli National Historic Site, and the proposed development in that area will include ground-mounted solar panels surrounded by an eight-foot-tall perimeter chain link fence. This proposed solar array compound will be sufficiently setback from the site and present a low visual contrast from only the extreme northern portions of the site. The presence of the fenced compound will not adversely affect the setting, location, or feeling of the Honouliuli National Historic Site. Further, there will be no irreversible impacts given that when the productive life of the solar development has been exhausted (roughly 35 years), the facilities will be decommissioned and the land restored to its preconstruction condition.

3. Of the 620-acre Mahi Solar project area, approximately 69.5 acres is located within lands designated as IAL. Currently, this land is not actively farmed. As part of the Agricultural Plan for the project, all 69.5 acres of IAL land are planned for agricultural uses and food production. Therefore, Mahi Solar will increase the use of IAL on the project site, thus meeting the intent of IAL lands articulated in HRS Chapter 205.

   The use of designated IAL lands of the project for solar panels is critical to ensuring the Mahi Solar project meets its commitment to generate enough clean energy to power 37,000 O'ahu households per year. The use of IAL lands in the project area is also key to Mahi Solar's goal of contributing to local food production through agricultural uses and local, Hawai'i-specific research. The co-location of both solar and agricultural uses on IAL helps the state meet its energy and food production goals, resulting in public benefits for all.

Exhibit 32

Let us know if you have any questions.

Thank you!

Noelle Besa Wright
Planner

t 808.523.5866
e noellew@g70.design

Randall F. Sakumoto

From: Kraintz, Franz <fkraintz@honolulu.gov>
Sent: Monday, May 17, 2021 3:24 PM
To: Noelle Besa Wright
Cc: Tracy Camuso
Subject: RE: Mahi Solar - HDOT Comments

Thanks for providing these. We'll see how to incorporate them.

From: Noelle Besa Wright [mailto:noellew@g70.design]
Sent: Monday, May 17, 2021 3:20 PM
To: Kraintz, Franz <fkraintz@honolulu.gov>
Cc: Tracy Camuso <tracyc@g70.design>
Subject: Mahi Solar - HDOT Comments

Hi Franz,

We are forwarding responses to HDOT's comment letter on the project (STP 8.3162). Please note that we are still waiting to hear from the traffic engineer on the HWY questions 1 and 2; we will forward you the answer as soon as we receive it.

Airports Division (HDOT-A):

1. The Mahi Solar glare analysis (POWER Engineers, October 2020) was performed in accordance with the "Technical Guidance for Evaluating Selected Solar Technologies on Airports" published by the Federal Aviation Administration (FAA) in April 2018. The FAA Technical Guidance suggests analyzing final approaches up to two miles from any runway located in close proximity to a solar installation. The Daniel K. Inouye International Airport (PHNL) was not analyzed as the closest point of any final approach to the project is greater than seven miles away, falling well out of the conservative threshold for analysis. In addition, the likelihood of potential glare impacts drops substantially for viewers south of a solar installation due to the trajectory of the sun in the northern hemisphere. Based on the findings of the Glare Analysis prepared for the project, the proposed Mahi project will not impact airport operations at PHNL due to the distance and orientation of the project to PHNL. If glint or glare from the PV array creates a hazardous condition for pilots, the Applicant is prepared to mitigate the hazard immediately upon notification by HDOT-A and/or FAA. Furthermore, Longroad Energy is prepared to mitigate potential radio frequency interference hazards upon notification by the HDOT-A and/or the FAA.

2. The project includes appropriate firefighting measures to prevent hazardous smoke in the protected airspace. Design of the site, structures, and fire access for the project will be based on applicable requirements of the State of Hawai'i Fire Code. A minimum clear area of 10 feet around ground-mounted solar PV installations will be provided. Particular attention will be paid to clearing areas around transformers, under power lines, and around the battery energy storage system (BESS) cabinets. Batteries will be installed in self-contained enclosures on open-air pads and are designed to contain/suppress fires with no active fire response necessary from the Honolulu Fire Department (HFD). Coordination with the HFD will occur throughout the project design and permit process to ensure adequate access and fire code requirements are met. If required by HFD, a vegetation management plan will also be provided. Throughout the life of the project, clear areas and fuel breaks, or areas that are frequently mowed, will be maintained.

Highway Division (HDOT-HWY):

Exhibit 33

1. Fehr & Peers is still coordinating and clarifying the question with HDOT (they are in contact with Jeyan Thirugnanam at HDOT).
2. HDOT has connected Fehr & Peers with the Highways Oahu District and Traffic Branch to review the comment regarding design standards for the driveways and access points.
3. Thank you for confirming your understanding of the CTA.
4. A Construction Traffic Management Plan incorporating the construction-phase traffic safety measures discussed in the CTA will be submitted to the HDOT-HWY O'ahu District for review and acceptance prior to the start of construction.
5. The traffic study does account for background growth in volumes between existing year and opening year at the site access points under both Opening Year (2023) Conditions and Opening Year (2023) Plus Operations Conditions. For all site access points, the total growth in volumes during the peak hours is 60 inbound vehicles and 38 outbound vehicles. Through traffic along Kunia Road was also grown by one percent per year. Farming activities associated with the project will add approximately 10 vehicle trips per day which is 25% or less of the total growth assumed between existing and opening years for the site access points. The remainder of growth in peak hour volumes at the site access points is considered reasonable since minimal changes outside of the project in the KLRF area expected. Therefore, Opening Year (2023) Plus Operations Conditions presented in the CTA account for impacts of expected farming activities within and around the project lease area.
6. All additional stormwater generated by the project will be managed and mitigated onsite.
7. We confirm that no work within the State Right-of-Way (ROW) is proposed by the project. Should work within the State ROW be required, the Applicant will seek a permit to perform work and construction plans will be submitted to the HDOT-HWY O'ahu District for review and approval.

Let me know if you have any questions about the above. We will forward you the remainder of the responses when we have them.

Mahalo,

Noelle Besa Wright
Planner

111 S. King Street, Suite 170
Honolulu, Hawaii 96813
t 808.523.5866
e noellew@g70.design
www.G70.design

MARK KĀWIKA MCKEAGUE

AICP
Principal Planner
Director of Cultural Planning

Mr. McKeague's background, experience, and passion provides a unique and knowledgeable approach to land use planning and cultural resource management. Mr. McKeague effectively administers and advocates a Native Hawaiian perspective in environmental and land use planning, and architectural design and space programming. Mr. McKeague brings over 19 years of experience in facilitating local and national level planning efforts for private, public, and non-profit sector clients. His work includes the preparation of Master Plans, Cultural Resource Management Programs, Environmental Impact Studies, and facilitating community dialogue.

SELECTED PROJECTS:

1 Hotel Hanalei SMA, Entitlements Support
Princeville, Kaua'i

'Aiea Town Center
'Aiea, O'ahu

Aloha Solar Energy Fund I
Lualualei, O'ahu

Aloha Solar Energy Fund II
Kalaeloa, O'ahu

Bishop Museum - Hōkūli'a Archaeological Review, Cultural Consultation and Policy Development
Kona Coast, Hawai'i

Board of Water Supply - Hai'iku Stairs
Kāne'ohe, O'ahu

Board of Water Supply - Ko'olau Loa Watershed Management Plan
Kāne'ohe, O'ahu

Board of Water Supply - Waihe'e Riparian Learning Center Master Plan, EA
Kāne'ohe, O'ahu

County of Kaua'i - West Kaua'i Community Plan GIS
Island of Kaua'i

CMNI Standard State Mitigation Plan
Northern Mariana Islands

Department of Hawaiian Home Lands - Anahola Kuleana Homestead Settlement Plan
Anahola, Kaua'i

Department of Hawaiian Home Lands - Ho'olehua Water Systems USDA Project
Ho'olehua, Moloka'i

Department of Hawaiian Home Lands - Ho'olehua Veteran Center - EA, Master Plan, CRM
Ho'olehau, Molokai

Department of Emergency Management O'ahu Coastal Communities Evacuation Planing Phase I
Island of O'ahu

Department of Hawaiian Home Lands & Papakōlea Community Development Corporation - Native Hawaiian Education Cultural Center and Kūpuna Assisted Living Center Master Plan
Puowaina, O'ahu

Department of Hawaiian Home Lands - Pu'u 'Ōpae Settlement Plan, EA
Waimea, Kaua'i

Department of Hawaiian Home Lands - Moloka'i Island Plan
Island of Moloka'i

Department of Hawaiian Home Lands - Waimea Nui Master Plan
Honolulu, O'ahu

Department of Hawaiian Home Lands - Wai'anae Coast Emergency Access Road/ Parallel Secondary Access Road
Wai'anae, O'ahu

Hapuna Beach Resort
Waimea, Hawai'i

PROFESSIONAL REGISTRATIONS & ASSOCIATIONS:

American Institute of Certified Planners (AICP), Member

Society for Hawaiian Archeology, Member

American Planning Association (APA), Member

PA'I Foundation, Board Directors, 2001-2003; **President,** 2003-Present

O'ahu Island Burial Council, Chair; Vice-Chair; 'Ewa Moku Representative, 2005-2012

Hulu Mamo Hawaiian Civic Club, 2012-2013

Native Hawaiian Chamber of Commerce, Member

Lamda Alpha International Aloha Chapter, Member

EDUCATION:

NAGPRA & ARPA Application & Requirement
National Preservation Institute

Hawai'i State Foundation on Culture and the Arts, Folk and Traditional Arts Apprentice Program
Cyril Lani Pahinui

Section 106: A Review for Experienced Practitioners
National Preservation Institute

Consultation and Protection of Native American Sacred Lands
National Preservation Institute

Master of Urban and Regional Planning
University of Hawai'i at Mānoa, HI

Historic Preservation Graduate Certificate
University of Hawai'i at Mānoa, HI

Identification & Management of Traditional Cultural Places
National Preservation Institute

B.A. Political Science
University of Hawai'i at Mānoa, HI

National Disaster Preparedness Training Center
FEMA Certified HURRIPLAN Resilient Building Design Coursework

PROJECT HONORS & AWARDS:

Hawai'i Business Magazine - 20 for the Next 20 Honoree, 2020

Omidyar Fellow, 2019-2020

APA Hawai'i Chapter - Kalaupapa Memorial Conceptual Design, Historic Preservation Award, 2018

MARK KĀWIKA MCKEAGUE

AICP
Principal Planner
Director of Cultural Planning

SELECTED PROJECTS:

Hilton Hawaiian Village Improvements - Master Plan, EIS, CRM
Honolulu, O'ahu

Hale Maluhia - Master Plan EA, SMA
Kahului, Maui

Hale'iwa Agricultural Park Master Plan
Hale'iwa, O'ahu

Hawaii Film Studio - Master Plan, EA, SMA, CRM
Honolulu, O'ahu

Hana Harbor Development Plan SDOT - Master Plan, SMA, CRM
Hana, Maui

Kanu O Ka 'Āina Learning 'Ohana - Master Plan and EA, CRM
Kamuela, Hawai'i

Kauai County West Kauai GIS
Island of Kaua'i

Kawaihae Deep Draft Harbor Modification - NEPA, EIS, CRM
North Kohala, Hawai'i

Kanakaloloa Cemetery - EA, Master Plan
Ho'olehau, Molokai

Kālia Fort DeRussy Wastewater Systems Improvement
Honolulu, O'ahu

Kawailoa Transfer Station - CIA
Hale'iwa, O'ahu

Kalaupapa Memorial Conceptual Design
Kalaupapa, Moloka'i

Kawailoa Transfer Station - CIA
Hale'iwa, O'ahu

Kalāhuipua'a Fishpond - Environmental & Cultural Restoration Plan Due Diligence
Puowaina, O'ahu

Kamehameha Schools - Cultural Resource Management Plan
State of Hawai'i

Kamehameha Schools - He'eia Master Plan
Kāne'ohe, O'ahu

Kamehameha Schools - North Shore Plan
Island of O'ahu

Kamehameha Schools - Natural Resource Management Plan Update
State of Hawai'i

Kamehameha Schools - Keauhou Bay Management Plan
Keauhou, Hawai'i

Kuilima Agricultural Park Master Plan
Kahuku, O'ahu

Maui County Service Center
Kahului, Maui

Mokuhinia and Moku'ula - Cultural Landscape & Ecological Restoration Plan
Lahaina, Maui

NAVFAC Pacific GIS IDIQ
State of Hawai'i

Outrigger Waikīkī Beach Walk - EIS, SMA Permit, CRM
Honolulu, O'ahu

Ocean Bay Hanamā'ulu - EIS, CDUP, General Plan Amendment, CRM
Hanamā'ulu, Kaua'i

Office of Hawaiian Affairs - Strategic Management Framework for Kaka'ako Makai
Honolulu, O'ahu

O'ahu Coastal Communities Evacuation Planning
Island of O'ahu

Pan-STARRS Observatory - NEPA EIS and CRM
Mauna Kea, Hawai'i

Pelekane Bay - EA, Ecological Restoration Assessment
North Kohala, Hawai'i

Prince Waikīkī
Honolulu, O'ahu

Pu'uhonua o Wai'anae Master Plan, Conditional Use Permit
Wai'anae, O'ahu

University of Hawai'i at Mānoa - C-MORE Hale, Master Plan, EA, CRM
Honolulu, O'ahu

University of Hawai'i at Mānoa - Hawai'i Institute of Marine Biology (Coconut Island), Master Plan, LRDP, EIS, CIA
Kāne'ohe, O'ahu

Wailea Beach Marriott - Cultural Visioning, Art Commissioning
Wailea, Maui

Waialua Town Master Plan
Waialua, O'ahu

U of N Bencorp - CIA
Kona, Hawai'i

WRITTEN DIRECT TESTIMONY OF
MARK KAWIKA MCKEAGUE, AICP, MURP
(Cultural/Community Engagement)

1. **Please state your name and business address for the record.**

Mark Kawika McKeague
G70
111 South King Street, Suite 170
Honolulu, HI 96813

2. **What is your current occupation?**

Planning Principal

3. **How long have you worked as ?**

I have been employed with G70 for nearly 19 years in the last 20.

4. **Did you provide a copy of your biography and or resume for these proceedings?**

Yes, a copy of my resume is attached as ***Exhibit 34***.

5. **Do you specialize in any particular area?**

My academic background and qualifications are in environmental, land use, and community planning. I am a Certified Planner as recognized by the national American Planning Association. Additionally, by virtue of my academic background, work experience in historic preservation and cultural resource management, and via cultural protocol training and background as a *ʻōlapa* and *hoʻopaʻa* under Kumu Hula Victoria Holt-Takamine, I do have specialization in the care and management of *wahi pana, wahi kupuna, koehana, iwi kūpuna, a na kumuwaiwai o ko kākou moʻomēheu.*

6. **Can you describe the Mahi Solar Project ("*Project*") that is the subject of the SUP application?**

Mahi Solar, LLC is proposing to construct a 120-megawatt solar project, a Battery Energy Storage System ("***BESS***"), and other associated appurtenances including fencing, roads, and electrical infrastructure on roughly 600 acres of agriculture-zoned land that includes portions of Tax Map Keys (1) 9-2-001:001; 9-2-004:003, 006, 009, 010, 011, 012, and 013; 9-04-003:0001.

7. **What is your role with this Project?**

I am generally responsible for advising the Client and Project Team on the overall planning process in my capacity and perspective as a Certified Planner, as a Native Hawaiian cultural practitioner, and as a *kua ʻāina* of the *ahupua ʻa* in which this project resides.

8. **What are your specific responsibilities for this Project?**

I was assigned the primary task of conducting selected community outreach in the form of informal discussions with cultural practitioners to help us formulate a strategy in the early phases of conceptual design. Our design approach was to be mindful of the natural and cultural environment where the project is situated. My secondary task was to work collaboratively with the qualified archaeologist and ethnohistorian in the completion of cultural resources studies that were completed for this project.

9. **With whom did you conduct outreach?**

I reached out to 10 individuals, two agencies, and one community organization who I know are *ʻohana, loea, kumu, kua ʻāina* with either strong ancestral and/or generational ties and connection to the *ʻāina* within the a*hupua ʻa* or are known experts in their field of cultural practice that I felt could help inform our design approach.

I conducted a series of one-on-one and small group virtual meetings with all ten individuals. We conducted two virtual informal meetings with the State Historic Preservation Division and three virtual informal meetings with the Office of Hawaiian Affairs. With respect to the community organization, we were advised that we would be welcome to present to the organization when they determine it is safe to meet in person due to the COVID-19 pandemic.

10. **What were the main summary points of discussion expressed by these stakeholders?**

- Solar observations are a traditional cultural practice in this *ahupua ʻa*, so we were asked to be respectful and mindful of where that source of energy comes from and how the community can benefit, especially the *keiki*.

- The upper slope of the Waiʻanae range is culturally important. However, access to this side of the Waiʻanae range has been limited in recent memory due to private land ownership. There is a history of mistrust with past and present mauka landowners regarding how access to the upper forest area has been blocked off from cultural practitioners. However, the issues of cultural access existed long before the consideration of this Project. There is an appreciation for the extent of biological and cultural studies that will be developed for this Project. It is recognized that access management would require multiple stakeholders, particularly landowners, and there is limited ability for the Project proponents to

address these broader concerns.

- On the matter of mauka access, there exists a mauka trail system that connects older cultural sites. This trail system that is understood as Pōhākea by at least one cultural practitioner who notes that it is marked by a series of standing upright stones which give the appearance of trail markers similar to those that demarcate Kualaka'i Trail. However, these were located further mauka above and beyond where homes are along the slope at present and not within the Project area.

- Although much of the landscape has been altered by land tenure practices from plantation agricultural uses, cultural resources still could be located in the gullies and valleys. The stakeholders asked that attention be paid to these areas when considering land use options. However, the Project is not expected to impact the gullies and valleys.

- Stakeholders asked that the Project consider impacts to habitat, nesting patterns, and foraging patterns for *'elepaio, nēnē, pueo, 'apapane, 'io*, and *'ōpe'ape'a*. However, given the relative height of the panels, issues related to other renewable energy projects, i.e. wind turbines, in terms of visibility and impacts to birds and bats seems to be less of an issue but they asked that protocols and procedures be put in place.

- The stakeholders asked that visual analysis consider not just public views but also cultural visual associations, especially the view to/from mauka points on Wai'anae Range and Kūnia Road. But the Project does not appear to lend any additional visual impact beyond what presently exists in the area with homes, farms, and other land use activities in the region.

Respectfully submitted,

MARK KAWIKA MCKEAGUE, AICP, MURP

DATED: Honolulu, Hawai'i, 11 June, 2021.

WRITTEN DIRECT TESTIMONY OF ANDY STEPHENS
(Glare)

1. Please state your name and business address for the record.

Andy Stephens, POWER Engineers, Inc., 2041 Cobalt Point Way, Meridian, ID 83642

2. What is your current occupation?

I am a Visualization Specialist III with POWER Engineers, Inc.

3. What is Power Engineers, Inc.?

POWER Engineers, Inc. is a multidiscipline engineering and environmental consulting firm.

4. How long have you worked for Power Engineers, Inc.?

I have worked for POWER Engineers, Inc. for over 10 years.

5. Where did you work and in what capacity prior to Power Engineers, Inc.?

Prior to POWER, I worked as an account manager for Hewlett Packard.

6. Did you provide a copy of your biography and or resume for these proceedings?

A copy of my resume was filed as ***Exhibit 25.***

7. Do you specialize in any particular area?

I specialize in engineering visualization services with 9 years of experience in PV Glare Analysis.

8. Can you describe the Mahi Solar Project ("Project") that is the subject of the SUP application?

Mahi Solar is proposing to construct a 120-megawatt solar project, a Battery Energy Storage System (BESS), and other associated appurtenances including fencing, roads, and electrical infrastructure on roughly 600 acres of agriculture-zoned land that includes portions of Tax Map Keys (1) 9-2-001:001; 9-2-004:003, 006, 009, 010, 011, 012, and 013; 9-04-003:0001.

9. What is your role with this Project?

I supervised the glare analysis for the Project (1) to identify sensitive viewers near the Project area, including structures, motorists, and airport operations at Kalaeloa Airport

and Wheeler Army Airfield; (2) to characterize typical glare behavior experienced from the Project throughout the day and year; and (3) to evaluate when and where glare might be visible to structures, motorists, and pilots.

Because the Project is outside the transitional airspace of the Daniel K. Inouye International Airport, as determined by the Hawaii Department of Transportation, no analysis was needed with respect to that facility.

10. When was your work completed?

We submitted our findings to G70 in October 2020.

11. Was your study submitted as part of the SUP Application?

Yes, it was included as Exhibit H to the SUP Application.

12. Describe the work conducted for your study.

We used the Solar Glare Hazard Analysis (SGHAT) tool licensed by Forge Solar that provides a quantified assessment of when and where glare may occur throughout the year from a solar installation, as well as identifying the potential effects on the human eye when glare does occur. Glare was analyzed at one-minute intervals throughout the entire year to determine when and where glare may be visible to structures, motorists, and pilots. This software meets FAA glare analysis requirements. Due to the size of the Project, each major block of the PV arrays was subdivided and analyzed individually to reduce any over-reporting of generalized glare.

13. What were the results of this study?

After conducting the glare analysis, we found no potential glare reported from the proposed solar operations due to the orientation of the PV panels and the distance from any sensitive viewers to the Project. As a result, we do not anticipate glare impacts to airport operations at Kalaeloa Airport, Wheeler Army Airfield, nearby structures, and motorists on Highway 750 (Kunia Road).

Respectfully submitted,

ANDY STEPHENS

DATED: Honolulu, Hawai‘i, June 15, 2021.