FILE COPY

U.S. Department
of Transportation
**Federal Aviation
Administration**

ATO NAS Defense Programs
800 Independence Avenue, S.W.
Room 535A
Washington, DC 20591

JUL 23 2018

July 11, 2018

Mr. Scott Glenn, Director
Office of Environmental Quality Control
Department of Health, State of Hawai'i
235 S. Beretania Street, Room 702
Honolulu, Hawai'i 96813

Mr. Glenn:

With this letter, the Federal Aviation Administration (FAA) hereby transmits the Environmental Assessment and Draft Finding of No Significant Impact (EA-DFONSI) for the Repairs to Mount Ka'ala Road Project situated at TMKs No. (1) 6-8-001:001 and (1) 6-8-007:004, in the Waialua District on the island of Oahu for publication in the next available edition of the Environmental Notice.

The completed OEQC Publication Form and Adobe Acrobat PDF file of the DEA-AFNSI is transmitted via the Office of Environmental Quality Control Submission website (http://health.hawaii.gov/oeqc/submittal-form/).

If there are any questions, please contact Scott Babos, the FAA NAS Defense Programs (NDP) Ka'ala Project Planner at 907- 269-1267 or at scott.babos@faa.gov.

Respectfully,

Ken J. Harris
Manager, FAA NAS Defense Programs

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19-035

NEPA Action EA/EIS
Publication Form

Project Name (Include type of document; EA-FONSI, DEIS, FEIS)

Repairs to Mount Kaala Road EA-Draft FONSI

Island: Oahu
District: Waialua
TMK: (1) 6-8-001:001; (1) 6-8-007:004
Permits: U.S. Fish and Wildlife Service, Section 7 Consultation, Endangered Species Act
U.S. Coast Guard, Section 106 Consultation, National Historic Preservation Act
USACE, Section 404 Clean Water Act, and Rivers and Harbors Act of 1899
Board of Land and Natural Resources, Conservation District Use Permit
Department of Business, Economic Development and Tourism, Office of Planning, Coastal Zone Management Act Consistency Determination
Department of Health, Chapter 46, HAR – Construction Noise Permit, as required
Chapter 11-55, HAR – National Pollutant Discharge Elimination System (NPDES) Permit
Department of Land and Natural Resources, Division of Forestry and Wildlife, Special Use Permit, Natural Area Reserves

Applicant or Proposing
Agency: United States Air Force
(Address, Contact Person, Telephone)
Julie M. Mages, P.E.
Engineering Flight Command
611 Civil Engineer Squadron
JBER, Alaska 99506
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Approving
Agency: Federal Aviation Administration
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Scott Babos
ATO NAS Defense Programs
800 Independence Avenue, S.W.
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(907) 269-1267

Consultant: Environmental Risk Analysis LLC
(Address, Contact Person, Telephone)
Rachel Okoji
905A Makahiki Place
Honolulu, HI 96826
(808) 783-6840

Status: (Please enter comment period (days) and deadline, and whom to send comments to)
Comment period – 30 days
Deadline: August 22, 2018
Comments sent to:

Kevin Nishimura
Environmental Protection Specialist
US Army Corps of Engineers, Honolulu District
CEPOH-PP-E, Bldg 230

19-035

Fort Shafter, HI 96858
Email: Kevin.H.Nishimura@usace.army.mil

Kalani Smith
US Army Corps of Engineers, Honolulu District
CEPOH-PP-M, Bldg 230
Fort Shafter, HI 96858-5440
Email: Kalani.M.Smith@usace.army.mil

Summary (Provide proposed action and purpose/need in less than 200 words. Please keep the summary brief and on this one page)**:**

Mt. Kaala is the highest point on the island of Oahu and can only be accessed through the road which is currently in need of repairs. Mt. Kaala Road supports the US Air Force, Federal Aviation Administration, State of Hawaii, and other Communications and Radar missions in Hawaii. The Proposed Project would allow for repairs and road infrastructure improvements of five sites impacted by severe landslides and erosion on Mt. Kaala Road. The repairs and improvements to the road infrastructure are needed to increase safety and operational efficiency.

Environmental Assessment
And Draft Finding of No Significant Impact

For the Proposed

Repairs to Mount Ka`ala Road
Oahu, Hawaii

July 2018

Prepared for:
United States Air Force
611 CES/CEN
10471 20th Street Ste 302
JBER, Alaska 99506

Applicant:
United States Air Force

Approving Agency:
Federal Aviation Administration

Prepared under:
Contract Number W9128A-16-P-0027

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Draft Finding of No Significant Impact

For the Proposed Repairs to Mount Ka`ala Road

Oahu, Hawaii

Authority

Pursuant to the National Environmental Policy Act of 1969 (NEPA), as amended; the Council on Environmental Quality (CEQ) regulations implementing the procedural provisions of NEPA; Department of Defense Directive 6050.1, *Environmental Effects in the United States of DOD Actions*; Air Force Instruction 32-7061, *The Environmental Impacts Process*; Department of Transportation Order 5610.1C, *Procedures for Considering Environmental Impacts*; and Federal Aviation Administration Order 1050.1F, *Environmental Impacts: Policies and Procedures*, the United States Air Force, 61 CES/CEN (USAF) and the Federal Aviation Administration (FAA) gives notice that an Environmental Assessment has been prepared for the proposed repairs to Mt Ka`ala Road, Oahu, Hawaii:

Proposed Action and Alternatives Considered

The USAF and FAA proposes repair work to the existing Mt Ka`ala Road. The EA evaluates the environmental impacts of the Proposed Action and the No Action Alternative.

The Proposed Action would involve repairs and road infrastructure improvements along Mt. Ka`ala Road for safety and operational effectiveness. Five sites on Mt. Ka`ala Road have been impacted by severe landslides and erosion. Repairs and infrastructure improvements are summarized in the table below:

Summary of Proposed Repairs to Mt Ka`ala Road

Site	Description of Proposed Repairs
Site 1: Culvert 39	The design moves and realigns the roadway away from the failed slope area. and calls for installation of a rockfall impact barrier system. The new road realignment requires excavation of the upslope embankment to build the realigned road
Site 2: Culvert 32	The design moves and realigns the roadway away from the failed slope area. The new road realignment requires excavation of the upslope embankment to build the realigned road. Existing storm water catch basins are retained to collect some of the runoff. Existing storm drain manholes will be modified and converted to be grated drain inlets to collect some of the runoff.
Site 3: Culvert Crossing	The design repairs the existing metal culverts by pouring a new concrete invert and slip-lining a new plastic pipe through the existing pipes. The roadway and shoulders will also be repaired. In addition to the above repairs, areas both upstream and downstream of the steam crossing will be grubbed and cleared of accumulated debris. Excess material generated as a result of excavation on the uphill sites (1, 2, 4, and 5) will be disposed at this site.
Sites 4 and 5: Culvert 42	Scaling to adjust the appropriate amount of soil for removal

The USAF will employ numerous best management practices (BMPs) to minimize impacts to the environment. These BMPs are described in detail in the EA.

In addition to the Proposed Action, the No Action Alternative was also analyzed. Under the No Action Alternative, the repair work to Mt Ka`ala Road would not be executed. Continued operational use of the road to gain access to the tracking station would be impaired and negatively impact operations critical for tracking flight operations for the State of Hawaii.

Summary of Environmental Analysis

The environmental analysis of the Proposed Action and No Action Alternative is presented in the EA. Based on this analysis, the USAF and FAA has determined that the Proposed Action would result in impacts that are less than significant. The employment of BMPs will avoid or minimize potential impacts to topography and geologic resources, flora and fauna, climate and air quality, noise, solid waste and historic and cultural resources. Beneficial impacts would be experienced with land use and economic resources. The Proposed Action will not act in association with past, present or anticipated future actions to cause appreciable cumulative impacts. The Proposed Action is consistent with the mission objectives of the different organizations utilizing Mt. Ka`ala.

Public Review and Comment

This Draft Finding of No Significant Impact (FNSI) has been issued in conjunction with the Environmental Assessment (EA) and incorporates it by reference. Notice of Availability of the EA and Draft FNSI will be published in the July 23, 2018 edition of the *Environmental Notice*.

Paper copies of the EA and Draft FNSI are also available for public review at the Hawaii State Public Library in Honolulu and the Waialua Public Library.

Written comments on the Draft FNSI must be received within 30 days of the publication of this notice (no later than August 22, 2018). Comments can be emailed to Kevin.h.nishimura@usace.army.mil or mailed to U.S. Army Corps of Engineers, Honolulu District, Environmental Programs Branch, Bldg 230, Fort Shafter, HI 96858, Attn: Kevin Nishimura.

Finding

Upon review of the EA, the USAF and FAA concluded that the proposed repairs and road infrastructure improvements at Mt. Ka`ala Road in Oahu, Hawaii, will not cause significant impacts to the human or natural environment. Pursuant to regulations, the EA and Draft FNSI will be made available for a 30-day public review and comment period. Once any comments have been addressed, and if a determination is made that the Proposed Action will have no significant impact, the FNSI will be signed and the action will be implemented. This analysis fulfills the requirement of NEPA and the CEQ regulations. Therefore an environmental impact statement is not required.

This Finding of No Significant Impact has therefore been prepared and is submitted to document environmental review and evaluation in compliance with NEPA.

ENVIRONMENTAL ASSESSMENT

AND DRAFT FINDING OF NO SIGNIFICANT IMPACT

FOR THE

PROPOSED REPAIRS TO MOUNT KA`ALA ROAD

OAHU, HAWAII

JULY 2018

Applicant/Reviewer

17 July 2018

JEREMIAH J. HAMMILL, Lt Col, USAF   Date
Commander
611th Civil Engineer Squadron
B10472 20th Street, Suite 301
Joint Base Elmendorf-Richardson Anchorage,
AK 99506

Approving Agency

17 July, 2018

KEN J. HARRIS   Date
Manager, FAA NAS Defense Programs
Federal Aviation Administration
800 Independence Avenue, S.W. Room 535A
Washington, DC 20591

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Environmental Assessment

Repairs to Mount Ka`ala Road
Oahu, Hawaii

Prepared for:
United States Air Force
611 CES/CEN
10471 20th Street Ste 302
JBER, Alaska 99506

Applicant:
United States Air Force

Approving Agency:
Federal Aviation Administration
ATO NAS Defense Programs
800 Independence Avenue, SW
Room 535A
Washington, DC 20591

July 2018

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Appendix F	Archaeological Inventory Survey
Appendix G	National Historic Preservation Act Section 106 Consultation Correspondence

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Acronyms and Abbreviations

AFI	Air Force Instruction
AFS	Air Force Station
APE	Area of Potential Effect
BMP	Best Management Practices
BA	Biological Assessment
BWS	Board of Water Supply
CELCP	Coastal and Estuarine Land Conservation Program
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CZMA	Coastal Zone Management Program
dBA	decibels
DAR	Division of Aquatic Resources
DES	Department of Environmental Services
DOD	Department of Defense
DLNR	Department of Land and Natural Resources
DOFAW	Division of Forestry and Wildlife
DOT	Department of Transportation
EA	Environmental Assessment
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FEMA	Federal Emergency Response Agency
FIRM	Flood Insurance Rate Map
FONSI	Finding of No Significant Impact
GIS	Geographic Information System
HAR	Hawaii Administrative Rules
HDOH	Hawaii State Department of Health
HIANG	Hawaii Air National Guard
HRS	Hawaii Revised Statutes
HIRAOC	Hawaii Region Air Operations Center
HFD	Honolulu Fire Department
ICSD	Information and Communication Services Division
IRP	Installation Restoration Program
km	kilometers
Ldn	Day-night noise level
m	meters

NAAQS	National Ambient Air Quality Standards
NAR	Natural Area Reserve
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NRHP	National Register of Historic Places
P-1	Restricted Preservation District
POH	U.S. Army Corps of Engineers, Honolulu District
ROM	Rough Order of Magnitude
SEL	Sound Exposure Level
SHPD	State Historic Preservation Division
TMK	tax map key
USAF	United States Air Force
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Services
USFWS PIFWO	United States Fish and Wildlife Services Pacific Island Fish and Wildlife Office
USGS	United States Geological Survey

EXECUTIVE SUMMARY

The United States Air Force (USAF) and Federal Aviation Administration (FAA) has conducted an Environmental Assessment (EA) to evaluate and address potential environmental impacts associated with the proposed repairs and road infrastructure improvements to Mt. Ka`ala Road on the island of Oahu. The EA examines the No Action Alternative and the Proposed Action Alternative. The Proposed Action to proceed with repairs and road infrastructure improvements of five sites impacted by severe landslides and erosion is the USAF's Preferred Alternative and can be accomplished without significant adverse effects to the environment and the quality of human life by the implementation of best management practices, which will avoid or minimize impacts on environmental resources. The No Action Alternative is prescribed by the Council on Environmental Quality regulations to serve as the baseline against, which the Proposed Action and other alternatives are analyzed.

The following potentially impacted environments were evaluated in this EA:

- Topography and Geology
- Soils
- Natural Hazard
- Flora and Fauna
- Wetlands
- Water Resources
- Climate and Air Quality
- Noise
- Solid Wastes
- Land Use Considerations and Zoning
- Archaeological and Cultural Considerations
- Circulation and Traffic
- Social Factors and Community Identity
- Economic Considerations
- Recreational and Public Facilities
- Visual and Aesthetic Resources
- Infrastructure Systems and Utilities

Purpose and Need

This EA has been prepared to satisfy the requirements of the National Environmental Policy Act of 1969 (NEPA). The purpose of the Proposed Action is to repair and improve road infrastructure at Mt. Ka`ala for safety and operational efficiency. Mt. Ka`ala is the highest point on the island of Oahu and can only be accessed through the road which is currently in need of repairs. The road extends 6.7 miles and leads to the Federal Aviation Administration (FAA) maintained tracking station at the summit of Mt. Ka`ala. Although helicopter access is a possibility, frequent poor weather and cost do not make it a regular viable option. Mt. Ka`ala Road supports the USAF, FAA, State of Hawaii, and other Communications and Radar missions in Hawaii. Mt. Ka`ala Air Force Station (AFS) is one of two vital radar sites serving Hawaii Region Air Operations Center (HIRAOC). The Radar Station provides 24-hour surveillance information to the Hawaiian Air Defense Network, under the central organization of HIRAOC. Mt. Ka`ala AFS and Kōke`e AFS are responsible for detecting and tracking all aircraft operating in the Hawaiian Islands. Radar data collected at Mt. Ka`ala AFS is shared with the FAA for normal traffic control use. Mt. Ka`ala AFS also provides assistance to military and civilian aircraft during emergencies.

Findings

- Under Alternative I, the No Action Alternative, Land Use Considerations and Zoning would be negatively impacted as access to the FAA radar station would be blocked by hazardous road conditions caused by erosion, landslides, clogged culverts and damaged concrete.

- Implementing the No Action Alternative would have no significant impact on the natural environment or on most resources. However, it would have long-term indirect, adverse effects on air traffic safety and other important government communications to the State and Federal government.

- Beneficial impacts to Land Use Considerations and Zoning are anticipated assuming implementation of Alternative II, the Proposed Action, as it would allow government agencies to continue using the only existing road for access to Mt. Ka`ala AFS. Without safe passage on this road, the negative impact to government funds would be significant, as the only other option is helicopter access (which is not only expensive, but is an ineffectual method of transportation during adverse weather conditions). There would also be short-term beneficial impacts with implementing the proposed project by providing an opportunity for the local construction community to engage in.

- Implementing the Proposed Action would have no significant impact on the natural environment. While potential short-term, direct impacts to topography and geology, soil, flora and fauna, water resources, climate and air quality, noise, solid waste, historic and cultural resources, and circulation and traffic may occur during construction, avoidance or minimizing adverse impacts by implementing best management practices would reduce these impacts to less than significant levels. Long-term effects are expected to be negligible.

Table ES-1. Summary of Potential Impacts

Alternatives	Resources Evaluated											
	Topography and Geology	Soils	Natural Hazards	Flora and Fauna	Water Resources	Climate and Air Quality	Noise	Solid Waste	Land Use	Historical and Cultural Resources	Circulation and Traffic	Economics
No Action	●	○	●	○	○	○	○	○	●	○	●	●
Proposed Action	◊	◊	○	◊	◊	◊	◊	◊	♦	◊	○	♦

Note: Alternatives summarized in table exclude resources evaluated that have no effects on the Proposed Action and the No Action Alternative.

Legend
○ No impact
◊ Less than significant impact
● Adverse impact
♦ Beneficial impact

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SECTION 1 INTRODUCTION AND SUMMARY

1.1 Scope and Authority

This Environmental Assessment (EA) has been prepared in accordance with the National Environmental Policy Act (NEPA) of 1969, as amended; the Council on Environmental Quality (CEQ) regulations implementing the procedural provisions of NEPA (Title 40 Code of Federal Regulations (CFR) 1500-1508); Department of Defense (DOD) Directive 6050.1, *Environmental Effects in the United States of DOD Actions; Air Force Instruction*; Air Force Instruction (AFI) 32-7061, *The Environmental Impact Analysis Process*; Department of Transportation (DOT) Order 5610.1C, *Procedures for Considering Environmental Impacts*; and Federal Aviation Administration (FAA) Order 1050.1F, *Environmental Impacts: Policies and Procedures*. The intent of the document is to ensure that systematic consideration is given to the environmental consequences of the Proposed Action. The Proposed Action is to perform repair and road infrastructure improvements on Mt. Ka`ala Road.

1.2 Project Information

Project Name:	Proposed Repairs to Mount Ka`ala Road Oahu, Hawaii
Applicant:	United States Air Force Engineering Flight Command 611 Civil Engineer Squadron JBER, Alaska 99506 Contact: Julie M. Mages, P.E.
Approving Agency:	Federal Aviation Administration ATO NAS Defense Programs 800 Independence Avenue, SW Room 535A Washington, DC 20591 Contact: Scott Babos
Project Location:	Mt. Ka`ala Road starts in Waialua, on the north shore of Oahu. The road leads to the Mt. Ka`ala Air Force Station (AFS), which is at the northern end of the Waianae Mountain Range. It is approximately 20 miles NW of Honolulu and 17 miles NW of Hickam Air Force Base, 21◦30’27” north latitude and 158◦8’33” west longitude.
Tax Map Key (TMK) No.:	(1) 6-8-001:001; (1) 6-8-007:004
Total Affected Area:	10.8 kilometers (km) section of Mt. Ka`ala Road
Existing Land Use:	Mt. Ka`ala Road is primarily owned by the U.S. Army. The U.S. Army has tenant agreements with other State and Federal agencies for use of the Road. The Road is maintained by the U.S. Air Force (USAF) and the FAA.
State Land Use Classification:	Conservation District
State Special District:	Waialua

LUO Zoning:	Restricted Preservation District (P-1)
LUO Special District:	None
Flood Zone:	Flood Insurance Rate Map Zone D and X
Land Owner:	U.S. Army

SECTION 2 PROJECT DESCRIPTION

2.1 Purpose and Need

Purpose: This EA has been prepared to satisfy the requirements of NEPA. The purpose of the Proposed Action is to repair and improve road infrastructure at Mt. Ka`ala for safety and operational efficiency. The road extends 6.7 miles and leads to the FAA maintained tracking station at the summit of Mt. Ka`ala.

Need: Mt. Ka`ala is the highest point on the island of Oahu at 4,025 feet in elevation above mean sea level. It can only be accessed through the road which is currently in need of repairs. Although helicopter access is a possibility, frequent poor weather and cost do not make it a regular viable option. Mt. Ka`ala Road supports the USAF, FAA, State of Hawaii, and other Communications and Radar missions in Hawaii. Mt. Ka`ala AFS is one of two vital radar sites serving Hawaii Region Air Operations Center (HIRAOC). The Radar Station provides 24-hour surveillance information to the Hawaiian Air Defense Network, under the central organization of HIRAOC. Mt. Ka`ala AFS and Kōke`e AFS are responsible for detecting and tracking all aircraft operating in the Hawaiian Islands area. Radar data collected at Mt. Ka`ala AFS is shared with the FAA for normal traffic control use. Mt. Ka`ala AFS also provides assistance to military and civilian aircraft during emergencies. Figure 1 is a map of the general site location.

2.2 Project Description

Mt. Ka`ala Access Road begins in Waialua and leads to the Mt. Ka`ala AFS, which is located at the northern end of the Waianae Mountain Range (Figure 2). Mt. Ka`ala Road is restricted to the public, making vehicular traffic on the roadway relatively light. Daily traffic consists of dozens of passenger cars and pickup trucks, many of whom are government employees, contractors, and local ranchers. A site reconnaissance of the road was conducted by the U.S. Army Corps of Engineers, Honolulu District (POH), which yielded a report entitled “Site Reconnaissance Report, Mount Ka`ala Road”, dated June 2015 (Appendix A). The purpose of the site reconnaissance was to assess existing roadway and slope conditions for erosion, slides, and instability that may make the roadway impassable and cut off access to the FAA tracking station. The intent is to look at options to repair these sections of the road, as well as set up a method by which future repairs can be made as erosion continues to occur. The POH identified three major areas of concern: Site 1 near Culvert 39, Site 2 near Culvert 32, and Site 3 at Makaleha Stream crossing. Sites 1 and 2 were damaged by landslides, while Site 3 suffered damage from a storm. Two additional Sites were subsequently identified as eroding areas requiring repairs: Site 4 near Culvert 41 and 42 and Site 5 near grade turn-a-round, close to the existing maintenance facility (Figure 3).

2.3 Project Background

The road is under the jurisdiction and joint management of the FAA, U.S. Army, and USAF based on existing real estate property documentation. In September 2015, the FAA submitted a letter requesting USAF assistance. The FAA and USAF signed commitment letters laying out the parameters and roles of each agency for this NEPA action. The two commitment letters, in addition to the existing Interagency Agreement for the management of the installation, provide further background on the roles the FAA, USAF, and U.S. Army play in this specific project area.

2.4 Construction Time Frame and Estimated Project Construction Costs

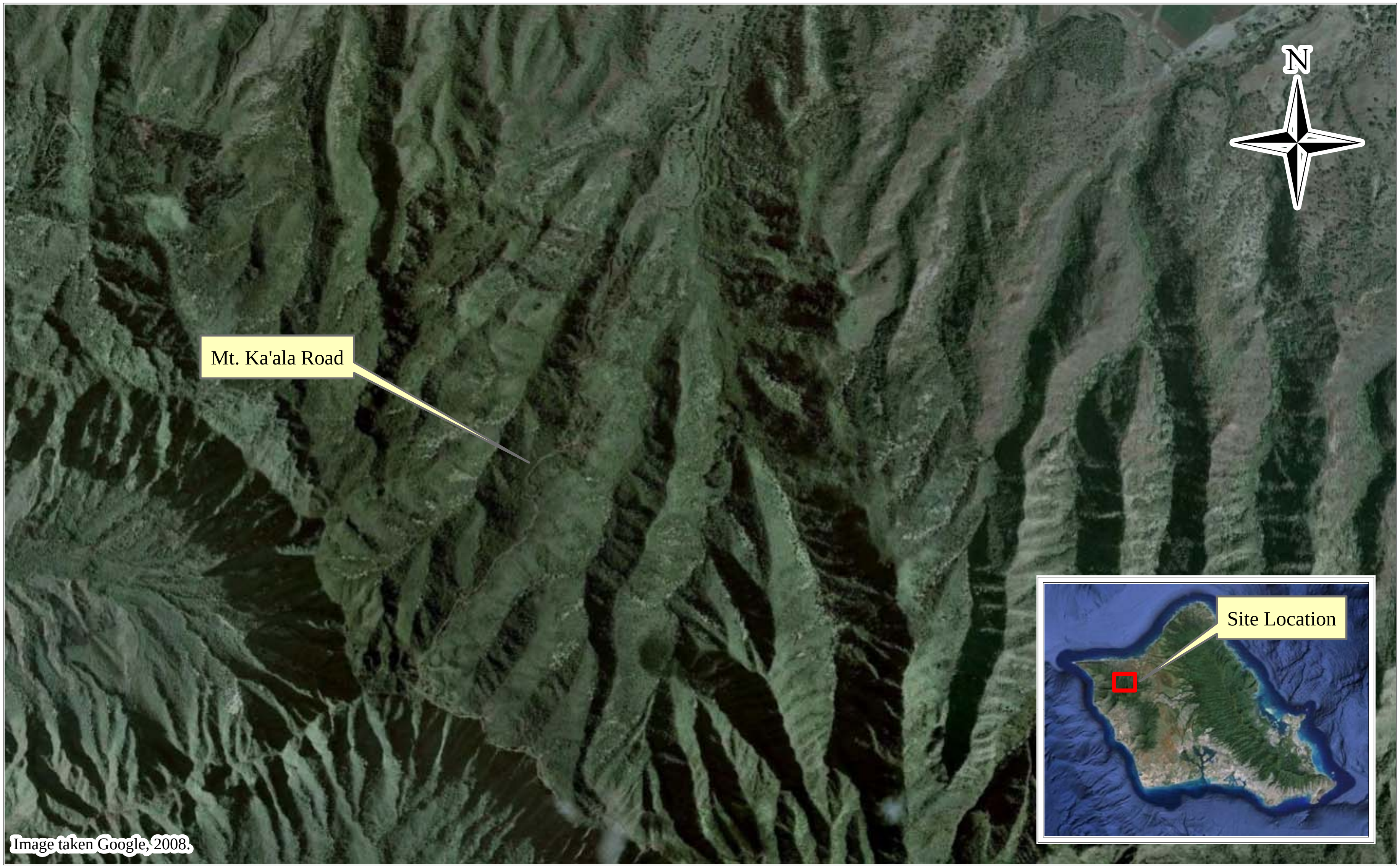
Construction is anticipated to commence in 2018. The construction is projected to take place for a duration of 12 months. The total budget for these improvement activities is estimated at $12 million and is outlined in the table below. Construction work is intended to occur while keeping the road accessible to vehicles.

This will minimize impacts to operations as well as provide access for emergency scenarios. It is assumed the existing conditions of the road can accommodate the size, weight, and volume of construction equipment and traffic required to perform the project.

Rough Order of Magnitude (ROM) Construction Cost Estimate

Site	ROM Cost	Remarks
Site 1: Culvert 39	$4,300,000	The design moves and realigns the roadway away from the failed slope area. and calls for installation of a rockfall impact barrier system. The new road realignment requires excavation of the upslope embankment to build the realigned road.
Site 2: Culvert 32	$2,000,000 $200,000	The design moves and realigns the roadway away from the failed slope area. The new road realignment requires excavation of the upslope embankment to build the realigned road. Existing storm water catch basins are retained to collect some of the runoff. Existing storm drain manholes will be modified and converted to be grated drain inlets to collect some of the runoff.
Site 3: Culvert Crossing	$500,000 $2,000,000	The design repairs the existing metal culverts by pouring a new concrete invert and slip-lining a new plastic pipe through the existing pipes. The roadway and shoulders will also be repaired. In addition to the above repairs, areas both upstream and downstream of the steam crossing will be grubbed and cleared of accumulated debris. Excess material generated as a result of excavation on the uphill sites (1, 2, 4, and 5) will be disposed at this site.
Site 4/5: Culvert 42, Turnaround Area	$600,000	Scaling to adjust the appropriate amount of soil for removal
Planning and Miscellaneous Costs*	$770,000 $100,000 $580,000 $950,000	Engineering Design (8% of ROM), Topographic Survey ($100,000), Construction Management (6% of ROM), Contingency Fund (10% of ROM)
Total Costs*	$12,000,000	

* Subject to change based on financing and selected alternatives.



PROJECT NAME:

Repairs to Mount Ka'ala Road
Oahu, Hawaii

FIGURE TITLE:

Site Location Map

FIGURE NUMBER:

1

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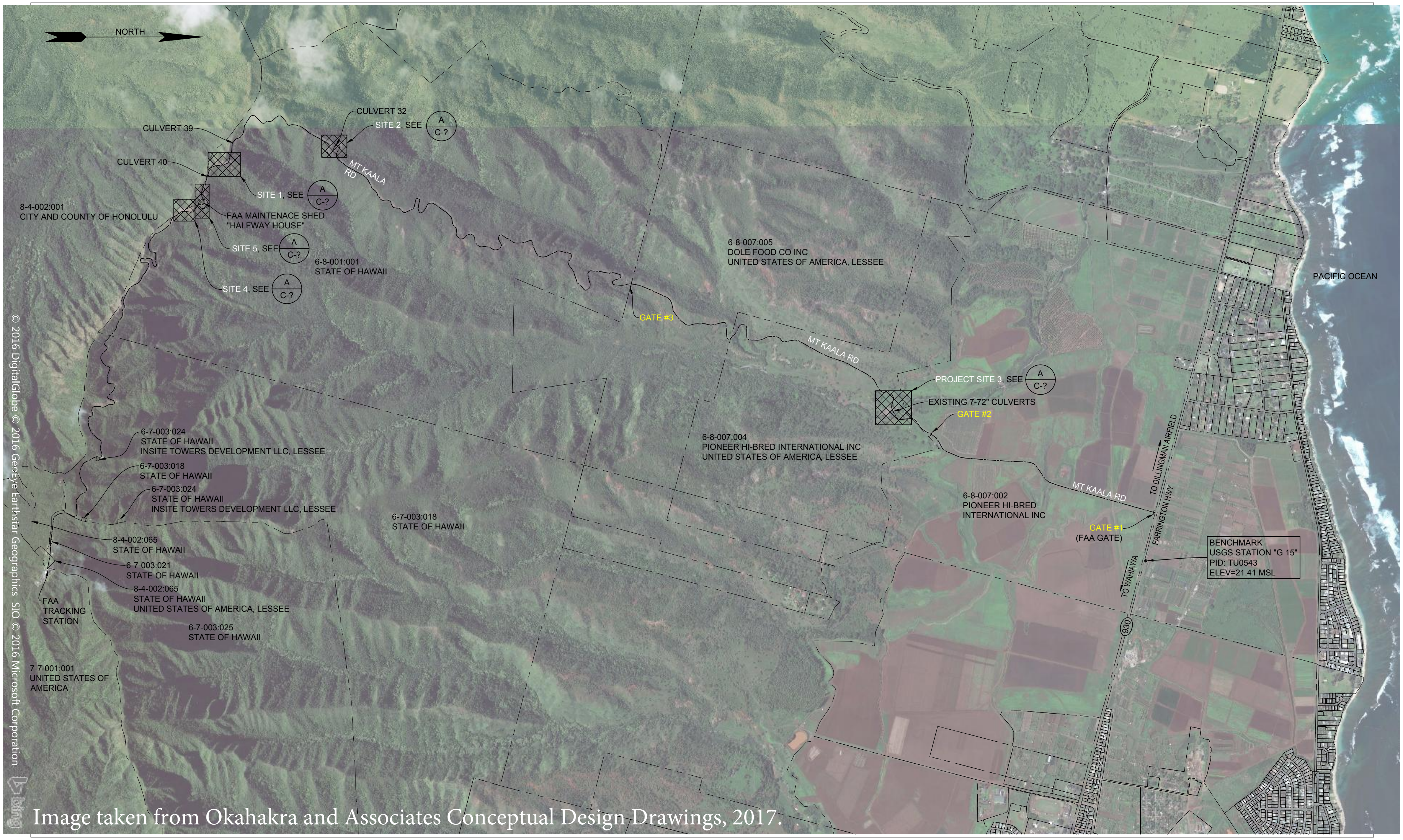

	PROJECT NAME: Repairs to Mount Ka'ala Road Oahu, Hawaii	FIGURE TITLE: USAF Station Map and Tax Map Key Map
		FIGURE NUMBER: 2

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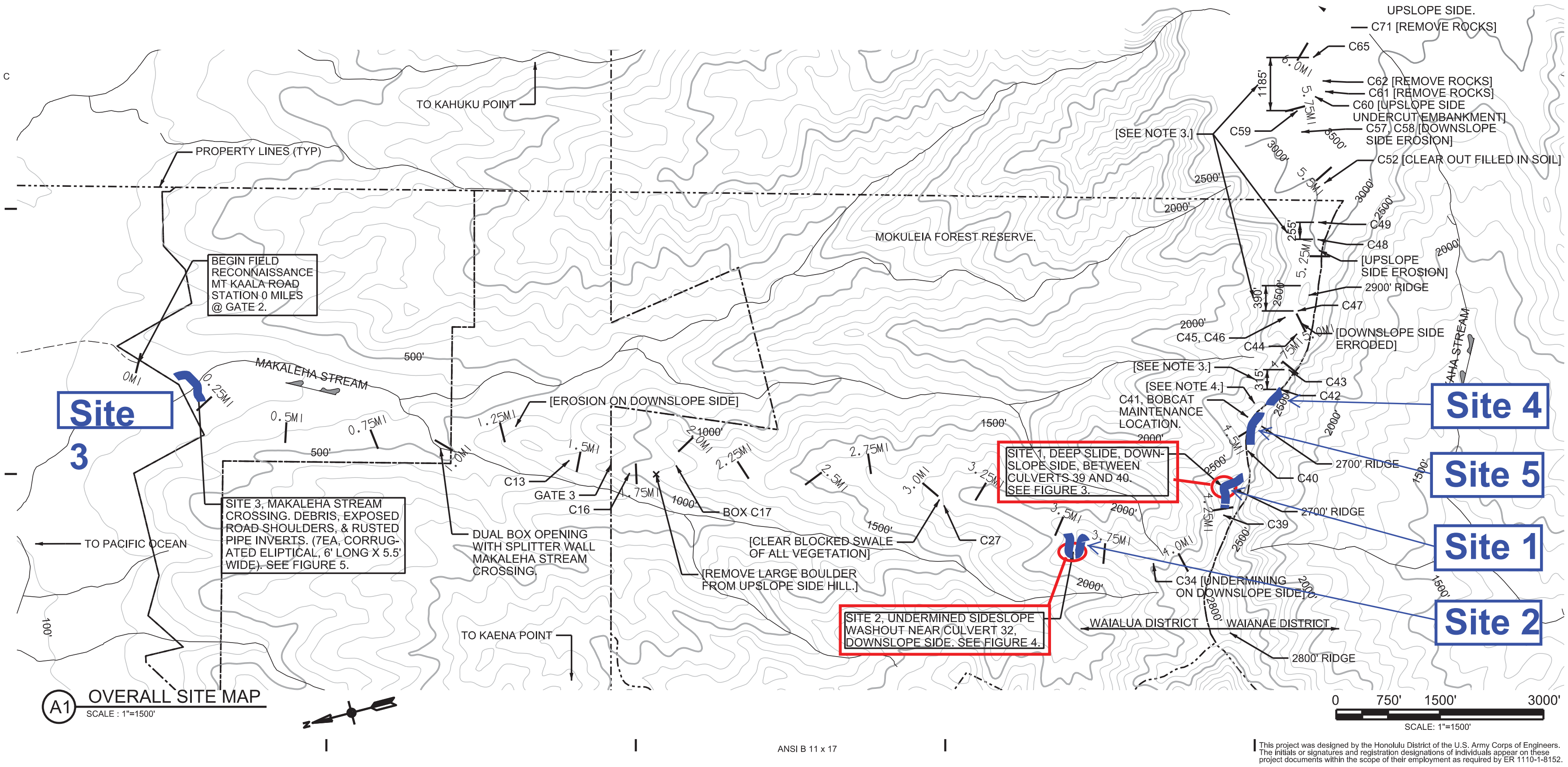

	PROJECT NAME: Repairs to Mount Ka'ala Road Oahu, Hawaii	FIGURE TITLE: Road Repairs Site Map FIGURE NUMBER: 3

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SECTION 3 ALTERNATIVES INCLUDING THE PROPOSED ACTION

This section details the alternatives that were analyzed in the EA. Under NEPA (as implemented by the CEQ regulations [40 CFR Parts 1500-1508], all alternatives considered for the proposed project should be evaluated. These alternatives may possibly enhance environmental quality or avoid, reduce, or minimize some or all of the adverse environmental effects, costs, and risks. Other alternatives were evaluated in the design process. Due to the unique nature of the Site, the presented alternatives were deemed most feasible in regards to constructability, safety, cost, and meeting the design objectives.

3.1 Alternative I: No Action Alternative

Under the No Action alternative, the Site would be kept as is with no changes or alterations. This alternative would not accomplish the goals detailed in Section 2.1, Purpose and Need and would not address adverse site conditions that could potentially make the existing roadway impassable and block all access to the FAA tracking station. As the Radar site is manned continuously with personnel on 24-hour shifts, helicopter access is not a viable option, due to cost and to frequent poor weather.

3.2 Alternative II: The Proposed Action – Repairs to Mt. Ka`ala Road

The Proposed Action is to repair five areas (referred to as Sites 1 through 5) along Mt. Ka`ala Road that are in need of repair due to slope erosion, landslides, and other environmental factors causing instability near the road, such as damage from debris, wind, and rain. Site descriptions, impacts, and proposed repair measures recommended to minimize adverse site conditions are as follows:

3.2.1 Site 1

Site 1 involves a steep downslope landslide area near the 2,700 feet elevation along Ka`ala Road. The design moves and realigns the roadway away from the failed slope area. The new road realignment requires excavation of the upslope embankment to build the realigned road. The design shows a 1H:2V slope for the resultant upslope embankment and a height of about 60 feet at the tallest reach.

Approximately 4,800 cubic yards of excavated soils result are removed from the upslope embankment and will be embanked at Site 3 within the new graded ramp area.

3.2.2 Site 2

Site 2 involves a landslide area at or near the 2,200 feet elevation along Ka`ala Road. The design moves and realigns the roadway away from the failed slope area. The new road realignment requires excavation of the upslope embankment to build the realigned road.

Surface water runoff within the Site 2 area is diverted from the landslide area by new concrete curbs. Existing storm water catch basins are retained to collect some of the runoff. Existing storm drain manholes will be modified and converted to be grated drain inlets to collect some of the runoff. The balance of surface water runoff will flow away from Ka`ala Road and into the drainage basin of Makaleha Stream.

Approximately 2,200 cubic yards of excavated soils result are removed from the upslope embankment and will be embanked at Site 3 within the new graded ramp area.

3.2.3 Site 3

Site 3 is the existing steel culvert crossing at Makaleha Stream at near the 240 feet elevation along Ka`ala Road. The existing stream crossing consists of seven 60-inch diameter corrugated metal pipes laid over by a 12-feet wide asphalt paved roadway.

Because each of the steel culverts have corrosion damages at the invert level, the prefinal design shows repairs to the metal pipes by pouring a new concrete invert while securing the not-corroded parts of the corrugated metal pipes. The roadway and shoulders will also be repaired.

In addition to the above repairs, areas both upstream and downstream of the steam crossing will be grubbed and cleared of accumulated debris. Approximately 7,000 cubic yards of excavated soils from Site 1 and 2 combined will be embanked along the shoulder of Ka`ala Road to build a new graded ramp for maintenance equipment access into the streambed of Makaleha Stream. The current lack of access appears contributory to the accumulated debris and heavy vegetative overgrowth impeding stream flow through the existing steel culverts.

3.2.4 Sites 4 and 5

Sites 4 and 5 are adjoining sites at or near the 2,700 feet elevation along Ka`ala Road.

Site 4 contains soils and rock outcroppings, which overhang the existing slopes and appear as potential future landslide hazards. The prefinal design shows to remove the outcroppings and scale the existing slopes to reduce the potential for future landslides at this at this location.

Site 5 is designated as the construction vehicle turnaround area. Because the work efforts will require trucks hauling soils, it is necessary to create a turnaround area for the trucks. Site 5 provides a safe feasible location for the turnaround.

The proposed work at Sites 4 and 5 is relatively straightforward and will result in approximately 400 cubic yards of excavated soils, which will be embanked along the shoulder of Ka`ala Road immediately uphill of Site 1.

SECTION 4 AFFECTED ENVIRONMENT

This section discusses the current status of the potentially affected environments should the Proposed Action be implemented. Affected environments include important natural and cultural sources and systems. Environmental Consequences are provided in Section 5.

4.1 Physical Environment

4.1.1 Topography and Geology

The five proposed sites for road repair are along a 10.8 km section of Mt. Ka`ala Road, which follows a northeast-southwest oriented foothill upslope until it reaches the northwest-southeast oriented ridgeline that separates Makua and Waianae Kai to the south and Makaleha to the north. The road starts from Farrington Highway (Hwy 930) with an elevation of 5 meters (m) above mean sea level, to an elevation of 1,227 m above mean sea level at the tracking station (Figure 4).

The one-lane road is paved with asphaltic concrete and averages four meters in width. Survey areas include the proposed construction areas as well as 50-meter buffer around these areas. Naming of the sites follows the reconnaissance report (POH, 2015). The following are brief descriptions of the survey sites.

(a) Site 1 is between Culverts 39 and 40 and is about 838 m in elevation. A landslide occurred on the downslope side of the roadway with the top of slide extending close to the roadway edge.

(b) Site 2 is near Culvert 32 between the 3.5- and 3.75-mile marks and is about 688 m in elevation. The ground and slope fronting the guardrail of a 55-foot long section of roadway has eroded, exposing guardrail posts, and undermining the asphaltic concrete paved shoulder.

(c) Site 3 is at the stream crossing of Makaleha Stream close to the 2.5-mile mark at the lower portion of the Mt. Ka`ala Road. It is about 80 m above mean sea level in elevation. Storms deposited debris on the upstream of the culvert crossing and washed out part of the asphaltic concrete cover protecting the downstream sideslopes.

(d) Site 4 and Site 5 are between Culvert 40 and Culvert 42 near the 4.5-mile mark. Site 4 is about 812 m in elevation and Site 5 is about 822 m in elevation. Site 4 and Site 5 are in close proximity to one another with overlapping buffers and were surveyed as a single area. The steep road cut on the upslope of the roadway of Site 4 and Site 5 has eroded over time, leading to an unstable slope face, which constantly slides onto the roadway.

4.1.2 Soils

Soils within the area of potential effect (APE) primarily consist of Kawaihapai very stony clay loam 0–15 percent slopes and Kemoo silty clay 12–20 percent slopes (Figure 5a-c). The Kawaihapai soil series are characterized as being well drained soils formed in alluvium derived from basic igneous rock (Foote et al., 1972:64). Kawaihapai very stony clay loam is especially noted for the presence of enough stones to make cultivation impractical. The runoff is medium and the erosion hazard moderate. The Kemoo soil series are characterized as being well drained soil on the uplands of the island of O‘ahu that developed from material weathered from basic igneous rock (Foote et al. 1972:69). The permeability Kemoo silty clay 12–20 percent slopes is moderate to moderately rapid. Runoff is medium and the erosion hazard moderate. A small section of the western area of Locale 3 consisted of Kemoo silty clay 35–70 percent slopes. While the development of these soils is similar to Kemoo silty clay 12–20 percent, they occur on the sides of slopes and drainage ways. Runoff is rapid and the erosion hazard is severe. Rainfall data collected from Rainfall Atlas of Hawai‘i indicates that the foothills of the Waianae Mountains in the vicinity of Locale 3 receive a mean annual rainfall of 98.7 cm with 70 percent occurring between October and March (Garcia and Associates, 2017).

4.1.3 Natural Hazards

(a) Earthquake Hazards –Except for the Island of Hawaii, the Hawaiian Islands are generally not situated in a high seismic area subject to numerous large earthquakes. Most of the earthquakes that have occurred in the past have been volcanic earthquakes causing little or no damage to the other islands. The U.S. Geological Survey's (USGS) Atlas of Natural Hazards in the Hawaiian Coastal Zone (USGS, 2002) assigned seismic hazard intensity ratings for all islands on a scale from 1 to 5 with 1 representing lowest hazard and 5 the highest. The southern half of Oahu extending from Makaha east around Diamond Head and Makapuu Head and north up to Kaneohe Bay was assigned a volcanic/seismic risk ranking of 3 due to the proximity to the Molokai Seismic Zone. The remainder of the island is ranked a 2 with respect to the volcanic/seismic hazard (USGS, 2002). The project area is situated within this northern half of the island and has a lower risk ranking of 2.

(b) Flood Hazards - Floods caused by heavy rainfall and strong winds normally occur during the winter months. However, accurate historic rainfall data for the Mt. Ka`ala area is not available due to its unique location. Usually most rainfall on the island generally occurs from November to April. Flood hazard areas are delineated by Flood Insurance Rate Maps (FIRMs) prepared by the Federal Emergency Response Agency (FEMA), National Flood Insurance Program. Firm Panel 15003C0115G (effective January 19, 2011) depicts flood hazard for the Site. The project area is categorized as Zone D. Zone D is defined as an area where flood hazards are undetermined, but flooding is possible. It is not considered a special flood hazard area.

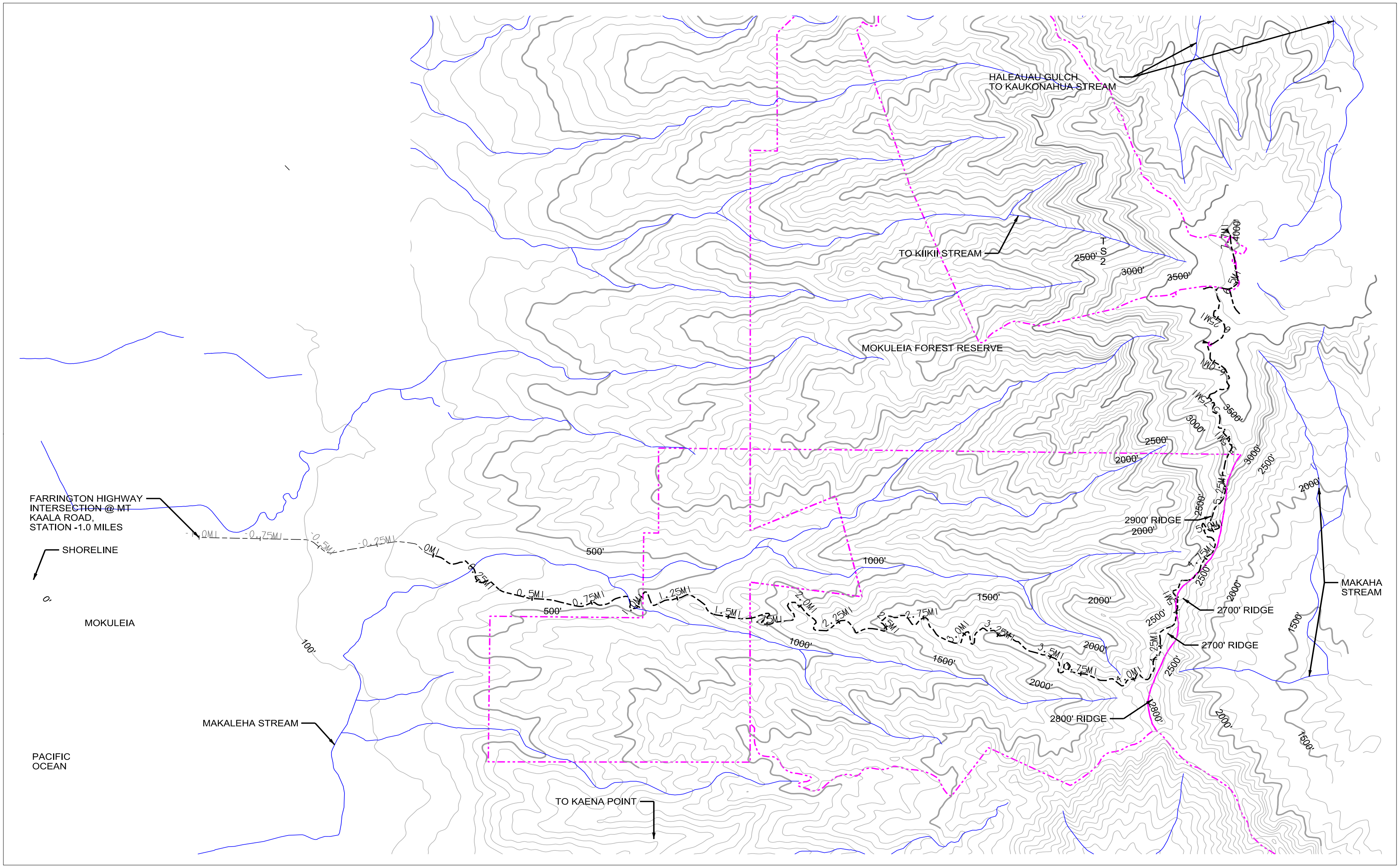
(c) Hurricane Hazards – Hurricanes are tropical storms with winds equal to or greater than 74 miles per hour. They have affected every island in the State and can cause major damage and injury due to high winds, marine over-wash, heavy rains, and other intense small-scale winds and high waves. A hazard mitigation report prepared by the FEMA determined that nine hurricanes approached within 300 nautical miles (about one day's travel time) of the Hawaiian Islands' coastlines between 1970 and 1992. Most hurricanes affecting the islands have focused on Kauai (DHS, 2017).

(d) Tsunami Hazards - A tsunami is a series of high waves, typically the result of a violent displacement of the seafloor. Tsunamis have the potential to inundate the coastline, causing severe property damage and/or loss of life. The project area is not designated as Tsunami Inundation Zones (City and County of Honolulu, 2016).

4.1.4 Flora and Fauna

No threatened or endangered plants or wildlife were observed during the field investigation conducted in December 2016 (Figures 6a-e). A Biological Survey was prepared by Garcia and Associates (Appendix B). Site 3 does not overlap with any federally designated critical habitat. However, four sites (1,2,4,5) overlap federally designated critical habitat for the Oʻahu ʻelepaio, a federally endangered species; three sites (1,2,5) overlap the Unit 1 of Lowland Mesic ecosystem critical habitat for 64 listed threatened or endangered plants of Oʻahu; and two sites (4,5) overlap Unit 1 of Lowland Wet ecosystem for 19 listed threatened or endangered plants of Oʻahu. Since work will occur on the designated critical habitat of Oʻahu ʻelepaio (*Chasiempis ibidis*), and the designated critical habitat units for threatened or endangered plants, it has the potential to adversely affect the critical habitat for the Oʻahu ʻelepaio and the listed plants. Though a designated (state and federally) critical habitat for the species, no species have been recorded within the project footprint. Background research and initial informal consultation indicates that the proposed action also has the potential to impact the endangered Oʻahu tree snail (*Achatinella mustelina*) and endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*) (Garcia and Associates, 2018).

Despite not finding any Endangered Species Act (ESA)-listed threatened or endangered species during the survey, the following listed species may be affected by the proposed action: the endangered Oʻahu tree snail (*Achatinella mustelina*) and the endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*).



PROJECT NAME:	FIGURE TITLE:
Repairs to Mount Ka'ala Road Oahu, Hawaii	Topographic Map
	FIGURE NUMBER: 4

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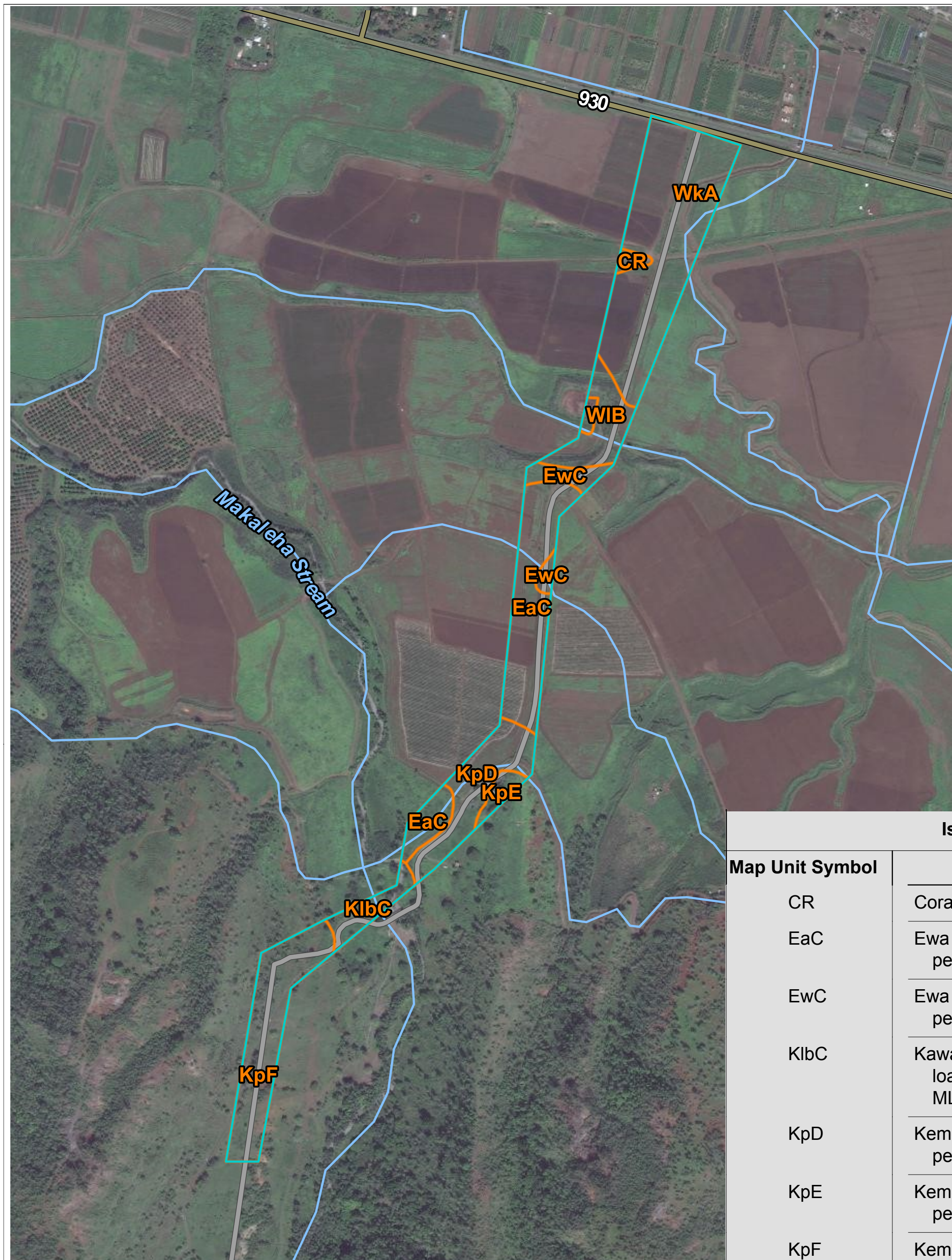

Soil Map may not be valid at this scale.

Island of Oahu, Hawaii (HI990)			
Map Unit Symbol	Map Unit Name	Acres	%of AOI
CR	Coral outcrop	0.6	0.9%
EaC	Ewa silty clay loam, 6 to 12 percent slopes	12.5	19.8%
EwC	Ewa stony silty clay, 6 to 12 percent slopes	2.2	3.5%
KlbC	Kawaihapai very stony clay loam, 0 to 15 percent slopes, MLRA 158	2.5	3.9%
KpD	Kemoo silty clay, 12 to 20 percent slopes	7.1	11.3%
KpE	Kemoo silty clay, 20 to 35 percent slopes	1.2	1.9%
KpF	Kemoo silty clay, 35 to 70 percent slopes	10.4	16.4%
W	Water > 40 acres	0.5	0.8%
WkA	Waialua silty clay, 0 to 3 percent slopes	21.7	34.3%
WlB	Waialua stony silty clay, 3 to 8 percent slopes	4.6	7.3%
Totals for Area of Interest		**63.2**	**100.0%**

PROJECT NAME:

Repairs to Mount Ka'ala Road
Oahu, Hawaii

FIGURE TITLE:

USGS Soils Map

FIGURE NUMBER:

5a

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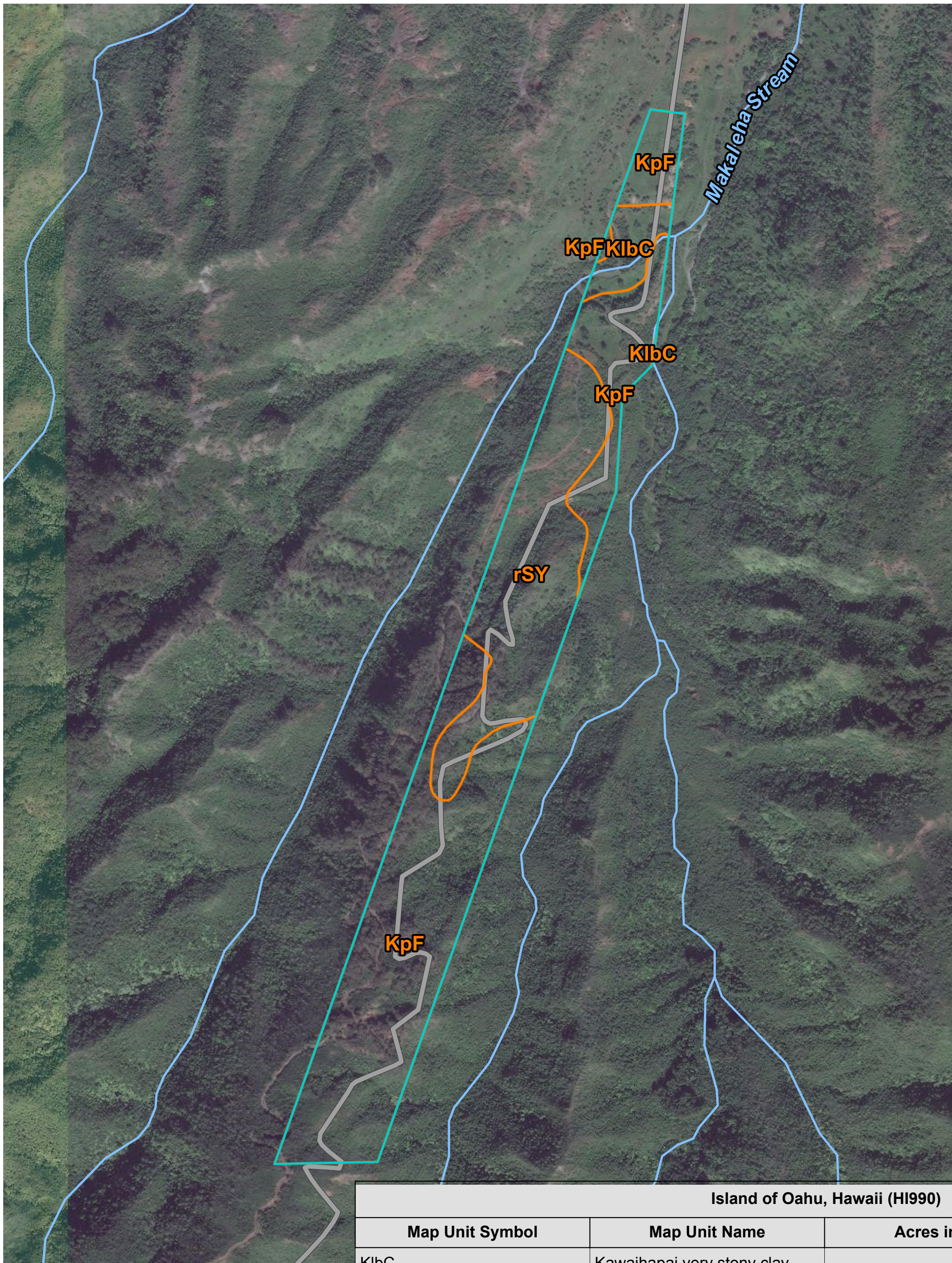

Island of Oahu, Hawaii (HI990)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
KlbC	Kawaihapai very stony clay loam, 0 to 15 percent slopes, MLRA 158	6.8	4.8%
KpF	Kemoo silty clay, 35 to 70 percent slopes	91.7	64.0%
rSY	Stony steep land	44.8	31.3%
Totals for Area of Interest		**143.3**	**100.0%**

PROJECT NAME:

Repairs to Mount Ka'ala Road
Oahu, Hawaii

FIGURE TITLE:

USGS Soils Map

FIGURE NUMBER:

5b

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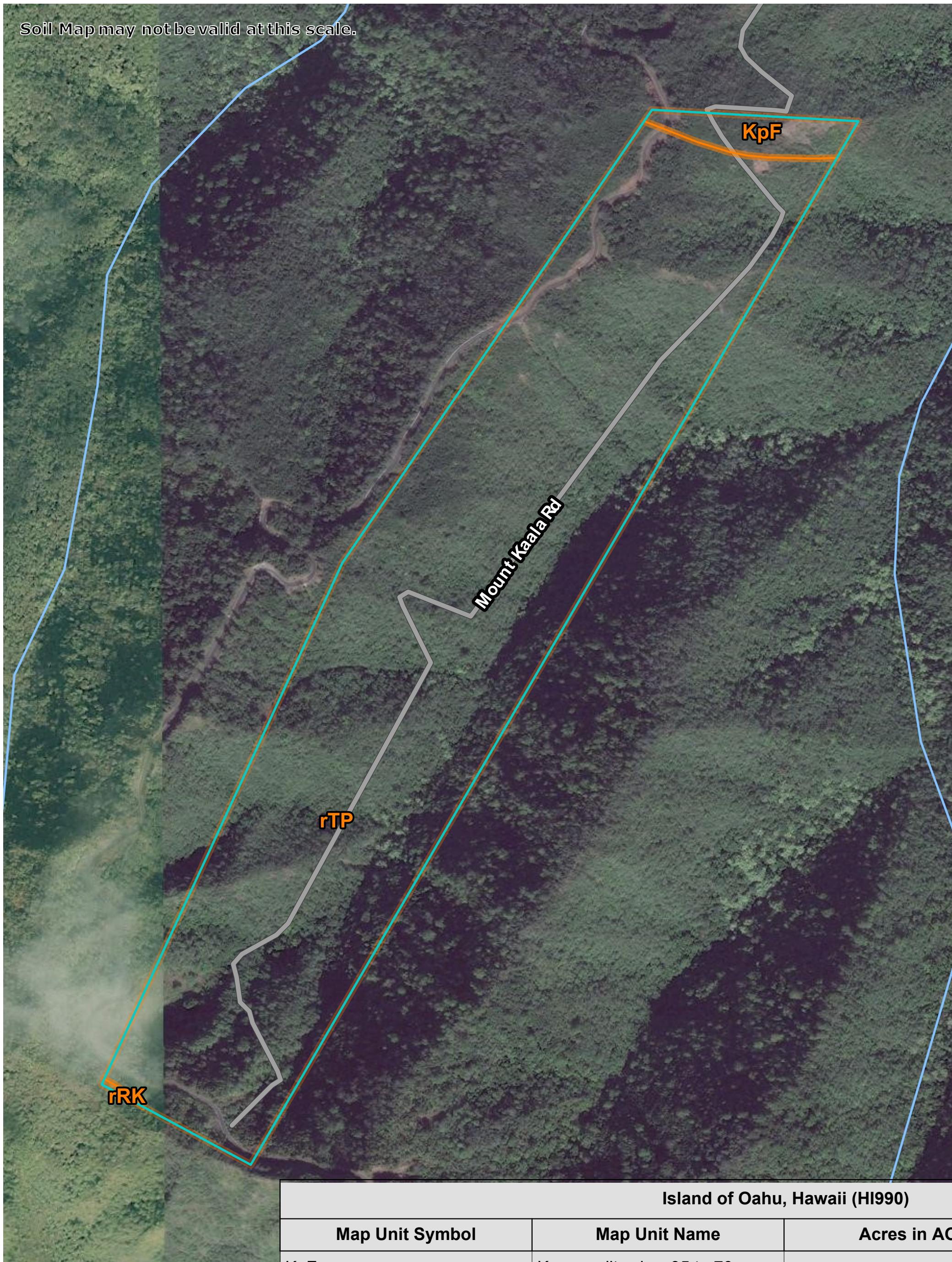

Island of Oahu, Hawaii (HI990)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
KpF	Kemoo silty clay, 35 to 70 percent slopes	1.9	2.9%
rRK	Rock land	0.0	0.1%
rTP	Tropohumults-Dystrandepts association	63.0	97.0%
Totals for Area of Interest		**65.0**	**100.0%**

PROJECT NAME:

Repairs to Mount Ka'ala Road
Oahu, Hawaii

FIGURE TITLE:

USGS Soils Map

FIGURE NUMBER:

5c

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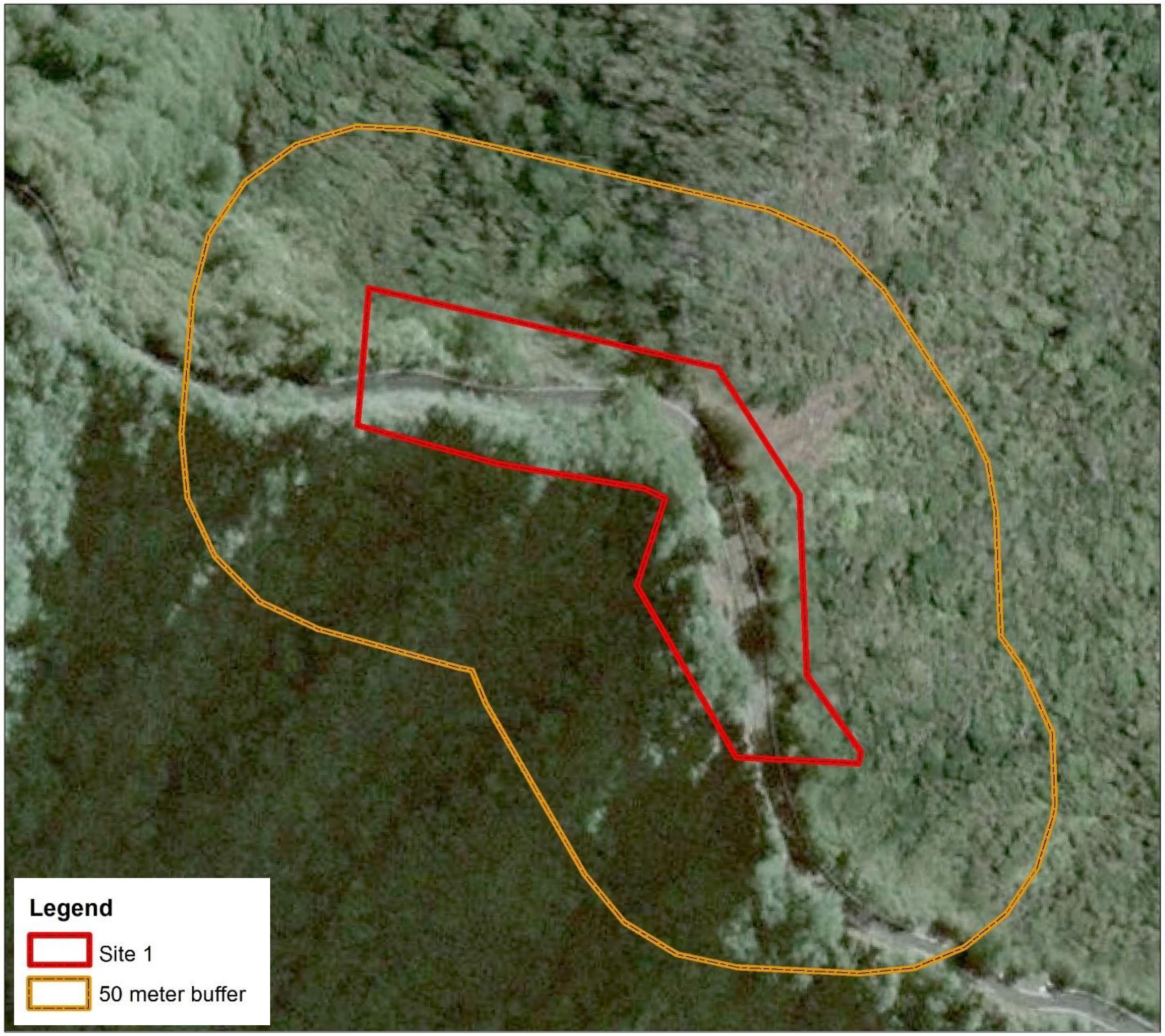

PROJECT NAME:

Repairs to Mount Ka'ala Road
Oahu, Hawaii

FIGURE TITLE:

Biological Survey Map
Site 1

FIGURE NUMBER:

6a

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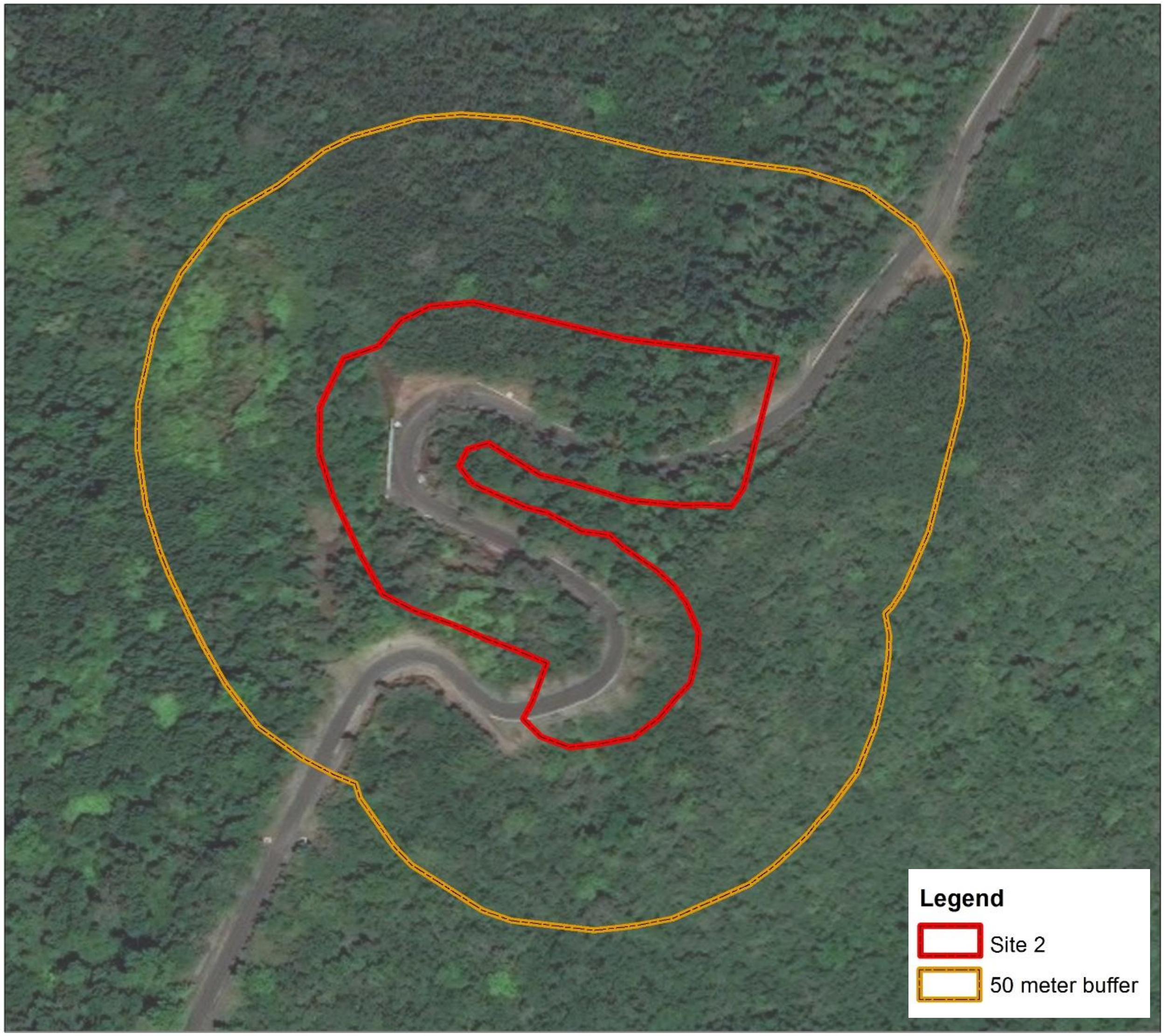

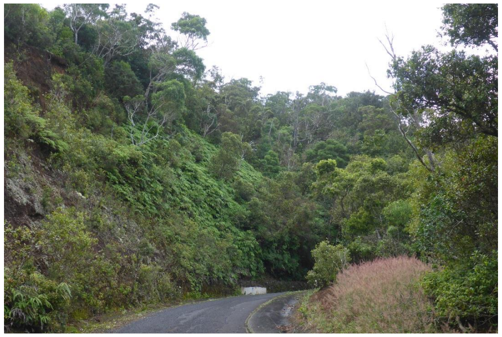

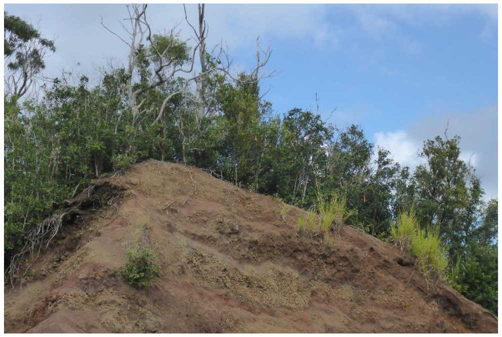

PROJECT NAME:

Repairs to Mount Ka'ala Road
Oahu, Hawaii

FIGURE TITLE:

Biological Survey Map
Site 2

FIGURE NUMBER:

6b

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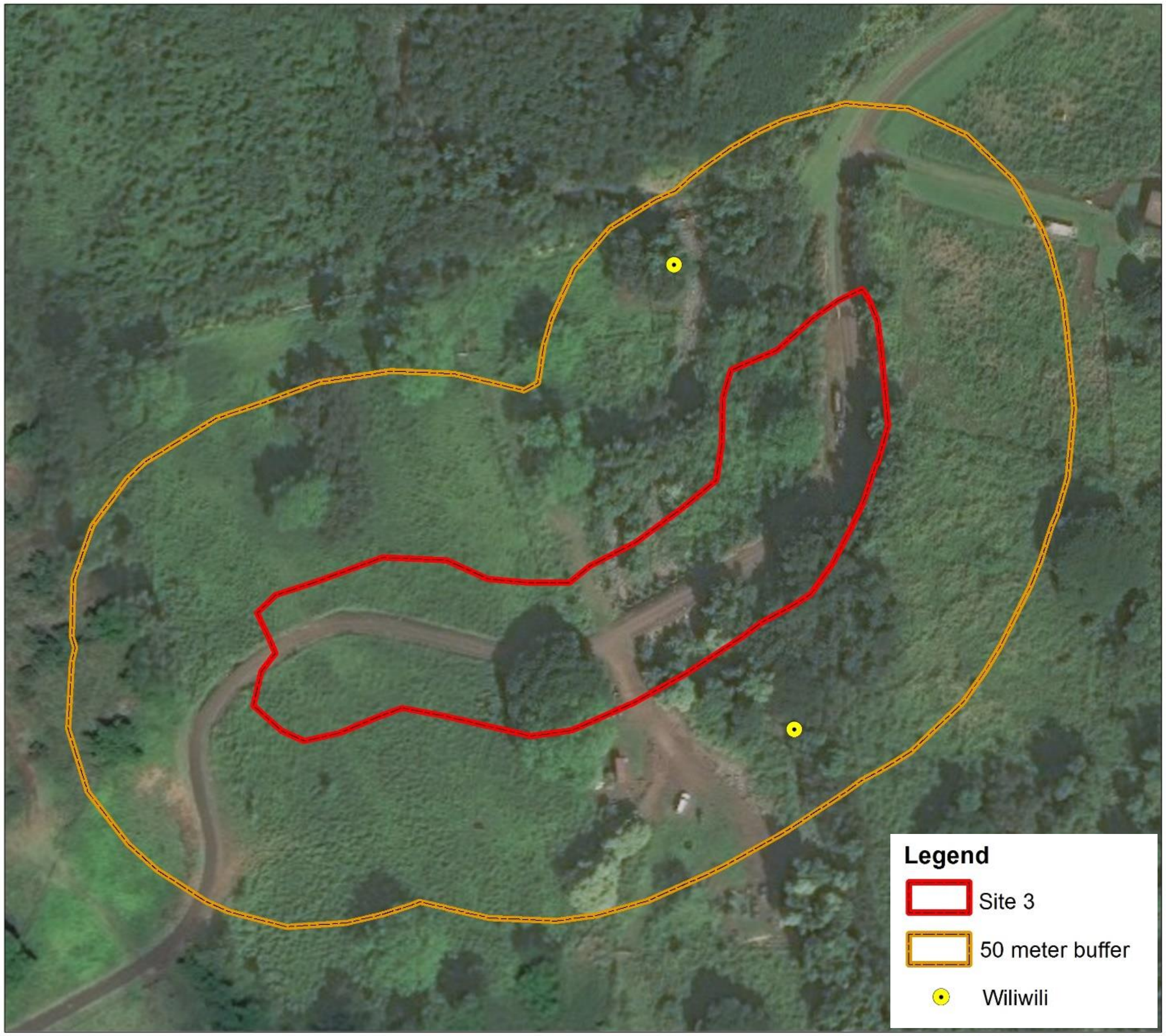

PROJECT NAME:

Repairs to Mount Ka'ala Road
Oahu, Hawaii

FIGURE TITLE:

Biological Survey Map
Site 3

FIGURE NUMBER:

6c

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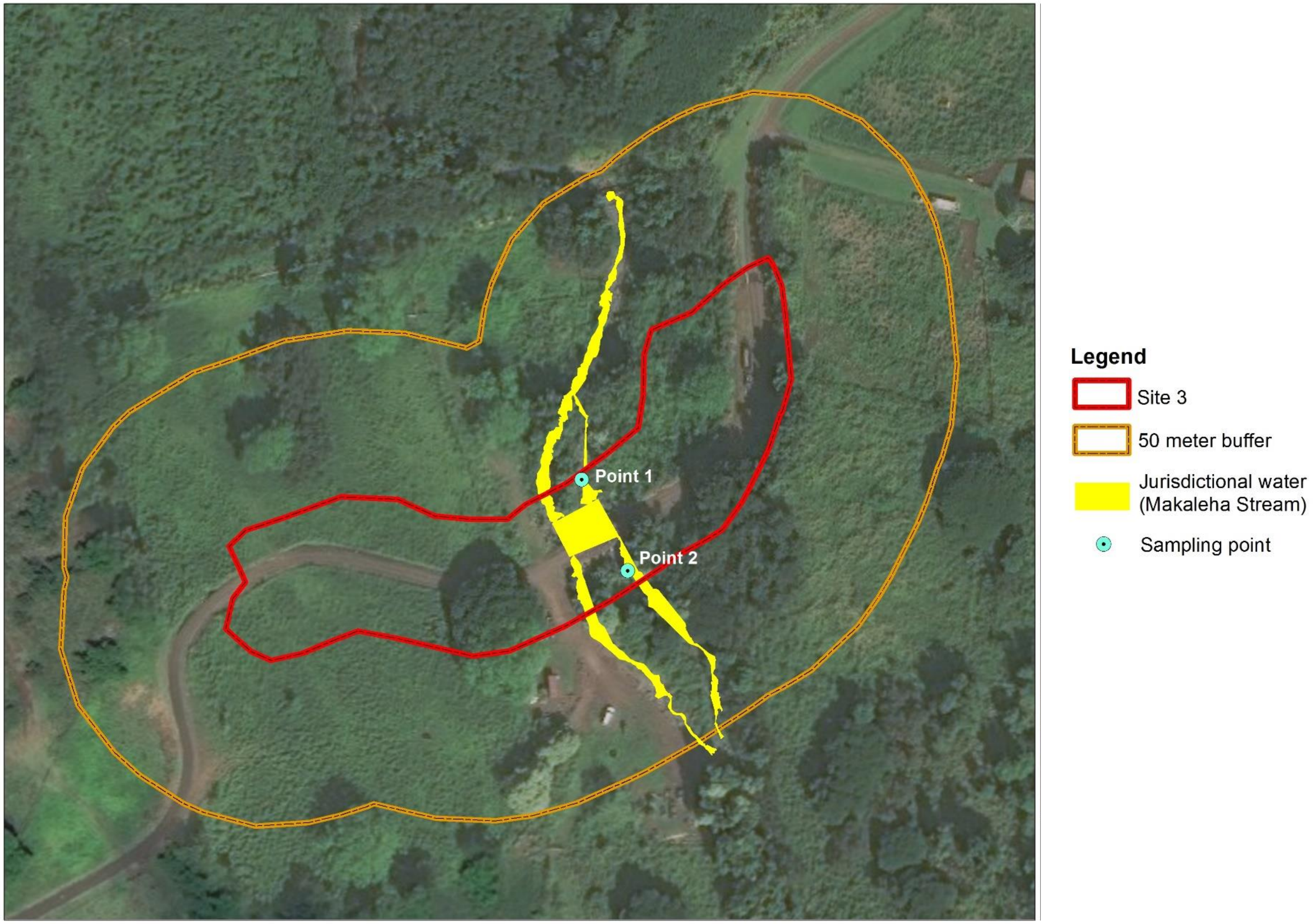

PROJECT NAME:	FIGURE TITLE:
Repairs to Mount Ka'ala Road Oahu, Hawaii	Biological Survey Map Site 3
	FIGURE NUMBER: 6d

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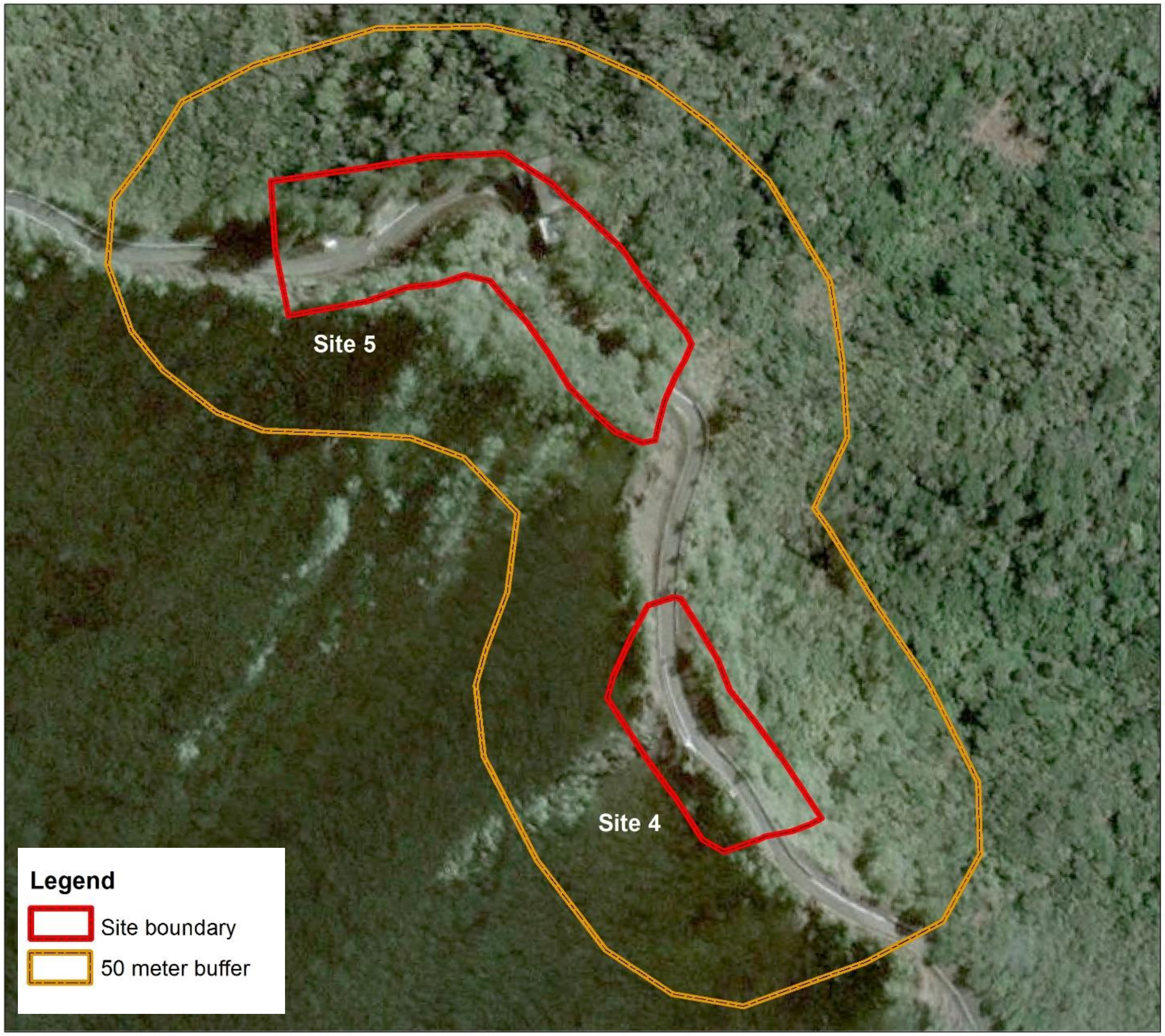

PROJECT NAME:

Repairs to Mount Ka'ala Road
Oahu, Hawaii

FIGURE TITLE:

Biological Survey Map
Sites 4 & 5

FIGURE NUMBER:

6e

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According to the survey (Garcia and Associates, 2018), two mature individuals of wiliwili (*Erythrina sandwicensis*), a species of concern, were identified in the buffer area of Site 3. Wiliwili is a keystone species of the highly threatened native Lowland Dry Forest ecosystem and was traditionally used by native Hawaiians for canoe building, lei, and surfboards (Abbott, 1992). The incidental introduction of a gall forming parasite, Erythrina gall wasp (*Quadrastichus erythrinae*), had caused significant loss of the existing population throughout the islands until the wiliwili gall wasp parasitoid (*Eurytoma erythrinaea*), a hyper-parasite of the Erythrina gall wasp, was released and successfully established. The identified individuals can be a valuable source for future recovery of the species. Construction should be planned to avoid the wiliwili.

Timed area searches for native tree snails in the Ohia Lowland Wet Forest, Ohia/Uluhe (*Metrosideros/Dicranopteris*) Fern Forest, and Ohia/Koa Mesic Forest did not detect any native and endangered tree snails. Three small snails, presumably *Elasmias sp.*, were found on the underside of the leaves of a *Melicope oahuensis* (Figure 6e).

Consultation with United States Fish and Wildlife Service, Pacific Island Fish and Wildlife Office (USFWS PIFWO) was initiated in February 2018 with the submission of the site Biological Assessment (BA) and request for concurrence of the BA findings of may affect but is not likely to adversely affect threatened or endangered species and not likely to adversely modify critical habitats. Prior to the February 2018 letter, USFWS PIFWO attended a site visit to better understand the project sites and proposed site work. USFWS PIFWO responded in April 2018, providing concurrence the proposed project may affect but is not likely to adversely affect threatened or endangered species and not likely to adversely modify critical habitats. Consultation documentation is presented in Appendix C.

Consultation for the Hawaii Coastal Zone Management Program Consistency Review with the State of Hawaii Office of Planning was completed on 9 July 2018 (Appendix D). The State of Hawaii Department of Land and Natural Resources (DLNR), Division of Aquatic Resources (DAR) indicated the *Lentipes concolor* (alamoo – endemic freshwater goby) has been detected in Makaleha Stream. The goby is known to traverse both down and upstream and was noted to potentially traverse the project areas during periods of stream flow. Mitigation measures to address up and downstream migration are discussed in Section 5.1.4.

4.1.5 Wetlands

Field investigation for wetland delineation was conducted on December 15, 2016 within the normal wet season weather patterns of Hawai'i. A site walkthrough didn't reveal any apparent wetland with either standing water or wetland plants. Two sampling points were then selected along the Makaleha Stream on minutely sloped and slightly depressed areas on the floodplain where damp soils and signs of hydrology suggested potential wetland conditions. The sampling points were located upstream and downstream of the culvert crossing.

Wetland determinations are made following the methods prescribed in the United States Army Corps of Engineers (USACE) Wetlands Delineation Manual (1987) and Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Hawaii and the Pacific Islands (Version 2.0) (USACE, 2012). Under the delineation procedures in this manual, an area must exhibit characteristic wetland hydrology, hydric soils, and hydrophytic vegetation to be considered a wetland. If field investigation determines that any of the three parameters are not satisfied, the area usually does not qualify as wetland.

Sampling Point 1 is downstream of the culvert on a gentle slope with a depression near the channel. Vegetation is dominated by Java plum and kukui (*Aleurites moluccana*) in the tree stratum, koa haole in the shrub stratum, and Guinea grass in the herb stratum. Scores of the Dominance Test at 50 percent and the Prevalent Index at 3.75 indicates the vegetation is not hydrophytic. No hydric soil indicator was observed at Sampling Point 1. The soil profile shows a single matrix layer from 0 to 12 inches in color 7.5YR 3/2 of the Munsell Soil Color Chart. Drift deposits were observed indicating wetland hydrology.

Wetland delineation data indicates that Sampling Point 1 lacked hydrophytic vegetation and hydric soils and therefore, is not a wetland.

Sampling Point 2 is upstream of the culvert adjacent to one of the stream channels. Vegetation is dominated by Java plum and kukui in the tree stratum, koa haole and *Buddleja asiatica* in the shrub stratum, Guinea grass in the herb stratum, and passion fruit (*Passiflora edulis*) in the woody vine stratum. Scores of the Dominance Test at 33 percent and the Prevalent Index at 3.8 indicates the vegetation is not hydrophytic. No hydric soil indicators were observed at Sampling Point 2. The soil profile shows a single matrix layer from 0 to 14 inches in color 7.5YR 3/2 of the Munsell Soil Color Chart. Two hydrology indicators (Drift deposits and water-stained leaves) were observed indicating wetland hydrology. Wetland delineation data indicates that Sampling Point 2 lacks hydrophytic vegetation and hydric soils and therefore, is not a wetland. The wetland delineation data forms for the two sites are provided in Appendix B. The jurisdictional water was delineated based on ordinary high water marks identified on both sides of the stream channels and mapped. The jurisdictional Waters of the United States contains two channels on both sides of the culvert and total about 0.15 acres.

No jurisdictional wetland was identified in the project sites. Site 3, however, contains jurisdictional waters of the United States in the form of ephemeral Makaleha Stream (Figure 7). Impact to these waters is regulated by the Section 404 of the Clean Water Act and the Rivers and Harbors Act of 1899 (Garcia and Associate, 2018).

Permanent surface water exists on the summit plateau of Mt. Ka`ala, outside of the project area and west of the installation in the form of a large bog, and is known as the Mt. Ka`ala Bog. This is a type of wetland area that has a peat substrate. Based upon State Geographic Information System (GIS) data of wetlands for the State, this bog encompasses an area of about 65 acres. The majority of the Mt. Ka`ala Bog is located within the State's Natural Area Reserve. Wetland data from the United States Fish and Wildlife Services' (USFWS) National Wetlands Inventory classifies this bog as Freshwater Forested/Shrub Wetland (FEA ICSD Mt. Ka`ala Radio Facilities Improvements Project, March 2012).

4.1.6 Water Resources

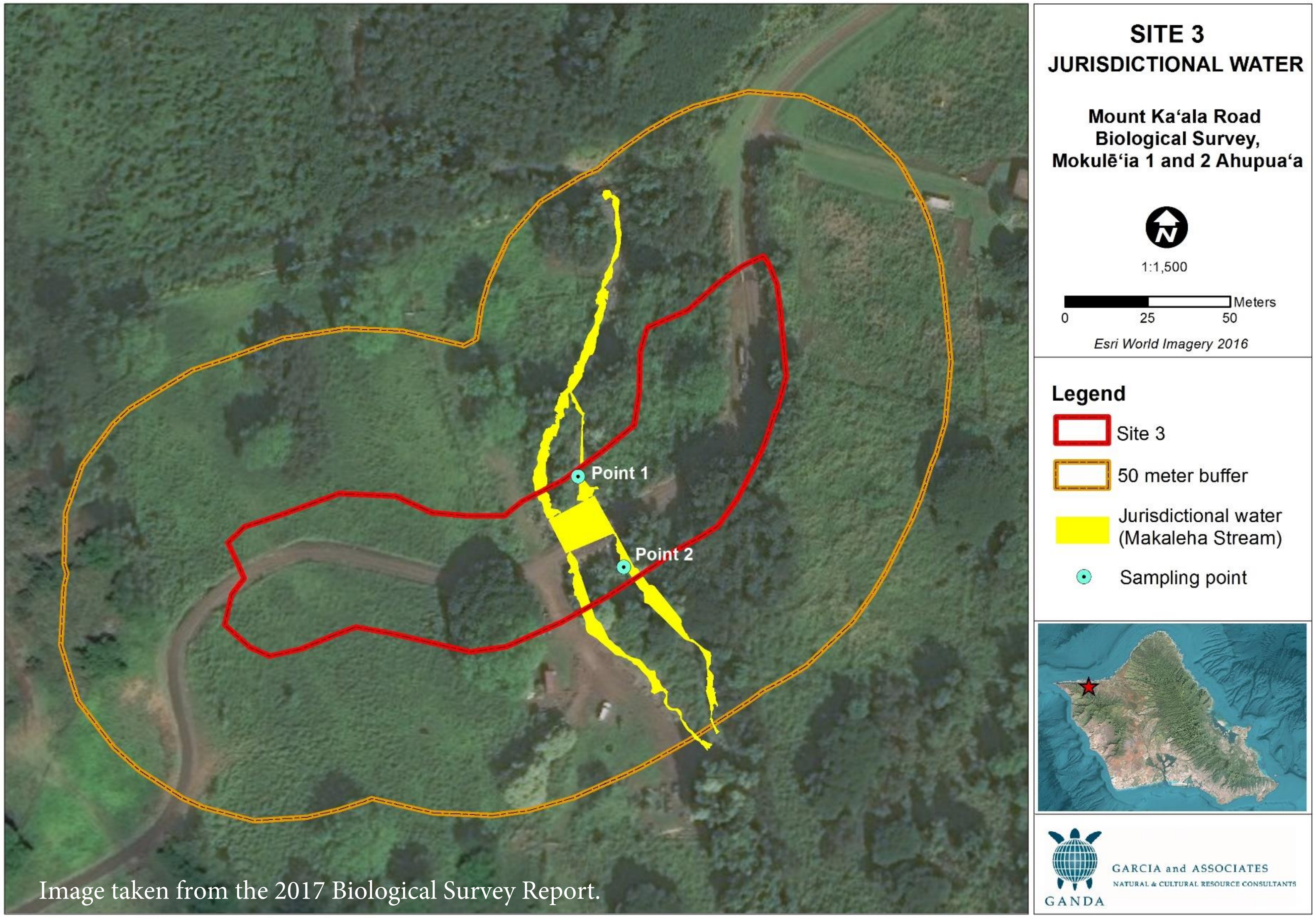
There are no permanent streams or surface water features on Mt. Ka`ala AFS (USAF, 2007). An ephermal stream (Makaleha Stream) exists along Mt. Ka`ala Road. Mt. Ka`ala AFS is at the peak of Mt. Ka`ala and the boundaries of three watersheds meet at the installation. The Mt. Ka`ala Bog is immediately adjacent to the installation on its southwestern boundary.

4.1.7 Climate and Air Quality

(a) Climate - Oahu was formed by two shield volcanoes whose eroded remnants now make up the Waianae Mountains and the Koolau Range. The highest point on the island is the 4,025-foot Mount Ka`ala in the Waianae Mountains. Rainfall ranges from less than 20 to over 250 inches a year and, combined with the diverse topographic features, has produced several forest types from semiarid woodlands to subtropical rain forests.

    The closest climate station with long-term records is approximately 2 miles south of the installation. Climate conditions can vary strongly over short distances in the Waianae Range, so accurate climate data for Mt. Ka`ala AFS is not available. The climate at Mt. Ka`ala AFS is mild but rainy. Historically, December is the wettest month. Actual (but unmeasured) precipitation is thought to be higher due to frequent heavy condensation on vegetation (fog drip).

(b) Air Quality - The Department of Health's Clean Air Branch is responsible for regulating and monitoring pollution sources to ensure that the levels of criteria pollutants remain well below the state and federal ambient air quality standards. Data collected from the ambient air network is validated by the Air Surveillance and Analysis Section to ensure that the reported data is of good



PROJECT NAME:	FIGURE TITLE: Wetlands Map
Repairs to Mount Ka'ala Road Oahu, Hawaii	FIGURE NUMBER: 7

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quality and meets all quality control and assurance requirements. The Hawaii State Department of Health (HDOH) maintains air monitoring locations throughout the state. The nearest monitoring station to the project site is in Pearl City, located approximately 23 miles away.

The monitoring stations in communities near the volcano record higher levels of SO2 and PM2.5, with regular exceedances of the National Ambient Air Quality Standards (NAAQS) for SO2 and occasional exceedances of the NAAQS for PM2.5. The United States Environmental Protection Agency considers the volcano a natural, uncontrollable event and therefore the state is requesting exclusion of these NAAQS exceedances from attainment/non-attainment determination. Excluding the exceedances due to the volcano, in 2015 the State of Hawaii was in attainment of all NAAQS. Data for individual parameters are provided in the State of Hawaii Annual Summary 2015 Air Quality Data Report (HDOH, 2016).

4.1.8 Noise

An Environmental Acoustical Measurement was performed in March 2017 by D.L. Adams Associates (Appendix E). General observations from visual observations and meter data sources include that: at Site 3, the local noise sources included ranch land agricultural operations, tractors, vehicular traffic, chained ranch dogs, many wild peacocks, chickens, farm animals and ordinary environmental noises including wind, rain, birds and general foliage noise; at Site 2, the local noise sources included vehicular traffic, and the ordinary environmental noises; at Site 5, the local noise sources included vehicular traffic, occasional construction equipment backup alarms and the ordinary environmental noises previously mentioned. An examination of the sound recordings shows that 357 events above 65 decibels (dBA) were triggered at Site 3, 49 at Site 2 and 41events at Site 5. The majority of the sounds recorded at Site 3 were peacocks, roosters and dogs. Exceedances at Sites 2 and 5 were primarily ordinary vehicular traffic. Overall, all sites measured are quiet and typical of rural areas. Site 3 is the noisiest of the three due to the animal noises and measured the day-night noise level (Ldn) as 59 dBA.

Noise impacts from construction-related activities are regulated under the Hawaii Administrative Rules (HAR), HDOH, Title 11, Chapter 46, Community Noise Control. The project area is zoned military and federal preservation land; and as such falls into District Class A under the HDOH regulations, with a maximum day (7:00 a.m. to 10:00 p.m.) and night (10:00 p.m. to 7:00 a.m.) sound level threshold of 55 dBA. District Class A also covers areas zoned as residential, conservation, open space and public space. Table 2 lists sound exposure levels (SELs) associated with typical equipment, in varying operating modes.

Table 2: Typical Equipment Sound Levels

Equipment	**Sound Level (in dBA) Under Indicated Operational Mode**		
	Idle Power	**Full Power**	**Moving Under Load**
Dozer	63	74	81
Dump Truck	70	71	74
Excavator	62	66	72
Forklift	63	69	91
Front-end Loader	60	62	68
Grader	63	68	78
Sweeper	64	76	85
Tractor-Trailer	67	78	77

4.1.9 Solid and Hazardous Waste

Mt. Ka`ala AFS is a conditionally exempt small quantity generator. The only ongoing potential hazardous waste concern on Mt. Ka`ala AFS are associated with hazardous waste practices from the past. These sites are currently being evaluated by the Installation Restoration Program (IRP). There are 10 IRP sites and 1 area of concern at Mt. Ka`ala AFS. IRP sites are located at the main diesel storage area, waste/new oil storage, waste oil sump, substation transformer, drum rack outfall, soils near Building 20, northeast disposal site, World War II tunnel, and the Mt. Ka`ala Bog area. The only active IRP site is the main diesel storage area. Groundwater, surface water, soil, and air impacts are being evaluated at each of these sites. The area of concern is located in the disposal area.

4.2 Social Environment

4.2.1 Land Use Considerations and Zoning

According to the State Land Use Commission district classifications, the project site is zoned P-1, restricted preservation district. According to Sec. 21-3.40-1, within the P-1 designation, all uses, structures and development standards shall be governed by the appropriate state agencies.

4.2.2 Archaeological and Cultural Considerations

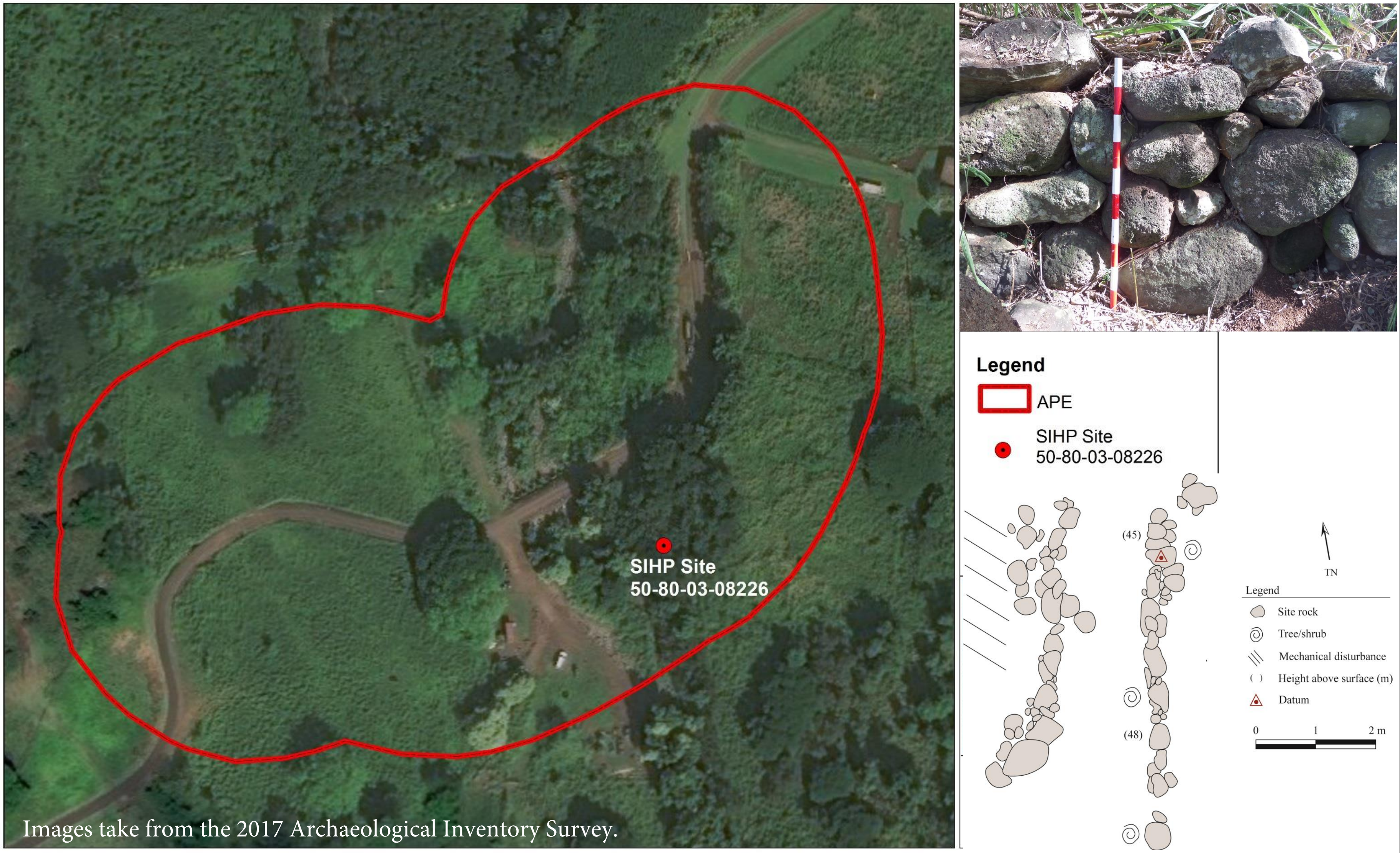
Mt. Ka`ala Road is adjacent to resources that may have historic significance, such as the remains of World War II installations, a Cold War era building, and the luakini bog. Oral traditions link Mt. Ka`ala with tales of traditional Hawaiian deities, and the perched bog with a freshwater fishpond said to have been located there. The Mt. Ka`ala bog area has been designated a State Natural Resource Area by the DLNR. State Historic Preservation Officer has requested that future Section 106 evaluations take into account that Mt. Ka`ala may be a traditional cultural property significant to Native Hawaiians.

According to the Archaeological Inventory Survey conducted in November 2016 (Appendix F), the APE for the Mt. Ka`ala Road repair undertaking includes both the areas, which direct impacts are expected to occur, as well as a 50 m buffer around each area to account for potential impacts to biological resources (Garcia and Associates, 2017). For the purposes of Section 106 consultation, the APE for the undertaking extends to the limit of the 50 m buffer, the likelihood of impacts with a buffer of this scope are quite small. Five locales proposed for road repairs were surveyed. One historic property, a dry-stone retaining wall associated with historic Ka`ala Ranch, was recorded at Locale 3. This site is designated SIHP Site 50-80-03-08226 and consists of a 5-meter-long dry-stone retaining wall. It is most likely a historic ranch feature and could date anywhere from the late 1800s to the mid-1900s. It retains all aspects of its historic integrity and is eligible for listing on the National Register of Historic Places (NRHP) (Figure 8). All other road repair locales contained no evidence of historic properties. Due to extreme slope conditions, survey could not be performed in much of the outlying buffer areas of Road Repair Locales 1, 2, 4, and 5. These areas, principally within a 50-meter buffer region around the primary repair locations, were inaccessible and are very unlikely to contain historic properties.

Section 106 consultation was initiated in February 2018. Supplementary information has been provided to the State Historic Preservation Division (SHPD) to request for a concurrence with the finding of no adverse effect as detailed in Appendix G. SHPD concurrence of no historic properties affected was received on 3 July 2018.

4.2.3 Circulation and Traffic

Mt. Ka`ala AFS is immediately surrounded by forests and shrub lands in the state-owned Mt. Ka`ala Natural Area Reserve (NAR). The reserve has native plant communities, including a rare montane 70-acre bog area near the mountain peak known as the Mt. Ka`ala Bog area, and associated native bird species. Beyond the natural reserve area are state forest reserves that include most of the upper elevations of the Wai`anae Mountains. Military lands of the Schofield Barracks Military Reservation lie approximately 2 miles to the



PROJECT NAME:	FIGURE TITLE:
Repairs to Mount Ka'ala Road Oahu, Hawaii	Area 3 Archeological/Cultural Finding
	FIGURE NUMBER: 8

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east and southeast of Mt. Ka`ala AFS. Mt. Ka`ala Road access is restricted to government employees, contractors, and local ranchers. Although there are trails that lead up to the mountaintop and bog area from both sides of the Wai`anae Mountains. The nearest residential areas, commercial establishments, or farms are 3-5 miles away on the lower slopes of the mountains.

4.2.4 Social Factors and Community Identity

The nearest residential areas, commercial establishments, or farms are 3-5 miles away on the lower slopes of the mountains. The surrounding communities of Mt. Ka`ala AFS are Makaha, Māʻili, Waialua, and Wai`anae. These areas are primarily rural and are not subject to as much military presence as some of the more urban communities. The public may be brought into contact with Mt. Ka`ala AFS as a result of its close proximity to the Mt. Ka`ala Bog area, which is a relatively well-known natural reserve area that is visited frequently by hikers.

The total population of the Mt. Ka`ala AFS surrounding communities was 34,803 in 2010 (United States Census Bureau, 2010), which is nearly 2 percent of the population of the island of O`ahu. Of the surrounding communities, Wai`anae had the largest population and Waialua had the smallest population. The ethnic distribution of these areas was 24 percent Native Hawaiian or Other Pacific Islander, 18 percent Asian, and 14 percent Caucasian. Six percent of the Mt. Ka`ala AFS community areas' population did not speak English. Twenty-three percent of the population was high school graduates, and 5 percent had a Bachelor's degree or higher level of education.

4.2.5 Economic Considerations

The labor force of the Mt. Ka`ala AFS community areas was 15,117 people (43 percent) in 2010 (United States Census Bureau, 2010); only 1 percent was employed by the armed forces. Of the labor force, 18 percent were employed in educational, health, and social services; 11 percent were employed in art, entertainment, recreation, accommodations, and food service; and 10 percent were employed in retail trade. Only 2 percent of the community was employed in agriculture, forestry, or fishing.

4.2.6 Recreational and Public Facilities

There are no recreational and public facilities in the project area that would be affected by the proposed repair and renovation improvements at Mt. Ka`ala Road. Mt. Ka`ala Access Road is for official use only and is prohibited from public use. Access is limited to government employees, contractors, and local ranchers.

The Oahu Army Natural Resource Program and State NARs program do conduct regular service projects on Mt. Ka`ala. The only other recreational activities occurring in the general vicinity are hiking and hunting. There are a few hiking trails leading to the summit of Mt. Ka`ala, one of which starts on the Waianae side at the end of Waianae Valley Road, and another on the Waialua side near Waialua High School. The trail from Waialua is known as the Dupont Trail. Near the summit, a hiking trail is routed through the Mt. Ka`ala Bog where there is a boardwalk for hikers to use to minimize impact on the native plants and vegetation.

Game hunting for both mammals and birds is permitted within the Mokuleia Forest Reserve which encompasses about 4,600 acres including the Mt. Ka`ala NAR. The hunting of game mammals is regulated under the Title 13, chapter 123 HAR. This allows for hunting wild pigs and goats. The large forest reserve hunting area is identified as Unit E, and the Mt. Ka`ala NAR as Unit N2 under this regulation. Certain restrictions apply that include a required entry permit from the Division of Forestry and Wildlife (DOFAW), NAR manager, and hunters must be accompanied by a staff member of the DOFAW. Access is through the Mt. Ka`ala AFS subject to availability based upon military activities occurring at that time. Hunting for various types of game birds (i.e. pheasant, quail) is also permitted within the Mokuleia Forest Reserve. Regulations identify the area as Unit 2 under Title 13, Chapter 122, HAR (State of Hawaii, December 2002).

Police and Fire Protection – The Honolulu Police Department provides police protection services for most of the island of Oahu. However, the Hawaii Air National Guard (HIANG) is responsible for such services for the Mt. Ka`ala AFS because it is a Federally protected installation. Areas outside this installation located to the west are State property under the jurisdiction of the State DLNR, DOFAW. Areas to the east are owned by and under the jurisdiction of the U.S. Army.

The Honolulu Fire Department (HFD) provides fire protection services for most of the island of Oahu. The island is divided into zones that designate the primary response area for either the HFD or DOFAW. Three types of responses are: 1) HFD primary response area; 2) DOFAW primary response area; 3) and shared primary response by both, HFD and DOFAW. At Mt. Ka`ala this primary response jurisdiction generally falls according to the State property line. Therefore, the area including a portion of the Mt. Ka`ala AFS and areas to the west are designated for State DLNR DOFAW as the primary response. The area to the east is designated for HFD as primary response area. HFD access to the site will need to be coordinated with the FAA and escorted.

4.2.7 Visual and Aesthetic Resources

The project location is on a one-lane government road starting from Farrington Highway (Hwy 930), with an elevation of 5 m above mean sea level, to an elevation of 1,227 m above mean sea level at the tracking station. The road is paved and averages four meters in width. There are no publicly identified and protected view planes in the project vicinity.

4.2.8 Infrastructure Systems and Utilities

The Proposed Action would not cause any change to existing infrastructure and utilities.

(a) Water Facilities – Due to the project's isolated and restricted location, there are no City Board of Water Supply (BWS) potable water facilities providing service. Instead, a rain water catchment system is used to collect non-potable water for use by personnel working at facilities at Mt. Ka`ala AFS. Collected storm water is treated in a water treatment plant on site and used for domestic use at the installation (i.e. toilets, sinks, showers). Bottled water for consumption is delivered to the installation by truck. The State Information and Communication Services Division (ICSD) building is not occupied by staff on a daily basis. Potable water is not provided for that building.

(b) Wastewater Facilities – There are no City Department of Environmental Services (DES) wastewater collection or treatment facilities serving the project area. Wastewater generated at the installation from activities consist of discharge from sinks, showers, and toilets. This wastewater is discharged to an on-site cesspool system located north of the FAA building.

(c) Drainage Facilities – There are a few drainage ditches (concrete swale) to transport storm water to the rain catchment system or discharge storm water away from Mt. Ka`ala AFS and the State ICSD building. Storm water runoff from the installation and summit plateau then drain radially down the flanks of the mountain into steep gulches. Shallow drainage ditches along the southern side of the installation channel surface water runoff toward the Mt. Ka`ala Bog area. The runoff there eventually discharges into two major watersheds identified as the Makaha and Kaukonahua watersheds that include several streams and drainageways.

(d) Solid Waste Facilities – The City DES' Refuse Division does not provide service to the project area. A solid waste dumpster is located on the Mt. Ka`ala AFS site for the storage of all waste. This waste is disposed of regularly by the HI ANG at Wheeler Army Airfield.

(e) Transportation – Mt. Ka`ala Access Road is the only roadway providing vehicular access to the Mt. Ka`ala AFS. This is a gated government controlled access road by the FAA. Only vehicles permitted by authorized government agencies are allowed to access and travel on this roadway. The roadway is generally wide enough for single vehicle passages, therefore, minimal traffic occurs on this road on a daily basis.

SECTION 5 ENVIRONMENTAL CONSEQUENCES

Potential impacts of Alternative I: No Action and Alternative II: Proposed Action are described in this section of the report. Impacts are evaluated on whether they constitute a "significant effect" on a particular environmental setting. Impacts are described as having No Impact, Significant Adverse Impact or Beneficial Impact depending on the outcome to the environment. The terms impact and effect are used synonymously in this EA. Impacts may apply to the full range of natural, aesthetic, historic, cultural and economic resources. The following subsections define key terms used throughout Section 5.

<u>Significance Criteria</u>

Significance requires considerations of both context and intensity. Context means that the action must be analyzed in several contexts such as society as a whole, the affected region and environment, the affected interests, and the locality. Intensity refers to the severity of the impact.

<u>Beneficial Versus Adverse</u>

Impacts from the Proposed Action may also have beneficial or adverse effects to the environment. Beneficial impacts are those that would favorable outcomes and add value to the environment. Adverse impacts are those that produce detrimental effects and cause harm to the environment.

<u>Cumulative Impacts</u>

Cumulative impacts are two or more individual effects which, when considered together, compound or increase the overall impact. Cumulative impacts can arise from the individual effects of a single action or from the combined effects of past, present, or future actions. Thus, cumulative impacts can result from individually minor but collectively significant actions taken over a period of time. The cumulative impacts of implementing the Proposed Action along with past and reasonably foreseeable future projects proposed were assessed based upon available information. Cumulative impacts are discussed in Section 5.3.

<u>Mitigative Measures</u>

Mitigative measures are defined as measures taken to avoid, reduce and compensate for adverse impacts to a resource. Mitigative measures are identified and discussed for each alternative, where relevant. In this EA, mitigative measures are provided to reduce adverse impacts when levels of impact are more than minor and to ensure levels of impact are not significant. Only those mitigative measures that are practicable have been identified.

5.1 Physical Environment

5.1.1 Topography and Geology

<u>Alternative I</u>

Adverse impacts to the topography or geology are expected to result from Alternative I. Without the necessary repairs to Mt. Ka`ala Road, access to the Radar station may not be possible. Three major areas of concern were identified. All three areas of concern should be repaired or mitigated with Site 1 being the highest priority, followed by Site 2 and Site 3 in the order of urgency.

Pending repair, the landslide area at Site 1 should be monitored and inspected regularly to assess if the slide is continuing. Continued sliding or movement will necessitate closing of the road to vehicular traffic. Visual inspection should be performed on a weekly basis. Survey stakes can be installed along the slide limit near the fringe of the slide and survey stakes used as reference points to visually and/or instrumentally determine if the landslide is continuing.

Site 2 should be similarly monitored and inspected for continued movement. At the time of the site investigation, Culvert 32 was observed to be partially clogged with leaves and debris, resulting in storm water overflowing to the slide area. Culvert 32 should be checked and cleared of debris on a regular basis. Stormwater flowing across the slide area may wash out the slope or reduce the shear strength of the soil and trigger movement or sliding of the remnant slope (Site Reconnaissance Report Mount Ka`ala Road, June 2015, Appendix A).

Alternative II

Less than significant impacts to the topography or geology are anticipated to result from implementing Alternative II. Contouring the failed slopes due to erosion will alter the topography but it would be localized to the repair sites. The changes are necessary to help stabilize the slopes from further erosion. Failure of the slopes would have the potential to block the roadway and have a detrimental impact on the mission of the tracking station.

5.1.2 Soils

Alternative I

No significant impacts are anticipated for Alternative I. Site conditions would remain the same.

Alternative II

Alternative II has the potential to incur less than significant impacts to soils from construction activities (i.e., clearing, grading, grubbing, excavation) that disturb the earth and soils. Exposed soils are susceptible to erosion during periods of heavy rain or wind. Short-term impacts would be minimized to less than significant or avoided by implementing temporary erosion control measures during construction activities. In addition, construction work will be conducted during the dry season, to the extent practicable, to reduce the potential for stormwater runoff and erosion.

5.1.3 Natural Hazard

Alternative I

Adverse impacts due to natural hazards are anticipated. Although the Site is not vulnerable to tsunamis, earthquakes, hurricanes, or floods, adverse weather conditions due to wind and rain are likely to affect the project sites. The Site Reconnaissance in May 2015 recommended temporary measures until the necessary repairs are completed.

(a) Site 1 should be monitored and inspected regularly to assess if the slide is continuing. Continued sliding or movement will necessitate closing of the road to vehicular traffic. Visual inspection should be performed on a weekly basis. Survey stakes can be installed along the slide limit near the fringe of the slide and the survey stakes used as reference points to visually and/or instrumentally determine if the landslide is continuing.

    Site 2 should be similarly monitored and inspected for continued movement. At the time of the site investigation, Culvert 32 was observed to be partially clogged with leaves and debris, resulting in storm water overflowing to the slide area. Culvert 32 should be checked and cleared of debris on a regular basis. Stormwater flowing across the slide area may wash out the slope or reduce the shear strength of the soil and trigger movement or sliding of the remnant slope.

Alternative II

No significant impacts due to natural hazards are anticipated as a result of implementing Alternative II. Should the necessary repairs be implemented, the road would repaired and provide safe passage for users.

5.1.4 Flora and Fauna

Alternative I

No significant impacts to flora/fauna are anticipated due to Alternative I as the site would remain the same.

Alternative II

Less than significant impacts to flora/fauna are anticipated due to Alternative II. No threatened or endangered species were observed in the project area during the field investigation. Two mature individuals of wiliwili, a species of concern, were identified in the buffer area of Site 3 (Garcia and Associates, 2018). Wiliwili is a keystone species of the highly threatened native Lowland Dry Forest ecosystem and was traditionally used by native Hawaiians for canoe building, lei, and surfboards (Abbott,1992). Additionally, tree snails were not observed during the survey, but have been spotted in the project area at various times (Garcia and Associates, 2018). Consultation with USFWS PIFWO was initiated in February 2018 with the submission of the site BA and request for concurrence of the BA findings of may affect but is not likely to adversely affect threatened or endangered species and is not likely to adversely modify critical habitats. Prior to the February 2018 letter, USFWS PIFWO attended a site visit to better understand the project sites and proposed site work. USFWS PIFWO responded in April 2018, providing concurrence the proposed project may affect but is not likely to adversely affect threatened or endangered species and is not likely to adversely modify critical habitats. Consultation documentation is presented in Appendix C. DLNR DAR noted the *Lentipes concolor* (alamoo – endemic fresh water goby) have been detected in Makaleha Stream and are known to move up and downstream. Mitigation measures will be taken to avoid and minimize risk of adverse impact to the Oʻahu tree snail, the wiliwili, the Hawaiian Hoary bat, the endemic freshwater goby, the lowland mesic critical habitat, and the lowland wet critical habitat. The following avoidance and minimization mitigation measures will be implemented to minimize the risks of impact to sensitive resources:

- Brief personnel on the sensitivity of the habitat present and will be informed of the need to follow all restrictions, protocols, and Best Management Practices (BMP) and special construction contract provisions;
- Silt fencing and other appropriate BMP measures will be installed and maintained for the duration of the construction phase of the project to ensure that no construction debris can migrate down-slope into the forest;
- Cleared areas on the steep slope will be stabilized to ensure that erosion does not occur;
- Restrict personnel within the project disturbance area to prevent trampling or further degradation of the habitat outside of the disturbance corridor;
- Personal pets will not be allowed on the job site;
- All trash shall be properly disposed of and removed from the site as soon as possible.
- If any vegetative replanting is proposed as part of this action, only native plants suitable for the habitat present at the site shall be used, where practicable;
- No woody vegetation taller than 4.6 m (15 feet) will be cleared from June 1 to September 15 during nursing season of the endangered Hawaiian hoary bat;
- Work will be conducted during the dry season, to the extent practicable, to reduce the potential for stormwater runoff and erosion;
- Work will be phased such that a portion of the existing seven culverts will be unobstructed to allow for up and downstream fish migration;

- All potential host plants of O‘ahu tree snails to be removed will be examined for snail occurrence prior to removal; and
- No work requiring artificial light will be performed during nighttime hours, since such work could cause fall-out of fledging seabirds.

Biosecurity BMP’s will be implemented to control invasive species movements. A control point will be established at Site 3 to ensure every vehicle, tool, and personnel is cleared of invasive species before proceeding to the work sites uphill. The following are controls that may be implemented:

- Wash racks for big machinery;
- Smaller racks for smaller machinery;
- Capture system for all by product water and its contents (most systems use filters, but biocides, fumigants, and thermal might be options);
- Sanitization station at the gate accessing U.S. Army land heading up the road;
- Inspectors at bottom of road;
- Inspectors looking for things the wash racks missed;
- Inspectors needed up top surveying the sites for new invaders;
- Fumigant plans for any aggregates or soil shipped up the mountain; and
- Inspectors will be trained in recognition of species.

A full biosecurity plan shall be written prior to construction activities.

5.1.5 Wetlands

Alternative I

No significant impacts to wetlands are anticipated due to Alternative I as Site conditions would remain the same.

Alternative II

No significant impacts are anticipated under Alternative II. There are no jurisdictional wetlands identified in the project sites.

5.1.6 Water Resources

Alternative I

No significant impacts to groundwater or surface water would result under Alternative I. If no action is taken Site conditions would remain the same.

Alternative II

No significant impacts are anticipated to ground water resources. The ephermal stream may be impacted during construction activities to clear and grub the area. However, appropriate BMPs to control erosion and timing the activities at this location during the dry months, as practicable, will be implemented to avoid or minimize the impacts to less than significant.

5.1.7 Climate and Air Quality

Alternative I

Alternative I would not have a significant impact to air quality as the existing conditions would remain unchanged.

Alternative II

Less than significant impacts to climate and air quality are anticipated. Fugitive dust emissions from earth moving and excavation activities during construction activities are expected, however an effective dust control plan for the construction phase should be prepared. If necessary, best management practices such as watering of roads and trenches during project activities or the use of a dust screen which surrounds the project area, would reduce any impacts to less than significant.

5.1.8 Noise

Alternative I

No significant impacts to noise are expected to occur under Alternative I. Site conditions would remain unchanged.

Alternative II

Construction activities at the Site are anticipated to increase noise levels. Mitigation measures to minimize the impacts would be implemented to lower the impact to less than significant. Limiting those activities that may increase noise levels to daylight hours will help to minimize noise impacts. HDOH HAR, Title 11, Chapter 46, "Community Noise Control" regulations will be complied with for the duration of the project. If noise levels exceed allowable levels, stated in Chapter 46 rules, a noise permit will be obtained.

5.1.9 Solid and Hazardous Waste

Alternative I

No significant impacts to solid waste are expected to occur under Alternative I. Site conditions would remain unchanged.

Alternative II

Less than significant impacts to solid waste are expected to occur under Alternative II. Proposed repair measures primarily require scaling and removal of soil and debris, or methods to stabilize the soil wall. Debris collected during grubbing operations would be disposed of in accordance with Honolulu County regulations.

5.2 Social Environment

5.2.1 Land Use Considerations and Zoning

Alternative I

Alternative I would have an adverse impact to existing land uses. The existing roadway is used daily to transit personnel and equipment to and from the tracking station in order to provide continuous mission support for monitoring flight operations within the State of Hawaii. Continued degradation of the roadway would make the road impassable and impede the mission.

Alternative II

Alternative II would have a significant beneficial impact on land use and zoning. The Proposed Action repairs the roadway used to support Communications and Radar missions in Hawaii, which would be consistent with its district classification (P-1).

Coastal Zone Management Program Federal Consistency Review of the proposed project was initiated in May 2018. USAF requested concurrence the proposed activity is consistent with the enforceable policies of the Hawaii Coastal Zone Management Program. The State of Hawaii Office of Planning responded in July 2018 noting conditional concurrence with USAF's determination based on the following conditions:

1) The proposed activity shall be implemented as represented in the consistency review.
2) Mitigation measures for the endemic freshwater goby (as noted in Section 5.1.4) will be implemented.
3) Additional mitigation measures regarding sedimentation will be implemented to the extent practicable.

5.2.2 Archaeological and Cultural Considerations

<u>Alternative I</u>

No significant impacts are associated with the No Action Alternative as no change to the current infrastructure would occur.

<u>Alternative II</u>

Less than significant impacts are anticipated with implementing Alternative II. As noted in the consultation with SHPD, implementation of a buffer would reduce any potential impacts associated with the dry-stone retaining wall, Site 50-80-03-08226. Although the site is not in direct conflict with planned undertaking activities and can be avoided during road repair operations, it is recommended that a 20-meter, high-visibility physical buffer be established around the site as the primary short-term preservation method. In addition, the site location and buffer fence will be clearly marked on engineering and construction plans. Construction crews will be instructed as to the presence of the historic site and the requirement for strict avoidance. Finally, the site will be monitored before, during, and after completion of the project. Implementation of this site protection measure will ensure that the undertaking has “no effect” to historic properties.

5.2.3 Circulation and Traffic

<u>Alternative I</u>

Significant adverse impacts are anticipated under Alternative I. Should site conditions remain the same, access to the FAA tracking station may become unsafe to use, as the road may be blocked by landslides, erosion, and debris.

<u>Alternative II</u>

No significant impacts are anticipated under Alternative II. Mt. Ka`ala Road access is restricted to the public, therefore, no impact to public transit or pedestrian traffic is anticipated as a result of the proposed action. During construction activities, access and traffic are anticipated to increase compared to normal Site operations. If access and traffic are impacted as a result of construction activities, minimizing impact on traffic and access to less than significant levels can be accomplished by the following:

(a) Mobilizing and de-mobilizing construction vehicles and equipment during non-peak traffic hours.

(b) Use of temporary traffic control devices, such as signage, barricades, flaggers, and cones, in accordance with City and County traffic standards; and

(c) If necessary, coordinate efforts with USAF, USACE, or HIANG staff to assist with traffic management.

(d) Coordinating construction activities and providing ample notice to all government staff, contractors, and ranchers that may be affected by any repair work.

(e) At least one lane of access will be available during construction to ensure emergency access will be available.

5.2.4 Social Factors and Community Identity

Alternative I

Alternative I would have no significant impacts to the social and community identity. There would be no change to the characteristics of the community surrounding Mt. Ka`ala. Repair work is to an existing road that is not only remotely located from the public, but inaccessible as well because it is mainly for government use.

Alternative II

The proposed action would have no significant impacts to the social and community identity. There would be no change to the characteristics of the community surrounding Mt. Ka`ala. Repair work is to an existing road that is not only remotely located from the public, but inaccessible as well because it is mainly for government use. Should construction affect ranchers on or near the project area (specifically at Site 3), measures will be taken to mitigate impacts such as noise, traffic, and air conditions.

5.2.5 Economic Considerations

Alternative I

There would be adverse impacts under the No Action alternative should the requisite repair work not be completed. If Mt. Ka`ala Road is blocked by hazardous conditions such as landslides, erosion, and debris, the only possible alternative is travel by helicopter, which would be costly and possibly dangerous depending on the weather. Furthermore, injury due to hazardous road conditions would also be undesirable and expensive. The blocked roadway passage could result in changes to air traffic if flight monitoring operations cannot be properly maintained. This could have economic implications.

Alternative II

The Proposed Action would have a beneficial effect on the economy. The project will result in short-term economic benefits for the construction industry by creating construction work and by the purchase of goods related to the project. Workers by proximity may also help support small businesses in the area.

5.2.6 Recreational and Public Facilities

Alternative I

No significant impacts are anticipated under Alternative I. Site conditions would remain unchanged.

Alternative II

Alternative II is not expected to have any significant impacts. There are no recreational and public facilities in the project area.

5.2.7 Visual and Aesthetic Resources

Alternative I

There would be no significant impacts on the visual resources and aesthetics in or around the project area. This alternative will not change existing conditions.

Alternative II

There would be no significant impacts to visual resources under Alternative II. The Proposed Action will repair an existing roadway and will not affect public views.

5.2.8 Infrastructure Systems and Utilities

Alternative I

No significant impacts are anticipated under Alternative I. Site conditions would remain unchanged.

Alternative II

The Proposed Action is expected to have no significant impacts on the infrastructure and utilities. Repairs to Mt. Ka`ala Road have little effect on water, wastewater, drainage, waste, and transportation utilities in the project area.

5.3 Cumulative Impacts

Cumulative effects are not anticipated as a result of implementing Alternative II. The actions themselves do not involve a commitment to larger actions. The Proposed Action involves the repair and restoration of an existing roadway. The majority of the surrounding area is undeveloped and designated as State Conservation District Land. Therefore, the Proposed Action is not expected to result in substantial secondary impacts, such as population changes, permanent job growth, effects on public facilities, infrastructure, land use patterns, or the natural environment. Furthermore, there are no other known projects planned in the vicinity of the project site prior to the completion of the repairs and renovations to Mt. Ka`ala Access Road. Thus, the discussion of impacts presented within this document has addressed the cumulative impacts associated with the project. No secondary or cumulative adverse impacts have been identified.

SECTION 6 OTHER CONSIDERATIONS REQUIRED BY NEPA

In addition to the analyses discussed in Section4 and Section 5, NEPA requires additional evaluation of the project's impacts including the relationship between short-term uses and long-term productivity, and any irreversible or irretrievable commitment of resources. Additionally this section confirms the absence of significant unavoidable impacts or required mitigation measures for the Proposed Action.

6.1 Relationship Between Short-Term Uses and Long-Term Productivity

NEPA requires that an EA consider the relationship between local short-term uses of the environment and the maintenance and enhancement of long-term productivity.

Short-term uses of the environment associated with the proposed road repair work have been presented, analyzed and discussed in Section 4, Affected Environment and Section 5 Environmental Consequences in this EA. The short-term impacts would occur during the construction phase of the proposed project. Completion of the repair work would maintain the primary transportation corridor for personnel and equipment requiring access to the tracking station on a 24-hour basis.

6.2 Irreversible or Irretrievable Commitment of Resources

Irreversible and irretrievable resource commitments are related to the use of nonrenewable resources and the effects that this use could have on future generations. Irreversible effects result primarily from the use or destruction of a specific resource that could not be replaced within a reasonable time frame (e.g. fossil fuels, minerals). Irretrievable resource commitments involve the loss in value of an affected resources that could not be restored as a result of the action (e.g. the extinction of a protected species, disturbance of a cultural resource).

Irreversible resources commitments resulting from the Proposed Action would include the use of fossil fuels by construction related equipment and construction materials during execution of the repair work. Although these resources are consumed and cannot be replaced, they would have served a useful and needed purpose to ensure that Mt Ka`ala Road remains useable for personnel and goods that must safely transit to and from the tracking station on a daily, routine basis. This would maintain overall mission effectiveness to ensure air traffic in the State can be continuously monitored.

The Proposed Action has the potential to result in irretrievable resource commitments with impacts to protected species and critical habitat. However through consultation with the USFWS under the ESA, these affects will be mitigated through the implementation of agreed upon BMPs that are meant to avoid or minimize such affects.

6.3 Significant Unavoidable Impacts

An EA must include a description of any significant impacts for which no mitigation, or only partial mitigation, is feasible. The Proposed Action would not incur any significant impacts for which no mitigation, or only partial mitigation is feasible. Mitigation measures as described in Section 5 would be implemented and result in impacts that would be less than significant.

6.4 Mitigation Measures

Mitigation measures as described in Section 5 of this EA would be employed to ensure that any potential impacts from the Proposed Action would be less than significant. These measures would be in the form of

BMPs and would be implemented in the following resource areas: topography and geology; soils; flora and fauna; water resources; climate and air quality; noise; solid waste; historical and cultural resources; and. Circulation and traffic.

6.5 Necessary Permits and Approvals

The following approvals will be required for the implementation of the project. All approvals will be obtained in accordance with approving agency guidelines. Per Honolulu Revised Ordinances Chapter 18, Article 3.1 (12), the project is exempt from having to obtain City building permits.

6.5.1 Federal Permits and Approvals

(a) USACE

- Section 404 Clean Water Act
- Rivers and Harbors Act of 1899

6.5.2 State of Hawaii

(a) Board of Land and Natural Resources

- Conservation District Use Permit

(b) Department of Health

- Chapter 46, HAR – Construction Noise Permit, as required
- Chapter 11-55, HAR – National Pollutant Discharge Elimination System Permit
  - ➢ construction stormwater discharges, if applicable
  - ➢ construction activities, if applicable

(c) Department of Land and Natural Resources, Division of Forestry and Wildlife

- Special Use Permit, Natural Area Reserves

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SECTION 8 AGENCIES AND ORGANIZATIONS CONSULTED

The following agencies and organizations were contacted to obtain information on agency requirements and potential issues that were addressed in the Draft EA:

Federal Agencies

U.S. Army Corps of Engineers, Honolulu District, Regulatory Branch

U.S. Department of the Air Force, Pacific Air Forces 611 CES/CEN

U.S. Department of Navy, Naval Facilities Engineering Command

U.S. Department of Transportation, Federal Aviation Administration

U.S. Fish and Wildlife Service Pacific Island Fish and Wildlife Office

State Agencies

State of Hawaii, Department of Land and Natural Resources, Division of Forestry and Wildlife

State of Hawaii, Department of Land and Natural Resources, State Historic Preservation Division

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APPENDIX A
USACE SITE RECONNAISSANCE REPORT

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US Army Corps
of Engineers
Honolulu District

SITE RECONNAISSANCE REPORT
MOUNT KAALA ROAD

OAHU, HAWAII
JUNE 2015

PREPARED FOR:
Commander, 611th CES/CEN, U.S. Air Force
Joint Base Elmendorf-Richardson, AK
(ATTN: 2nd LT Corey Watt)

PREPARED BY:
U.S. Army Corps of Engineers
Design Branch
Honolulu District

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A Photo Logs
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C Product Data – Erosion Control Mat

EXECUTIVE SUMMARY

A site reconnaissance was performed by the US Army Corps of Engineers (USACE), US Air Force (USAF), and Federal Aviation Administration (FAA) along a 6.7-mile section of Mount Kaala Road on Oahu, Hawaii. The purpose of the site reconnaissance was to check existing roadway and slope conditions for erosion, slides, and instability that may make the roadway impassable and cut off access to the FAA-maintained tracking station.

Three major areas of concerns were identified: Site 1 near Culvert 39, Site 2 near Culvert 32, and Site 3 at Makaleha Stream crossing. A landslide occurred at Site 1 in December 2014. The limit of the landslide extends within 14 feet of the roadway edge, and depth of the landslide is estimated to be at least 55 feet. Continued movement of the slope or further sliding of the soil mass will encroach into the roadway and render the roadway impassable. Post-slide slopes at Site 1 are at an inclination of near vertical to about 1/2H:1V (Horizontal:Vertical), an unstable slope configuration that is susceptible to further sliding and movement.

At Site 2, the slope fronting the guardrail along a 55-foot long section of roadway slid in 2013, exposing the guardrail posts and undermining the asphaltic concrete-paved shoulder. The slide depth is approximately 25 to 30 feet, and extends to within 6 feet of the roadway edge. Post-slide slopes at Site 2 are at an inclination of near vertical at the top to about 3H:1V at the mid section, an unstable slope configuration that is susceptible to further sliding and movement. Similar to Site 1, continued slide or movement of the slope will encroach into the roadway and render the roadway impassable.

Site 3 is at the Makaleha Stream culvert crossing. A storm deposited debris on the upstream side of the culvert crossing and washed out part of the asphaltic concrete cover protecting the downstream sideslopes. The capacity of the culvert to convey stormwater flow has been greatly reduced with clogged or partially clogged culverts. A large storm could result in stormwater overtopping and washing out the roadway entirely.

All three areas of concern should be repaired. Site 1 is the highest priority followed by Sites 2 and 3. Options considered for Site 1 are a passive retaining system consisting of closely-spaced drilled shafts on the roadway shoulder; realigning the roadway to outside projected slide area; or stabilizing the slide using a soil-nailed wall. Options considered for Site 2 include filling the undermined area with compacted granular fill or stabilizing the slide with a soil-nailed wall. Sites 1 and 2 are not readily accessible to heavy construction equipment due to narrow and winding roadway leading to the sites. ROM construction cost is about $3,000,000 for Site 1 drilled shaft system; $1,000,000 and $1,700,000 for Site 2 fill option and soil-nailed wall option, respectively; and $200,000 for Site 3.

Oversteepened slopes along the roadway with saprolite and clayey soils are expected to slough until the slope inclination is reduced from the present 1/4H:1V to 1/2H:1V range to about 1H:1V or flatter. Although our site reconnaissance walk-through only uncovered three areas of major concerns, landslides of the magnitude observed at Sites 1 and 2 should be expected due to oversteepened slopes, and may occur with or without heavy precipitation or external loadings.

1.0 INTRODUCTION

This report presents the results of a site reconnaissance of a 6.7-mile section of Mount Kaala Road. The general location of the site and the 6.7-mile section of road of interest are shown on Figure 1.

The one-way road provides access from Farrington Highway to a tracking station maintained by the Federal Aviation Administration (FAA) at the summit of Mount Kaala. The road is paved with asphaltic concrete, about 13 feet wide on the average, and rises from about Elevation 275 feet above mean sea level (msl) at the base to about Elevation 4,025 feet above msl at the tracking station with an average slope of about 10 to 12 percent. The roadway is restricted to the public. Vehicular traffic on the roadway is relatively light with daily traffic consisting of dozens of passenger cars and pickup trucks.

1.1 Site Reconnaissance Objective

The objective of the site reconnaissance was to visually check the roadway for signs of instability, erosion, and slides that if progresses could make the road impassable and the tracking station inaccessible. The engineering aspects of the site reconnaissance were performed by the US Army Corps of Engineers (USACE) for the US Air Force (USAF).

1.2 Scope of Work

USACE scope of services, as outlined in a memorandum dated February 25, 2015, included the following:

- Performing a 3-day site reconnaissance of a 1.5 mile-section of Mount Kaala Road to map general areas of concerns. The purpose of the site reconnaissance was to better understand the existing conditions, problems, and severity of the problems as it relates to the roadway stability for continued usage.
- Preparing a report to include a site plan, photos, findings, general assessment, and recommended fix as applicable, and submitting the report in electronic pdf format.

The scope of work was expanded by USAF to include preparing schematic designs to develop Rough-Order-of-Magnitude (ROM) construction cost estimate for the recommended fixes, and the length of roadway surveyed was extended from 1.5 miles to about 6.7 miles.

2.0 SITE RECONNAISANCE

The site reconnaissance was conducted on May 6 through 8, 2015 with USACE engineers and representatives from USAF and FAA. The purpose of the site reconnaissance was to check the roadway for signs of instability, erosion, and slides and to gather site information for an engineering assessment of areas of concern along Mount Kaala Road. In attendance were:

- Corey Watt – Team Leader, USAF 611 CES/CEN
- Wendy Parker- Programmer, USAF 611 CES
- Chris Ruff – Maintenance Manager, FAA
- Thomas Porter- NDP Infrastructure Program Manager, FAA
- Chen Sam Lee – Lead Civil Engineer, USACE Team Leader
- Eric Li – Civil Engineer, USACE

Brendon Hayashi, USACE structural engineer also supported the May 6 site survey. The site reconnaissance was performed by walking along the roadway and visually checking the roadway and adjacent slopes for signs of instability, slope erosion, and slides that if progresses could make the road impassable and the tracking station inaccessible.

For the most part, the roadway is flanked by steep slopes more than 50 feet high on one or both sides of the roadway with slope inclination of near vertical in some locations to about 1/4H:1V to 1/2H:1V (Horizontal: Vertical). Typical sections representative of the roadway conditions are shown on Figure 2 and photos in Appendix A. Stormwater is collected along a roadway concrete swale system, diverted to culverts, piped across the roadway, and discharged on the downslope side of the roadway. The site reconnaissance indicates overgrown vegetation along portions of concrete swales, debris in most culverts, erosion on steep barren slopes on the upslope side of the roadway, and miscellaneous maintenance-type issues.

Material exposed on the steep slopes is basalt rock formation of varying degrees of weathering, saprolite (decomposed basalt), or clayey soils. Slope surfaces of basalt rock formation were observed to be vegetated and appear to be stable with no or little erosion. Slope surfaces of saprolite and clayey soils were observed to be barren, severely-eroded, and sloughed in many locations. Oversteepened slopes with exposed saprolite and clayey soils are expected to slough until the slope inclination is reduced from the present 1/4H:1V to 1/2H:1V range to about 1H:1V or flatter.

Maintenance to remove sloughed materials deposited in the concrete swale and on the roadway are performed periodically and on an as-needed basis by FAA maintenance crews to keep the concrete swale, culverts, and roadway clear. Maintenance-type concerns are not the main objective of this site investigation and will be briefly discussed in Section 5 with suggested best management practices. The site reconnaissance reveals three major areas of concerns at Sites 1, 2, and 3. Figure 2 shows the approximate location of the three sites.

2.1 Site 1 – Culvert 39

Site 1 is between Culverts 39 and 40. A landslide occurred on the downslope side of the roadway with the top of slide extending close to the roadway edge. According to FAA maintenance crew, the landslide occurred in December 2014.

Figure 3 shows the existing condition of the roadway and the approximate slide area. The slide length is about 60 feet, slide depth is at least 55 feet, and the slide extends to within 14 feet of the roadway edge. Adjacent to the roadway, on the upslope side is an unpaved shoulder, about 6 to 9 feet wide and tall slopes, about 50 to 60 feet high. As shown in the cross section on Figure 3, continued sliding or movement of the slope is likely to encroach into the roadway and render the roadway impassable.

2.2 Site 2 – Culvert 32

Site 2 is near Culvert 32. The ground and slope fronting the guardrail of a 55-foot long section of roadway slid, exposing guardrail posts, and undermining the asphaltic concrete paved shoulder. Figure 4 shows the existing conditions of the roadway and the approximate slide area. According to FAA personnel, the top of the pre-slide slope previously extended about 6 feet laterally from the edge of the guard rail. An existing steel-bin retaining system was observed parallel to the guardrail, with the base extending about 8 feet deep into the slopes. The steel-bin retaining system is shown on Figure 4 and photos on the figure, and appears to hold back the upper portion of the failed slope. Post-slide slope inclination ranges from near vertical at the top to about 3/4H:1V at mid to lower portion of the slope.

The slide depth is approximately 25 to 30 feet, and the slide extends to within 6 feet of the roadway edge. Adjacent to the roadway, on the upslope side is a 3-foot wide concrete swale, about 4 feet of unpaved shoulder, and tall slopes, about 30 to 35 feet high. Continued sliding or movement of the slope will encroach into the roadway and render the roadway impassable.

2.3 Site 3 – Culvert Crossing

Site 3 is at Makaleha Stream culvert crossing. A storm deposited debris on the upstream of the culvert crossing and washed out part of the asphaltic concrete cover protecting the downstream sideslopes. Figure 5 and photos on the figure show debris, damages, and clogged culverts. The capacity of the culvert to convey stormwater flow is greatly reduced with clogged or partially clogged culverts. A large storm could result in stormwater overtopping and washing out the roadway.

3.0 SCHEMATIC DESIGN AND ROM COST

Schematic sketches to mitigate continued movement or future slide at Sites 1 and 2 and to remove debris and repair washout asphaltic concrete at Site 3 are discussed in this section. A Rough-Order-of-Magnitude (ROM) construction cost is provided for USAF to budget repair funds.

3.1 Site 1-Culvert 39

Three possible alternatives were considered to mitigate the landslide area. Alternative 1 would involve relocating the roadway to outside projected slide zone. This alternative will require cutting back the 50 to 60-foot high slope to realign the existing roadway about 20 feet into the upslope side of the roadway. This alternative will require mobilizing heavy construction equipment such as a crane or an excavator with a reach that can excavate the 50 to 60-foot high slope. We judge that the narrow and winding 13-foot wide roadway may not allow mobilizing large pieces of heavy construction equipment necessary to excavate the tall slope to realign the roadway.

Alternative 2 would involve stabilizing the slide mass with an anchored or soil-nailed wall. Soil nailing information is included in Appendix B. As illustrated in the brochure, soil nailing is primarily used as an earth retention technique for deep excavation with installation in stages and from top down. The base of the failed slope extends hundreds of feet below the roadway surface. For the specific conditions at the site, soil nailing can only be installed to stabilize the existing steep slopes using crane or excavator suspended working platforms. Placing a crane or excavator near the landslide area of Site 1 may trigger further soil movement, making this alternative to stabilize the slide not readily constructable and highly risky.

Alternative 3 would install a closely-spaced drilled shaft wall barrier along the downslope shoulder to protect the roadway should the existing slide continue to move or a future slide occurs. This alternative would be constructed using closely spaced drilled shafts to form a retaining barrier. A schematic sketch to develop ROM construction cost is shown on Figure 6. Preliminary analyses indicate that 3-foot diameter drilled shafts spaced at 4-foot on center, and with the drilled shafts extending about 50 feet below the projected slide plane would be required to mitigate Site 1.

3.2 Site 2 –Culvert 32

Two possible alternatives were considered to mitigate the landslide area. The base of the failed slope extends about 25 to 30 feet below the roadway surface. Alternative 1 would involve placing granular fill on the face of the existing slope to buttress the failed slope, and prevent further movement of the soil mass and sloughing of the slope surfaces. A schematic design showing placement of granular fill on the failed slope is shown on Figure 7. The granular fill should be well-graded with 6-inch to 12-inch rock fragments and compacted to a dense and unyielding mass. Placing granular fill with a finish slope of 1.5H:1V and fill height of about 30 feet will impact a large area beyond the slope area and may require easement approval from the property owner and trigger environmental concerns.

A second alternative that would disturb less area is provided in the event that environmental concerns or the project fails to obtain easement approval. Alternative 2 would install a soil-nailed wall to stabilize the failed slope. A schematic design of a soil-nailed wall to develop ROM construction cost is shown on Figure 8. Crane-suspended working platforms will be required to install soil nails on the existing steep slopes. A photograph of soil nailing installation over steep slopes using a crane-suspended working platforms is shown in Appendix B.

3.3 Site 3 –Culvert Crossing

Figure 9 shows details to remove debris on the upstream side of the culverts and in the culverts, patching of washed out asphaltic concrete, and miscellaneous repairs to restore the culvert crossing stormwater carrying capacity.

3.4 ROM Construction Cost Estimate

The below table summarizes rough order magnitude (ROM) construction cost estimates for Sites 1 through 3. The ROM estimates are based on readily available information, engineering judgment and/or experience with similar projects. Rough quantities for drilled shafts, granular fill, and soil nailing are estimated from the schematic sketches shown on Figures 6 through 8. Higher cost and slower production rate to account for remote site location and narrow and winding road that would preclude large construction equipment were factored into the ROM estimate.

ROM Construction Cost Estimate

Site	ROM Cost	Remarks
Site 1: Culvert 39 (Drilled Shaft Barrier)	$3,000,000	ROM cost is for seventeen 80-foot deep 3-foot diameter drilled shafts.
Site 2: Culvert 32 (Granular Fill Alternative) Site 2: Culvert 32 (Soil Nailed Wall Alternative)	$1,000,000 $1,700,000	Granular fill option will require clearance from environmental and may require easement approval.
Site 3: Culvert Crossing	$200,000	ROM cost is for removal of debris and restoring the culvert systems to pre-storm flow-through capacity.
Total ROM Cost	$4,900,000	Assume Soil Nailed Wall for Site 2.

The ROM construction costs do not include engineering design, topographic survey, geotechnical investigation, construction management, and contingency. For budgeting purpose, we suggest allocating the following additional fund:

- Engineering Design: 8 percent of ROM construction cost, or approximately $380,000
- Topographic Survey (Sites 1, 2, and 3) and Geotechnical Investigation (Sites 1 and 2): $100,000
- Construction Management: 6 percent of ROM construction cost, or approximately $300,000
- Contingency Fund (change orders, etc.): 10 percent of ROM construction cost, or approximately $500,000.

The ROM construction cost and engineering design, topographic survey/geotechnical investigation, and construction management fees are provided to assist USAF with project planning. The USACE would be glad to provide additional support on the repair projects if additional engineering and design services are requested.

4.0 RECOMMENDATIONS

All three areas of concerns should be repaired or mitigated with Site 1 the highest priority followed by Site 2 and Site 3 in the order of urgency.

4.1 Temporary Measures

Pending repair, which may take a couple of years to plan, fund, and execute, the landslide area at Site 1 should be monitored and inspected regularly to assess if the slide is continuing. Continued sliding or movement will necessitate closing of the road to vehicular traffic. Visual inspection should be performed on a weekly basis. Survey stakes can be installed along the slide limit near the fringe of the slide and the survey stakes used as reference points to visually and/or instrumentally determine if the landslide is continuing.

Site 2 should be similarly monitored and inspected for continued movement. At the time of the site investigation, Culvert 32 was observed to be partially clogged with leaves and debris, resulting in storm water overflowing to the slide area. Culvert 32 should be checked and cleared of debris on a regular basis. Stormwater flowing across the slide area may wash out the slope or reduce the shear strength of the soil and trigger movement or sliding of the remnant slope.

4.2 Design and Construction

If funded for design and construction, this project should be awarded under a Design-Build procurement to reduce risks to the Government due to inherent risks and uncertainties with mobilizing heavy construction equipment to the site.

The Design-Build Contractor can engage the services of specialty contractors who can factor in constructability taking into considerations the site constraints and the limitation of their construction equipment.

5.0 BEST MANAGEMENT PRACTICES FOR ROADWAY MAINTENANCE

In general, the roadway is well-maintained and the drainage system appears to perform as designed to convey runoff away from slope surfaces. Slope erosion and sloughing are due primarily to oversteepened and barren slopes with inclination as steep as 1/2H:1V in most locations. FAA maintenance crews periodically remove soils and debris from slope erosion that fall into concrete swale systems, culverts, and roadway. The following were noted during our walk-through site investigation:

- Overgrown vegetation in swales.
- Debris in culverts.
- Disposal of roadway debris and eroded soils.
- Barren eroded slopes.

5.1 Overgrown vegetation in swales

Vegetation growing and covering concrete swales along stretches of the roadway should be cleared to maintain the capacity of the swale to convey stormwater runoff and discharge the runoff to the network of culvert-and-pipe drainage system. Overgrowth could reduce the carrying capacity of swale and result in stormwater overflowing and discharging to steep barren slopes causing slope erosion and sloughing.

5.2 Debris in drainage systems

Debris and soil deposited on drainage system should be removed from swales, culvert intake, and culverts. A blocked drainage system could result in stormwater overflowing and discharging to steep barren slopes causing slope erosion and sloughing.

5.3 Disposal of roadway sloughing and debris

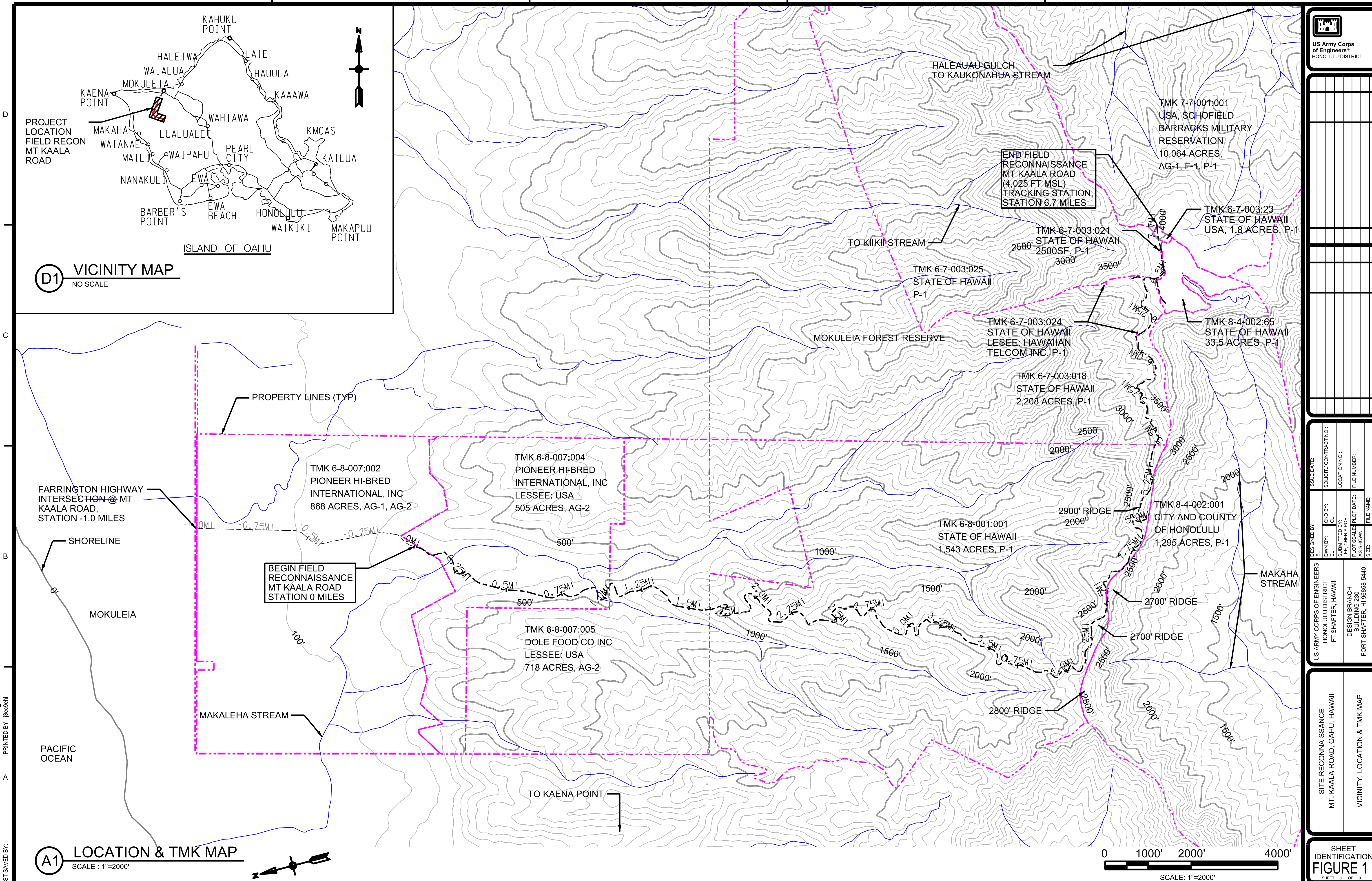
Debris and soils deposited in concrete swales and sloughed soils on roadway should not be cleared by placing the soils and debris adjacent or on top of existing roadway slopes. Placing soil and debris near the top of roadway slopes will add weight to the embankment, and may induce slope movement. Debris and soils from roadway clearing should be removed and placed at least 10 feet laterally from edge of slope.

5.4 Barren eroded slopes

Most of the steep barren and eroded slopes are located on the upslope side of the roadway. A large-scale landslide will deposit soils and debris on the roadway and may cut off access to the tracking station. These slopes should be checked for signs of landslide and resources such as trucks and loaders made readily available to clear the roadway. Currently, FAA maintenance staff has small bobcat loaders that may not be able to remove debris and soils from a large-scale landslide.

Permanent turf reinforcement mat (TRM) and erosion control blanket (ECB) suitable for steep slope application can be installed on the barren slope surfaces to reduce erosion and sloughing and to promote vegetation growth. Product data of TRM and ECB typically installed on steep slope is included in Appendix C.

FIGURES



ANSI B 11 x 17

This project was designed by the Honolulu District of the U.S. Army Corps of Engineers. The initials or signatures and registration designations of individuals appear on these project documents within the scope of their employment as required by ER 1110-1-8152.

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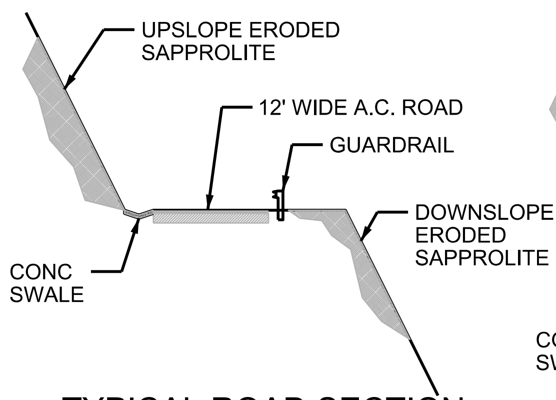
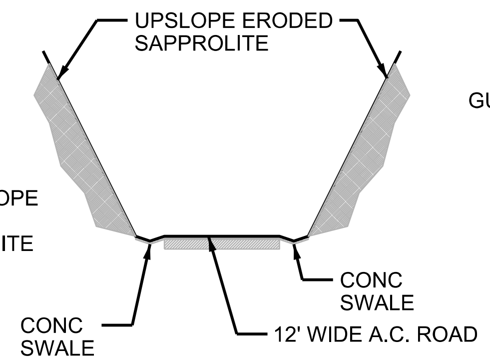
NOTES:

1. C# [ ] = CULVERT # [COMMENT]
2. DIMENSIONS PROVIDED ARE APPROXIMATE AND ALONG ROADWAY.
3. UPSLOPE EXPOSED RED SOIL. REQUIRES INCREASED MAINTENANCE IN CLEARING SWALES, CULVERTS, AND ROADWAY.
4. DUMPING OF ERRODED SOILS ON UPSLOPE SHOULD NOT BE PLACED ON STEEP SLOPES ON THE DOWNSLOPE SIDE. THIS WILL EVENTUALLY CAUSE A LANDSLIDE DUE TO THE INCREASED MASS ON THE STEEP SLOPE OF THE DOWNSLOPE SIDE.



TYPICAL ROAD SECTION LOOKING WEST OR NORTH

NO SCALE



VARIOUS ROAD SECTIONS MILES 1-4

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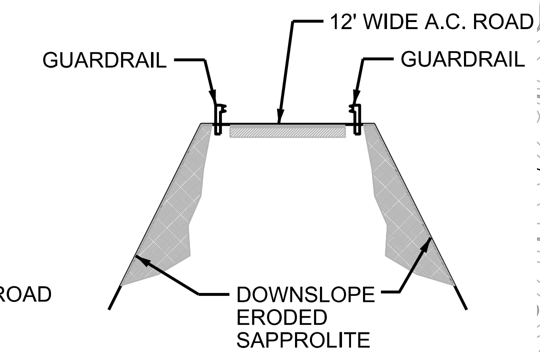

ROAD SECTION MILE 5.2

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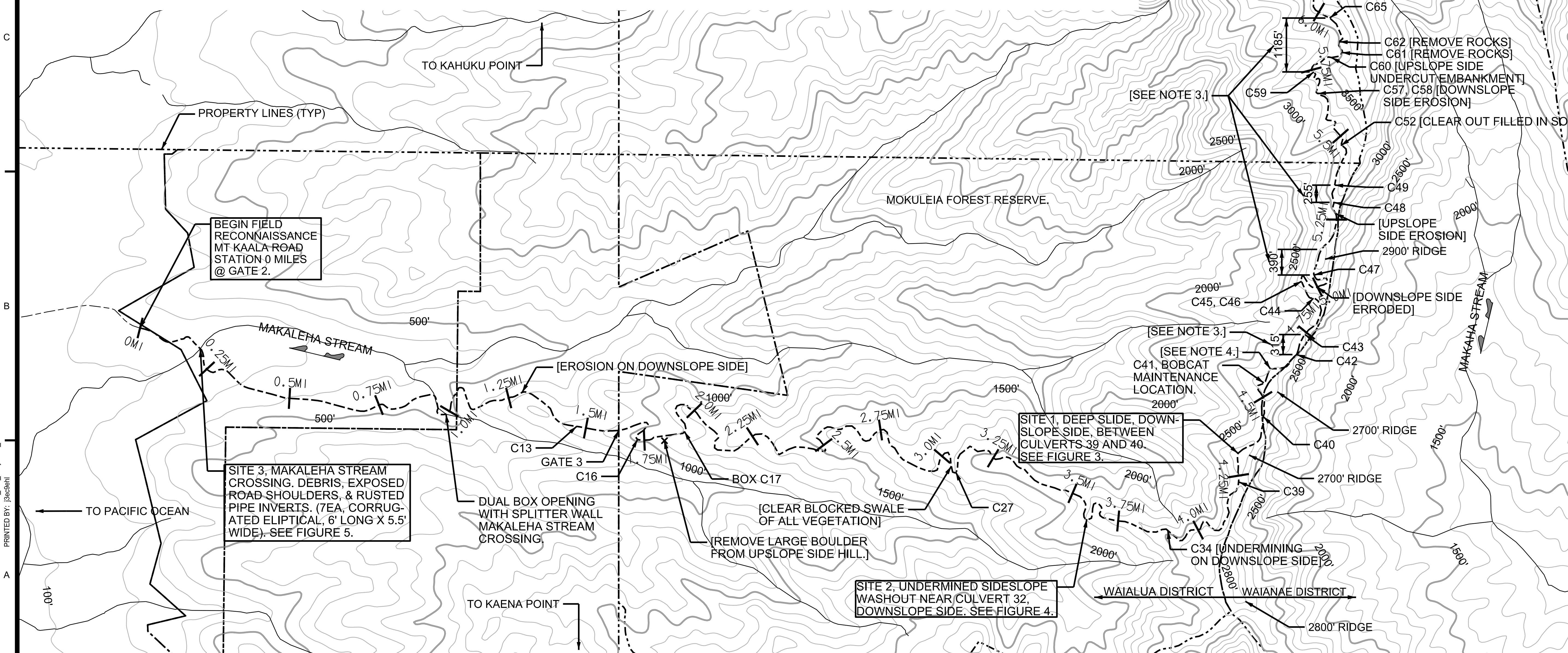

A1 OVERALL SITE MAP

SCALE : 1"=1500'

0 750' 1500' 3000'

SCALE: 1"=1500'

US Army Corps of Engineers®
HONOLULU DISTRICT

MARK	DESCRIPTION	DATE	APPR

MARK	DESCRIPTION	DATE	APPR

US ARMY CORPS OF ENGINEERS
HONOLULU DISTRICT
FT SHAFTER, HAWAII

DESIGN BRANCH
BUILDING 230
FORT SHAFTER, HI 96858-5440

DESIGNED BY: EL	CKD BY: CL		ISSUE DATE:
DWN BY: EL		SOLICIT./CONTRACT NO.:	
SUBMITTED BY: LEE, CHEN S. POH	PLOT DATE:	LOCATION NO.:	
PLOT SCALE: AS SHOWN	FILE NAME:	FILE NUMBER:	
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SITE RECONNAISSANCE
MT. KAALA ROAD, OAHU, HAWAII

OVERALL SITE MAP

SHEET IDENTIFICATION
FIGURE 2

SHEET 0 OF 0

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ANSI B 11 x 17

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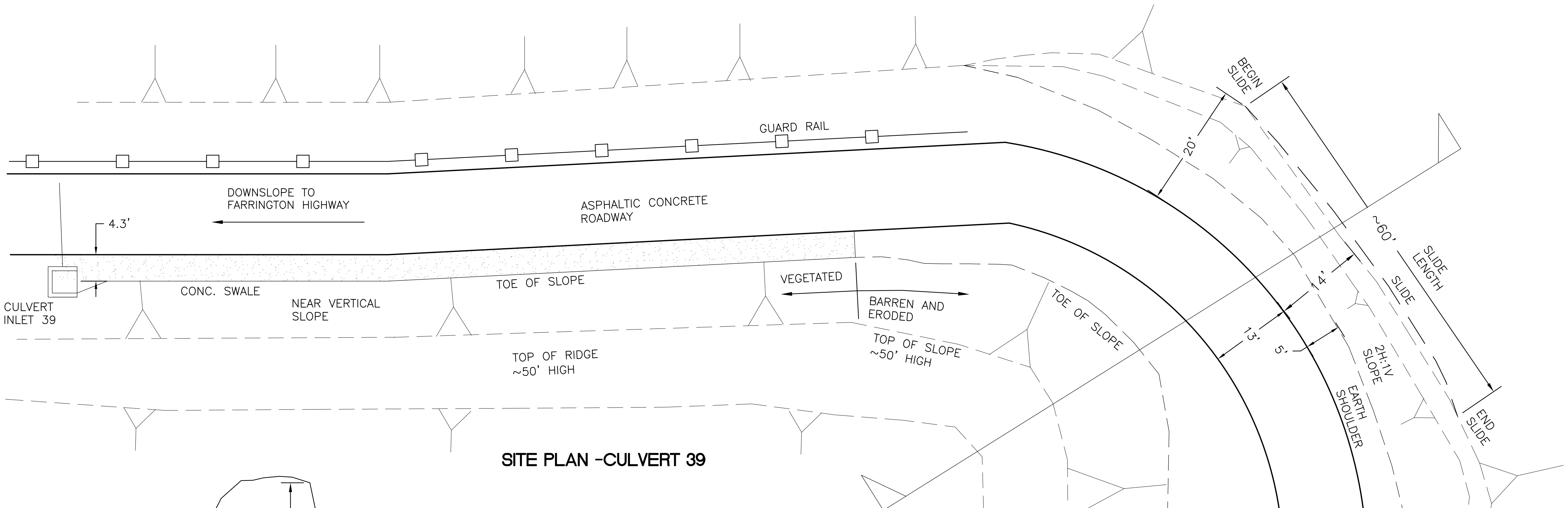
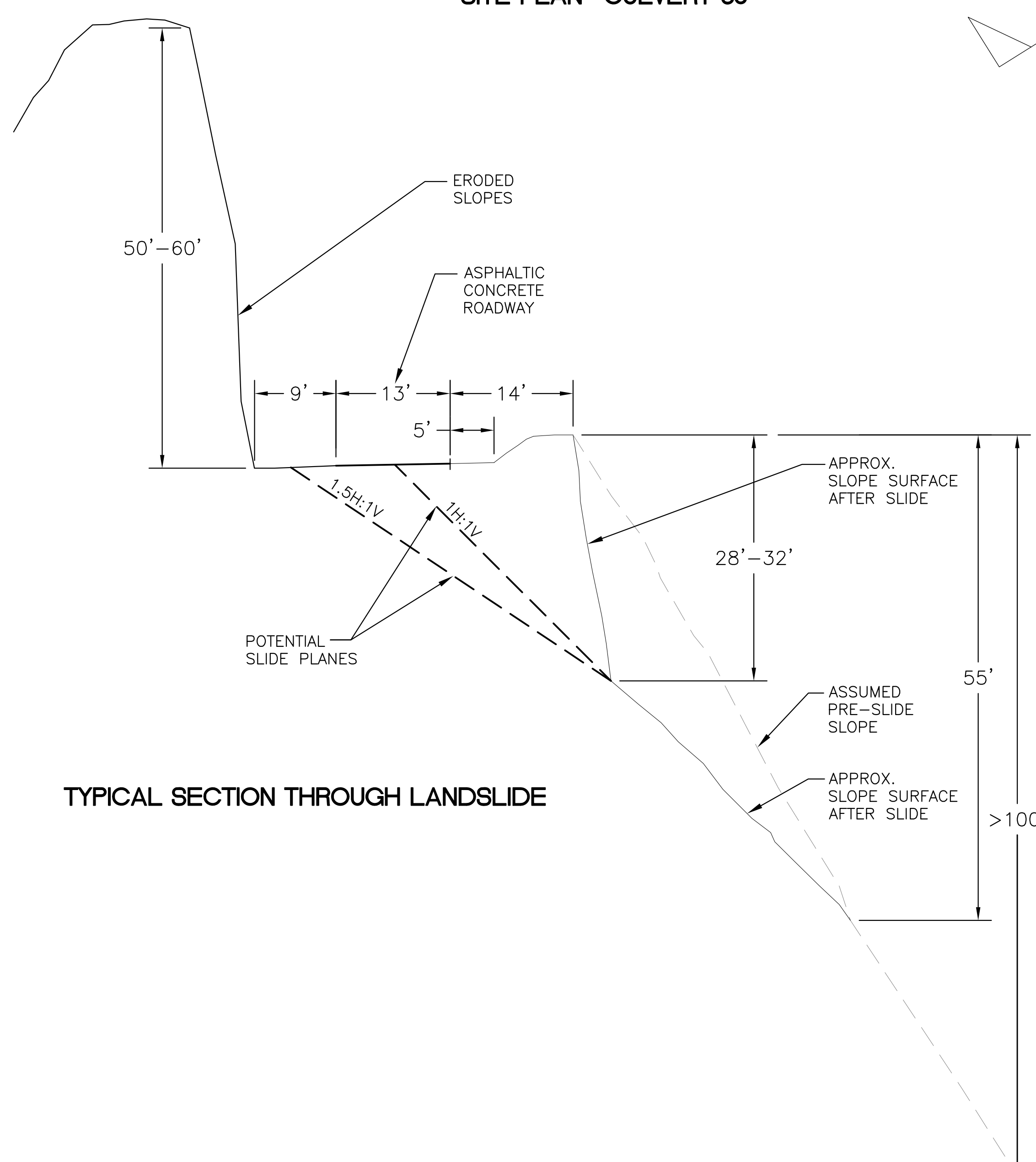


SITE PLAN -CULVERT 39

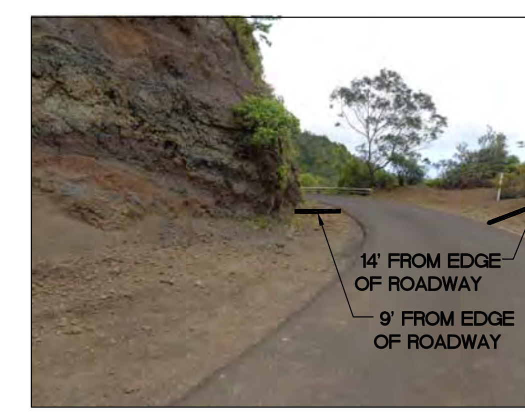


TYPICAL SECTION THROUGH LANDSLIDE

LANDSLIDE - 14 FEET FROM ROAD EDGE

LANDSLIDE - 14 FEET FROM ROAD EDGE

LIMIT OF LANDSLIDE



50'-60' HIGH SLOPE BEHIND ROADWAY

SITE PLAN
SCALE: 1" = 20'-0"

GRAPHIC SCALE
10' 5' 0 10' 20'
1" = 20'-0"

DESIGN BRANCH
US ARMY CORPS OF ENGINEERS
HONOLULU DISTRICT

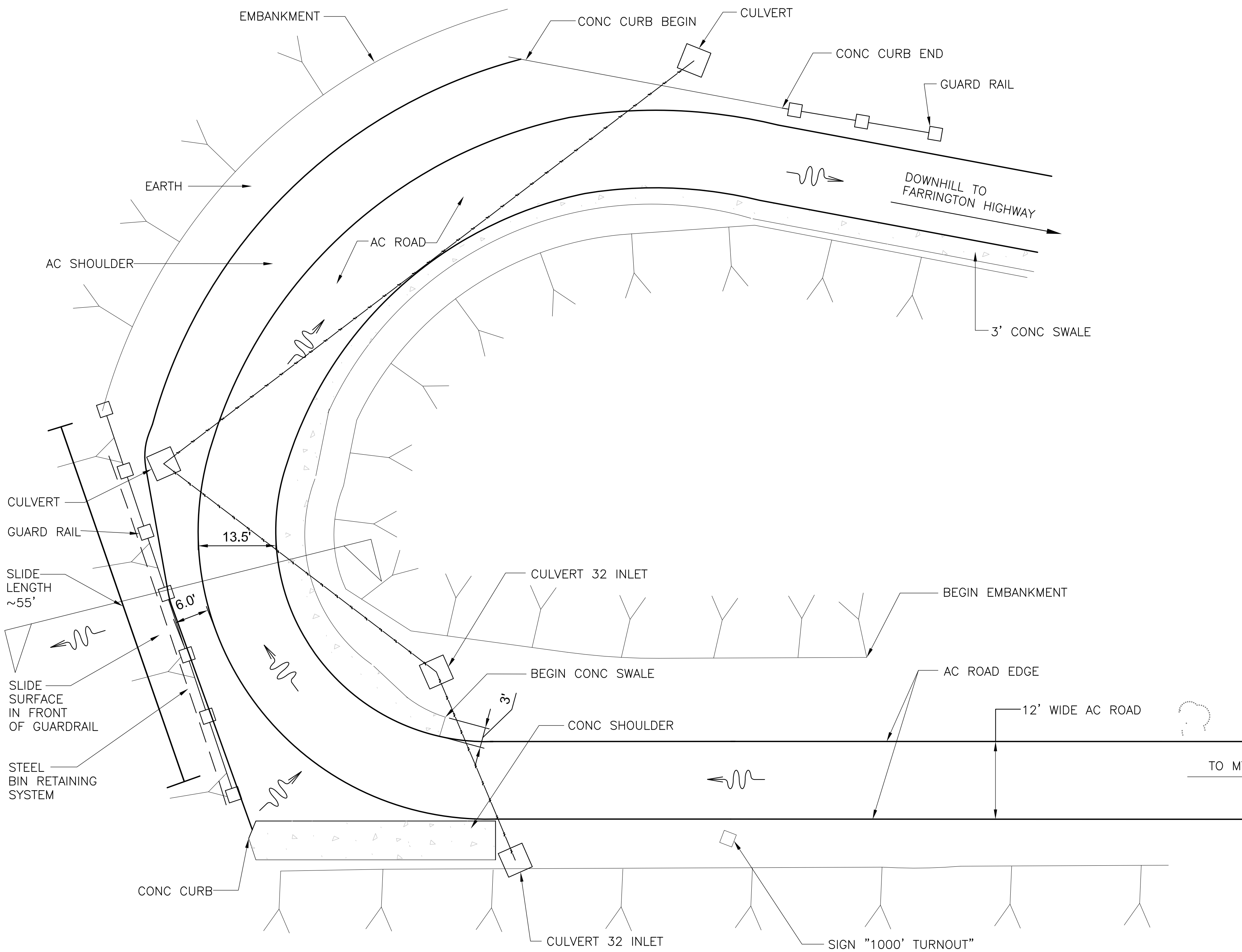
EXISTING CONDITIONS - CULVERT 39

KAALA ROAD SITE RECONNAISANCE
OAHU, HAWAII

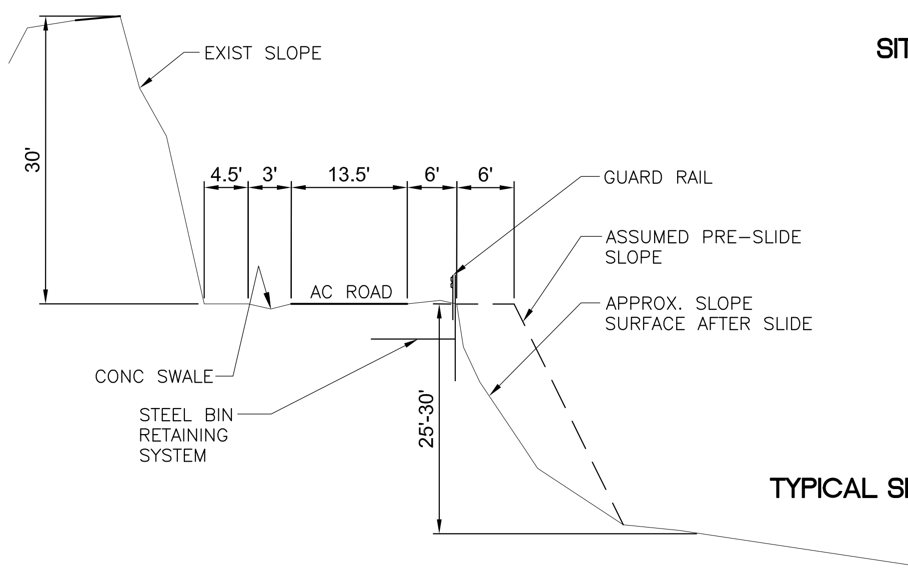
FIGURE
3

DRAWN	DESIGNED	DATE	REVISED DATE
CHEN SAM	CHEN SAM	5/15	6-30-15

P:\POHEC\EC-DC\KAALA ROAD SITE RECON\DRAWING\FIGURE-3.DWG



SITE PLAN -CULVERT 32



TYPICAL SECTION THROUGH LANDSLIDE

SITE PLAN
SCALE: 1" = 20'-0"

GRAPHIC SCALE
10' 5' 0 10' 20'
1" = 20'-0"

STEEL BIN RETAINING SYSTEM

SLOPE SLIDE - 6 FEET FROM ROAD EDGE

SLIDED SURFACE FRONTING GUARDRAIL

UNDERMINED GUARDRAIL POST

UNDERMINED GUARDRAIL SUPPORT

30'-35' HIGH SLOPE BEHIND ROADWAY

DESIGN BRANCH
US ARMY CORPS OF ENGINEERS
HONOLULU DISTRICT

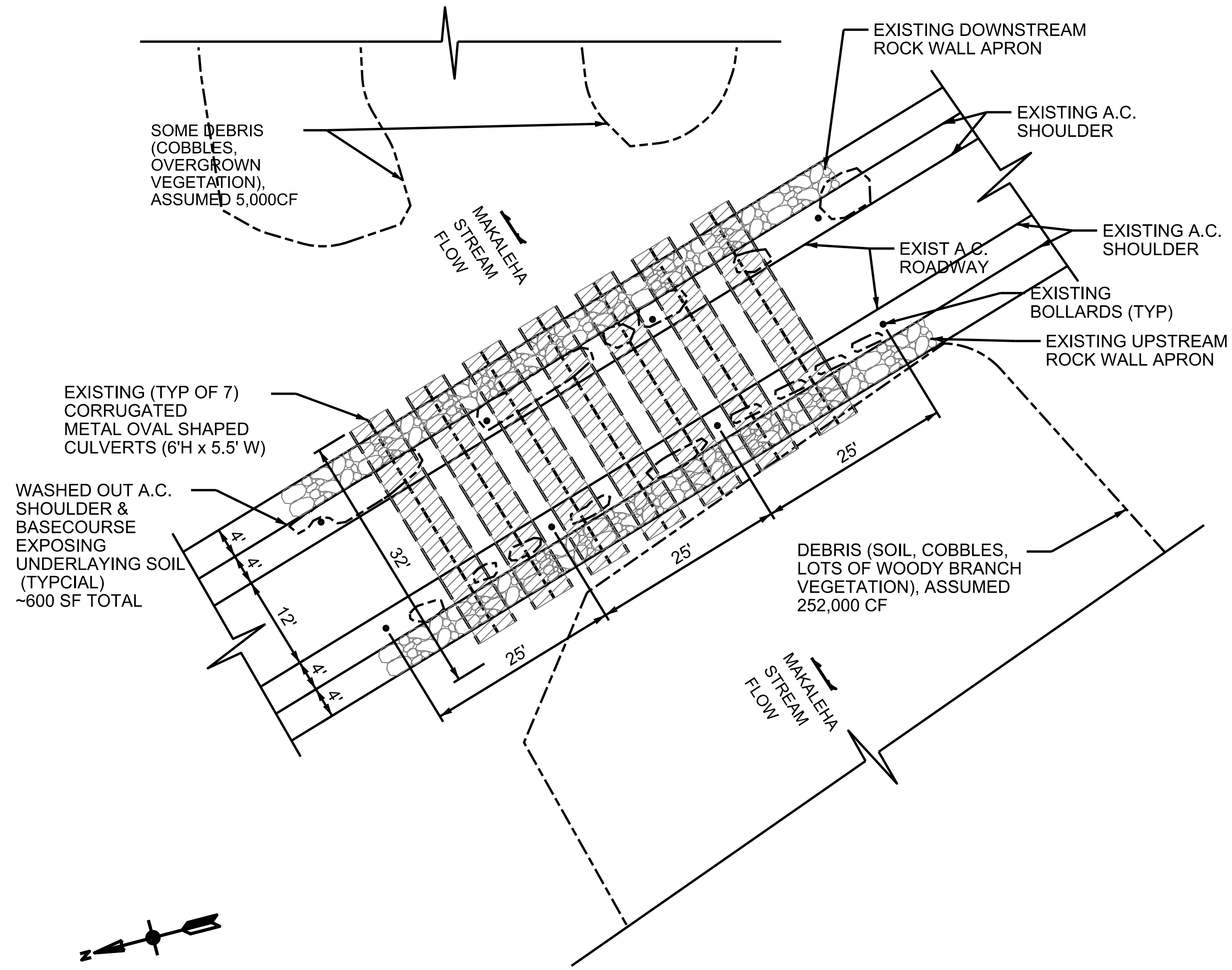
EXISTING CONDITIONS - CULVERT 32

KAALA ROAD SITE RECONNAISANCE
OAHU, HAWAII

FIGURE
4

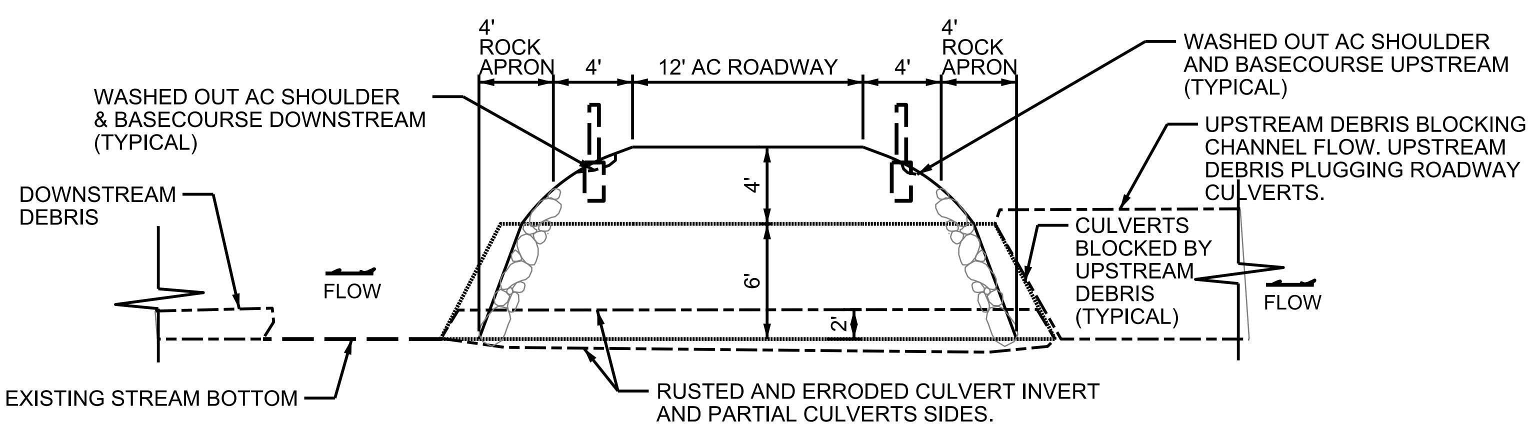
DRAWN	DESIGNED	DATE	REVISED DATE
CHEN SAM	CHEN SAM	5/15	6-30-15

P:\POHEC\EC-DC\KAALA ROAD SITE RECON\DRAWING\FIGURE-4.DWG



B1 MAKALEHA STREAM 7 CULVERT CROSSING PLAN

SCALE : 1"=20'



A1 MAKALEHA STREAM 7 CULVERT CROSSING PROFILE

SCALE : 1"=10'

NOTES:

1. MEASUREMENTS FROM THE FIELD ARE APPROXIMATE. THIS FIGURE IS TO BE USED AS PART OF AN INFORMATIVE REPORT FOR FUTURE DESIGN AND COST ESTIMATING DECISION MAKING PURPOSES ONLY; NOT FOR CONSTRUCTION PURPOSES.

0 5' 10' 20'
SCALE: 1"=10'

0 10' 20' 40'
SCALE: 1"=20'

US Army Corps of Engineers®
HONOLULU DISTRICT

MARK | DESCRIPTION | DATE | APPR

DESIGNED BY: EL
DWN BY: EL
CKD BY: CL
SUBMITTED BY: LEE, CHEN S POH
PLOT SCALE: AS SHOWN
SIZE: ANSI B
ISSUE DATE:
SOLICIT./CONTRACT NO.:
LOCATION NO.:
FILE NUMBER:
PLOT DATE:
FILE NAME:

US ARMY CORPS OF ENGINEERS
HONOLULU DISTRICT
FT SHAFTER, HAWAII

DESIGN BRANCH
BUILDING 230
FORT SHAFTER, HI 96858-5440

SITE RECONNAISSANCE
MT. KAALA ROAD, OAHU, HAWAII

SITE 3: MAKALEHA STREAM
7 CULVERT CROSSING PLAN
EXISTING CONDITIONS

SHEET IDENTIFICATION
FIGURE 5

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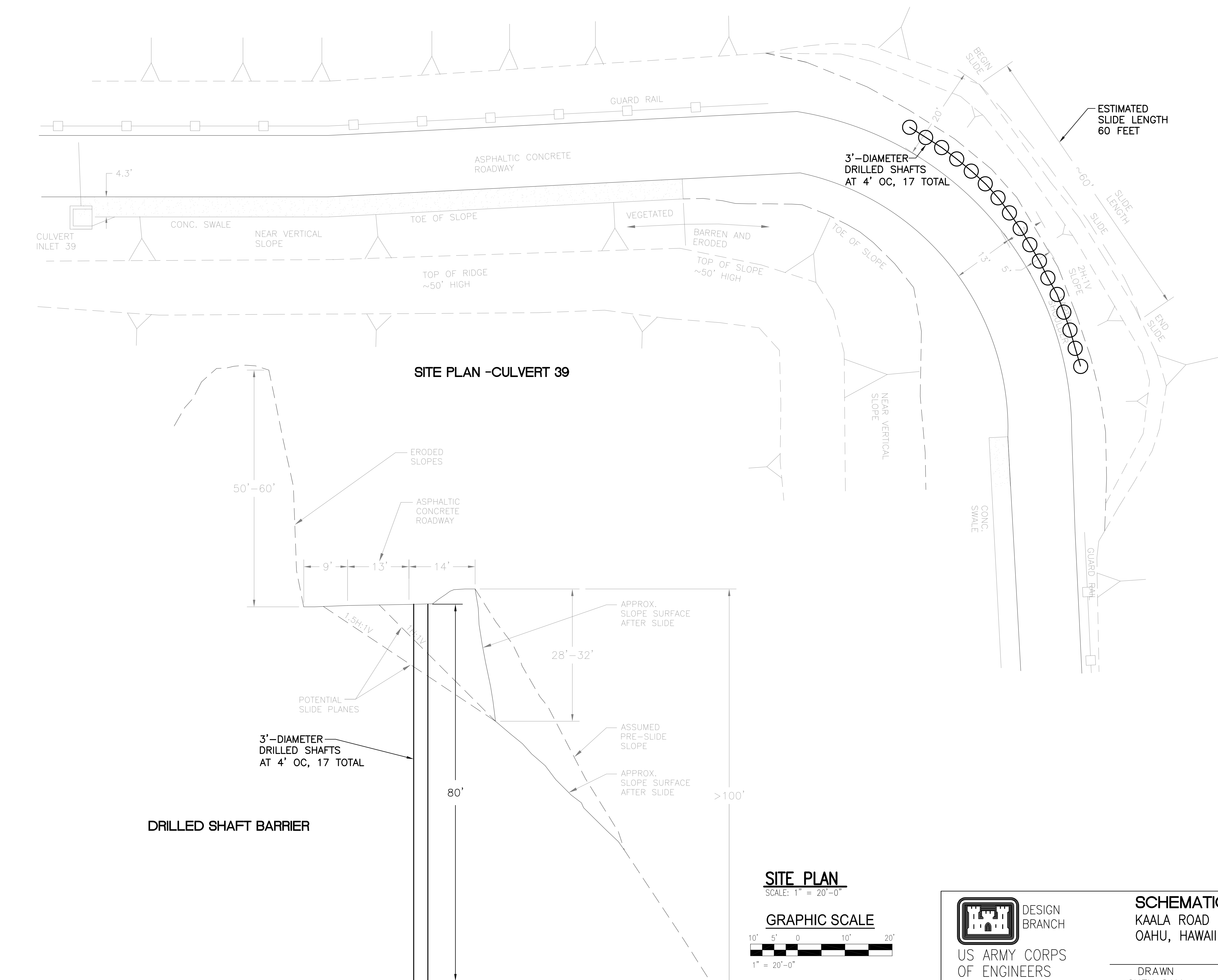
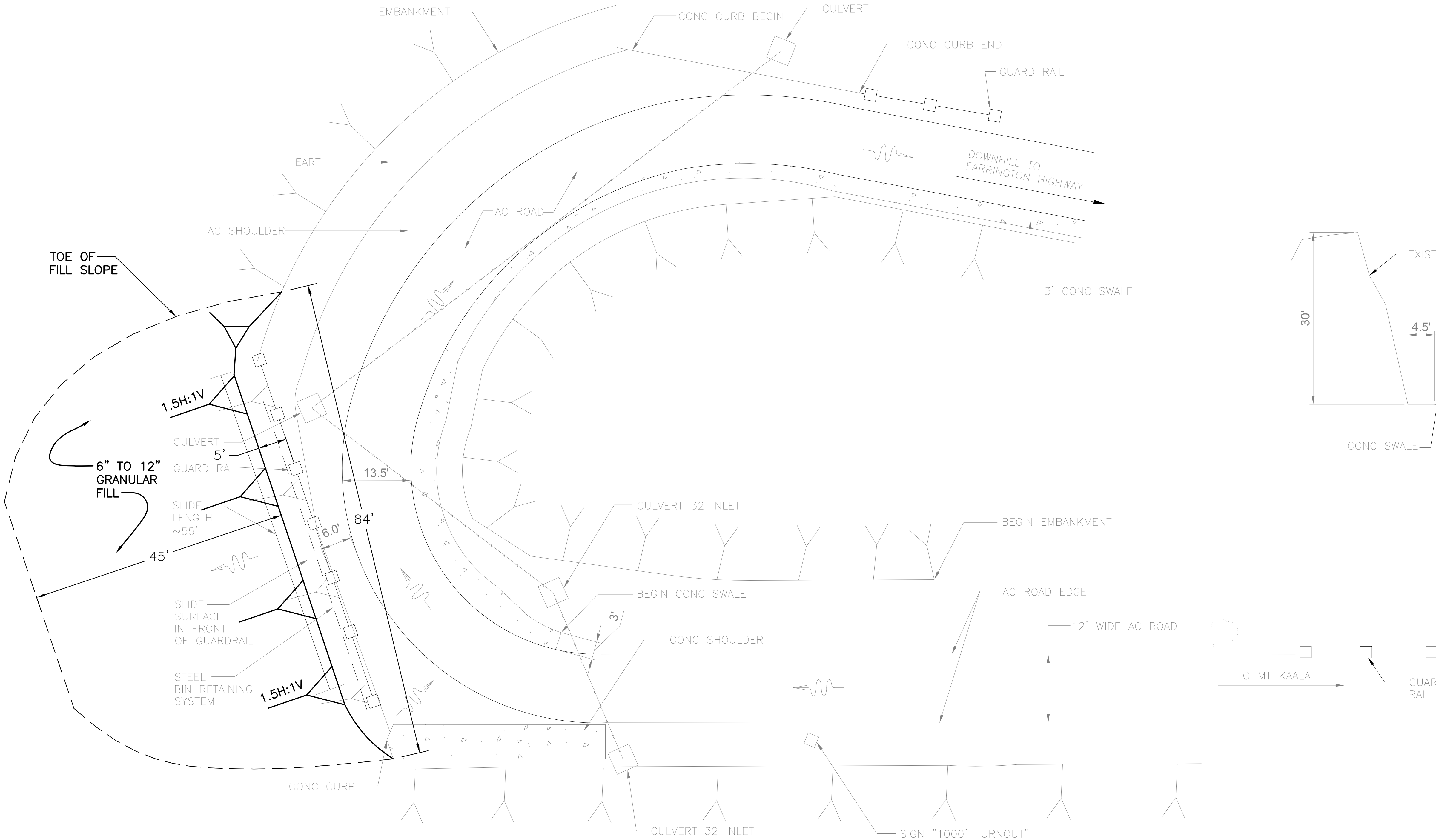
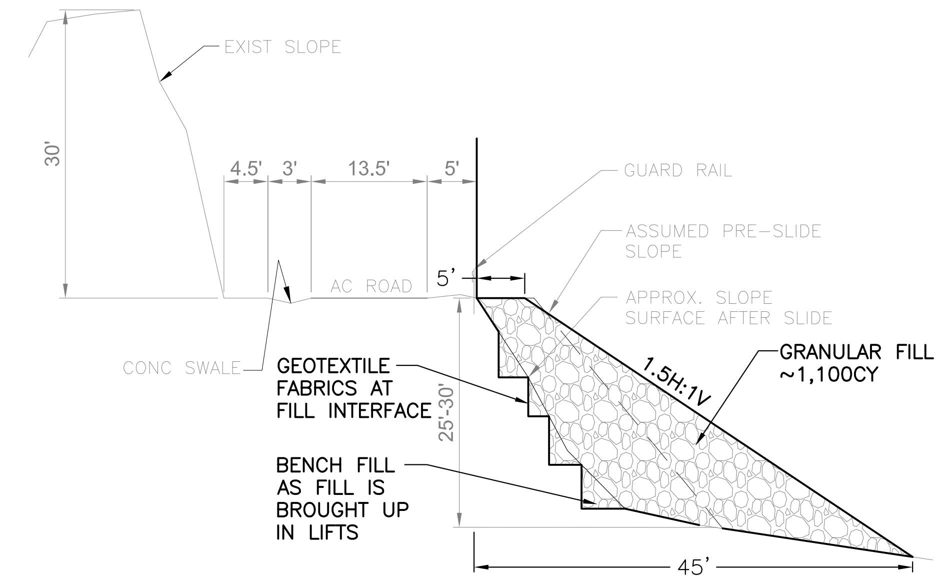


P:\POHEC\EC-DC\KAALA ROAD SITE RECON\DRAWING\FIGURE-6.DWG

DESIGN BRANCH US ARMY CORPS OF ENGINEERS HONOLULU DISTRICT	SCHEMATIC DESIGN - CULVERT 39 KAALA ROAD SITE RECONNAISANCE OAHU, HAWAII			FIGURE 6
	DRAWN	DESIGNED	DATE	REVISED DATE
	CHEN SAM	CHEN SAM	5/15	6-30-15



SITE PLAN -CULVERT 32



GRANULAR FILL ALTERNATIVE

SITE PLAN
SCALE: 1" = 20'-0"

GRAPHIC SCALE

10' 5' 0 10' 20'

1" = 20'-0"

DESIGN BRANCH
US ARMY CORPS OF ENGINEERS
HONOLULU DISTRICT

SCHEMATIC DESIGN - CULVERT 32 (ALT 1)
KAALA ROAD SITE RECONNAISANCE
OAHU, HAWAII

FIGURE 7

DRAWN	DESIGNED	DATE	REVISED DATE
CHEN SAM	CHEN SAM	5/15	6-30-15

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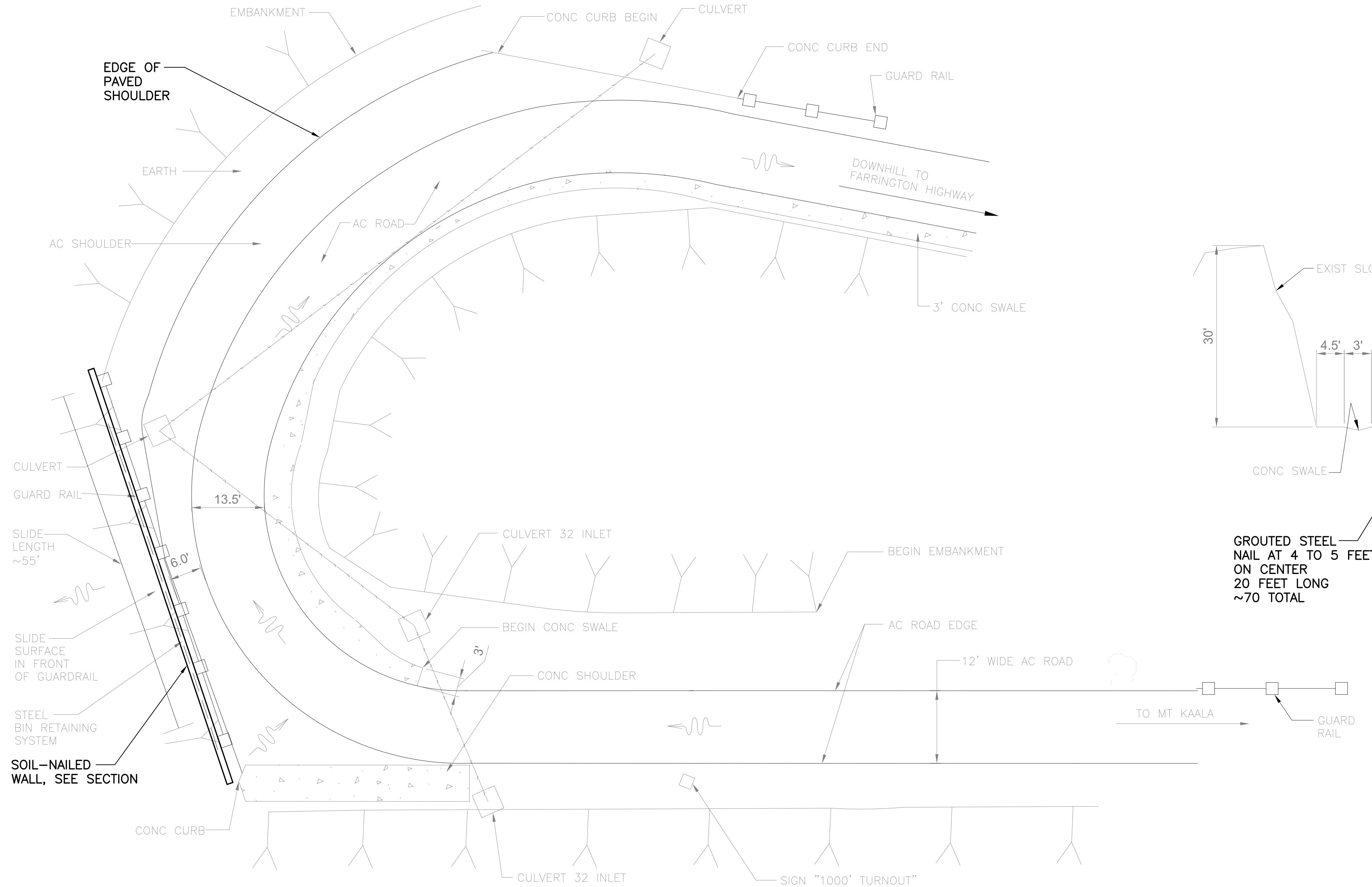
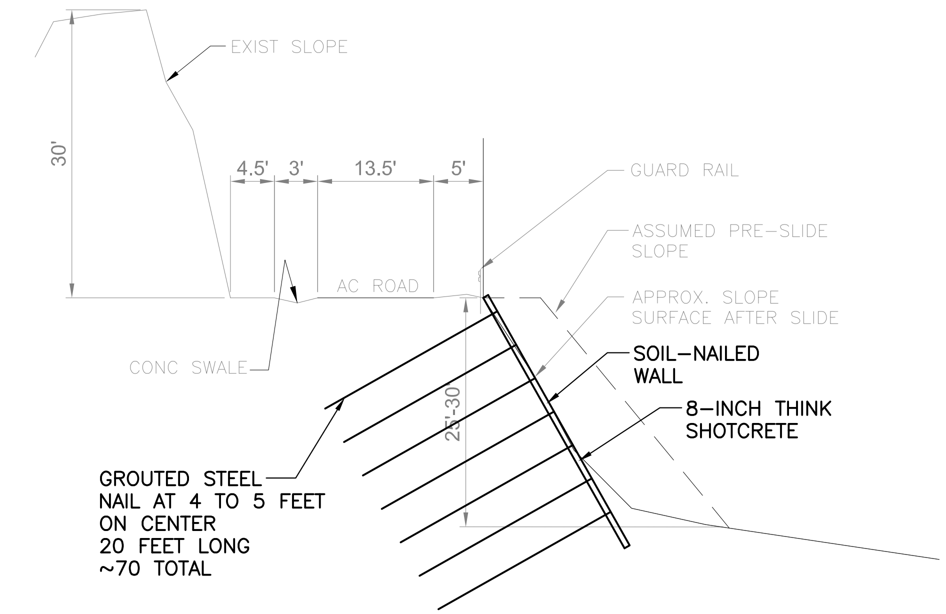




SOIL-NAILED WALL ALTERNATIVE 2

SITE PLAN -CULVERT 32

SITE PLAN

SCALE: 1" = 20'-0"

GRAPHIC SCALE

10' 5' 0 10' 20'

1" = 20'-0"

P:\POHEC\EC-DC\KAALA ROAD SITE RECON\DRAWING\FIGURE-8.DWG

DESIGN BRANCH

US ARMY CORPS OF ENGINEERS HONOLULU DISTRICT

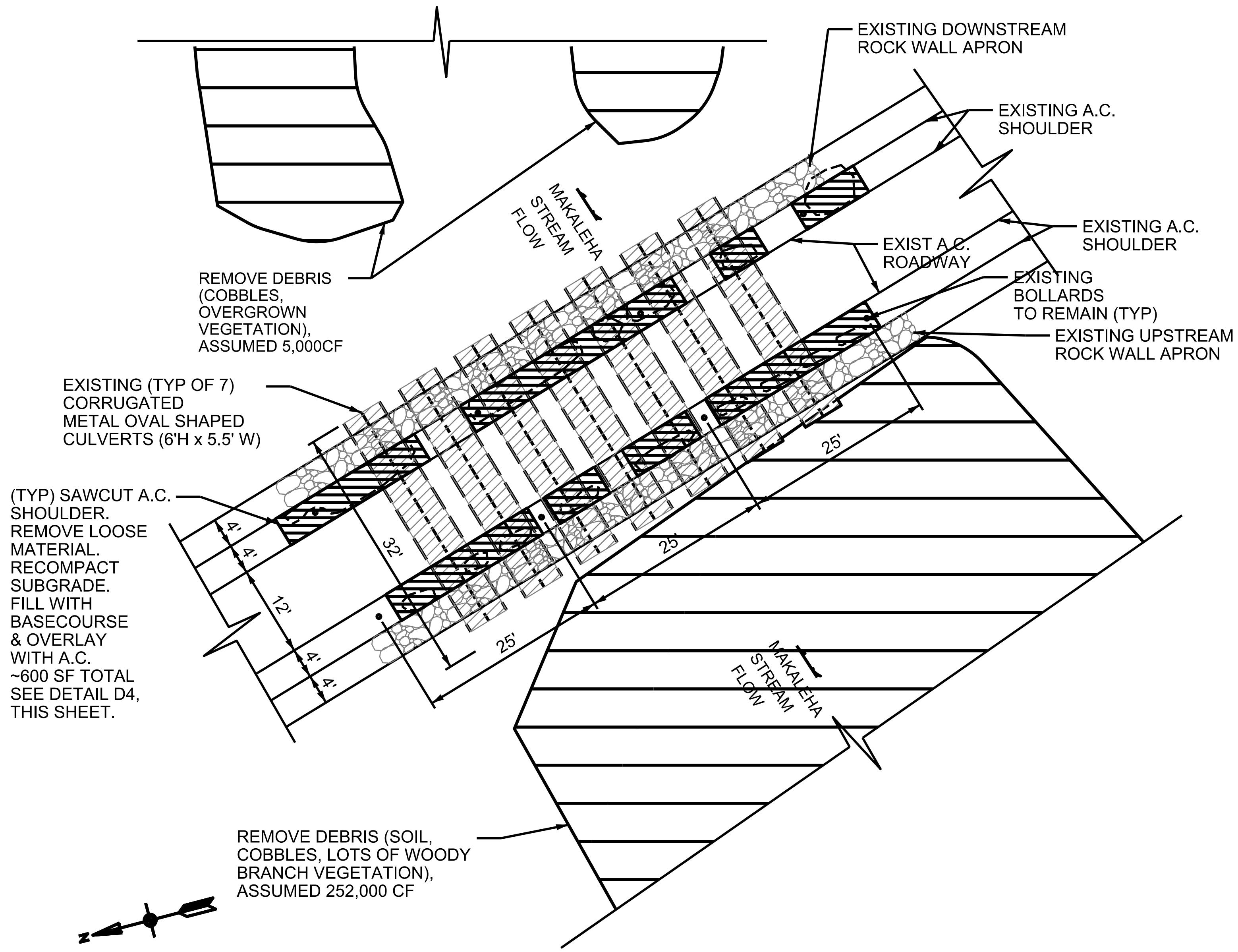
SCHEMATIC DESIGN - CULVERT 32 (ALT 2)

KAALA ROAD SITE RECONNAISANCE

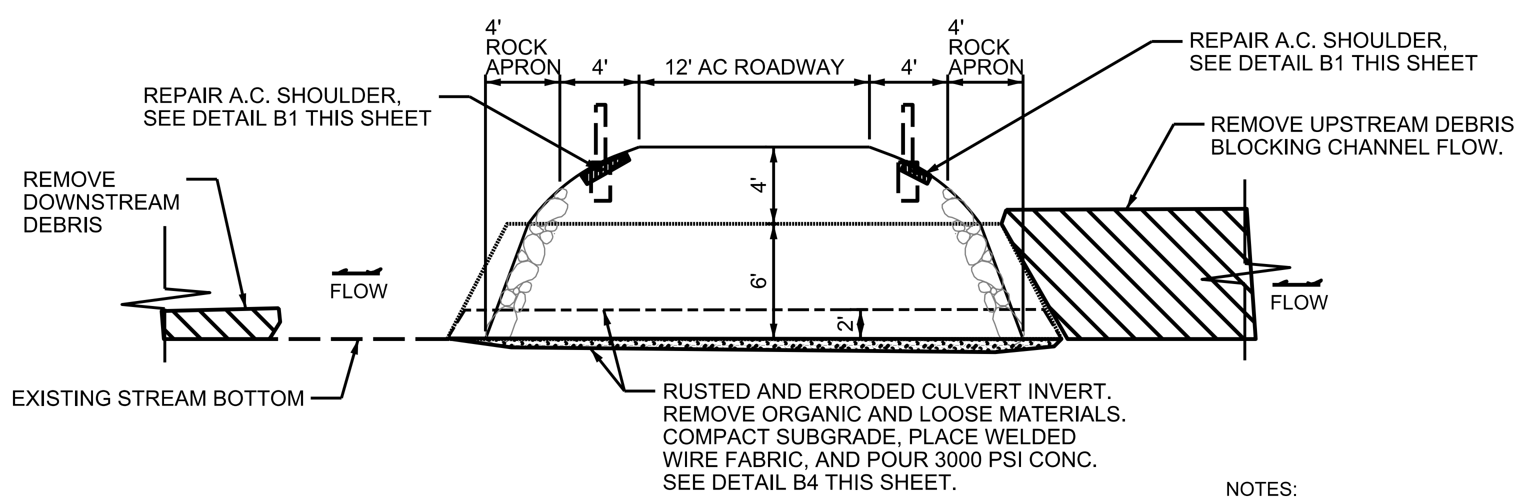
OAHU, HAWAII

FIGURE **8**

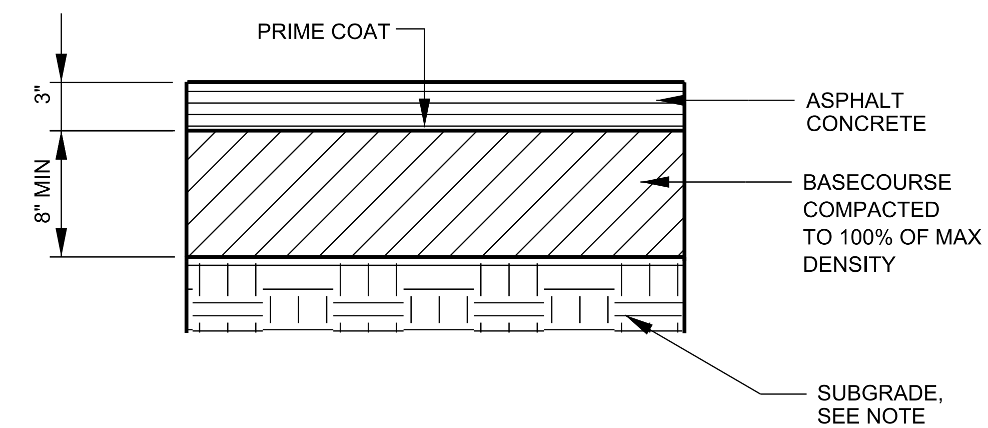
DRAWN	DESIGNED	DATE	REVISED DATE
CHEN SAM	CHEN SAM	5/15	6-30-15



B1 MAKALEHA STREAM 7 CULVERT CROSSING PLAN
SCALE : 1"=20'

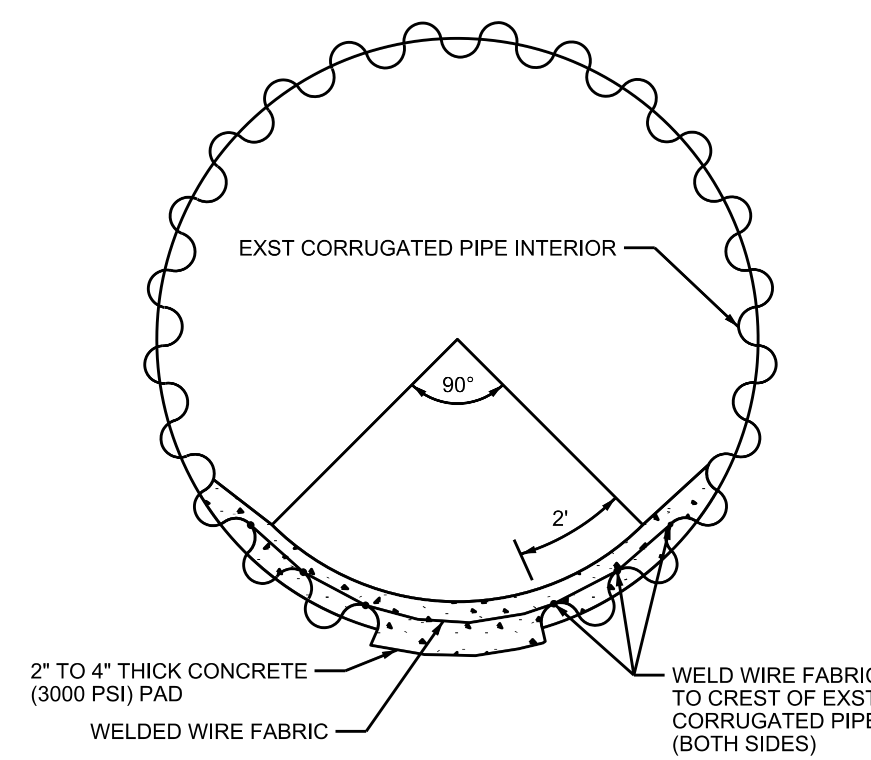


A1 MAKALEHA STREAM 7 CULVERT CROSSING PROFILE
SCALE : 1"=10'



NOTE:
SCARIFY TOP 8 INCHES MINIMUM OF SUBGRADE BELOW BASE COURSE AND COMPACT TO A MINIMUM 95% OF MAXIMUM DRY DENSITY @ 2% OF WET OPTIMUM MOISTURE CONTENT.

D4 A.C. PAVEMENT SHOULDER REPAIR DETAIL
NO SCALE



B4 CORRUGATED METAL PIPE REPAIR DETAIL
NO SCALE

NOTES:

1. MEASUREMENTS FROM THE FIELD ARE APPROXIMATE. THIS FIGURE IS TO BE USED AS PART OF AN INFORMATIVE REPORT FOR FUTURE DESIGN AND COST ESTIMATING DECISION MAKING PURPOSES ONLY; NOT FOR CONSTRUCTION PURPOSES.

0 5' 10' 20'
SCALE: 1"=10'

0 10' 20' 40'
SCALE: 1"=20'

US Army Corps of Engineers®
HONOLULU DISTRICT

MARK	DESCRIPTION	DATE	APPR

MARK	DESCRIPTION	DATE	APPR

US ARMY CORPS OF ENGINEERS
HONOLULU DISTRICT
FT SHAFTER, HAWAII

DESIGN BRANCH
BUILDING 230
FORT SHAFTER, HI 96858-5440

DESIGNED BY: EL		ISSUE DATE:
DWN BY: EL	CKD BY: CL	SOLICIT./ CONTRACT NO.:
SUBMITTED BY: LEE, CHEN S POH		LOCATION NO.:
PLOT SCALE: AS SHOWN	PLOT DATE:	FILE NUMBER:
SIZE: ANSI B	FILE NAME:	

SITE RECONNAISSANCE
MT. KAALA ROAD, OAHU, HAWAII

SITE 3: MAKALEHA STREAM
7 CULVERT CROSSING PLAN
SCHEMATIC DESIGN

SHEET IDENTIFICATION
FIGURE 9
SHEET 0 OF 0

ANSI B 11 x 17

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APPENDIX A

PHOTO LOGS

Vertical rock face around mile 6.2.

Remove rock and vegetation blocking culvert 71 and several other culverts within this area.

Eroded upslope in vicinity of culvert 66 will require more intensive maintenance to clear swales, culverts, and roadways.

Overview of upslope erosion cuts vicinity culvert 60 to 2900 feet mean sea level ridge(s).

Overview of upslope undermined area in the vicinity of culvert 60 will require more intensive maintenance to clear swales, culverts, and roadways. Downslope erosion is also visible due to culvert outlet discharge.

Typical upslope undermined in vicinity of Culvert 60 will require more intensive maintenance to clear swale, culverts, and roadways.

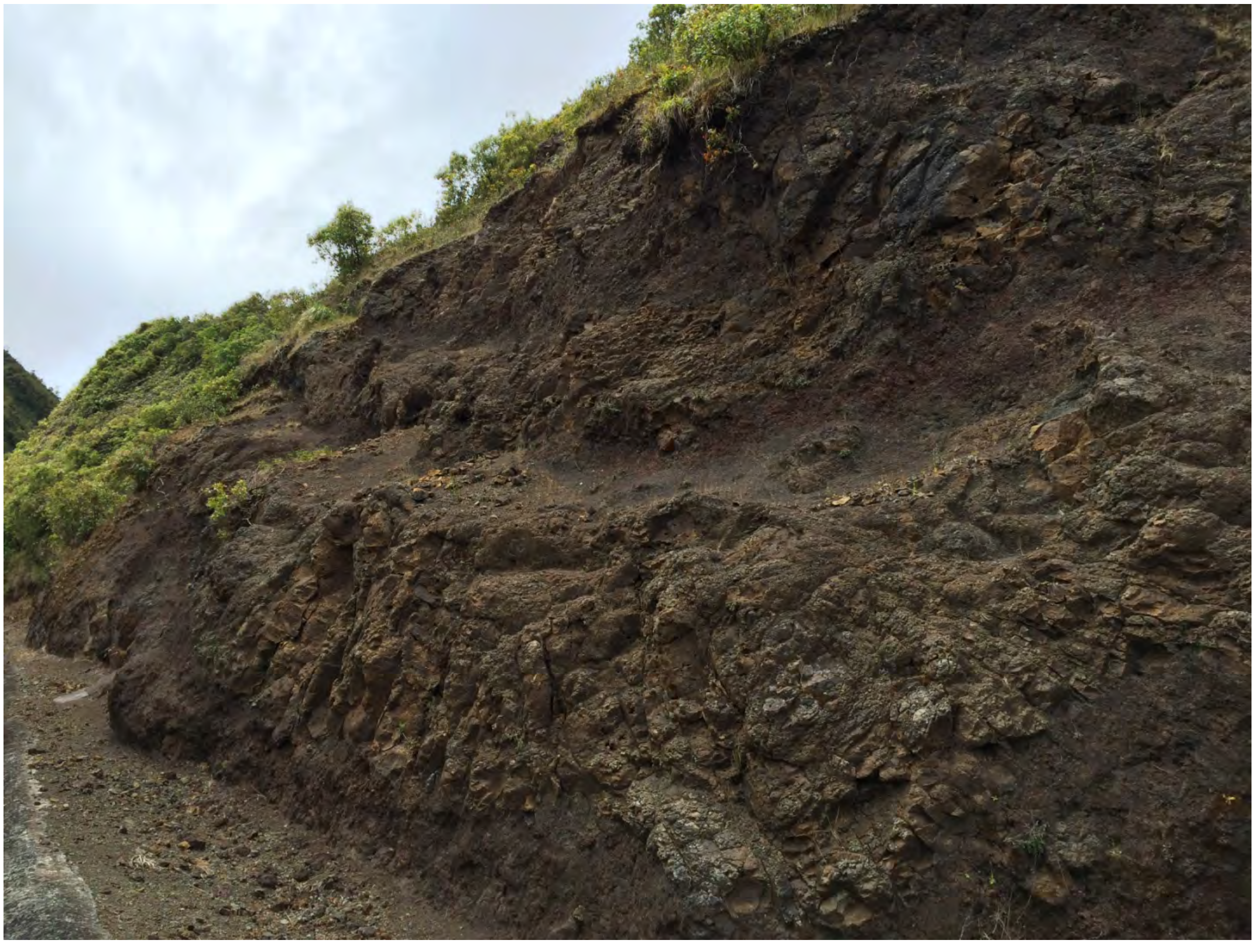
Downslope dumping of eroded upslope soil material in the vicinity of culvert 60 (typical throughout project) is highly discouraged in downslope areas of steep drops; this can cause slope instability from the additional soil mass leading to a landslide.


Downslope erosion near vicinity of culvert 58 discharge.


Upslope erosion at vicinity of 2900 foot mean sea level ridge.

Vertical drop in vicinity of 2900 foot mean sea level ridge supported by weathered dark bluish colored rock.

Remove debris and rocks blocking Culvert 47 (typical of culverts).



Upslope undermined near Culvert 47.

Upslope erosion near Culvert 42.

Ridge upslope erosion near Culvert 42.

Ridge near Culvert 42.

Remove blockages of channel swales to control drainage and reduce potential downslope erosion (typical).

Dumping of eroded upslope material should not be placed on the downslope side where there is steep slope else this could cause a landslide due to additional mass; upslope material should be placed in stable flatter areas or be moved off site (typical).

Dumping of eroded upslope material should not be placed on the downslope side where there is steep slope else this could cause a landslide due to additional mass; upslope material should be placed in stable flatter areas or be moved off site (typical).

Near Culvert 42 is a typical Bobcat used for roadway maintenance.

Site 1: Downslope top of slide.

Site 1: Downslope slide.

Site 1: Downslope slide.

Site 1: Downslope landslide.

Site 1: Downslope slide looking straight down.

Site1: Downslope slide.

Site 1: Adjacent roadway. Slide is to the right of the photo.

Site 1: Upslope.

Site 1: Upslope.

Site 1: Upslope.

Downslope undermined in vicinity of culvert 34.


Downslope undermined in vicinity of culvert 34.

Site 2: Roadway upslope fairly steep allowing runoff during large events to over flow bank beyond guardrails in photo .

Site 2: Runoff induced downslope erosion.

Site 2: Downslope erosion. Guardrail supports exposed and asphalt roadway is undermined.

Site 2: Looking straight down at runoff induced downslope.

Site 2: Upslope hill on right and downslope hill on upper left. Runoff induced downslope is to the left (not pictured).

Site 2: View from the top of the upslope hill.

Site 2: Clear blocked swale from soil and vegetation which can create new drainage paths causing downslope erosion (typical).

Culvert 30 exposed upslope (typical).

Culvert 29 exposed upslope (typical).

Culvert 27 needs to be cleared of vegetation (typical).


Large boulder near Culvert 16 on the upslope side should be removed.

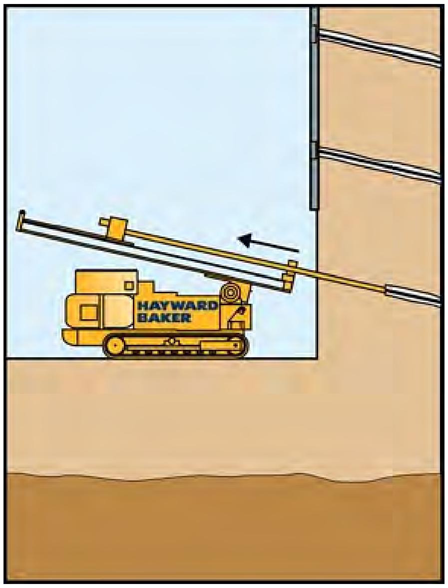
Site 3: Downstream culverts.

Site 3: Downstream culverts.

Site 3: Upstream culverts completely blocked by debris flow consisting of tree branches, boulders, cobbles, vegetation, and soil.

APPENDIX B

SOIL NAILING INFORMATION



View all images

Soil Nailing

Soil nailing is an earth retention technique using grouted tension-resisting steel elements (nails) that can be design for permanent or temporary support. The walls are generally constructed from the top down. Typically, 3 to 6 feet of soil is excavated from the top of the planned excavation. Near-horizontal holes are drilled into the exposed face at typically 3 to 6 foot centers. Tension-resisting steel bars are inserted into the holes and grouted. A drainage system is installed on the exposed face, followed by the application of reinforced shotcrete facing. Precast face panels have also been used instead of shotcrete. Bearing plates are then fixed to the heads of the soil nails. The soil at the base of this first stage is then removed to a depth of about 3 to 6 feet. The installation process is repeated until the design wall depth is reached. The finished soil nails produce a zone of reinforced ground.

Soil nailing equipment is small enough that it can easily negotiate restricted access. For existing steep slopes, such as bluffs or existing retaining walls, the soil nails can be installed from crane-suspended working platforms. Soil nails can also be installed directly beneath existing structures adjacent to excavations. Care should be exercised when applying the system underneath an existing structure. Hayward Baker has used extensive 3D modeling to avoid conflicts between soil nails and other earth retention systems on complex projects that involve the use of multiple techniques, and to ensure the safety of buried utilities.

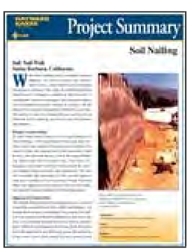
Soil nailing has been used to stabilize slopes and landslides, provide earth retention for excavations for buildings, plants, parking structures, tunnels, deep cuts, and repair existing retaining walls.

This technique is available in most areas through either Hayward Baker or sister Keller companies. Contact your local Hayward Baker office for more information on soil nailing.

View/Downloads

Animations | Specifications | Information Brochures

Project Summaries | Technical Papers



FEATURE CASE STUDY

Soil NailWall, Santa Barbara, CA

To make room for the future site of an office building, a 38-ft-high portion of the steep slope covering part of the proposed foundation area needed to be removed. Hayward Baker was approached to install a soil nail wall that would provide the necessary support during excavation and construction.

Read full case study

Look for Others

TYPICAL CHALLENGES

Earth Retention/Shoring

Slope Stabilization

TYPICAL STRUCTURES

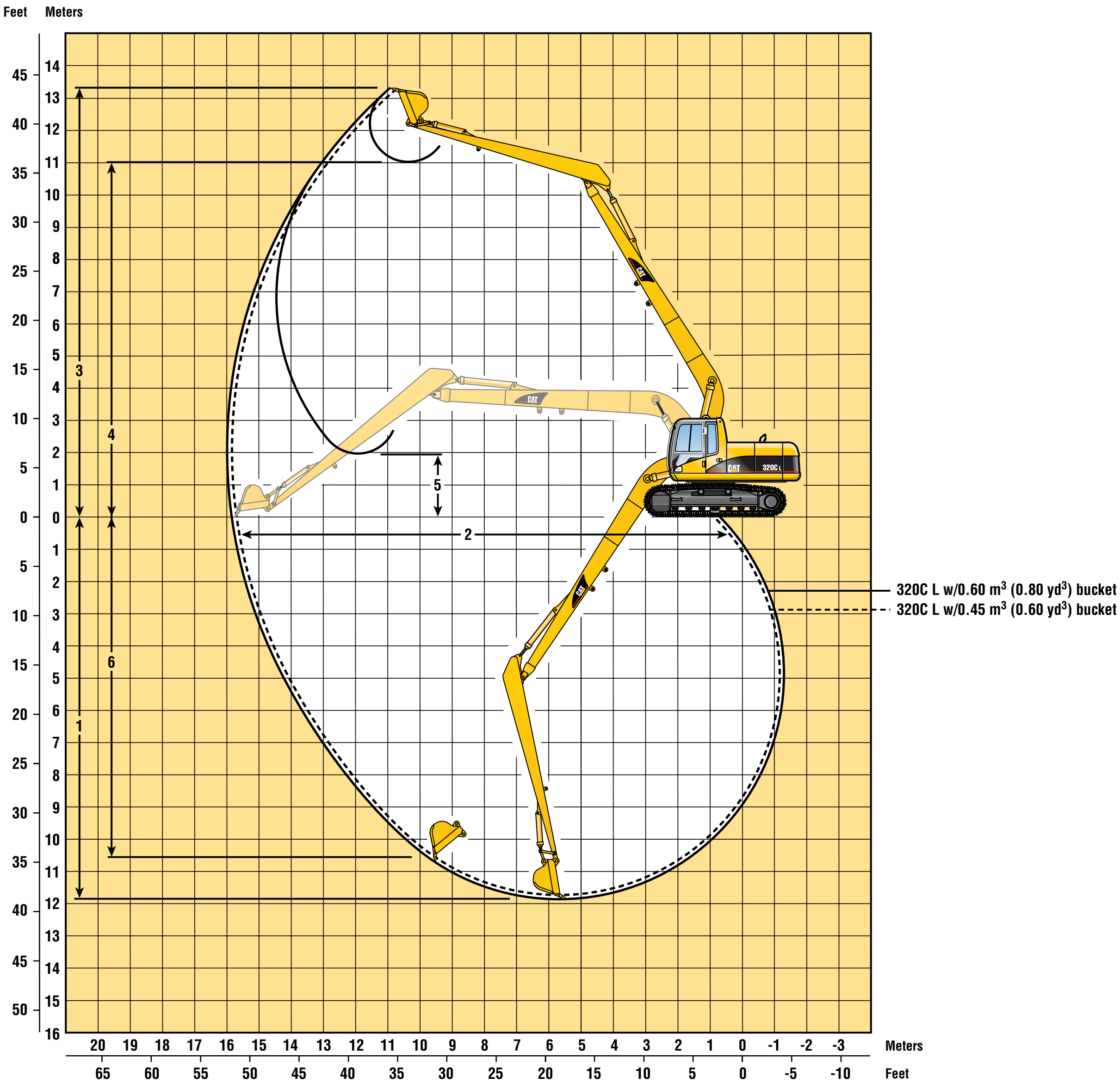
Retaining Walls

Slopes/Embankments

ask us a question | request technical assistance


CAT

Long Reach Excavator Working Ranges



Arrangements	320C L SLR 0.45 m³ (0.60 yd³) Excavation	320C L SLR 0.60 m³ (0.80 yd³) Ditch
1 Maximum Digging Depth	11.88 m (39'0")	11.75 m (38'7")
2 Maximum Reach at Ground Level	15.72 m (51'7")	15.59 m (51'2")
3 Maximum Cutting Height	13.29 m (43'7")	13.23 m (43'5")
4 Maximum Loading Height	11.01 m (36'1")	11.14 m (36'6")
5 Minimum Loading Height	1.97 m (6'6")	2.09 m (6'10")
6 Maximum Vertical Wall Digging Depth	10.7 m (35'1")	11.31 m (37'1")
Bucket Digging Force (ISO)	60 kN (13,500 lb)	60 kN (13,500 lb)
Stick Digging Force (ISO)	46 kN (10,300 lb)	46 kN (10,300 lb)
Bucket Digging Force (SAE)	54 kN (12,100 lb)	60 kN (13,500 lb)
Stick Digging Force (SAE)	46 kN (10,300 lb)	46 kN (10,300 lb)

Major Component Weights

Booms: including lines, boom cylinders, stick cylinders and left side light

	kg	lb
Boom	2180	4800

Sticks: including bucket cylinder and bucket linkage

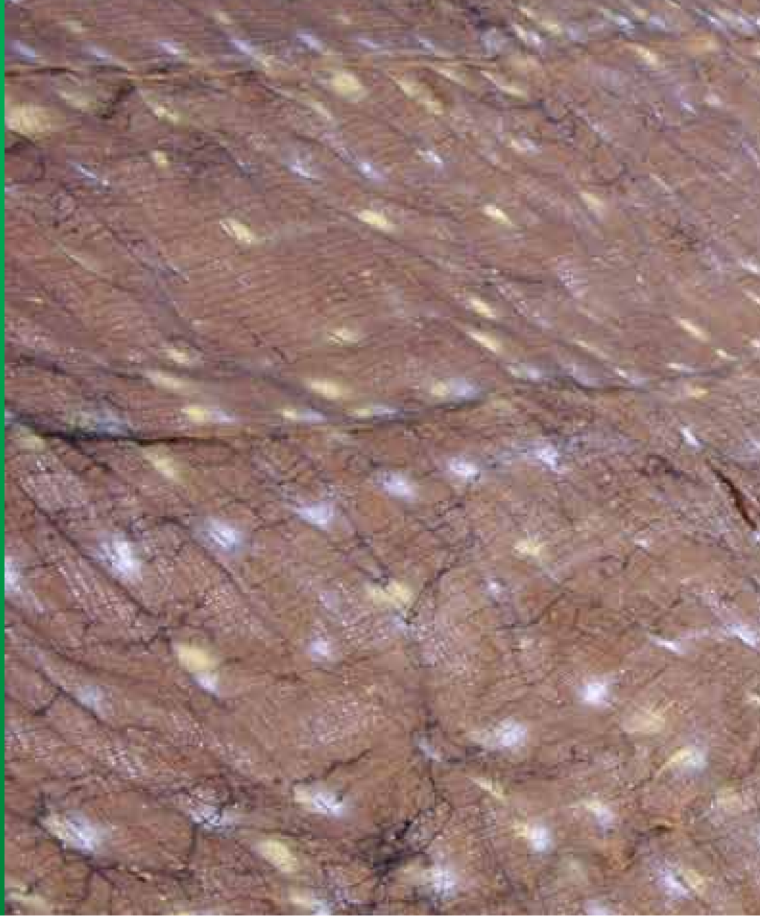
Stick	1600	3520
Counterweight	4830	10,630

Page: E1-8

APPENDIX C

EROSION CONTROL MAT

Tensar® VMax® products will provide permanent vegetative reinforcement, allowing the area to look natural and green but with an engineered solution that will withstand bankfull flood events.



A greener and more cost-effective bioengineering solution can provide underlying engineering stability whilst improving the visual landscape.

RollMax™ Rolled Erosion Control

Every site has unique challenges created by soil characteristics, topography, climate and other environmental conditions. Tensar can cover them all, with our family of RollMax™ Rolled Erosion Control Products (RECPs). Whether you need temporary or permanent protection, short-term or long-term durability, biodegradable or photodegradable solutions, our RollMax products deliver a wide variety of advantages, features and benefits:

- High-performance protection of topsoil from wind and water erosion
- Support quick, healthy vegetation growth
- Protect dormant seeds during winter months
- Stabilise slope erosion to keep roads safe and clean
- Reinforce vegetation roots and stems
- Protect water quality in lakes, rivers and streams
- Conform to landscape features
- Provide easy handling and transport

PERMANENT TURF REINFORCEMENT MATS

Tensar's permanent Turf Reinforcement Mats (TRMs) are ideal for high-flow channels, stream banks, shorelines and other areas needing permanent vegetation reinforcement and protection from water and wind. More economical and aesthetically pleasing than rock riprap, articulated concrete blocks or poured concrete, our TRMs protect vulnerable areas with minimum maintenance and maximum durability.

- VMax® permanent composite TRMs combine three-dimensional matting and fibre matrix material for erosion protection, vegetation establishment and reinforcement. These products increase the permissible shear stress of many types of vegetation up to 0.67kN/m² – erosion protection equal to 900 mm rock riprap and concrete. VMax TRMs are available with various performance capabilities and support reinforced vegetative lining development from germination to maturity.

Stabilisation and Margin Landscape Improvement, Barcelona, Spain

Concrete walls were constructed as part of the channelling work that was required on the Riera de Santa Susanna, a stream channel that temporarily or seasonally fills and flows after heavy rain. The bank was made up of compacted back fill and tiered to obtain a profile of 1H:1V. Hydroseeding and the installation of Tensar's VMax® P550® permanent TRM will ensure protection against erosion and deliver a clear landscape improvement.

EROSION CONTROL BLANKETS

Erosion Control Blankets (ECBs) immediately prevent erosion and help vegetation get established. As vegetation root and stem systems stabilise the underlying soil, most ECBs gradually degrade. These products come in a range of weights and materials to accommodate low- to high-flow channels and moderate to severe slopes.

- EroNet™ Short-Term Photodegradable ECBs are designed for moderate slopes and low-flow channels. Made of 100% agricultural straw stitched to or between lightweight polypropylene netting with degradable thread, EroNet ECBs come in short-term varieties to protect and mulch soil surfaces from 45 days to 12 months.
- EroNet Extended-Term, Long-Term and permanent ECBs use heavy-duty double-netting and long-lasting coconut or permanent polypropylene fibre for protection and vegetation support for up to 36 months or longer. These products are available for extended and long-term stabilisation of steep slopes, medium- to high-flow channels and shorelines.
- BioNet® Short-Term Biodegradable ECBs are appropriate for bioengineering projects, environmentally sensitive sites, shaded areas, stream banks and shorelines. They're made of 100% agricultural straw stitched with biodegradable thread to 100% biodegradable jute fibre netting. Available in single- or double-net varieties, they protect for up to 12 months and leave no synthetic residues.
- BioNet Extended-Term and Long-Term Biodegradable ECBs incorporate coconut fibre stitched with biodegradable thread between biodegradable jute fibre top and bottom nets. Great for steep slopes, medium- to high-flow channels and shorelines, a choice of two products can provide erosion protection and vegetation establishment for 18 to 24 months.



Railway Bank Improvement, Yamal, Russia

The Bovanenkovskoye railway is located north of the Arctic Circle and has been built to provide a vital rail link for gas exploration. Tensar's EroNet™ SC150® temporary ECB was installed to provide erosion protection and enable vegetation to establish in an area that is subjected to severe permafrost.

The complete line of RollMax products offers a variety of options for both short-term and permanent erosion control needs.

Reference the RollMax Products Chart below to find the right solution for your next project.

Riverbank protection works in mid Wales using VMax® P550,® UK.

RollMax™ Product Selection Chart

	TEMPORARY			
	ERONET		BIONET	ERONET
				
	SC150	**C125**	**C125BN**	**P300**
Longevity	24 mo.	36 mo.	24 mo.	Permanent
Applications	Medium Flow Channels 2:1-1:1 Slopes	High-Flow Channels 1:1 and Greater Slopes	High-Flow Channels 1:1 and Greater Slopes	High-Flow Channels 1:1 Slopes
Design Permissible Shear Stress Pa	Unvegetated 96	Unvegetated 108	Unvegetated 112	Unvegetated 144 Vegetated 383
Design Permissible Velocity m/s	Unvegetated 2.44	Unvegetated 3.05	Unvegetated 3.05	Unvegetated 2.7 Vegetated 4.9
Top Net	Heavyweight UV-stabilised polypropylene 1.47 kg/100 m² approx wt	Heavyweight UV-stabilised polypropylene 1.47 kg/100 m² approx wt	Leno woven. 100% biodegradable jute fibre 4.53 kg/100 m² approx wt	Heavyweight UV-stabilised polypropylene 2.44 kg/100 m² approx wt
Center Net	N/A	N/A	N/A	N/A
Fibre Matrix	Straw/coconut matrix 70% Straw 0.19 kg/m² 30% Coconut 0.08 kg/m²	Coconut fibre 0.27 kg/m²	Coconut fibre 0.27 kg/m²	UV-stabilised polypropylene fibre 0.38 kg/m²
Bottom Net	Lightweight photodegradable polypropylene 0.73 kg/100 m² approx wt	Heavyweight UV-stabilised polypropylene 1.47 kg/100 m² approx wt	Woven. 100% biodegradable jute fibre 3.76 kg/100 m² approx wt	Heavyweight UV-stabilised polypropylene 1.47 kg/100 m² approx wt
Thread	Degradable	UV-stabilised polypropylene	Biodegradable	UV-stabilised polypropylene

Vegetation establishment through VMax® P550® six months after installation, UK.

PERMANENT		
VMAX		
		
SC250	**C350**	**P550**
Permanent	Permanent	Permanent
High-Flow Channels 1:1 and Greater Slopes	High-Flow Channels 1:1 and Greater Slopes	Extreme High-Flow Channels 1:1 and Greater Slopes
Unvegetated 144 Vegetated 480	Unvegetated 153 Vegetated 576	Unvegetated 191 Vegetated 672
Unvegetated 2.9 Vegetated 4.6	Unvegetated 3.2 Vegetated 6.0	Unvegetated 3.8 Vegetated 7.6
Heavyweight polypropylene 2.44 kg/100 m² approx wt	Extra heavyweight polypropylene 3.91 kg/100 m² approx wt	Ultra heavyweight polypropylene 11.7 kg/100 m² approx wt
Ultra heavyweight polypropylene – corrugated 11.7 kg/100 m²	Ultra heavyweight polypropylene – corrugated 11.7 kg/100 m²	Ultra heavyweight polypropylene – corrugated 11.7 kg/100 m²
Straw/coconut matrix 70% Straw 0.19 kg/m² 30% Coconut 0.08 kg/m²	Coconut fibre 0.27 kg/m²	UV-stabilised polypropylene fibre 0.27 kg/m²
Heavyweight UV-stabilised polypropylene 2.44 kg/100 m² approx wt	Extra heavyweight polypropylene 3.91 kg/100 m² approx wt	Ultra heavyweight polypropylene 11.7 kg/100 m² approx wt
UV-stabilised polypropylene	UV-stabilised polypropylene fibre	UV-stabilised polypropylene

INSTALLATION MADE EASY

- Tensar's exclusive Earth Anchors increase the veneer's mechanical strength by reaching deep into the soil strata for enhanced anchoring in the worst conditions. Earth Anchors can be used to permanently secure our VMax® Turf Reinforcement Mats or our RevetMax™ flexible revetment systems.
- Tensar fastener options include wire staples, PinPounder installation tool, rebar stakes, ShoreMax® high-impact plastic stakes, environmentally friendly BioStakes™ and wooden EcoStakes.™

Proper staple patterns must be used to achieve optimal results in RECP installation (staple patterns to be obtained from Tensar).

HYDRAMAX™
HYDRAULIC EROSION CONTROL

Slope erosion protection on the M25 Motorway, UK.

HydraMax™ Hydraulic Erosion Control

Hydraulic Erosion Control Products (HECPs) prevent erosion and aid vegetation establishment on slopes. Tensar's HydraMax™ Systems apply seed, soil amendments and hydraulic mulch in one step, offering a low-cost, low-labour solution. All HydraMax Systems' products are made with our patented proprietary blend of straw, reclaimed cotton plant material and tackifiers to ease application, enhance adhesion, retain moisture and stabilise soil. HydraMax HECPs also:

- Consist of a porous matrix with strong soil adhesion that forms an excellent vegetation establishment and erosion control medium
- Reduce expensive site preparation
- Can be installed up to three times faster than Erosion Control Blankets (ECBs) with 1/3 of the man power
- Come in easy to break bales for fast mixing
- Have low water to mulch ratios that increase productivity by requiring fewer tank loads per site
- Grow grass quickly with increased germination and biomass production over bare soil
- Contain only biodegradable, non-synthetic fibres
- Come in a pleasing natural green colour

HIGH-PERFORMANCE HECPs

Tensar's high-performance HECPs are effective on construction site slopes with gradients of 1:1 (H:V) or steeper. In many steep slope applications, they can cost-effectively replace temporary ECBs.

- HydraCX™ Extreme Slope Matrix is recommended for long-length, steep to severe slope gradients of 3:1 to 0.5:1. It is our highest performing hydraulic mulch and has demonstrated an unprecedented 100% soil protection in American Association of State Highway and Transportation Officials (AASHTO) – National Transportation Product Evaluation Program (NTPEP) testing.
- HydraCM™ Steep Slope Matrix scored 99.7% effective in reducing soil erosion when tested by AASHTO's NTPEP. Designed for medium length, moderate to steep slope gradients of 4:1 to 1:1.

Slope Restoration and Landscape Improvement, High-Speed Rail Line, Spain

Installed up to three times faster than ECBs with 1/3 of the man power, Tensar's HydraCX extreme slope matrix ensured vegetation cover of the entire slope just 45 days after application. The benefits of HydraCX include fast germination, rapid growth of vegetation, strong adhesion to the ground and resistance to rain.

FACTS

North American Green C350: Innovative Design for Steep Embankments

Problem

Installation involved anchoring the C350 to a subsurface geogrid system. The wall eventually becomes vegetated.

Increasingly, geotechnical designers are seeking ways to control soil erosion in critical areas without the use of concrete or rock. This situation was recently encountered in the rapidly growing town of Issaquah, WA, located near I-90 about 15 miles east of Seattle. Construction of the Issaquah Highlands Community housing development required the clearing of an area exceeding several hundred acres, which produced an exceptionally large stockpile of marginal soil classified as "weathered topsoil". Due to the very loose, non-cohesive, erodible soil composition, engineers determined that it could not be used as a base for building construction. Standard slope construction methods would also not be adequate since there was significant risk of slope failure due to the soil's composition and structural capabilities. After estimating the expense of hauling the weathered topsoil and disposing of it at an off-site location, the site's owner decided to use it in an area that would eventually become a series of athletic fields. Utilization of this marginal material for this purpose would satisfy the objectives of the project, although an innovative approach would be needed in engineering the slopes around the athletic field.

NORTH AMERICAN GREEN®

CASE STUDY

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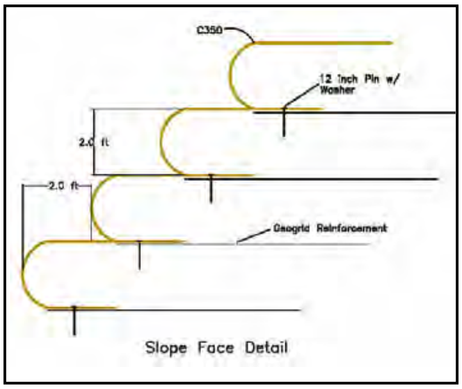
This value engineered design eliminates the need for hard armor such as rock and concrete.

Solution

Engineers at Icicle Creek Engineering in Washington state proposed a geotextile reinforced 1:1 (H:V) slope design to support the perimeter of elevated athletic fields. The primary consideration was to achieve a balance between the economics of constructing and stabilizing the steep fill slopes and maintaining level athletic fields-a value engineered approach. The owner sought to make the slopes as steep as possible so they would not consume land that could otherwise be used to build houses upon. He liked the engineering proposal but requested that the slopes be vegetated for aesthetic purposes. The engineer's biotechnical design ultimately detailed a system that would be easier to maintain than alternatives such as rock or concrete.

In response to the demands of the design, ACF West Inc. (Woodinville, WA) worked with the engineers to produce the final design involving North American Green's high performance C350 Composite Turf Reinforcement Mat (C-TRM) for a soil wrapped, vegetated slope face. Ben Nelson at ACF West provided assistance on the project. Nelson recalls, "We became involved when the contractor, Summit General, asked us for a materials estimate. We then began talking with the engineer to determine their primary design concerns and see if they would consider alternate materials." Mr. Nelson discussed with the engineers what properties were desired in an erosion control material that might be used in such a design. "High on the list was the face stability of each lift of soil, they regarded this soil as 'highly erodible' and did not want to see any sluffing, rilling, or eroding", notes Nelson. Effective soil retention properties, desirable moisture retaining mulch benefits, and long-term vegetation reinforcement, and high tensile strength were other considerations that made the C350 C-TRM a perfect match to the project's needs.

Installation



Steep slopes and loose soils are typically a combination for disaster in cases where the soil may be left exposed and unprotected or covered with a simple short-term temporary erosion control blanket. For this project it was necessary to not only control surface erosion, but to also ensure the structural integrity of the slope. Both of these concerns were addressed by applying the C350 C-TRM following a procedure of layering the slope with geogrid reinforcement between 2.00 foot layers of soil wrapped by the C350. The C350 acting as the wrap on the face ensured that the soils were in direct contact with the matting. A section of the matting was tied back into the geogrid on the top and bottom of the soil wrap to retain slope stability. However, in order to perform this part of the design, the matting had to perform a function similar to a geogrid, with high tensile strength to support the soil lift. With a tensile strength of 658 x 910 lbs/ft, the engineer determined C350 possessed the necessary strength, which also allowed the contractor to use less of the primary reinforcement geogrid material.

The geogrid and C350 system was secured with 12 inch pins near the face of the slope. The face of the slope was hydroseeded after installation of the C350, even though North American Green generally recommends seeding beneath the matting. In this case, it was impossible to hydroseed before the matting installation because of the construction sequence. The C350 had to be installed at the same time as the geogrid in order to compact the soils at the wall face prior to removing the forming system. Seeding could only take place after the wooden forming system was removed. With this design, the slope is structurally stabilized by the layers of geogrid that extend back into the slope. The C-TRM is anchored to the grids and filled with soil, progressively building the slope upwards at a 45 degree angle. C350's permanent net structure holds the face of the slope in place while reinforcing vegetation, whereas the dense coconut fiber matrix will retain small soil particles and act as a mulch to accelerate vegetation growth.

Performance

As a result of the importance the owner placed on establishing a vegetated slope face, the designer selected the North American Green C350. Unlike some TRM's requiring soil in-filling to enable maximum performance, the C350's combination of dense coconut fiber and a three-dimensional net structure effectively retained soil on the steep unvegetated slope while also retaining adequate soil moisture for quick seed germination. Even after heavy rain caused flooding in the area that impacted the newly constructed wall, the C350 retained soil and encouraged vegetative growth. After nearly a year after installation, vegetation had become well established and the permanent three-dimensional net structure of the C350 will remain indefinitely to reinforce the base of the vegetation and prevent future erosion.

Vegetation becomes progressively more dense and is reinforced by the C350 C-TRM to provide permanent protection against soil erosion.

Use of the C350 in this way is widely considered an environmentally friendly "biotechnical" or "bioengineered" application-terms used to describe some engineering practices involving the mutual use of man-made materials and natural vegetation to control soil erosion in an aesthetic manner.

APPENDIX B
BIOLOGICAL SURVEY

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FINAL—Biological Survey Report for Proposed Road Repair Sites on Mount Ka‘ala Road, Mokulē‘ia 1 and 2 Ahupua‘a, Waialua District, O‘ahu Island, Hawai‘i

TMKs (1) 6-8-001:001 and (1) 6-8-007:004

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GANDA Report No. 2377-2

GANDA

13 March 2017

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1.0 INTRODUCTION

At the request of Environmental Risk Analysis, LLC, Garcia and Associates conducted biological survey of five proposed road repair locales along Mt. Kaʻala Road, Mokulēʻia 1 and 2 Ahupuaʻa, District of Waialua, Island of Oʻahu. This report summarizes the results of a biological survey for plants and wildlife listed under the Endangered Species Act (50 CFR 17.11 and 50 CFR 17.12), the Migratory Bird Treaty Act (50 CFR 10.13), and the state list of threatened or endangered wildlife (Exhibit 2 and 3, HAR 13-124). The main objective of the investigation was to document the biological resources of the project area, including habitat condition, to support the planning for the proposed road repair. The investigation also involves identifying jurisdictional wetlands and Waters of the United States in the proposed road repair sites.

1.1 Project Description

The five proposed sites for road repair are along a 10.8 kilometers (km) section of Mt. Kaʻala Road. Mt. Kaʻala Road is a one-lane government road that provides access to a Federal Aviation Administration-maintained tracking station at the summit of Mount Kaʻala. The road starts from Farrington Highway (Hwy 930) with an elevation of 5 meters (m) above mean sea level to an elevation of 1,227 m above mean sea level at the tracking station. The road is paved and averages four meters in width. The roadway is currently restricted to government employees, contractors, and local ranchers.

In 2015, the U.S. Army Corps of Engineers (USACE), U.S. Air Force, and the Federal Aviation Administration conducted a site reconnaissance to assess existing roadway and slope conditions (USACE 2015). Five areas along the road were identified with adverse site conditions due to slope erosion, landslides, and instability that could potentially make the roadway impassable and cut off access to the Federal Aviation Administration tracking station.

Proposed repair measures recommended to minimize adverse site conditions included: 1) removal of landslide material encroaching the roadway and: a) cutting back the 50 to 60-foot high slope, b) stabilizing the side mass with anchor or soil-nailed wall or, c) install a closely-spaced drill shaft wall barrier, 2) filling in areas where down slope erosion has compromised the road with compacted granular fill and, 3) removing debris on the upstream side of culverts and in the culverts, patching of washed out concrete, and miscellaneous repairs to restore the culverts crossing to storm water carrying capacity. These recommended activities, or some combination thereof, constitute the proposed actions.

1.2 Survey Area

The five proposed sites for road repair are along the Mt. Kaʻala Road (Figure 1), which follows a NE-SW oriented foothill upslope until it reaches the NW-SE oriented ridgeline that separates Makua and Waianae Kai to the south and Makaleha to the north. Survey areas include the proposed construction areas as well as 50-meter buffer around these areas. Naming of the sites follows the reconnaissance report (USACE 2015). The following are brief descriptions of the survey sites.

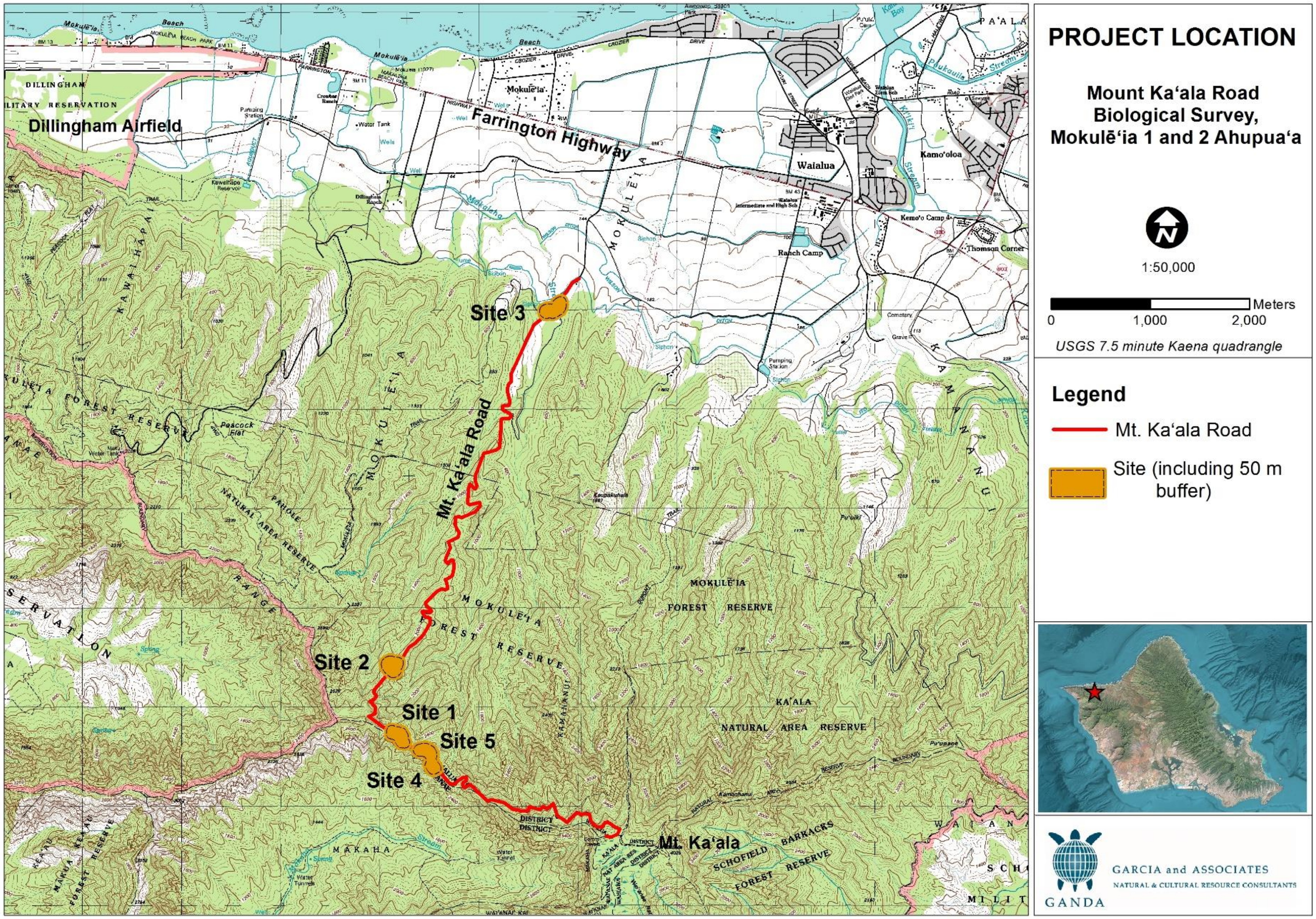

Figure 1. Project location.

Site 1 is between Culverts 39 and 40 and is about 838 meters (m) in elevation. A landslide occurred on the downslope side of the roadway with the top of slide extending close to the roadway edge. The proposed repair involves either relocating the roadway to outside the projected slide zone by cutting back the 50 to 60-foot high slope to realign the existing roadway about 20 feet into the upslope side of the roadway, or stabilizing the eroded slope with either an anchored or soil-nailed wall or by installing a closely-spaced drilled shaft wall barrier. The area of direct impact is about 1.64 acres. Site 1 is part of the critical habitat area for O‘ahu *‘elepaio* and within Unit 1 of the Lowland Mesic critical habitat for O‘ahu (Figure 2).

Site 2 is near Culvert 32 between the 3.5 and 3.75 mile marks and is about 688 m in elevation. The ground and slope fronting the guardrail of a 55-foot long section of roadway has eroded, exposing guardrail posts, and undermining the asphaltic concrete paved shoulder. The proposed repair involves either installing a soil-nailed wall to stabilize the failed slope or placing granular fill on the existing slope to buttress the failed slope and prevent further movement of the soil mass. The area of direct impact is about 2.13 acres. Site 2 is part of the critical habitat for O‘ahu *‘elepaio* and within Unit 1 of the Lowland Mesic critical habitat for O‘ahu (Figure 2).

Site 3 is at the stream crossing of Makaleha Stream close to the 2.5 mile mark at the lower portion of the Mt. Ka‘ala Road. It is about 80 m above mean sea level in elevation. Storms deposited debris on the upstream of the culvert crossing and washed out part of the asphaltic concrete cover protecting the downstream sideslopes. The proposed road repair will involve removing the debris, patching of washed out asphaltic concrete, and miscellaneous repairs to restore the culvert crossing. The area of direct impact is about 1.98 acres.

Site 4 and Site 5 are between Culvert 40 and Culvert 42 near the 4.5 mile mark. Site 4 is about 812 m in elevation and Site 5 is about 822 m in elevation. Site 4 and Site 5 are in close proximity to one another with overlapping buffers and were therefore surveyed as a single area. The steep road cut on the upslope of the roadway of Site 4 and Site 5 has eroded over time, leading to an unstable slope face which constantly slides onto the roadway. The proposed road repair involves cutting back the slope to increase stability. The areas of direct impact are about 0.68 acres for Site 4 and 1.49 acres for Site 5. The Sites 4 and 5 survey area is part of the critical habitat for O‘ahu *‘elepaio*, is within Unit 1 of the Lowland Mesic critical habitat, and Unit 1 of the Lowland Wet critical habitat for O‘ahu (Figure 2).

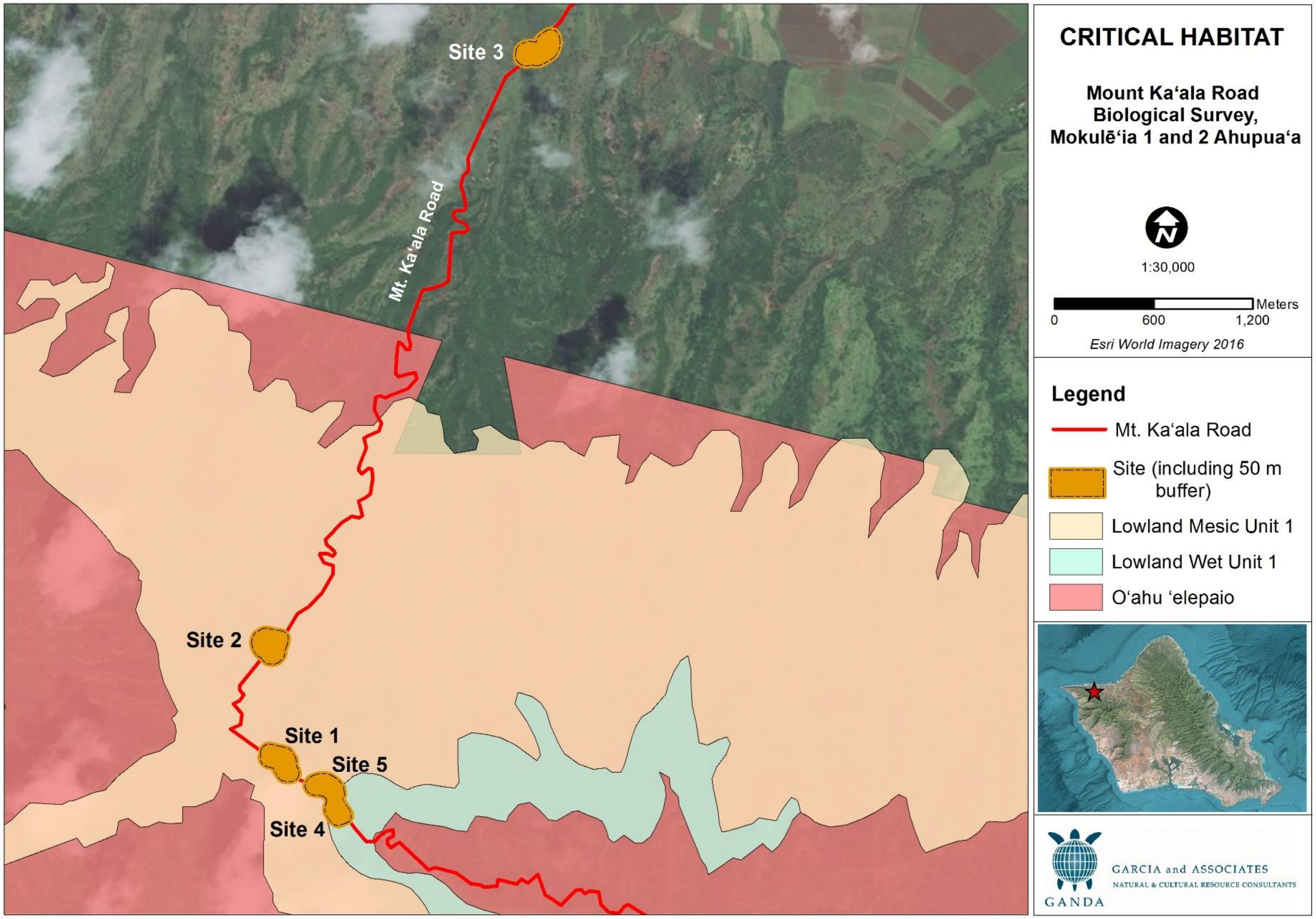

Figure 2. Road repair sites and critical habitat areas.

2.0 METHODS

The field investigation was conducted on 12–15 December 2016 and consisted of a pedestrian survey for flora and terrestrial faunal resources and point count surveys for avian resources. A wetland delineation was performed for Site 3 to identify jurisdictional waters. The following describes the survey methodology.

Botanical Survey: The botanical survey involved identifying plant communities and compiling a checklist of vascular plants that occur in the project area. The botanical survey was performed by walking transects spaced at 15-meter intervals to provide sufficient visual coverage of the area at Site 3 where the terrain permited safe access. For the other sites, steep terrain often precluded pedestrian access on the steep and often eroded slopes on either side of the roadway. Under these conditions, transects were generally placed parallel to the road or along ridgelines that permited safe access. For areas that were not accessible by foot, visual survey was performed from a safe location with the aid of binoculars. Except for Site 3, the steep terrain on the higher sites limited the areas that could be safely accessed by foot. The actual surveyed areas hence are limited to areas that either can be safely accessed by foot or visually surveyed with the aid of binoculars. These include slopes on both sides of the roadway and areas that could be safely accessed along the ridgeline.

Avian Survey: Avian resources in the project area were surveyed using a timed point-count method in early morning (before 10:00 am). Point-count stations were selected in locations that provided sufficient visual coverage of the survey areas. Each observation point was surveyed for eight minutes. Both visual and audio detection methods were employed.

Terrestrial Wildlife Survey: Pedestrian survey using timed area search was used to target the endangered O‘ahu tree snails (*Achatinella* spp.). A reference population of the endangered *Achatinella mustelina* was visited prior to the survey, providing search images for the species, which included adults, juveniles, scads, and snail habitat. During pedestrian survey, potential habitats along the transects were inspected for the target tree snails for ten minutes in a 25-square-meter area. Occasional observations of invertebrate resources were also noted during the pedestrian transect survey.

Wetland Delineation: To identify jurisdictional wetlands, potential locations were sampled according to the *Corps of Engineers Wetlands Delineation Manual* (USACE 1987) and the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Hawai‘i and Pacific Islands Region, Version 2.0* (USACE 2012). The jurisdictional water was then delineated based on wetland boundary and ordinary high water mark (USACE 2005) and recorded using a sub-meter accurate handheld GPS.

3.0 RESULTS

3.1 Site 1

3.1.1 Vegetation

Vegetation in Site 1 (Figure 3) consists of Lowland Mesic and Lowland Wet communities according to Gagne and Cuddihy's classification (Gagne and Cuddihy 1990). The following describes the plant communities identified in the survey area of Site 1.

1) ʻŌhia/Uluhe (Metrosideros/Dicranopteris) Fern Forest (Figure 4): This lowland wet community is composed mostly of a thick blanket of uluhe (*Dicranopeteris linearis*) with emergent and widely spaced ʻōhia (*Metrosideros plolymorpha*). It is found on the north-facing slope of the survey area that had been disturbed by road construction or erosion. A variety of native shrubs (e.g. *Leptecophylla* and *Vaccinium*), herbs (e.g. *Dianella*), sedges (e.g. *Machaerina*), and ferns (e.g. *Sadleria* and *Sphenomeris*) as well as non-native species (e.g. *Clidemia* and *Arundina*) are also found in this community. This community is considered in the early succession toward ʻōhia forest as soils develop.

2) ʻŌhia Lowland Wet Forest (Figure 5): This lowland wet community is dominated by ʻōhia lehua and is found on the east-facing downslope of the roadway. Many native trees (e.g. *Antidesma, Bobea, Ilex,* and *Psychotria*), shrubs (e.g. *Coprosma* and *Kadua*), and vines (e.g. *Alyxia*) can be found in the understory. Non-native tress (e.g. Psidium, and Schinus) have invaded the plant community and established small areas that are dominated by the invasive species. Groundcover is composed of various native and non-native species (e.g. *Dicranopteris, Clidemia, Doodia,* and *Viola*). This community harbors the most native plant diversity.

3) Koa Mesic Forest (Figure 6): This lowland mesic community is dominated by koa (*Acacia koa*) and is only found on narrow strips along the ridgeline in the survey area. The understory consists of uluhe and *Clidemia hirta.* Silk oak (*Grevillea robusta*), Christmas berry (*Schinus terebinthifolius*), moalasses grass (*Melinis minitiflora*) has invaded this community to various degree.

4) Ruderal Vegetation (Figure 7): This vegetation type results from frequent disturbance and is composed of a wide variety of non-native grasses and herbs that can colonize disturbed areas quickly. It is found mostly along roadsides and recently disturbed areas. The composition of this artificial vegetation varies wildly from location to location and cannot be consistently predicted. Since native plants are rarely found in this community we will not discuss this vegetation type for the other survey areas even though it is found on all sites.

3.1.2 Flora

The flora of Site 1 consists of 11 ferns and fern allies, 59 dicot, and 14 monocots. 30 of the 74 vascular plants identified (40.5%) are native, including 20 endemic and 10 indigenous species. A checklist of the vascular plants observed at Site 1 is provided in Table A-1.

No threatened or endangered plant was observed at Site 1 during the field investigation.

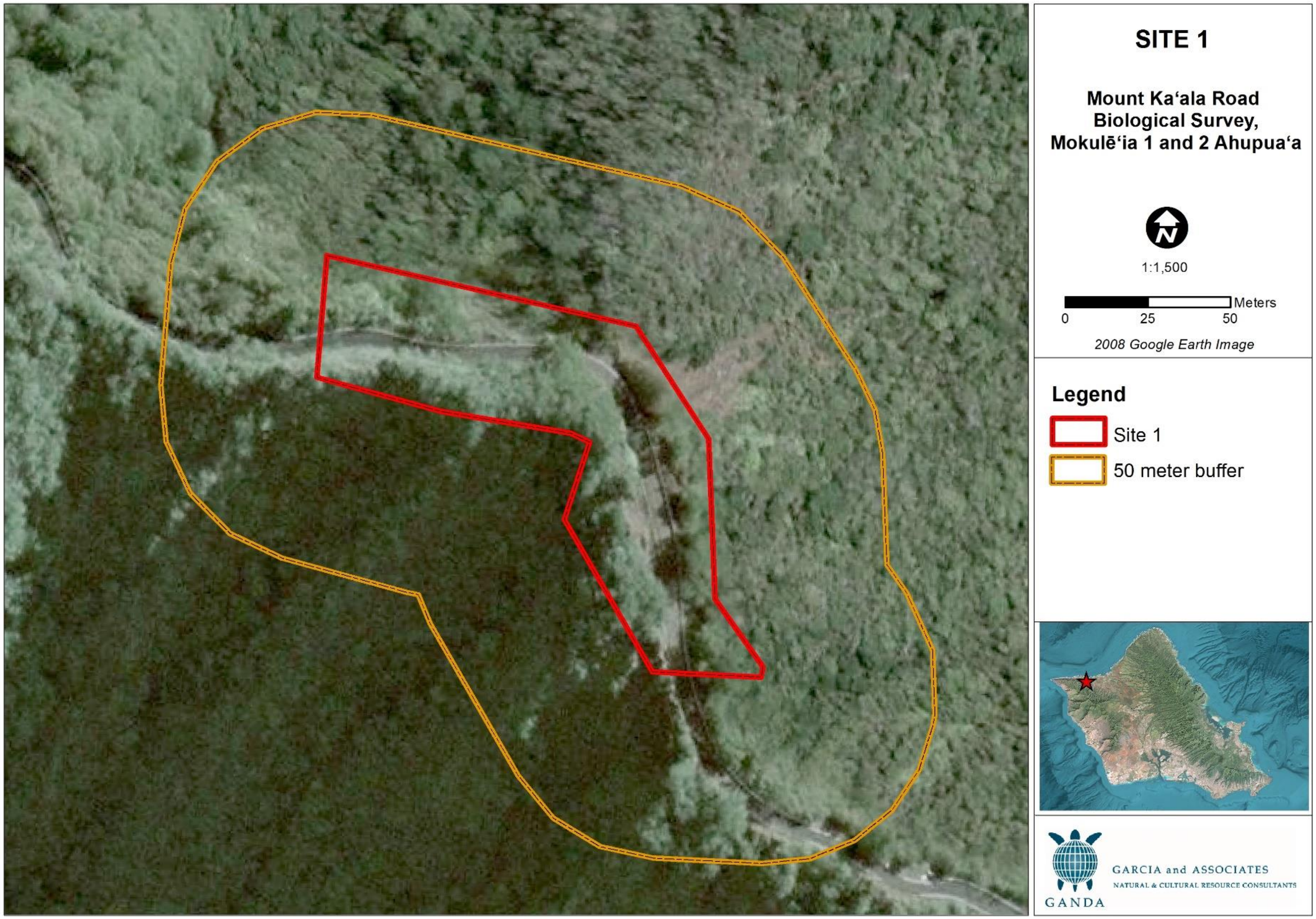

Figure 3. Survey area of Site 1.

Figure 4. ‘Ōhia/Uluhe Fern Forest on the slope cut at Site 1. View to east.

Figure 5. Understory of ‘Ōhia Lowland Wet Forest dominated by *‘ōhia lehua* with diverse understory. View to east.

Figure 6. Koa Mesic Forest showing invading Christmas berry and molasses grass. View to northeast.

Figure 7. Ruderal Vegetation found along roadside.

3.1.3 Fauna

A point-count avian survey was conducted on December 15, 2016, from 8:42 am to 8:50 am. Weather conditions were overcast with 100% cloud cover and no rain. The temperature was 22.2°C when the point count started. A low wind from the ENE ranged 0–3 miles per hour. Four Japanese white-eye (*Zosterops japonicus*) were observed during the survey.

Timed area searches for tree snails in the ʻŌhia Lowland Wet Forest and ʻŌhia/Uluhe (Metrosideros/Dicranopteris) Fern Forest did not detect any tree snails.

No threatened or endangered wildlife was observed.

3.2 Site 2

3.2.1 Vegetation

Vegetation in Site 2 (Figure 8) is classified as the Lowland Mesic community according to Gagne and Cuddihy's classification (Gagne and Cuddihy 1990). The following describes the plant communities in the Site 2 survey area.

1) Strawberry Guava Forest (Figure 9): This lowland mesic community is dominated by the invasive strawberry guava (*Psidium cattleianum*). It is found on the windward slopes and ridgelines of the survey area. Isolated native trees (e.g., *Acacia* and *Metrosideros*) and shrubs persist among the guava. Understory of the guava forest is often composed of *Clidemia hirta* with occasional native shrubs and vines (e.g., *Dodonaea* and *Wikstroemia*).

2) ʻŌhia/Koa Mesic Forest (Figure 10): This lowland mesic community is dominated by ʻōhia amd koa. The understory is composed of uluhe in wetter areas (Figure 11) and a variety of native shrubs (e.g., *Dodonaea, Leptecophylla*, and *Psydrax*) in drier areas. Native groundcover (e.g. *Carex, Dianella* and *Gahnia*) are relatively uncommon. Strawberry guava and toona (*Toona ciliata*) have invaded this community (Figure 12). Molasses grass (*Melinis minitiflora*) is frequently found in disturbed pockets.

3.2.2 Flora

The flora of Site 2 consist of 9 ferns and fern allies, 39 dicot, and 14 monocots. 20 of the 62 vascular plants identified (31%) are native, including 10 endemic species and 10 indigenous species. A checklist of the vascular plants observed at Site 2 is provided in Table A-2.

No threatened or endangered plants were observed at Site 2 during the field investigation.

3.2.3 Fauna

A point-count avian survey was conducted on December 15, 2016, from 8:14 am to 8:22 am. Weather was overcast with 100% cloud cover and no rain. The temperature was 20.1°C when the survey started. A low wind of variable direction ranged 0–3 miles per hour. An endemic and two non-native species of forest bird were detected. These included eight Japanese white-eye (*Zosterops japonicus*), one red-whiskered bulbul (*Pycnonotus jocosus*) and three *ʻapapane* (*Himatione sanguinea*). The endemic *ʻapapane* were observed foraging on the canopy of *ʻōhiʻa lehua*.

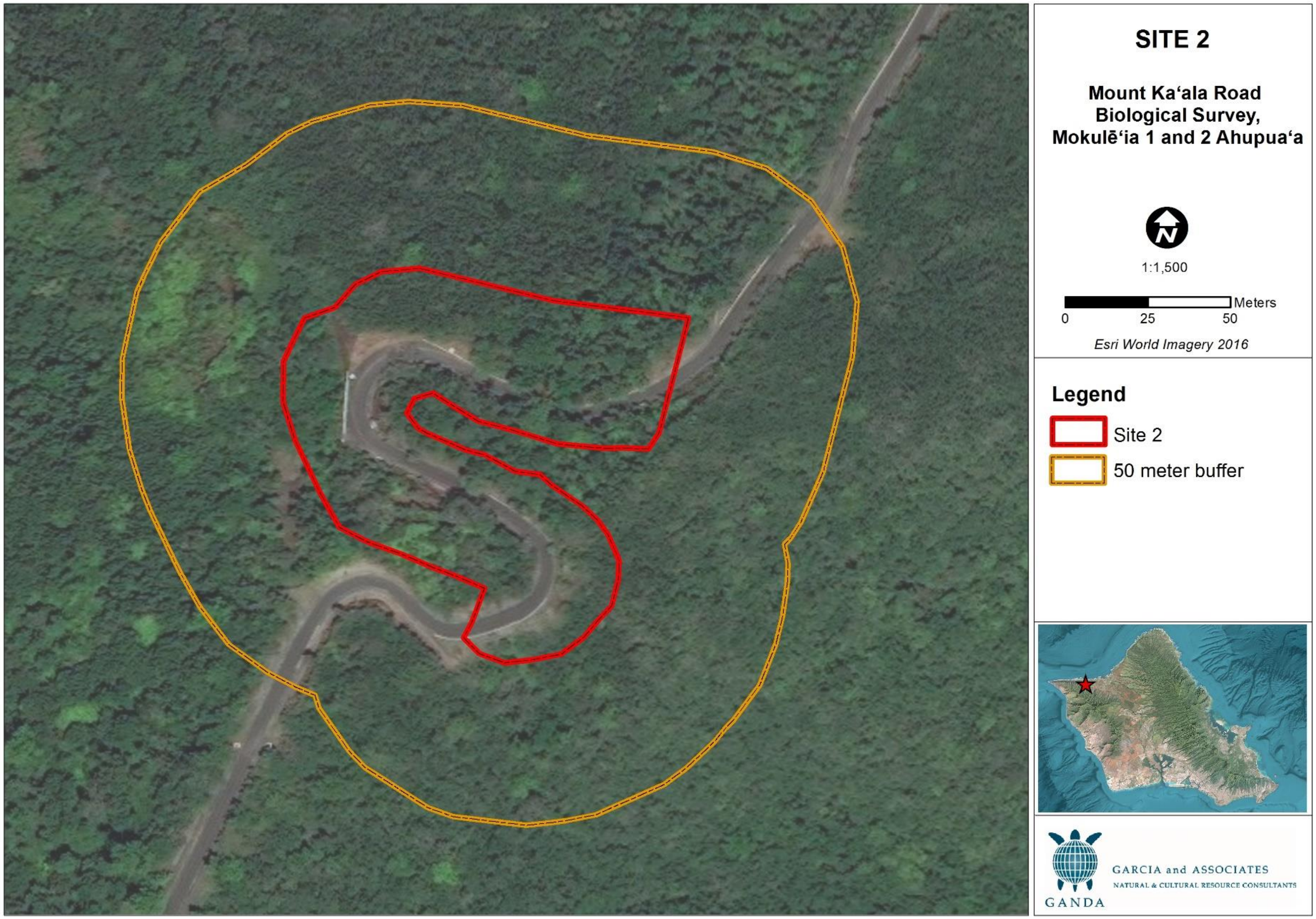

Figure 8. Survey area of Site 2.

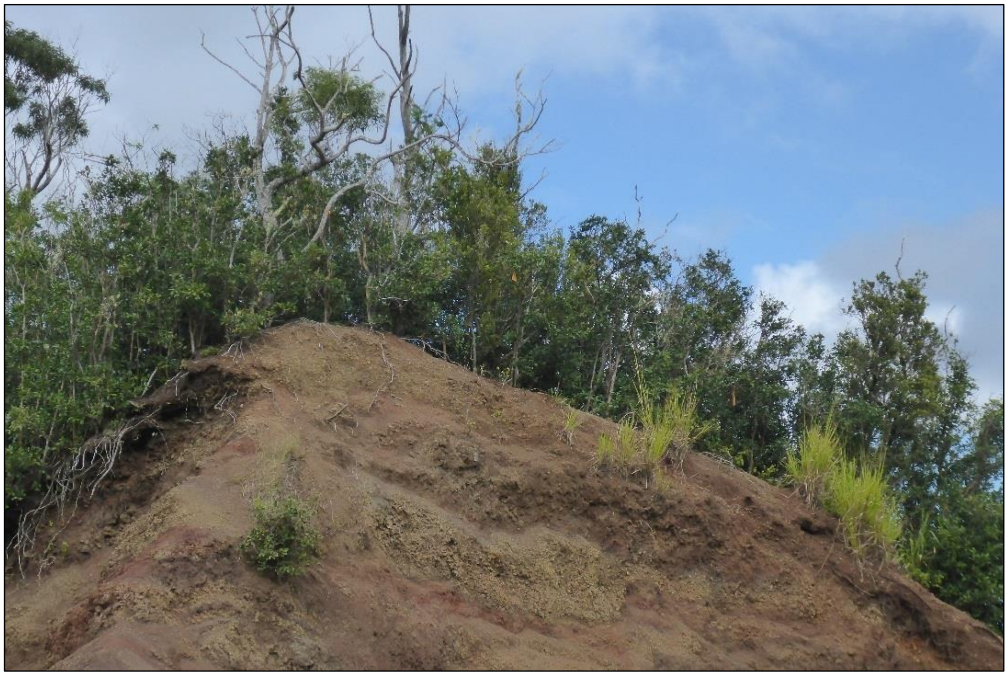

Figure 9. Strawberry Guava Forest with isolated *'ōhia* and *koa*. View to north.

Figure 10. Ohia/Koa Mesic Forest. View to north.

Figure 11. Ohia/Koa Mesic Forest with thick *uluhe* cover.

Figure 12. Toona invading the ‘Ōhia/Koa Mesic Forest. View to north.

Timed area searches for tree snails in the ‘Ōhia/Koa Mesic Forest did not detect any tree snails.

No threatened or endangered wildlife was observed in Site 2.

3.3 Site 3

3.3.1 Vegetation

Vegetation in Site 3 (Figure 13) is classified as the Lowland Dry community according to Gagne and Cuddihy's classification (Gagne and Cuddihy 1990). Native vegetation has been almost entirely eliminated from the landscape in Site 3. Two plant communities were identified in the Site 3 survey area.

1) Urochloa Grassland (Figure 14): The majority of the survey area was dominated by Guinea grass (*Urochloa maxima*) which likely results from colonization of the invasive grass on the relatively recent land clearing associated with agriculture. Introduced species associated with ranchland such grasses, legumes, and weeds are the common associates in this plant community.

2) Riparian Forest (Figure 14): This community is found along the stream banks. Java Plum (*Syzygium cumini*) and kiawe (*Prosopis pallida*) are the dominant species of this community. The understory is dominated by guinea grass.

3.3.2 Flora

The flora of Site 3 consists of 1 fern, 45 dicots, and 11 monocots. Only 2 of the 57 vascular plants identified (3.5%) are native, including one endemic (*Erythrina sandwicensis*) and one presumably indigenous species (*Waltheria indica*). A checklist of the vascular plants observed at Site 3 is provided in Table A-2.

Two mature individuals of *wiliwili* (Figure 15) were observed on the buffer area in the Riparian Forest of Site 3. *Wiliwili* is a species of concern that is threatened by the introduced Erythrina gall wasp (*Quadrastichus erythrinae*), which has decimated the *wiliwili* population in Hawai‘i prior to the successful establishment of a biological control agent.

No listed threatened or endangered plants were observed at Site 3 during the field investigation.

3.3.3 Fauna

A point-count avian survey was conducted on December 14, 2016, from 8:45 am to 8:53 am. Weather conditions were cloudy with 80% cloud cover and no rain. The temperature was 21.6°C when the survey started. A low wind from the SSE ranged 0–6 miles per hour. Six species of non-native lowland and open-country birds were observed. These included 38 zebra dove (*Geopelia striata*), two common waxbill (*Estrilda astrild*), two Japanese white-eye, two red-vented bulbul (*Pycnonotus cafer*), one northern mockingbird (*Mimus polyglottos*), and one Indian peafowl (*Pavo cristatus*).

No suitable habitat for the listed tree snails are available in Site 3 and a search was therefore not performed.

No threatened or endangered wildlife was observed in Site 3.

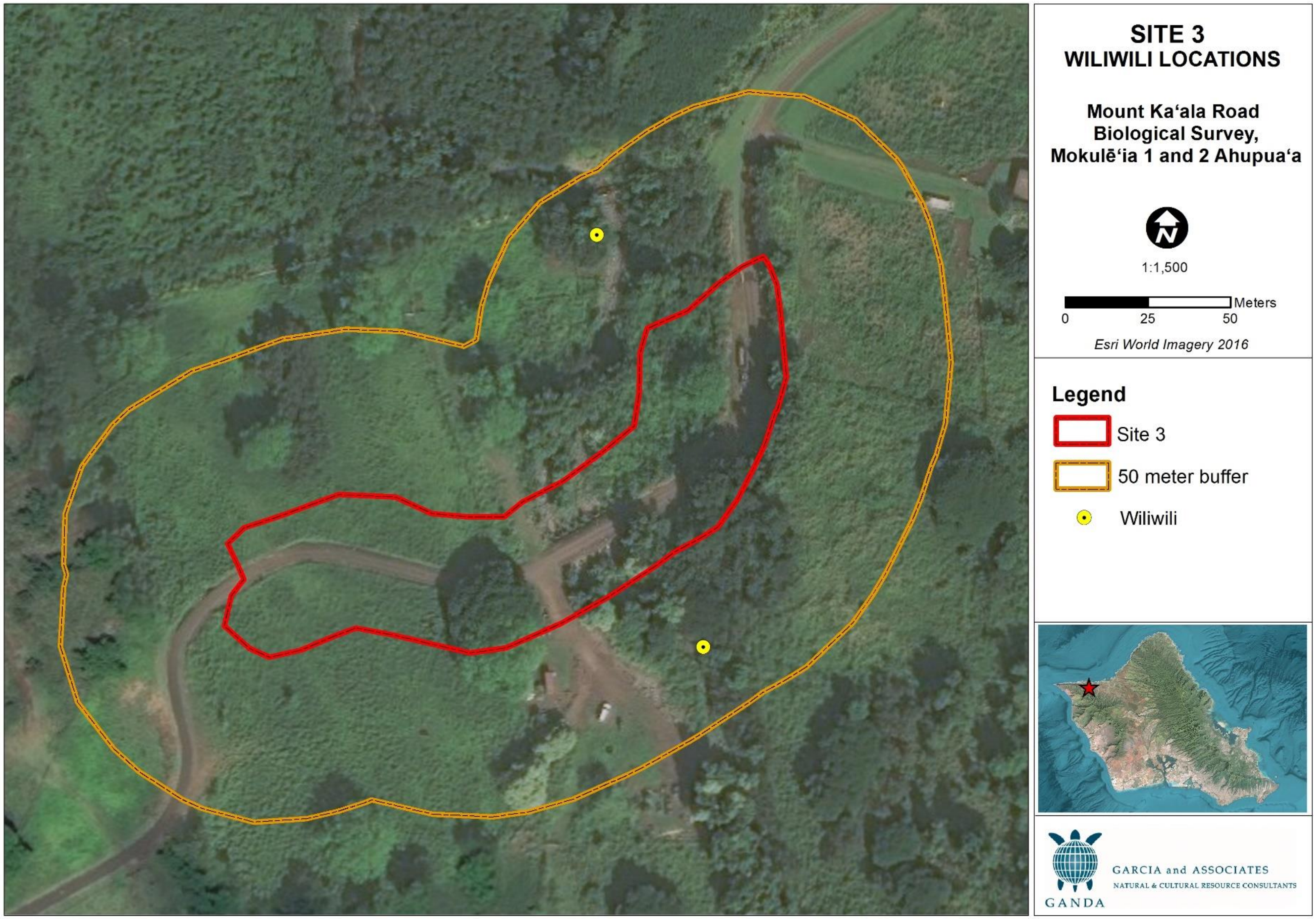

Figure 13. Survey area of Site 3.

Figure 14. Urochloa Grassland (foreground) and Alien Riparian Forest (background). View to northwest.

Figure 15. *Wiliwili* (*Erythrina sandwicensis*).

3.3.4 Wetland Delineation

Field investigation for wetland delineation was conducted on December 15, 2016 within the normal wet season weather patterns of Hawai‘i. A site walkthrough didn’t reveal any apparent wetland with either standing water or wetland plants. Two sampling points were then selected along the Makaleha Stream on minutely sloped and slightly depressed areas on the floodplain where damp soils and signs of hydrology suggested potential wetland conditions. The sampling points were located upstream and downstream of the culvert crossing.

Sampling Point 1 (Figures 16 and 17) was downstream of the culvert on a gentle slope with a depression near the channel. Vegetation was dominated Java plum and kukui (*Aleurites moluccana*) in the tree stratum, koa haole in the shrub stratum, and Guinea grass in the herb stratum. Scores of the Dominance Test at 50% and the Prevalent Index at 3.75 indicate the vegetation is not hydrophytic. No hydric soil indicator was observed at Sampling Point 1. The soil profile showed a single matrix layer from 0 to 12 inches in color 7.5YR 3/2 of the Munsell Soil Color Chart. Drift deposits were observed indicating wetland hydrology. Wetland delineation data indicated that Sampling Point 1 lacks hydrophytic vegetation and hydric soils and therefore is not a wetland.

Sampling Point 2 (Figures 18 and 19) is upstream of the culvert adjacent to one of the stream channels. Vegetation is dominated by Java plum and kukui in the tree stratum, koa haole and *Buddleja asiatica* in the shrub stratum, Guinea grass in the herb stratum, and passion fruit (Passiflora edulis) in the woody vine stratum. Scores of the Dominance Test at 33% and the Prevalent Index at 3.8 indicate the vegetation is not hydrophytic. No hydric soil indicators were observed at Sampling Point 2. The soil profile showed a single matrix layer from 0 to 14 inches in color 7.5YR 3/2 of the Munsell Soil Color Chart. Two hydrology indicators (Drift deposits and water-stained leaves) were observed indicating wetland hydrology. Wetland delineation data indicated that Sampling Point 2 lacks hydrophytic vegetation and hydric soils and therefore is not a wetland.

The wetland delineation data forms for the two sites are provided in Appendix B.

The jurisdictional water was delineated based on ordinary high water marks identified on both sides of the stream channels and mapped. The jurisdictional Waters of the United States contains two channels on both sides of the culvert and total about 0.15 acres (Figure 20).

Figure 16. Vegetation at Sampling Point 1. View to north.

Figure 17. Soil profile of Sampling Point 1.

Figure 18. Vegetation at Sampling Point 2. View to south.

Figure 19. Soil profile of Sampling Point 2.

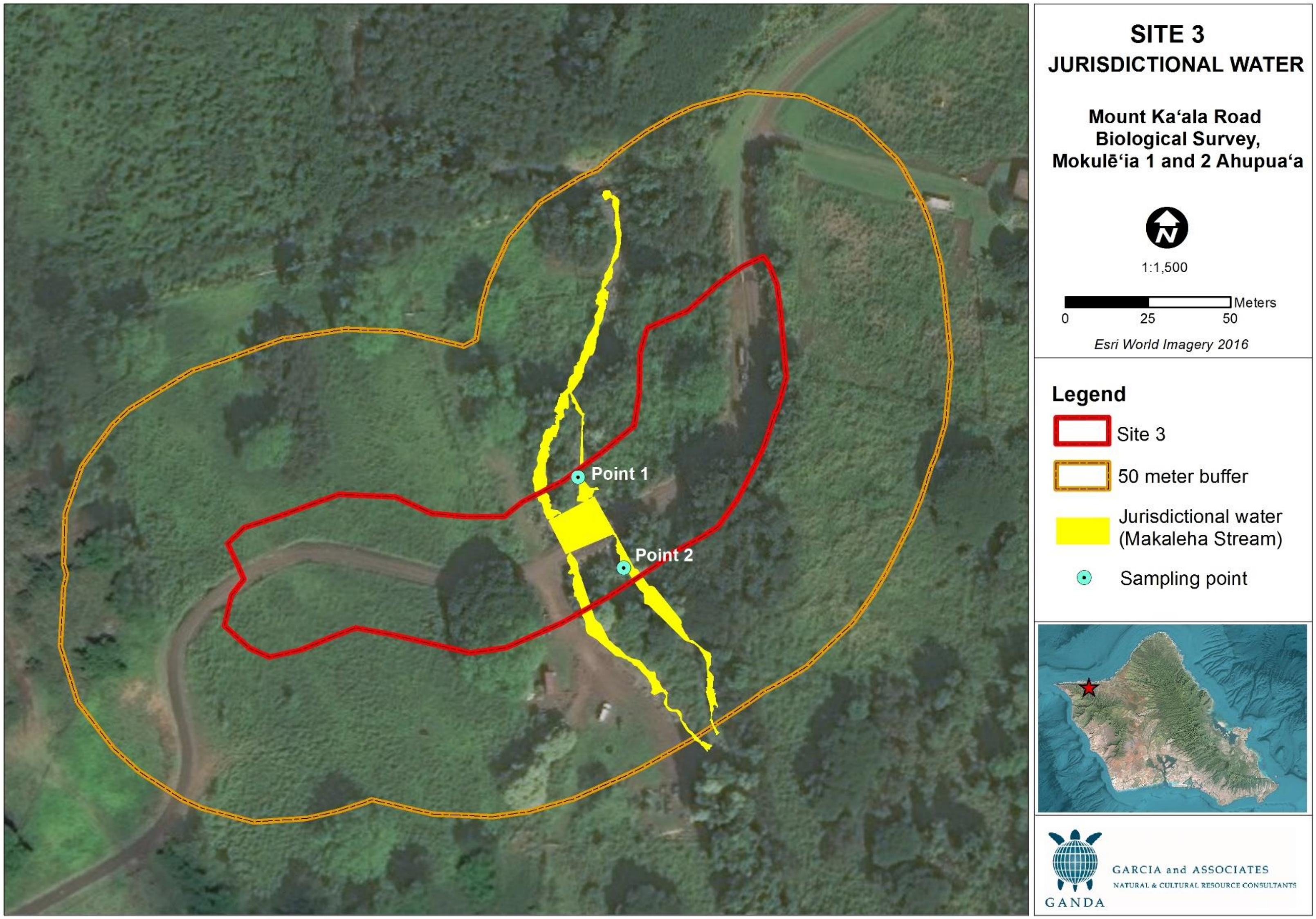

Figure 20. Jurisdictional water in Site 3.

3.4 Site 4 and Site 5

3.4.1 Vegetation

Vegetation in the survey areas of Site 4 and Site 5 (Figure 21) closely resembles that of Site 1. Plant communities can be classified into either Lowland Mesic to Lowland Wet communities according to Gagne and Cuddihy's classification (Gagne and Cuddihy 1990). The following describes the plant communities in the survey areas of Site 4 and Site 5.

1) ʻŌhia/Uluhe (Metrosideros/Dicranopteris) Fern Forest (Figure 22): This lowland wet community is composed mostly of a thick blanket of *uluhe* (*Dicranopeteris linearis*) with emergent and widely spaced *ʻōhia* (*Metrosideros plolymorpha*). It is found on the north-facing slope of the step road cut at Site 5. A variety of native shrubs (e.g., *Leptecophylla* and *Vaccinium*), herbs (e.g. *Dianella*), sedges (e.g., *Machaerina*), and ferns (e.g., *Sadleria* and *Sphenomeris*) as well as non-native species (e.g., *Clidemia* and *Arundina*) are also found in this community. This community is considered to be in the early succession toward *ʻōhia* forest as soils develop.

2) ʻŌhia Lowland Wet Forest (Figure 23): This lowland wet community is dominated by *ʻōhia lehua* and in some areas co-dominated by both *ʻōhia* and *koa*. It is found on the east-facing downslope of the roadway in Site 4 and Site 5. Many native trees (e.g., *Antidesma, Bobea, Cheirodendron*, *Ilex*, and *Psychotria*), shrubs (e.g., *Coprosma* and *Kadua*), and vines (e.g., *Alyxia*) can be found in the understory. Groundcover is composed of various native and non-native species (e.g., *Dicranopteris*, *Clidemia*, *Doodia*, and *Viola*).

3) Schinus Shrubland (Figures 24 and 25): This lowland mesic community is dominated by Christmas berry (*Schinus terebinthifolius*) and is found on the steep south-facing and west-facing slopes in the survey area. The understory is dominated by *Clidemia hirta* and molasses grass. Isolated *koa* and *ʻōhia lehua* persists in this community.

3.4.2 Flora

The flora of Site 4 and Site 5 consists of 17 ferns and fern allies, 1 gymnosperm, 64 dicots, and 27 monocots. The survey areas, however, contain rich native plant diversity, the highest among the proposed sites. 45 of the 109 vascular plants identified (41%) are native, including 32 endemic and 13 indigenous species. A checklist of vascular plants observed at the surveyed areas of Site 4 and Site 5 is provided in Table A-4.

No listed threatened or endangered plants were observed at Site 3 during the field investigation.

3.4.3 Fauna

A point-count avian survey for Site 5 was conducted on December 13, 2016 from 8:35 am to 8:43 am. The weather condition was cloudy with 90% cloud cover and no rain. The air temperature was 16.9°C when the survey started. A low wind of variable direction ranged 0–6 miles per hour. Two non-native forest birds were detected. These include three Japanese white-eye and one white-rumped shama (*Copsychus malabaricus*).

A point-count avian survey for Site 4 was conducted on December 15, 2016 from 8:42 am to 8:50 am. The weather condition was overcast with 100% cloud cover and drizzling rain. The air temperature was 22.2°C when the survey started. A low wind of variable direction ranged 0–3 miles per hour. Two non-native forest birds were detected. These include five Japanese white-eye (*Zosterops japonicus*) and one house finch (*Haemorhous mexicanus*)

Timed area searches for tree snails in the ‘Ōhia Wet Forest did not detect any endangered O‘ahu tree snails. Three small tree snails, presumably *Elasmias* sp., were found on the underside of the leaves of a *Melicope oahuensis*. Since the snails are not the target species they were not collected for positive identification. During the survey an empty shell of a rosy wolfsnail (*Euglandina rosea*) was observed on Site 4. Invasion of rosy wolfsnail may have significant impact to the tree snail resources in the area.

No threatened or endangered wildlife was observed in the survey areas of Site 4 and Site 5.

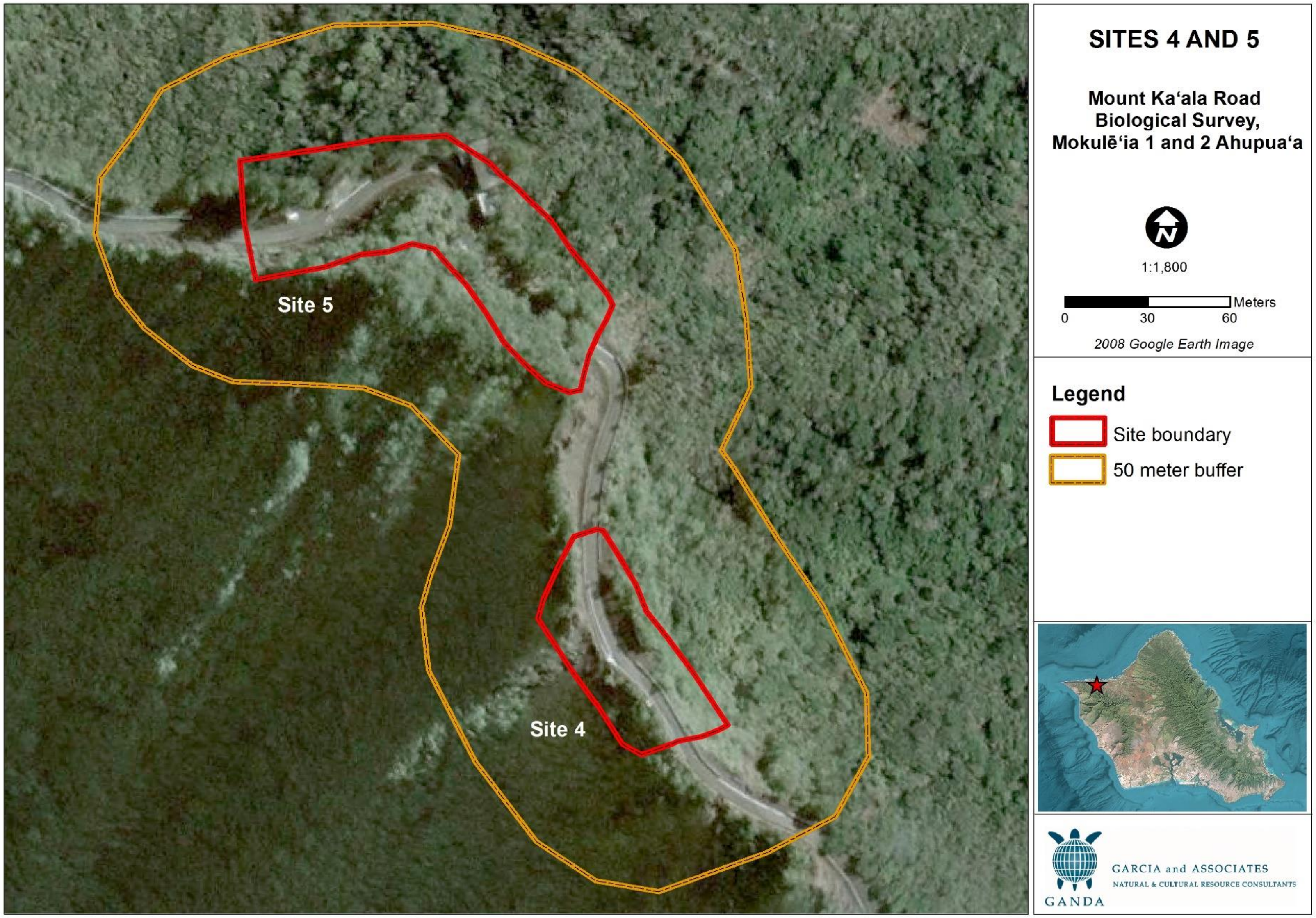

Figure 21. Survey areas of Site 4 and Site 5.

Figure 22. ‘Ōhia/Uluhe Fern Forest on the crest of the steep road cut in Site 5. View to east.

Figure 23. ‘Ōhia Wet Forest in the buffer area between Site 4 and Site 5. View to northwest.

Figure 24. Vegetation on the narrow ridge of Site 5. View to west.

Figure 25. Schinus Shrubland at Site 5. View to east.

4.0 Summary and Conclusions

4.1 Critical Habitats

Four of the proposed road repair sites are on the federally designated critical habitats, including the critical habitats for O‘ahu *‘elepaio* and two ecosystem-based critical habitat units of O‘ahu: Lowland Mesic Unit 1 and Lowland Wet Unit 1.

O‘ahu *‘elepaio* is a small forest bird endemic to the island of O‘ahu. It is approximately 11–13 grams, dark brown above and white below, with light brown streaks on the breast. O‘ahu *‘elepaio* prefers areas with a tall forest canopy and a dense understory and are most abundant in riparian habitat in valleys (Pyle and Pyle 2009; VanderWerf 2012). The total estimated population of the species is 1,261 birds, consisting of about 477 breeding pairs and 307 single males (VanderWerf et al. 2013). A census using the spot-mapping method with song playbacks in all suitable forest habitat in the Wai‘anae Mountains from 2006 to 2009 detected a total of 300 O‘ahu *‘elepaio*, including, 108 breeding pairs and 84 single males (VanderWerf et al. 2011). None of the known occupied habitats is in close vicinity to the proposed road repair sites. The four project sites are located on major ridgelines, which do not provide preferred habitat for the O‘ahu *‘elepaio*. Considering the available habitats in the project sites, it is unlikely that construction would significantly affect the critical habitat of O‘ahu *‘elepaio*.

Botanical survey shows that although invasive species have significantly degraded the habitat quality of these sites, native plants remain a significant component of the plant communities and can be dominant in selected communities. To minimize impact to the critical habitats, it is advisable to preserve as much of the native plant community as possible during project planning and construction, and to restore the impacted areas after construction is completed, preferably using techniques that encourage recovery of native plant communities.

4.2 Threatened or Endangered Species

No threaten or endangered plant or wildlife was observed during the field investigation. Two mature individuals of *wiliwili*, a species of concern, were identified in the buffer area of Site 3. *Wiliwili* is a keystone species of the highly threatened native Lowland Dry Forest ecosystem and was traditionally used by native Hawaiians for canoe building, *lei*, and surfboards (Abbott 1992). The incidental introduction of a gall forming parasite, Erythrina gall wasp (*Quadrastichus erythrinae*), had caused significant loss of the existing population throughout the islands until the *wiliwili* gall wasp parasitoid (*Eurytoma erythrinaea*), a hyper-parasite of the Erythrina gall wasp, was released and successfully established. The identified individuals can be a valuable source for future recovery of the species. Construction should be planned to avoid the *wiliwili*.

4.3 Jurisdictional Wetlands and Waters

No jurisdictional wetland was identified in the project sites. Site 3, however, contains jurisdictional waters of the United States in the form of ephemeral Makaleha Stream. Impact to these waters is regulated by the Section 404 of the Clean Water Act and the Rivers and Harbors Act of 1899.

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APPENDIX A: CHECKLIST OF VASCULAR PLANTS OBSERVED DURING THE BIOLOGICAL SURVEY

Table A-1. Checklist of Vascular Plants Observed at Site 1

Family	Scientific Name -- Common Name	Nativity*	Relative Abundance**
Ferns and Fern Allies			
Blechnaceae	*Blechnum appendiculatum* Willd. -- Palm fern	x	c
Blechnaceae	*Doodia kunthiana* Gaudich. -- Kunths hacksaw fern	e	u
Blechnaceae	*Sadleria cyatheoides* Kaulf. -- Amaumau fern	e	r
Dennstaedtiaceae	*Microlepia speluncae* (L.) T. Moore -- Limpleaf fern	e	u
Dicksoniaceae	*Cibotium chamissoi* Kaulf. -- Chamissos manfern	e	u
Dryopteridaceae	*Nephrolepis exaltata* (L.) Schott -- Boston swordfern	i	c
Gleicheniaceae	*Dicranopteris linearis* (Burm.) Underw. -- Old World forkedfern	i	d
Lindsaeaceae	*Sphenomeris chinensis* (L.) Maxon	i	c
Polypodiaceae	*Lepisorus thunbergianus* (Kaulf.) Ching -- Weeping fern	i	u
Pteridaceae	*Pityrogramma austroamericana* Domin -- Leatherleaf goldback fern	x	c
Thelypteridaceae	*Christella parasitica* (L.) H. Lév.	x	c
Dicotyledons			
Anacardiaceae	*Schinus terebinthifolius* Raddi -- Brazilian peppertree	x	a
Apiaceae	*Centella asiatica* (L.) Urb. -- Spadeleaf	x	u
Apiaceae	*Ciclospermum leptophyllum* (Pers.) Sprague	x	r
Apocynaceae	*Alyxia stellata* (J. R. Forst. and G. Forst.) Roem. & Schult.	i	c
Apocynaceae	*Asclepias physocarpa* (E. Mey.) Schltr. -- Balloonplant		
Aquifoliaceae	*Ilex anomala* Hook. & Arn. -- Hawaii holly	i	u
Araliaceae	*Cheirodendron trigynum* (Gaudich.) A. Heller -- Olapalapa	e	r
Asteraceae	*Ageratina adenophora* (Spreng.) King & H. Rob. -- Sticky snakeroot	x	u
Asteraceae	*Ageratina riparia* (Regel) King & H. Rob. -- Hamakua pamakani	x	c
Asteraceae	*Ageratum conyzoides* L. -- Tropical whiteweed	x	a
Asteraceae	*Conyza bonariensis* (L.) Cronquist -- Asthmaweed	x	u
Asteraceae	*Emilia sonchifolia* (L.) DC. -- Lilac tasselflower	x	c
Asteraceae	*Erechtites valerianifolia* (Link ex Spreng.) DC. -- Tropical burnweed	x	u
Asteraceae	*Erigeron karvinskianus* DC. -- Latin American fleabane	x	u

Table A-1. (cont.)

Family	Scientific Name -- Common Name	Nativity*	Relative Abundance**
Asteraceae	*Gamochaeta purpurea* (L.) Cabrera -- Spoonleaf purple everlasting	x	u
Asteraceae	*Pluchea carolinensis* (Jacq.) G. Don -- Cure for all	x	u
Asteraceae	*Youngia japonica* (L.) DC. -- Oriental false hawksbeard	x	c
Buddlejaceae	*Buddleja asiatica* Lour. -- Dogtail	x	c
Ericaceae	*Vaccinium calycinum* Sm. -- Ohelo kau laau	e	u
Ericaceae	*Leptecophylla tameiameiae* (Cham. and Schltdl.) C. M. Weiller	i	u
Fabaceae	*Acacia koa* A. Gray -- Koa	e	c
Fabaceae	*Crotalaria pallida* Aiton -- Smooth rattlebox	x	u
Gentianaceae	*Centaurium erythraea* Rafn -- European centaury	x	u
Goodeniaceae	*Scaevola gaudichaudiana* Cham. -- Mountain naupaka	e	u
Lythraceae	*Cuphea carthagenensis* (Jacq.) J.F. Macbr. -- Colombian waxweed	x	u
Lythraceae	*Lythrum maritimu*m Kunth -- Pukamole	x	u
Malvaceae	*Sida acuta* Burm. f. -- Common wireweed	x	r
Melastomataceae	*Clidemia hirta* (L.) D. Don -- Soapbush	x	a
Meliaceae	*Toona ciliata* Roem. -- Australian redcedar	x	a
Myrtaceae	*Metrosideros polymorpha* Gaudich. -- Ohia lehua	e	d
Myrtaceae	*Metrosideros tremuloides* (A. Heller) P. Knuth -- Lehua ahihi	e	u
Myrtaceae	*Psidium cattleianum* Sabine -- Strawberry guava	x	d
Myrtaceae	*Syzygium sandwicensis* (A. Gray) Nied.	e	r
Plantaginaceae	*Plantago major* L. -- Common plantain	x	u
Primulaceae	*Anagallis arvensis* L. -- Scarlet pimpernel	x	u
Proteaceae	*Grevillea robusta* A. Cunn. ex R. Br. -- Silkoak	x	c
Rosaceae	*Rubus argutus* Link -- Sawtooth blackberry	x	r
Rosaceae	*Rubus rosifolius* Sm. -- West Indian raspberry	x	u
Rubiaceae	*Bobea brevipes* A. Gray -- Akupa; Bobea mannii	e	r
Rubiaceae	*Coprosma foliosa* A. Gray -- Forest mirrorplant	e	u
Rubiaceae	Kadua affinis DC. -- Variable starviolet	e	u
Rubiaceae	*Psychotria mariniana* (Cham. & Schltdl.) Fosberg -- Forest wild coffee	e	u
Sapindaceae	*Dodonaea viscosa* (L.) Jacq. -- Florida hopbush	i	u

Table A-1. (cont.)

Family	Scientific Name -- Common Name	Nativity*	Relative Abundance**
Urticaceae	*Pipturus albidus* (Hook. & Arn.) A. Gray -- Waimea pipturus	e	r
Verbenaceae	*Stachytarpheta cayennensis* (Rich.) Vahl -- Cayenne porterweed	x	c
Verbenaceae	*Verbena litoralis* Kunth -- Seashore vervain	x	u
Violaceae	*Viola chamissoniana* Ging. subsp. *tracheliifolia* (Ging.) W. L. Wagner, D. R. Herbst & Sohmer -- Olopu	e	u
Monocotyledons			
Cyperaceae	*Carex wahuensis* C.A. Mey. -- Oahu sedge	e	u
Cyperaceae	*Cyperus brevifolius* (Rottb.) Hassk. -- Shortleaf spikesedge	x	c
Cyperaceae	*Cyperus polystachyos* Rottb. -- Manyspike flatsedge	i	c
Cyperaceae	*Machaerina angustifolia* (Gaudich.) T. Koyama -- Polynesian twigrush	i	u
Cyperaceae	*Machaerina mariscoides* (Gaudich.) J. Kern -- Tropical twigrush	e	u
Juncaceae	*Juncus planifolius* R. Br. -- Broadleaf rush	x	u
Orchidaceae	*Arundina graminifolia* (D. Don) Hochr. -- Bamboo orchid	x	c
Poaceae	*Agrostis avenacea* J.F. Gmel. -- Pacific bentgrass	x	a
Poaceae	*Andropogon virginicus* L. -- Broomsedge bluestem	x	u
Poaceae	*Axonopus fissifolius* (Raddi) Kuhlm. -- Common carpetgrass	x	u
Poaceae	*Digitaria ciliaris* (Retz.) Koeler -- Southern crabgrass	x	c
Poaceae	*Melinis minutiflora* P. Beauv. -- Molassesgrass	x	d
Poaceae	*Sacciolepis indica* (L.) Chase -- Glenwoodgrass	x	c
Poaceae	*Setaria parviflora* (Poir.) Kerguélen -- Marsh bristlegrass	x	u
Poaceae	*Vulpia bromoides* (L.) Gray -- Brome fescue	x	u
Xanthorrhoeaceae	*Dianella sandwicensis* Hook. & Arn. -- Ukiuki	e	u

* e: endemic; i: indigenous; x: naturalized.

** d (dominant): >25% area of coverage; a (abundant): > 100 individuals per 100m transect surveyed but not dominant; c (Common): 5-100 individuals per 100m transect surveyed; u (Uncommon): 1-4 individuals per 100m transect surveyed; r (Rare): <1 individual per 100m transect surveyed.

Table A-2. Checklist of Vascular Plants Observed at Site 2

Family	Scientific Name – Common Name	Nativity*	Relative Abundance**
Ferns and Fern Allies			
Blechnaceae	*Blechnum appendiculatum* Willd. -- Palm fern	x	c
Blechnaceae	*Doodia kunthiana* Gaudich. -- Kunths hacksaw fern	e	u
Dryopteridaceae	*Nephrolepis exaltata* (L.) Schott -- Boston swordfern	i	u
Gleicheniaceae	*Dicranopteris linearis* (Burm.) Underw. -- Old World forkedfern	i	a
Lindsaeaceae	*Sphenomeris chinensis* (L.) Maxon. – Lace fern	i	c
Polypodiaceae	*Lepisorus thunbergianus* (Kaulf.) Ching -- Weeping fern	i	u
Psilotaceae	*Psilotum nudum* (L.) P. Beauv. -- Whisk fern	i	u
Pteridaceae	*Pityrogramma austroamericana* Domin -- Leatherleaf goldback fern	x	c
Thelypteridaceae	*Christella parasitica* (L.) H. Lév.	x	c
Dicotyledons			
Anacardiaceae	*Schinus terebinthifolius* Raddi -- Brazilian peppertree	x	c
Apocynaceae	*Alyxia stellata* (J. R. Forst. and G. Forst.) Roem. & Schult.	i	u
Asteraceae	*Ageratina adenophora* (Spreng.) King & H. Rob. -- Sticky snakeroot	x	u
Asteraceae	*Ageratina riparia* (Regel) King & H. Rob. -- Hamakua pamakani	x	u
Asteraceae	*Ageratum conyzoides* L. -- Tropical whiteweed	x	c
Asteraceae	*Bidens alba* (L.) DC. -- Romerillo	x	u
Asteraceae	*Bidens torta* Sherff -- Corkscrew beggarticks	e	r
Asteraceae	*Conyza bonariensis* (L.) Cronquist -- Asthmaweed	x	u
Asteraceae	*Crassocephalum crepidioides* (Benth.) S. Moore -- Redflower ragleaf	x	u
Asteraceae	*Emilia sonchifolia* (L.) DC. -- Lilac tasselflower	x	u
Asteraceae	*Erechtites valerianifolia* (Link ex Spreng.) DC. -- Tropical burnweed	x	u
Asteraceae	*Gamochaeta purpurea* (L.) Cabrera -- Spoonleaf purple everlasting	x	u
Asteraceae	*Pluchea carolinensis* (Jacq.) G. Don -- Cure for all	x	u
Asteraceae	*Youngia japonica* (L.) DC. -- Oriental false hawksbeard	x	c
Buddlejaceae	*Buddleja asiatica* Lour. -- Dogtail	x	c
Ericaceae	*Leptecophylla tameiameiae* (Cham. and Schltdl.) C. M. Weiller	i	c
Fabaceae	*Acacia koa* A. Gray -- Koa	e	d
Fabaceae	*Chamaecrista nictitans* (L.) Moench -- Sensitive partridge pea	x	u

Table A-2. (cont.)

Family	Scientific Name – Common Name	Nativity*	Relative Abundance**
Fabaceae	*Crotalaria pallida* Aiton -- Smooth rattlebox	x	u
Fabaceae	*Desmanthus pernambucanus* (L.) Thell. -- Pigeon bundleflower	x	u
Fabaceae	*Desmodium sandwicense* E. Mey. -- Hawaii ticktrefoil	x	u
Goodeniaceae	*Scaevola gaudichaudiana* Cham. -- Mountain naupaka	e	u
Melastomataceae	*Clidemia hirta* (L.) D. Don -- Soapbush	x	a
Meliaceae	*Toona ciliata* Roem. -- Australian redcedar	x	c
Myrtaceae	*Metrosideros polymorpha* Gaudich. -- Ohia lehua	e	d
Myrtaceae	*Psidium cattleianum* Sabine -- Strawberry guava	x	d
Myrtaceae	*Psidium guajava* L. -- Guava	x	u
Oxalidaceae	*Oxalis debilis* Kunth -- Pink woodsorrel	x	r
Passifloraceae	*Passiflora edulis* Sims -- Purple granadilla	x	r
Plantaginaceae	*Plantago lanceolata* L. -- Narrowleaf plantain	x	u
Proteaceae	*Grevillea robusta* A. Cunn. ex R. Br. -- Silkoak	x	c
Rosaceae	*Rubus argutus* Link -- Sawtooth blackberry	x	u
Rosaceae	*Rubus rosifolius* Sm. -- West Indian raspberry	x	u
Rubiaceae	*Psydrax odorata* (G. Forst.) A.C. Sm. & S. Darwin -- Alahee	i	r
Santalaceae	*Santalum freycinetianum* Gaudich. -- Forest sandalwood	e	r
Sapindaceae	*Dodonaea viscosa* (L.) Jacq. -- Florida hopbush	i	u
Thymelaeaceae	*Wikstroemia oahuensis* (A. Gray) Rock -- Oahu false ohelo	e	u
Verbenaceae	*Lantana camara* L. -- Lantana	x	u
Verbenaceae	*Stachytarpheta cayennensis* (Rich.) Vahl -- Cayenne porterweed	x	c
Monocotyledons			
Cyperaceae	*Carex wahuensis* C.A. Mey. -- Oahu sedge	e	u
Cyperaceae	*Cyperus polystachyos* Rottb. -- Manyspike flatsedge	i	c
Cyperaceae	*Gahnia beecheyi* H. Mann -- Forest sawsedge	e	u
Orchidaceae	*Spathoglottis plicata* Blume -- Philippine ground orchid	x	u
Poaceae	*Agrostis avenacea* J.F. Gmel. -- Pacific bentgrass	x	a
Poaceae	*Andropogon virginicus* L. -- Broomsedge bluestem	x	u
Poaceae	*Axonopus fissifolius* (Raddi) Kuhlm. -- Common carpetgrass	x	c
Poaceae	*Cenchrus polystachios* (L.) Morrone -- Mission grass	x	u
Poaceae	*Digitaria ciliaris* (Retz.) Koeler -- Southern crabgrass	x	u
Poaceae	*Melinis minutiflora* P. Beauv. -- Molassesgrass	x	a

Table A-2. (cont.)

Family	Scientific Name – Common Name	Nativity*	Relative Abundance**
Poaceae	*Sacciolepis indica* (L.) Chase -- Glenwoodgrass	x	c
Poaceae	*Setaria parviflora* (Poir.) Kerguélen -- Marsh bristlegrass	x	u
Poaceae	*Urochloa maxima* (Jacq.) R. Webster -- Guineagrass	x	u
Xanthorrhoeaceae	*Dianella sandwicensis* Hook. & Arn. -- Ukiuki	e	u

* e: endemic; i: indigenous; x: naturalized.

** d (dominant): >25% area of coverage; a (abundant): > 100 individuals per 100m transect surveyed but not dominant; c (Common): 5-100 individuals per 100m transect surveyed; u (Uncommon): 1-4 individuals per 100m transect surveyed; r (Rare): <1 individual per 100m transect surveyed.

Table A-3. Checklist of Vascular Plants Observed at Site 3

Family	Scientific Name – Common Name	Nativity*	Relative Abundance**
Fern			
Thelypteridaceae	*Christella parasitica* (L.) H. Lév.	x	c
Dicotyledons			
Anacardiaceae	*Schinus terebinthifolius* Raddi -- Brazilian peppertree	x	c
Asteraceae	*Ageratum conyzoides* L. -- Tropical whiteweed	x	c
Asteraceae	*Calyptocarpus vialis* Less. -- Straggler daisy	x	x
Asteraceae	*Conyza bonariensis* (L.) Cronquist -- Asthmaweed	x	x
Asteraceae	*Emilia fosbergii* Nicolson -- Florida tasselflower	x	x
Asteraceae	*Emilia sonchifolia* (L.) DC. -- Lilac tasselflower	x	x
Asteraceae	*Synedrella nodiflora* (L.) Gaertn. -- Nodeweed	x	x
Asteraceae	*Tridax procumbens* L. -- Coatbuttons	x	x
Buddlejaceae	*Buddleja asiatica* Lour. -- Dogtail	x	x
Caricaceae	*Carica papaya* L. -- Papaya	x	x
Clusiaceae	*Clusia rosea* Jacq. -- Autograph tree	x	x
Euphorbiaceae	*Aleurites moluccana* (L.) Willd. -- Indian walnut	p	u
Euphorbiaceae	*Euphorbia hirta* L. -- Pillpod sandmat	x	x
Euphorbiaceae	*Euphorbia prostrata* Aiton -- Prostrate sandmat	x	x
Euphorbiaceae	*Ricinus communis* L. -- Castorbean	x	x
Fabaceae	*Albizia lebbeck* (L.) Benth. -- Womans tongue	x	x
Fabaceae	*Alysicarpus vaginalis* (L.) DC. -- White moneywort	x	x
Fabaceae	*Crotalaria pallida* Aiton -- Smooth rattlebox	x	x
Fabaceae	*Erythrina sandwicensis* O. Deg. -- Wili wili	e	r
Fabaceae	*Indigofera hendecaphylla* Jacq. -- Trailing indigo	x	c
Fabaceae	Indigofera suffruticosa Mill. -- Anil de pasto	x	u
Fabaceae	*Leucaena leucocephala* (Lam.) de Wit -- Koa haole	x	a
Fabaceae	*Macroptilium atropurpureum* (Moc. & Sessé ex DC.) Urb. -- Purple bushbean	x	c
Fabaceae	*Mimosa pudica* L. -- Shameplant	x	u
Fabaceae	*Prosopis pallida* (Humb. & Bonpl. ex Willd.) Kunth -- Kiawe	x	u
Fabaceae	*Senna occidentalis* (L.) Link -- Septicweed	x	u
Fabaceae	*Stylosanthes scabra* Vog. -- Pencilflower	x	u
Lamiaceae	*Hyptis pectinata* (L.) Poit. -- Comb bushmint	x	c
Malvaceae	*Abutilon grandifolium* (Willd.) Sweet -- Hairy Indian mallow	x	r

Table A-3. (cont.)

Family	Scientific Name – Common Name	Nativity*	Relative Abundance**
Malvaceae	*Sida ciliaris* L. -- Bracted fanpetals	x	u
Malvaceae	*Sida rhombifolia* L. -- Cuban jute	x	u
Malvaceae	*Sida spinosa* L. -- Prickly fanpetals	x	c
Malvaceae	*Sidastrum micranthum* (St. Hil.) Fryxell	x	c
Malvaceae	*Triumfetta semitriloba* Jacq. -- Sacramento burbark	c	u
Malvaceae	*Waltheria indica* L. -- Uhaloa	i?	c
Moraceae	*Ficus microcarpa* L. f. -- Chinese banyan	x	u
Myrtaceae	*Syzygium cumini* (L.) Skeels -- Java plum	x	d
Oxalidaceae	*Oxalis corniculata* L. -- Creeping woodsorrel	p?	u
Passifloraceae	*Passiflora edulis* Sims -- Purple granadilla	x	u
Passifloraceae	*Passiflora suberosa* L. -- Corkystem passionflower	x	c
Phyllanthaceae	*Phyllanthus debilis* Klein ex Willd. -- Niruri	x	u
Plantaginaceae	*Plantago major* L. -- Common plantain	x	u
Verbenaceae	*Lantana camara* L. -- Lantana	x	c
Verbenaceae	*Stachytarpheta cayennensis* (Rich.) Vahl -- Cayenne porterweed	x	c
Verbenaceae	*Stachytarpheta jamaicensis* (L.) Vahl -- Light-blue snakeweed	x	u
Monocotyledons			
Cyperaceae	*Cyperus compressus* L. -- Poorland flatsedge	x	c
Poaceae	*Bothriochloa pertusa* (L.) A. Camus -- Pitted beardgrass	x	c
Poaceae	*Cynodon dactylon* (L.) Pers. -- Bermudagrass	x	u
Poaceae	*Digitaria ciliaris* (Retz.) Koeler -- Southern crabgrass	x	c
Poaceae	*Digitaria insularis* (L.) Mez ex Ekman -- Sourgrass	x	u
Poaceae	*Eleusine indica* (L.) Gaertn. -- Indian goosegrass	x	u
Poaceae	*Eragrostis amabilis* (L.) Wight & Arn. ex Nees -- Japanese lovegrass	x	c
Poaceae	*Eragrostis tenuifolia* (A. Rich.) Hochst. ex Steud. -- Elastic grass	x	u
Poaceae	*Sporobolus africanus* (Poir.) Robyns and Tournay	x	u
Poaceae	*Urochloa maxima* (Jacq.) R. Webster -- Guineagrass	x	d
Poaceae	*Urochloa reptans* (L.) Stapf -- Sprawling signalgrass	x	u

* e: endemic; i: indigenous; i?: presumably indigenous; p: Polynesian introduction; p?: presumably polynesian introduction; x: naturalized; ? nativity arguable.

** d (dominant): >25% area of coverage; a (abundant): > 100 individuals per 100m transect surveyed but not dominant; c (Common): 5-100 individuals per 100m transect surveyed; u (Uncommon): 1-4 individuals per 100m transect surveyed; r (Rare): <1 individual per 100m transect surveyed.

Table A-4. Checklist of Vascular Plants Observed at Site 4 and Site 5

Family	Scientific Name -- Common Name	Nativity*	Relative Abundance**
Ferns and Fern Allies			
Blechnaceae	*Blechnum appendiculatum* Willd. -- Palm fern	x	c
Blechnaceae	*Doodia kunthiana* Gaudich. -- Kunths hacksaw fern	e	u
Dennstaedtiaceae	*Microlepia speluncae* (L.) T. Moore -- Limpleaf fern	e	u
Dennstaedtiaceae	*Pteridium aquilinum* (L.) Kuhn -- Western brackenfern	i	u
Dicksoniaceae	*Cibotium chamissoi* Kaulf. -- Chamissos manfern	e	u
Dryopteridaceae	*Elaphoglossum crassifolium* (Gaudich.) W.R. Anderson & Crosby -- Royal tonguefern	e	r
Dryopteridaceae	*Elaphoglossum paleaceum* (Hook. and Grev.) Sledge	e	u
Dryopteridaceae	*Nephrolepis cordifolia* (L.) C. Presl -- Narrow swordfern	e	u
Dryopteridaceae	*Nephrolepis exaltata* (L.) Schott -- Boston swordfern	e	c
Gleicheniaceae	*Dicranopteris linearis* (Burm.) Underw. -- Old World forkedfern	i	d
Grammitidaceae	*Adenophorus tenellus* (Kaulf.) Ranker -- Kolokolo	e	u
Lindsaeaceae	*Sphenomeris chinensis* (L.) Maxon	i	c
Polypodiaceae	*Lepisorus thunbergianus* (Kaulf.) Ching -- Weeping fern	i	u
Psilotaceae	*Psilotum complanatum* Sw. -- Flatfork fern	i	r
Psilotaceae	*Psilotum nudum* (L.) P. Beauv. -- Whisk fern	i	u
Pteridaceae	*Pityrogramma austroamericana* Domin -- Leatherleaf goldback fern	x	c
Thelypteridaceae	*Christella parasitica* (L.) H. Lév.	x	c
Gymnosperms			
Araucariaceae	*Araucaria columnaris* (G. Forst.) Hook. -- New Caledonia pine	x	r
Dicotyledons			
Anacardiaceae	*Schinus terebinthifolius* Raddi -- Brazilian peppertree	x	d
Apiaceae	*Centella asiatica* (L.) Urb. -- Spadeleaf	x	u
Apiaceae	*Ciclospermum leptophyllum* (Pers.) Sprague	x	u
Apocynaceae	*Alyxia stellata* (J. R. Forst. and G. Forst.) Roem. & Schult.	x	u
Apocynaceae	*Asclepias physocarpa* (E. Mey.) Schltr. -- Balloonplant	x	u
Aquifoliaceae	*Ilex anomala* Hook. & Arn. -- Hawaii holly	i	u
Asteraceae	*Ageratina adenophora* (Spreng.) King & H. Rob. -- Sticky snakeroot	x	u
Asteraceae	*Ageratina riparia* (Regel) King & H. Rob. -- Hamakua pamakani	x	c

Table A-4. (cont.)

Family	Scientific Name -- Common Name	Nativity*	Relative Abundance**
Asteraceae	*Ageratum conyzoides* L. -- Tropical whiteweed	x	c
Asteraceae	*Bidens torta* Sherff -- Corkscrew beggarticks	e	r
Asteraceae	*Conyza bonariensis* (L.) Cronquist -- Asthmaweed	x	u
Asteraceae	*Crassocephalum crepidioides* (Benth.) S. Moore -- Redflower ragleaf	x	u
Asteraceae	*Emilia sonchifolia* (L.) DC. -- Lilac tasselflower	x	u
Asteraceae	*Erechtites valerianifolia* (Link ex Spreng.) DC. -- Tropical burnweed	x	u
Asteraceae	*Erigeron karvinskianus* DC. -- Latin American fleabane	x	u
Asteraceae	*Gamochaeta purpurea* (L.) Cabrera -- Spoonleaf purple everlasting	x	u
Asteraceae	*Pluchea carolinensis* (Jacq.) G. Don -- Cure for all	x	u
Asteraceae	*Sonchus oleraceus* L. -- Common sowthistle	x	u
Asteraceae	*Youngia japonica* (L.) DC. -- Oriental false hawksbeard	x	c
Balsaminaceae	*Impatiens walleriana* Hook. f. -- Buzzy lizzy	x	r
Buddlejaceae	*Buddleja asiatica* Lour. -- Dogtail	x	c
Dipentodontaceae	*Perrottetia sandwicensis* A. Gray -- Olomea	e	r
Ebenaceae	*Diospyros sandwicensis* (A. DC.) Fosberg -- Lama	e	r
Elaeocarpaceae	*Elaeocarpus bifidus* Hook. & Arn. -- Kalia	e	r
Ericaceae	*Vaccinium calycinum* Sm. -- Ohelo kau laau	e	u
Ericaceae	*Leptecophylla tameiameiae* (Cham. and Schltdl.) C. M. Weiller	i	u
Euphorbiaceae	*Euphorbia hyssopifolia* L. -- Hyssopleaf sandmat	x	u
Fabaceae	*Acacia koa* A. Gray -- Koa	x	d
Fabaceae	*Crotalaria pallida* Aiton -- Smooth rattlebox	x	u
Fabaceae	*Leucaena leucocephala* (Lam.) de Wit -- Koa haole	x	u
Fagaceae	*Xylosma hawaiiense* Seem.	e	r
Goodeniaceae	*Scaevola gaudichaudiana* Cham. -- Mountain naupaka	e	u
Lythraceae	*Cuphea carthagenensis* (Jacq.) J.F. Macbr. -- Colombian waxweed	x	u
Malvaceae	*Sida rhombifolia* L. -- Cuban jute	x	u
Melastomataceae	*Clidemia hirta* (L.) D. Don -- Soapbush	x	a
Meliaceae	*Toona ciliata* Roem. -- Australian redcedar	x	a
Menispermaceae	*Cocculus orbiculatus* (L.) DC. -- Queen coralbead	i	u

Table A-4. (cont.)

Family	Scientific Name -- Common Name	Nativity*	Relative Abundance**
Myrtaceae	*Metrosideros polymorpha* Gaudich. -- Ohia lehua	e	d
Myrtaceae	*Metrosideros tremuloides* (A. Heller) P. Knuth -- Lehua ahihi	e	u
Myrtaceae	*Psidium cattleianum* Sabine -- Strawberry guava	x	d
Myrtaceae	*Psidium guajava* L. -- Guava	x	u
Orobanchaceae	*Castilleja arvensis* Cham. & Schltdl. -- Field Indian paintbrush	x	u
Phyllanthaceae	*Antidesma platyphyllum* H. Mann -- Hame	e	u
Phyllanthaceae	*Phyllanthus tenellus* Roxb. -- Mascarene Island leaf-flower	x	u
Plantaginaceae	*Plantago lanceolata* L. -- Narrowleaf plantain	x	u
Plantaginaceae	*Plantago major* L. -- Common plantain	x	u
Primulaceae	*Anagallis arvensis* L. -- Scarlet pimpernel	x	u
Primulaceae	*Myrsine lessertiana* A. DC. -- Kolea lau nui	e	r
Proteaceae	*Grevillea robusta* A. Cunn. ex R. Br. -- Silkoak	x	a
Rosaceae	*Rubus rosifolius* Sm. -- West Indian raspberry	x	u
Rubiaceae	*Coprosma foliosa* A. Gray -- Forest mirrorplant	e	u
Rubiaceae	*Coprosma longifolia* A. Gray -- Oahu mirrorplant	e	u
Rubiaceae	*Kadua affinis* DC. -- Variable starviolet	e	u
Rubiaceae	*Psychotria mariniana* (Cham. & Schltdl.) Fosberg -- Forest wild coffee	e	u
Rubiaceae	*Spermacoce assurgens* Ruiz & Pav. -- Woodland false buttonweed	x	u
Rutaceae	*Melicope oahuensis* (Levl.) T.G. Hartley & B.C. Stone -- Oahu melicope	e	u
Sapindaceae	*Dodonaea viscosa* (L.) Jacq. -- Florida hopbush	i	u
Sapotaceae	*Planchonella sandwicensis* (A. Gray) Pierre -- Alaa	e	r
Urticaceae	*Pipturus albidus* (Hook. & Arn.) A. Gray -- Waimea pipturus	e	r
Verbenaceae	*Citharexylum caudatum* L. -- Juniper berry	x	u
Verbenaceae	*Lantana camara* L. -- Lantana	x	u
Verbenaceae	*Stachytarpheta cayennensis* (Rich.) Vahl -- Cayenne porterweed	x	c
Verbenaceae	*Verbena litoralis* Kunth -- Seashore vervain	x	u
Violaceae	*Viola chamissoniana* Ging. subsp. *tracheliifolia* (Ging.) W. L. Wagner, D. R. Herbst & Sohmer -- Olopu	e	u

Table A-4. (cont.)

Family	Scientific Name -- Common Name	Nativity*	Relative Abundance**
Monocotyledons			
Asparagaceae	*Dracaena fragrans* (L.) Ker Gawl. -- fragrant dracaena	x	r
Cyperaceae	*Carex meyenii* Nees -- Meyens sedge	e	u
Cyperaceae	*Carex wahuensis* C.A. Mey. -- Oahu sedge	e	u
Cyperaceae	*Cyperus brevifolius* (Rottb.) Hassk. (syn. Kyllinga brevifolia Rottb.) -- Shortleaf spikesedge	x	u
Cyperaceae	*Cyperus cyperinus* (Retz.) Sur. -- Old World flatsedge	x	u
Cyperaceae	*Cyperus polystachyos* Rottb. -- Manyspike flatsedge	i	c
Cyperaceae	*Gahnia beecheyi* H. Mann -- Forest sawsedge	e	u
Cyperaceae	*Machaerina angustifolia* (Gaudich.) T. Koyama -- Polynesian twigrush	i	u
Juncaceae	*Juncus planifolius* R. Br. -- Broadleaf rush	x	u
Orchidaceae	*Arundina graminifolia* (D. Don) Hochr. -- Bamboo orchid	x	c
Orchidaceae	*Dendrobium* sp.	x	r
Orchidaceae	*Spathoglottis plicata* Blume -- Philippine ground orchid	x	x
Pandanaceae	*Freycinetia arborea* Gaudich. -- Ieie	i	r
Poaceae	*Agrostis avenacea* J.F. Gmel. -- Pacific bentgrass	x	c
Poaceae	*Andropogon virginicus* L. -- Broomsedge bluestem	x	u
Poaceae	*Axonopus fissifolius* (Raddi) Kuhlm. -- Common carpetgrass	x	c
Poaceae	*Digitaria ciliaris* (Retz.) Koeler -- Southern crabgrass	x	u
Poaceae	*Eleusine indica* (L.) Gaertn. -- Indian goosegrass	x	u
Poaceae	*Eragrostis variabilis* (Gaudich.) Steud. -- Kawelu	e	r
Poaceae	*Melinis minutiflora* P. Beauv. -- Molassesgrass	x	d
Poaceae	*Paspalum conjugatum* P.J. Bergius -- Hilograss	x	u
Poaceae	*Paspalum fimbriatum* Kunth -- Panama crowngrass	x	u
Poaceae	*Sacciolepis indica* (L.) Chase -- Glenwoodgrass	x	a
Poaceae	*Urochloa maxima* (Jacq.) R. Webster -- Guineagrass	x	u
Poaceae	*Vulpia bromoides* (L.) Gray -- Brome fescue	x	u
Xanthorrhoeaceae	*Dianella sandwicensis* Hook. & Arn. -- Ukiuki	e	u
Zingiberaceae	*Hedychium flavescens* Carey ex Roscoe -- Cream garland-lily	x	r

* e: endemic; i: indigenous; x: naturalized.

** d (dominant): >25% area of coverage; a (abundant): > 100 individuals per 100m transect surveyed but not dominant; c (Common): 5-100 individuals per 100m transect surveyed; u (Uncommon): 1-4 individuals per 100m transect surveyed; r (Rare): <1 individual per 100m transect surveyed.

APPENDIX B: WETLAND DETERMINATION DATA FORMS

WETLAND DETERMINATION DATA FORM – Hawai'i and Pacific Islands Region

Project/Site: Mt. Kaala Rd. Site 3 City: Honolulu Sampling Date: 12/15/16 Time: 12:30

Applicant/Owner: USACE State/Terr/Comlth.: HI Island: Oahu Sampling Point: 1

Investigator(s): Huang-Chi Kuo TMK/Parcel: 1-6-8-7-004

Landform (hillslope, coastal plain, etc.): Floodplain Local relief (concave, convex, none): Depression

Lat: 2384019.9 mN Long: 587769.3 mE Datum: NAD83 Slope (%): <1

Soil Map Unit Name: Kawaihapai Very Stony Clay Loam 0-15% NWI classification: n.a.

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No ___ (If no, explain in Remarks.)

Are Vegetation ___, Soil ___, or Hydrology ___ significantly disturbed? No Are "Normal Circumstances" present? Yes ✓ No ___

Are Vegetation ___, Soil ___, or Hydrology ___ naturally problematic? No (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ___	No X	Is the Sampled Area within a Wetland? Yes ___ No X
Hydric Soil Present?	Yes ___	No X	
Wetland Hydrology Present?	Yes X	No ___	

Remarks:

VEGETATION – Use scientific names of plants.

	Absolute % Cover	Dominant Species?	Indicator Status
Tree Stratum (Plot size: 30' radius circle)			
1. Syzygium cumini	10	Y	FAC
2. Aleurites moluccana	6	Y	FACU
3.			
4.			
5.			
= Total Cover			
Sapling/Shrub Stratum (Plot size: 30' radius circle)			
1. Leucaena leucocephala	3	Y	UPL
2.			
3.			
4.			
5.			
= Total Cover			
Herb Stratum (Plot size: 1 m²)			
1. Urochloa maxima	90	Y	FAC
2. Sida rhombifolia	<1	N	
3.			
4.			
5.			
6.			
7.			
8.			
= Total Cover			
Woody Vine Stratum (Plot size: 30' radius circle)			
1. NA.			
2.			
= Total Cover			

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 50 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species	0	x 1 = 0
FACW species	0	x 2 = 0
FAC species	2	x 3 = 6
FACU species	1	x 4 = 4
UPL species	1	x 5 = 5
Column Totals:	4 (A)	15 (B)

Prevalence Index = B/A = 3.75

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

___ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

___ Problematic Hydrophytic Vegetation[1] (Explain in Remarks or in the delineation report)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ___ No X

Remarks:

SOIL

Sampling Point: No. 1.

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0-12	7.5YR3/2	100					Sandy loam	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Muck Presence (A8)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Dark Surface (S7)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ Stratified Layers (A5)
- ___ Sandy Mucky Mineral (S1)
- ___ Red Parent Material (F21)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ______

Depth (inches): ______

Hydric Soil Present? Yes ___ No X

Remarks:
Soil contain many rubbles.

HYDROLOGY

Wetland Hydrology Indicators: (Explain observations in Remarks, if needed.)

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- X Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Tilapia Nests (B17)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Fiddler Crab Burrows (C10) (Guam, CNMI, and American Samoa)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Salt Deposits (C5)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ___ No X Depth (inches):

Water Table Present? Yes ___ No X Depth (inches):

Saturation Present? (includes capillary fringe) Yes ___ No X Depth (inches):

Wetland Hydrology Present? Yes X No

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Hawai'i and Pacific Islands Region

Project/Site: Mt. Kaala Rd. Site 3 City: Honolulu Sampling Date: 12/15/16 Time: 13:20

Applicant/Owner: USACE State/Terr/Comlth.: HI Island: Oahu Sampling Point: 2

Investigator(s): Huang-Chi Kuo TMK/Parcel: 1-6-8-7-004

Landform (hillslope, coastal plain, etc.): floodplain Local relief (concave, convex, none): depression

Lat: 2383992.4 mN Long: 587283.2 mE Datum: NAD83 Slope (%): <1

Soil Map Unit Name: Kawaihapai Very Stony Clay Loam 0-15% NWI classification: n.a.

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ___ (If no, explain in Remarks.)

Are Vegetation ___, Soil ___, or Hydrology ___ significantly disturbed? No Are "Normal Circumstances" present? Yes X No ___

Are Vegetation ___, Soil ___, or Hydrology ___ naturally problematic? NO (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ___ No X	Is the Sampled Area within a Wetland? Yes ___ No X
Hydric Soil Present?	Yes ___ No X	
Wetland Hydrology Present?	Yes X No ___	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 30' radius circle)	Absolute % Cover	Dominant Species?	Indicator Status
1. Syzygium cumini	20	Y	FAC
2. Aleurites moluccana	15	Y	FACU
3.			
4.			
5.			
	35 = Total Cover		
Sapling/Shrub Stratum (Plot size: 30' radius circle)			
1. Leucaena leucocephala	2	Y	UPL
2. Budleja asiatica	1	Y	FACU
3.			
4.			
5.			
	3 = Total Cover		
Herb Stratum (Plot size: 1 m²)			
1. Urochloa maxima	70	Y	FAC
2. Hyptis pectinata	5	N	?
3. Triumfetta semitriloba	1	N	UPL
4.			
5.			
6.			
7.			
8.			
	76 = Total Cover		
Woody Vine Stratum (Plot size: 30' radius circle)			
1. Passiflora edulis	1	Y	FACU
2.			
	1 = Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 6 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 33% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species	0	x 1 = 0
FACW species	0	x 2 = 0
FAC species	2	x 3 = 6
FACU species	2	x 4 = 8
UPL species	1	x 5 = 5
Column Totals:	5 (A)	19 (B)

Prevalence Index = B/A = 3.8

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

___ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

___ Problematic Hydrophytic Vegetation[1] (Explain in Remarks or in the delineation report)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ___ No X

Remarks:

SOIL

Sampling Point: No. 2

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0~14	7.5 YR 3/2	100					Sandy loam	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Muck Presence (A8)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Dark Surface (S7)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ Stratified Layers (A5)
- ___ Sandy Mucky Mineral (S1)
- ___ Red Parent Material (F21)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ______

Depth (inches): ______

Hydric Soil Present? Yes ___ No X

Remarks:

HYDROLOGY

Wetland Hydrology Indicators: (Explain observations in Remarks, if needed.)

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- X Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- X Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Tilapia Nests (B17)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Fiddler Crab Burrows (C10) (Guam, CNMI, and American Samoa)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Salt Deposits (C5)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ___ No X Depth (inches):

Water Table Present? Yes ___ No X Depth (inches):

Saturation Present? (includes capillary fringe) Yes ___ No X Depth (inches):

Wetland Hydrology Present? Yes X No

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

APPENDIX C
ENDANGERED SPECIES ACT SECTION 7 CONSULTATION CORRESPONDENCE

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DEPARTMENT OF THE AIR FORCE
PACIFIC AIR FORCES

22 February 2018

Lt Col Jeremiah Hammill
United States Air Force 611th Civil Engineer Squadron
Commander
10471 20th Street, Suite 302
JBER, AK 99506-2201

Ms. Mary Abrams
United States Fish and Wildlife Service Pacific Island Fish and Wildlife Office
Field Supervisor
300 Ala Moana Blvd Room 3-122
Honolulu, HI 96850

Dear Ms. Abrams,

The United State Air Force's Pacific Air Forces Regional Support Center, with support from the 611th Civil Engineer Squadron, Hawaiian Air National Guard (HIANG), Federal Aviation Administration (FAA), and Army Corps of Engineers (ACOE), proposes to repair sections of the road leading to Mt Ka'ala Microwave Antenna Station (MAS) on the island of O'ahu. In alignment with the Endangered Species Act, and Fish and Wildlife Coordination Act, the project team has developed a Biological Assessment (BA) to guide future discussions and coordination with your office regarding potential impacts which may affect specific threatened and endangered species and or their respective critical habitats. Preceding delivery of this BA, we performed a site visit with Ms. Jiny Kim from your O'ahu based office and we hope this coordination and predecessor planning effort have yielded a better understanding of the scope of repairs being proposed. This biological assessment is a continuation of that engagement and consultation in alignment with federal guidance depicted within the March 1998 "Endangered Species Consultation Handbook: Procedures for Conducting Consultation and Conference Activities Under Section 7 of the Endangered Species Act".

If you have questions pertaining to the content of this biological assessment or require supplemental access to the site for a day visit to better understand the scope of the proposed action, please feel free to contact our installation wildlife biologist, Mr. Joel Helm, at 907-552-5230 or via email at joel.helm.1@us.af.mil.

Sincerely

JEREMIAH J. HAMMILL, Lt Col, USAF
Commander

Attachment:
Final Biological Assessment for Proposed Road Repair on Mount Ka'ala Road, Mokulē'ia 1 and 2 Ahupua'a, Waialua District, O'ahu Island, Hawai'i_25 Jan 2018

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122
Honolulu, Hawaiʻi 96850

In Reply Refer To:
01EPIF00-2018-I-0245

April 18, 2018

Lieutenant Colonel Jeremiah Hammill
United States Air Force
611th Civil Engineer Squadron
10471 20th Street, Suite 302
JBER, Alaska 99506-2201

Subject: Informal Consultation for the Proposed Road Repair on Mount Kaʻala Road, Mokulēʻia 1 and 2 Ahupuaʻa, Waiālua District, Oʻahu

Dear Lt Col. Jeremiah Hammill:

The U.S. Fish and Wildlife Service (Service) received your letter on March 7, 2018, requesting our concurrence that the proposed Road Repair on Mount Kaʻala Road, Mokulēʻia 1 and 2 Ahupuaʻa, located in the district of Waiālua, on the island of Oʻahu [TMKs: (1) 6-8-001:001 por. and (1) 6-8-007:004 por.] may affect, but is not likely to adversely affect the following federally listed species: the endangered Oʻahu tree snail (*Achatinella* spp.), endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*), endangered Oʻahu ʻelepaio (*Chasiempis ibidis*); and is not likely to adversely modify the following designated critical habitats: Oʻahu ʻelepaio—Unit 1 (Northern Waiʻanae Mountains), Oʻahu—Lowland Mesic—Unit 1 (for 64 listed plants), and Oʻahu—Lowland Wet—Unit 1 (for 19 listed plants).

The findings and recommendations in this consultation are based on the following: (1) your consultation request dated February 22, 2018; (2) your biological assessment dated January 25, 2018; and (3) other information available to us. 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*.).

Project Description

The United State Air Force's (USAF) Pacific Air Forces Regional Support Center, with support from the 611th Civil Engineer Squadron, Hawaiʻi Air National Guard (HIANG), Federal Aviation Administration (FAA), and Army Corps of Engineers (ACOE), proposes to repair sections of the road leading to Mt. Kaʻala Microwave Antenna Station (MAS) on the island of Oʻahu.

The road is under the jurisdiction and joint management of the FAA, U.S. Army, and USAF based on existing real estate property documentation. In September 2015, the FAA submitted a letter requesting USAF assistance. The FAA and USAF signed commitment letters laying out the parameters and roles of each agency for this NEPA action. The two commitment letters, in addition to the existing Interagency Agreement for the management of the installation, provide further background on the roles the FAA, USAF, and U.S. Army play in this specific project area.

The purpose of the proposed action is to repair five areas along the Mt. Kaʻala Road. Mt. Kaʻala Road is a one-lane government road that provides the only vehicle access route to the summit of Mount Kaʻala, the highest point on the island of Oʻahu. The road starts from Farrington Highway (Hwy 930) with an elevation of 5 meters above mean sea level to an elevation of 1,227 meters above mean sea level at the tracking station. The road is paved and averages four meters in width. The roadway is currently restricted to government employees, contractors, and local ranchers.

These five sites were identified with adverse site conditions due to slope erosion, landslides, and instability that could potentially make the roadway impassable and cut off access to the Mt. Kaʻala summit. The proposed repair is essential to maintain the service of Mt. Kaʻala Road and support the missions of the government agencies and other parties that utilize this road.

The five proposed sites for road repair are along a 10.8 kilometer section of Mt. Kaʻala Road (Figure 1), which follows a NE-SW oriented foothill upslope until it reaches the NW-SE oriented ridgeline that separates Mākaha and Waiʻanae Kai to the south and Makaleha to the north. The total acreage of the proposed action is approximately 3.2 hectare. Naming of the project sites follows the reconnaissance report as described the Biological Assessment. The following sections describe the five sites and their proposed action, starting from the top of Mt. Kaʻala road.

<u>Site 3</u> is at the stream crossing of Makaleha Stream close to the 2.5-mile marker at the lower portion of the Mt. Kaʻala Road. It is about 80 meters above mean sea level in elevation. Storms have deposited debris on the upstream of the culvert crossing and have washed out part of the asphaltic concrete cover protecting the downstream sideslopes. The existing stream crossing consists of seven 1.5-meters diameter corrugated metal pipes laid over by a 3.7-meters wide asphalt paved roadway. Because each of the steel culverts have corrosion damage at the invert level, the pre-final design shows repairs to the metal pipes by pouring a new concrete invert while securing the not-corroded parts of the corrugated metal pipes. The roadway and shoulders will also be repaired. In addition to the above repairs, areas both upstream and downstream of the steam crossing will be grubbed and cleared of accumulated debris. Approximately 3,566 cubic meters of excavated soils from Site 1 and 2 combined will be embanked along the shoulder of Kaʻala Road to build a new graded ramp for maintenance equipment access into the streambed of Makaleha Stream. The current lack of access appears contributory to the accumulated debris and heavy vegetative overgrowth impeding stream flow through the existing steel culverts. The proposed action at Site 3 is approximately 0.8 hectares. The footprint of the permanent structure will not extend beyond the existing structure. Site 3 does not overlap with any federally designated critical habitat.

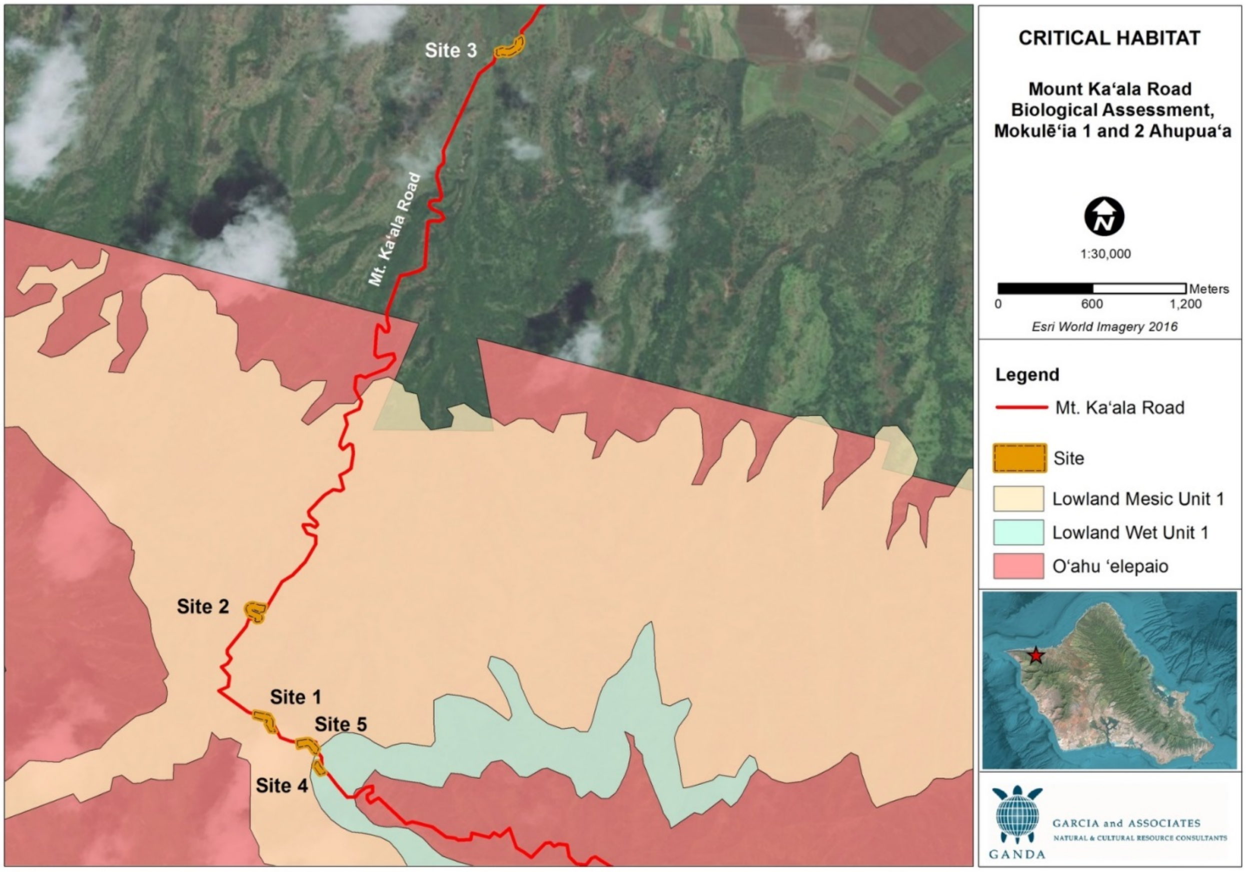

Figure 1. Road repair sites and federally designated critical habitat areas.

<u>Site 2</u> is near Culvert 32 between the 3.5 and 3.75-mile markers and is about 688 meters in elevation. The ground and slope fronting the guardrail of 16.8-meters long section of roadway has eroded, exposing guardrail posts, and undermining the asphaltic concrete paved shoulder. The proposed project design moves and realigns the roadway away from the failed slope area. The new road realignment requires excavation of the upslope embankment to build the realigned road. Surface water runoff within the Site 2 area is diverted from the landslide area by new concrete curbs. Existing storm water catch basins are retained to collect some of the runoff. Existing storm drain manholes will be modified and converted to be grated drain inlets to collect some of the runoff. The balance of surface water runoff will flow away from Kaʻala Road and into the drainage basin of Makaleha Stream. Approximately 2012 cubic meters of excavated soils result are removed from the upslope embankment and will be embanked at Site 3 within the new graded ramp area. The area of direct impact is about 0.86 hectares. Site 2 overlaps with the critical habitat for Oʻahu ʻelepaio and is within the Oʻahu—Lowland Mesic—Unit 1 critical habitat boundary.

<u>Site 1</u> is between Culverts 39 and 40 and is about 838 meters in elevation. A landslide occurred on the downslope side of the roadway with the top of the slide extending close to the roadway edge. The proposed project design moves and realigns the roadway away from the failed slope area. The new road realignment requires excavation of the upslope embankment to build the realigned road. The pre-final design shows a 1H:2V slope for the resultant upslope embankment

and a height of about 18.3 meters at the tallest reach. Approximately 1,554 cubic meters of excavated soils are expected to be removed from the upslope embankment and will be embanked at Site 3 within the new graded ramp area. The proposed action at Site 1 is approximately 0.66 hectares. The proposed action will use 17 drilled shafts at 24 meters deep and 0.9 meters in diameter to stabilize the slope. The construction footprint will be about 20 meters long by 1.5 meters wide. Site 1 is overlaps with the critical habitat area for Oʻahu ʻelepaio and the Oʻahu—Lowland Mesic—Unit 1 critical habitat boundary.

Site 5 is between Culvert 40 and Culvert 41 near the 4.5-mile marker. Site 5 is about 822 meters in elevation. Site 5 is designated as the construction vehicle turnaround area. Because the work efforts will require trucks hauling soils, it is necessary to create a turnaround area for the trucks. Site 5 provides a safe feasible location for the turnaround. The areas of direct impact are about 0.6 hectares for Site 5. Sites 5 overlaps with the critical habitat area for Oʻahu ʻelepaio, the Oʻahu—Lowland Mesic—Unit 1 critical habitat, and the Oʻahu—Lowland Wet—Unit 1 critical habitat.

Site 4 is between Culvert 41 and Culvert 42 near the 4.5-mile marker and is about 812 meters in elevation. The steep road cut on the upslope of the roadway of Site 4 has eroded over time, leading to an unstable slope face which constantly slides onto the roadway. The proposed project design removes the outcroppings and scale the existing slopes to reduce the potential for future landslides at this location. The areas of direct impact are about 0.28 hectares. Site 4 overlaps with the critical habitat for Oʻahu ʻelepaio and the Oʻahu—Lowland Wet—Unit 1 critical habitat boundary.

Oʻahu tree snail

Oʻahu tree snails are arboreal and feed on fungus and algae that feed on fungi and algae that grow on the leaves of trees on a variety of predominately native, but also some non-native tree species. Threats to tree snails include habitat destruction and fragmentation resulting from the impacts of nonnative ungulates such as pigs, goats, and deer, habitat modification due to invasive plants, and predation by nonnative mammals, reptiles, flatworms and snails. Wildfire is also a threat to the tree snails.

Molecular phylogenetic studies indicate genetic structure exists within the species. Six genetically distinct populations are largely geographically correlated and are recognized as evolutionary significant units (ESUs) (Holland and Hadfield 2002, 2007 as cited in USAF 2018). The subpopulation in East and Central Makaleha is one of the two subpopulations of the ESU-B, and was named ESU-B2. The population size of ESU-B2 was estimated at 659 individuals based on survey data collected between 2000 and 2017 (OANRP 2017 as cited in USAF 2018). The projected current distributional range of ESU-B2 encompasses Site 1, Site 4, and Site 5.

Oʻahu tree snails may occur in the vicinity of the proposed project area. To avoid and minimize project impacts to the Oʻahu tree snail:

- All potential host plants of Oʻahu tree snails to be removed will be examined for snail occurrence prior to removal. Vegetation removal work will stop immediately if endangered tree snails are found. The finding will be reported to the Service to decide appropriate conservation measures.

- All construction personnel shall be briefed on the sensitivity of the habitat present on the down-slope from both sides of the ridge and will be informed of the need to follow all restrictions, protocols, and Best Management Practices (BMPs) and special construction contract provisions.
- To prevent the introduction of exotic invasive species into the sensitive native dominated ecosystem below the site, all project-related materials, equipment, and construction personnel boots and clothing used on the project site shall be cleaned of seedy soils prior to their use at the site. A control point will be established at Site 3 to ensure every vehicle, tool, and personnel are cleared of invasive species before proceeding to the work sites uphill.
- Silt fencing and other appropriate BMP measures will be installed and maintained for the duration of the construction phase of the project to ensure that no construction debris can migrate down-slope into the forest.
- Any cleared areas on the steep slope will be stabilized to ensure that erosion does not occur.
- Construction personnel will be restricted within the project disturbance area to prevent trampling or further degradation of the habitat outside of the disturbance corridor.
- No personal pets will be allowed on the job site.
- If any vegetative replanting is proposed as part of this action, only native plants suitable for the habitat present at the site shall be used, where practicable.

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 4.6 meters 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.

To avoid and minimize project impacts to the endangered Hawaiian hoary bat:

- Vegetation clearing will avoid cutting trees taller than 4.6 meters during the bat's nursing season between June 1 and September 15

O'ahu 'elepaio and O'ahu 'elepaio critical habitat—Unit 1 (*Northern Wai'anae Mountains*)
Hawaiian forest birds' current ranges are predominately restricted to montane forests (above 1,067 meters in elevation) due to habitat loss and threats at lower elevations. Hawaiian forest bird habitat has been lost due to development, agriculture, grazing, wildfire, and spread of invasive habitat-altering species. Forest birds are also affected by mosquito-borne diseases. Mosquitoes are not native to Hawai'i; their occurrence increases in areas where ungulate presence results in small pools of standing water. Actions such as road construction and development increase human access and result in increased wildfire and invasive species threats. Grazing results in reductions in woody vegetation and increased grass cover, which reduces forest habitat quality and results in increased wildfire risk on the landscape.

O'ahu 'elepaio was not observed during the avian survey at the proposed project site. None of the currently known populations are in close vicinity to the proposed road repair sites. The population that is the closest to the action areas is located on the backslopes of Mākaha Valley

(VanderWerf 2012 as cited in USAF 2018) and no longer can be found (VanderWerf 2016 as cited in USAF 2018). The construction area will occur on the north side of the ridge crest, where no recent records of O‘ahu ‘elepaio occur (VanderWerf 2013, 2015 as cited in USAF 2018; OANRP 2017 as cited in USAF 2018).

The primary constituent elements (PCEs) of the critical habitat that are essential for the biological needs of foraging, sheltering, roosting, nesting, and rearing of young are undeveloped wet, mesic, and dry forest habitats with a generally continuous canopy and a dense understory composed of native and/or introduced plant species. The PCEs of the critical habitat associated with the biological needs of dispersal and genetic exchange are undeveloped wet or dry shrub land and wet or dry cliff habitats composed of native and/or introduced plant species that separate ‘elepaio populations. Existing developed features and structures, that do not contain one or more of the primary constituent elements, are not included as critical habitat.

To avoid and minimize project impacts to the endangered O‘ahu elepaio and the O‘ahu ‘elepaio critical habitat—Unit 1 (Northern Wai‘anae Mountains):

- All construction personnel shall be briefed on the sensitivity of the habitat present on the down-slope from both sides of the ridge and will be informed of the need to follow all restrictions, protocols, and Best Management Practices and special construction contract provisions.
- To prevent the introduction of exotic invasive species into the sensitive native dominated ecosystem below the site, all project-related materials, equipment, and construction personnel boots and clothing used on the project site shall be cleaned of seedy soils prior to their use at the site. A control point will be established at Site 3 to ensure every vehicle, tool, and personnel are cleared of invasive species before proceeding to the work sites uphill.
- Silt fencing and other appropriate BMP measures will be installed and maintained for the duration of the construction phase of the project to ensure that no construction debris can migrate down-slope into the forest.
- Any cleared areas on the steep slope will be stabilized to ensure that erosion does not occur.
- Construction personnel will be restricted within the project disturbance area to prevent trampling or further degradation of the habitat outside of the disturbance corridor.
- No personal pets will be allowed on the job site.
- All trash, especially those created from human consumables, shall be properly disposed of and removed from the site as soon as possible.
- If any vegetative replanting is proposed as part of this action, only native plants suitable for the habitat present at the site shall be used, where practicable.

O‘ahu—Lowland Mesic—Unit 1

O‘ahu—Lowland Mesic—Unit 1 is occupied by the plants *Abutilon sandwicense*, *Alectryon macrococcus, Bonamia menziesii, Cenchrus agrimonioides, Chamaesyce herbstii, Colubrina oppositifolia, Ctenitis squamigera, Cyanea acuminata, C. calycina, C. grimesiana* ssp. *grimesiana*, *C. grimesiana* ssp. *obatae, C. longiflora*, *C. superba*, *Cyrtandra dentata*, *Delissea subcordata*, *Diellia falcata*, *Dubautia herbstobatae*, *Eragrostis fosbergii*, *Euphorbia haeleeleana*, *Flueggea neowawraea*, *Hesperomannia arborescens*, *H. arbuscula*, *Hibiscus* *brackenridgei*, *Isodendrion laurifolium*, *I. longifolium*, *Kadua degeneri*, *Lobelia niihauensis*, *Melanthera tenuifolia*, *Melicope makahae*, *M. pallida*, *Neraudia angulata*, *Nototrichium humile*, *Phyllostegia kaalaensis*, *Platydesma cornuta* var. *decurrens*, *Pleomele forbesii*, *Pteralyxia macrocarpa*, *Schiedea hookeri*, *S. kaalae*, *S. nuttallii*, *S. obovata*, and *Viola chamissoniana* ssp. *chamissoniana*, and includes the mesic forest and shrubland, the moisture regime, and canopy, subcanopy and understory native plant species identified as physical or biological features in the lowland mesic ecosystem. This unit is not known to be occupied by the plants *Chamaesyce celastroides* var. *kaenana*, *Cyanea pinnatifida*, *Cyperus pennatiformis*, *Diellia unisora*, *Diplazium molokaiense*, *Eugenia koolauensis*, *Gardenia mannii*, *Gouania meyenii*, *G. vitifolia*, *Kadua coriacea*, *K. parvula*, *Labordia cyrtandrae*, *Melicope saint-johnii*, *Phyllostegia hirsuta*, *P. mollis*, *P. parviflora*, *Plantago princeps*, *Sanicula mariversa*, *Silene perlmanii*, *Solanum sandwicense*, *Stenogyne kanehoana*, *Tetramolopium lepidotum* ssp. *lepidotum*, or *Urera kaalae*, however, is essential to the conservation and recovery of these lowland mesic species because it provides the PCEs necessary for the reestablishment of wild populations within the historical ranges of the species.

The primary constituent elements of the lowland mesic critical habitat include elevation less than 1,000 meters; annual precipitation of 1,300–1,900 millimeters; and substrates that consist of shallow soils of little to no herbaceous layer. The canopy may consist of *Acacia*, *Diospyros*, *Metrosideros*, *Myrsine*, *Pouteria*, and *Santalum*. The subcanopy may consist of *Dodonaea*, *Freycinetia*, *Leptecophylla*, *Melanthera*, *Osteomeles*, *Pleomele*, and *Psydrax*. Understory may consist of *Carex*, *Dicranopteris*, *Diplazium*, *Elaphoglossum*, and *Peperomia*.

The botanical survey conducted for the proposed project did not find any federally listed plants within the proposed project area and a 50-meter buffer around the proposed sites. Areas that are affected by erosion and required stabilization are mostly barren or only sparsely vegetated by non-native plants.

To avoid and minimize project impacts to the O‘ahu—Lowland Mesic—Unit 1 critical habitat:

- All construction personnel shall be briefed on the sensitivity of the habitat present on the down-slope from both sides of the ridge and will be informed of the need to follow all restrictions, protocols, and Best Management Practices and special construction contract provisions.
- To prevent the introduction of exotic invasive species into the sensitive native dominated ecosystem below the site, all project-related materials, equipment, and construction personnel boots and clothing used on the project site shall be cleaned of seedy soils prior to their use at the site. A control point will be established at Site 3 to ensure every vehicle, tool, and personnel are cleared of invasive species before proceeding to the work sites uphill.
- Silt fencing and other appropriate BMP measures will be installed and maintained for the duration of the construction phase of the project to ensure that no construction debris can migrate down-slope into the forest.
- Any cleared areas on the steep slope will be stabilized to ensure that erosion does not occur.
- Construction personnel will be restricted within the project disturbance area to prevent trampling or further degradation of the habitat outside of the disturbance corridor.

- No personal pets will be allowed on the job site.
- All trash, especially those created from human consumables, shall be properly disposed of and removed from the site as soon as possible.
- If any vegetative replanting is proposed as part of this action, only native plants suitable for the habitat present at the site shall be used, where practicable.

O'ahu—Lowland Wet—Unit 1

O'ahu—Lowland Wet—Unit 1 is occupied by the plants *Gouania vitifolia*, *Schiedea hookeri*, and *Urera kaalae*, and includes the wet forest and shrubland, the moisture regime, and canopy, subcanopy and understory native plant species identified as physical or biological features in the lowland wet ecosystem. This unit is not known to be occupied by the plants *Cyanea acuminata*, *C. calycina*, *C. grimesiana* ssp. *grimesiana*, *C. grimesiana* ssp. *obatae*, *Cyrtandra dentata*, *Diplazium molokaiense*, *Gardenia mannii*, *Hesperomannia arbuscula*, *Isodendrion longifolium*, *Labordia cyrtandrae*, *Lobelia oahuensis*, *Phyllostegia hirsuta*, *P. mollis*, *Plantago princeps*, *Pterlyxia macrocarpa*, or *Schiedea kaalae*, however, is essential to the conservation and recovery of these lowland wet species because it provides the PCEs necessary for the reestablishment of wild populations within the historical ranges of the species.

The primary constituent elements of the lowland wet critical habitat include elevation less than 1,000 meters, annual precipitation more than 1,900 millimetres, and substrates that may consist of clays, ashbeds, deep, well-drained soils, or lowland bogs. The canopy may consist of *Antidesma*, *Metrosideros*, *Myrsine*, *Pisonia*, and *Psychotria*. The subcanopy may consist of *Cibotium*, *Claoxylon*, *Kadua*, and *Melicope*. The understory may consist of *Alyxia*, *Cyrtandra*, *Dicranopteris*, *Diplazium*, *Machaerina*, and *Microlepia*.

The botanical survey conducted for the proposed project did not find any federally listed plants within the proposed project area and a 50-meter buffer around the proposed sites. Both Site 4 and Site 5 contain areas with the PCEs, where native plant communities or native plants components occur. In general, the north and east facing slopes of the sites are less affected by invasive plants (e.g. strawberry guava and Christmas berry), and have higher diversity and abundance of native flora. Areas affected by erosion and requiring stabilization are largely barren or only sparsely vegetated by non-native plants.

To avoid and minimize project impacts to the O'ahu—Lowland Mesic—Unit 1 critical habitat the above avoidance and minimization measures as described in the O'ahu—Lowland Mesic—Unit 1 avoidance and minimization measures will be implemented.

Analysis of Effects

By incorporating the above avoidance and conservation measures (*e.g.*, vegetation removal work will stop immediately if endangered tree snails are found; the Service will be contacted to decide appropriate conservation measures; and measures to prevent the introduction of exotic invasive species into the sensitive native dominated ecosystem below the site by cleaning all project-related materials, equipment, and construction personnel boots and clothing of seedy soils prior to their use at the site) for O'ahu tree snails, the clearing of trees occupied by snails and the introduction of invasive plants that may cause habitat modification from the project is not probable, the effects of the action are, therefore, discountable. Because effects from the proposed action are discountable, the proposed project is not likely to adversely affect O‘ahu tree snails.

By incorporating the above avoidance and conservation measures (*e.g*., avoid cutting trees taller than 4.6 meters during the bat’s nursing season between June 1 and September 15) for the Hawaiian hoary bat, impacts to non-flying young left unattended in trees is not probable, and therefore the effects of the action are discountable. Because effects from the proposed action are discountable, the proposed project is not likely to adversely affect the Hawaiian hoary bat.

By incorporating the above avoidance and minimization measures (*e.g*., all project-related materials, equipment, and construction personnel boots and clothing used on the project site shall be cleaned of seedy soils prior to their use at the site; ensuring every vehicle, tool, and personnel is cleared of invasive species before proceeding to the work sites uphill; ensuring that no construction debris can migrate down-slope into the forest; restrictions for personnel to remain within the project disturbance area to prevent trampling or further degradation of the habitat outside of the disturbance corridor; etc.) for the O‘ahu ‘elepaio and the O‘ahu ‘elepaio critical habitat—Unit 1, the threat of invasive species from the proposed project is not probable, and therefore, effects of the action are discountable. Because effects from the action are discountable, the proposed project is not likely to adversely affect the O‘ahu ‘elepaio or adversely modify the O ‘ahu ‘elepaio critical habitat—Unit 1.

By incorporating the above avoidance and minimization measures (*e.g*., all project-related materials, equipment, and construction personnel boots and clothing used on the project site shall be cleaned of seedy soils prior to their use at the site; ensuring every vehicle, tool, and personnel is cleared of invasive species before proceeding to the work sites uphill; ensuring that no construction debris can migrate down-slope into the forest; restrictions for personnel to remain within the project disturbance area to prevent trampling or further degradation of the habitat outside of the disturbance corridor; etc.) for the O‘ahu—Lowland Mesic—Unit 1 and the O‘ahu—Lowland Wet—Unit 1 critical habitat units, the threat of invasive species and modification of the primary constituent elements of the respective units from the proposed project is not probable, and therefore effects of the action are discountable. Because effects from the action are discountable, the proposed project is not likely to adversely modify the O‘ahu—Lowland Mesic—Unit 1 and the O‘ahu—Lowland Wet—Unit 1 critical habitat units.

Summary
Based upon the above, we concur that the proposed action may affect, but is not likely to adversely affect the O‘ahu tree snail, Hawaiian hoary bat, O‘ahu ‘elepaio; and is not likely to adversely modify the following designated critical habits: O‘ahu ‘elepaio—Unit 1 (Northern Wai‘anae Mountains), O‘ahu—Lowland Mesic—Unit 1, and O‘ahu—Lowland Wet—Unit 1. Unless the project description changes, or new information reveals that the action may affect listed species in a manner or to an extent not considered, or a new species or critical habitat is designated that may be affected by the proposed action, no further action pursuant to section 7 of the ESA is necessary.

We thank you for your efforts to conserve listed species and native habitats. Please contact Jiny Kim, Fish and Wildlife Biologist (phone: 808-792-9400, email: Jiny_Kim@fws.gov) should you have any questions pertaining to this response or require further guidance. Please include reference number: 01EPIF00-2018-I-0245 in future correspondence when referring to this project.

Sincerely,

4/18/2018

X Aaron Nadig

Aaron Nadig

Signed by: AARON NADIG

Island Team Manager
O‘ahu, Kaua‘i, Northwestern Hawaiian Islands and American Samoa

APPENDIX D
COASTAL ZONE MANAGEMENT CONSISTENCY REVIEW
CORRESPONDENCE

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DEPARTMENT OF THE AIR FORCE
HEADQUARTERS ELEVENTH AIR FORCE (PACAF)
JOINT BASE ELMENDORF-RICHARDSON ALASKA

RECEIVED
MAY 11 2018
11:23 AM
OFFICE OF PLANNING

Mr. Leo R. Asuncion
Office of Planning, State of Hawaii
Coastal Zone Management Program
P.O. Box 2359
Honolulu, Hawaii 96804

Dear Mr. Asuncion:

In accordance with the 1972 Coastal Zone Management Act (CZMA) §307 (16 United States Code [U.S.C.] §1456) and the National Oceanic and Atmospheric Administration federal consistency regulations (15 Code of Federal Regulations [C.F.R.] Part 930), please find enclosed the U.S. Air Force, 611th Civil Engineer Squadron (611th CES) and the Federal Aviation Administration (FAA) application for a Coastal Zone Management (CZM) Federal Consistency review for proposed road repair work on Mount Kaala Road. The enclosed packet contains the completed CZM application, assessment form, and supporting documentation including a project description, site maps, and consultation correspondence.

Per 15 CFR §930.33, the 611th CES assessed reasonably foreseeable direct, indirect, and cumulative effects on Hawaii's defined coastal zone and reviewed relevant management programs of the Hawaii CZM Program in accordance with the CZMA. Based on the information, data, and analysis contained in the attached completed assessment form, the 611th CES finds that the proposed road repair work is consistent to the maximum extent practicable with the enforceable policies of the Hawaii CZM Program.

We appreciate your consideration of our determination and look forward to your response. If you have any questions, please contact Kevin Nishimura with the U.S. Army Corps of Engineers, Honolulu District who will be acting as our agent for this action at 808-835-4086 or via e-mail at kevin.h.nishimura@usace.army.mil.

Sincerely,

LEMON.DANIEL.W.1184493906 Digitally signed by LEMON.DANIEL.W.1184493906 Date: 2018.05.11 11:23:57 -08'00'

DANIEL W. LEMON, Colonel, USAF
Commander, PACAF Regional Support Center

Attachments:

1. MT Kaala Road CZM FC Application Form Enclosure
2. MT Kaala Road FC Project Description Enclosure
3. Site Location Map and Project Drawings Enclosure
4. FA Assessment Form
4.1 Section 106 Letter Enclosure
4.2 AIS
4.3 Approved SAP
4.4 Section 7 Correspondence

DAVID Y. IGE
GOVERNOR OF HAWAII

SUZANNE D. CASE
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

June 20, 2018

State of Hawaii
DBEDT - Office of Planning
Attention: Mr. John Nakagawa; CZM Program via email: john.nakagawa@hawaii.gov
235 South Beretania Street, 6th Floor
Honolulu, Hawaii 96813

Dear Mr. Nakagawa:

SUBJECT: Hawaii Coastal Zone Management Program Federal Consistency Review of **Mount Kaala Road Repair Project**, Waialua, Oahu

Thank you for the opportunity to review and comment on the subject matter. The Department of Land and Natural Resources' (DLNR) Land Division distributed or made available a copy of your report pertaining to the subject matter to DLNR Divisions for their review and comments.

At this time, enclosed are comments from the (a) Engineering Division, (b) Land Division – Oahu District, (c) Office of Conservation & Coastal Lands and (d) Division of Aquatic Resources on the subject matter. Should you have any questions, please feel free to call Lydia Morikawa at 587-0410. Thank you.

Sincerely,

Russell Y. Tsuji
Land Administrator

Enclosure(s)
cc: Central Files

DAVID Y. IGE
GOVERNOR OF HAWAII

*18 MAY 23 AM 11:03 ENGINEERING
RECEIVED
LAND DIVISION

SUZANNE D. CASE
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE
MANAGEMENT

2018 MAY 30 PM 1:18

DEPT. OF LAND & NATURAL RESOURCES
STATE OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

May 22, 2018

MEMORANDUM

~~TO:~~ FROM

DLNR Agencies:
X Div. of Aquatic Resources
__Div. of Boating & Ocean Recreation
X Engineering Division
X Div. of Forestry & Wildlife
__Div. of State Parks
X Commission on Water Resource Management
X Office of Conservation & Coastal Lands
X Land Division – Oahu District
X Historic Preservation

~~FROM:~~ TO Russell Y. Tsuji, Land Administrator

SUBJECT: Hawaii Coastal Zone Management Program Federal Consistency Review of **Mount Kaala Road Repair Project**

LOCATION: Waialua, Island of Oahu; TMK: (1) 6-8-007:002 & 6-8-001:001

APPLICANT: State of Hawaii, Office of Planning

Transmitted for your review and comment is information on the above-referenced project. We would appreciate your comments on this project which can be found at:

1. https://hawaiioimt.sharepoint.com/sites/dlnr-ld (using the Chrome browser)
2. Username: your Hawaii.gov email address
3. Password: outlook password (if you do not know it, please contact IT by email to reset and get a password)
4. Click on: Request for Comments, then click on the subject link.
5. If you cannot access the document, please scan this memo and email to Quoc Le at quoc.le@hawaii.gov to grant you access.

Please submit any comments by **June 20, 2018**. If no response is received by this date, we will assume your agency has no comments. If you have any questions about this request, please contact Lydia Morikawa at 587-0410. Thank you.

( ) We have no objections.
( ) We have no comments.
(✓) Comments are attached.

Signed:
Print Name: Carty S. Chang, Chief Engineer
Date: 5/29/18

Attachments
cc: Central Files

DEPARTMENT OF LAND AND NATURAL RESOURCES
ENGINEERING DIVISION

LD/Russell Y. Tsuji
Ref: Hawaii Coastal Zone Management Program Federal Consistency Review of Mount Kaala Road Repair Project, Waialua, Island of Oahu; TMK: (1) 6-8-007:002 & 6-8-001:001

COMMENTS

The rules and regulations of the National Flood Insurance Program (NFIP), Title 44 of the Code of Federal Regulations (44CFR), are in effect when development falls within a Special Flood Hazard Area (high risk areas). State projects are required to comply with 44CFR regulations as stipulated in Section 60.12. Be advised that 44CFR reflects the minimum standards as set forth by the NFIP. Local community flood ordinances may stipulate higher standards that can be more restrictive and would take precedence over the minimum NFIP standards.

The owner of the project property and/or their representative is responsible to research the Flood Hazard Zone designation for the project. Flood Hazard Zones are designated on FEMA's Flood Insurance Rate Maps (FIRM), which can be viewed on our Flood Hazard Assessment Tool (FHAT) (http://gis.hawaiinfip.org/FHAT).

If there are questions regarding the local flood ordinances, please contact the applicable County NFIP coordinating agency below:

- Oahu: City and County of Honolulu, Department of Planning and Permitting (808) 768-8098.
- Hawaii Island: County of Hawaii, Department of Public Works (808) 961-8327.
- Maui/Molokai/Lanai County of Maui, Department of Planning (808) 270-7253.
- Kauai: County of Kauai, Department of Public Works (808) 241-4846.

Signed: ____________________
CARTY S. CHANG, CHIEF ENGINEER

Date: 5/29/18

DAVID Y. IGE
GOVERNOR OF HAWAII

SUZANNE D. CASE
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

May 22, 2018

MEMORANDUM

TO: **DLNR Agencies:**
_X_ Div. of Aquatic Resources
__ Div. of Boating & Ocean Recreation
_X_ Engineering Division
_X_ Div. of Forestry & Wildlife
__ Div. of State Parks
_X_ Commission on Water Resource Management
_X_ Office of Conservation & Coastal Lands
_X_ Land Division – Oahu District
_X_ Historic Preservation

FROM: Russell Y. Tsuji, Land Administrator
SUBJECT: Hawaii Coastal Zone Management Program Federal Consistency Review of **Mount Kaala Road Repair Project**
LOCATION: Waialua, Island of Oahu; TMK: (1) 6-8-007:002 & 6-8-001:001
APPLICANT: State of Hawaii, Office of Planning

Transmitted for your review and comment is information on the above-referenced project. We would appreciate your comments on this project which can be found at:

1. https://hawaiioimt.sharepoint.com/sites/dlnr-ld (using the Chrome browser)
2. Username: your Hawaii.gov email address
3. Password: outlook password (if you do not know it, please contact IT by email to reset and get a password)
4. Click on: Request for Comments, then click on the subject link.
5. If you cannot access the document, please scan this memo and email to Quoc Le at quoc.le@hawaii.gov to grant you access.

Please submit any comments by **June 20, 2018**. If no response is received by this date, we will assume your agency has no comments. If you have any questions about this request, please contact Lydia Morikawa at 587-0410. Thank you.

( ) We have no objections.
(X) We have no comments.
( ) Comments are attached.

Signed: Darlene Bryant-Takamatsu
Print Name: Darlene Bryant-Takamatsu
Date: 6/4/18

Attachments
cc: Central Files

OA-18-243

DAVID Y. IGE
GOVERNOR OF HAWAII

RECEIVED
LAND DIVISION
2018 JUN -5 AM 10: 49
DEPT. OF LAND & NATURAL RESOURCES
STATE OF HAWAII

SUZANNE D. CASE
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

RECEIVED
OFFICE OF CONSERVATION AND COASTAL LANDS
2018 MAY 23 A 11: 21
DEPT. OF LAND & NATURAL RESOURCES
STATE OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

May 22, 2018

MEMORANDUM

FROM

~~TO~~: **DLNR Agencies:**
X Div. of Aquatic Resources
__Div. of Boating & Ocean Recreation
X Engineering Division
X Div. of Forestry & Wildlife
__Div. of State Parks
X Commission on Water Resource Management
X Office of Conservation & Coastal Lands
X Land Division – Oahu District
X Historic Preservation

TO:

~~FROM~~: Russell Y. Tsuji, Land Administrator
SUBJECT: Hawaii Coastal Zone Management Program Federal Consistency Review of **Mount Kaala Road Repair Project**
LOCATION: Waialua, Island of Oahu; TMK: (1) 6-8-007:002 (1) & 6-8-001:001 (2)
APPLICANT: State of Hawaii, Office of Planning

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Please submit any comments by **June 20, 2018**. If no response is received by this date, we will assume your agency has no comments. If you have any questions about this request, please contact Lydia Morikawa at 587-0410. Thank you.

(1) SLU AG DISTRICT

(2) SLU CON RESOURCE + PROTECTIVE

OCCL PERMIT ISSUED

( ) We have no objections.
( ) We have no comments.
(X) Comments are attached.

JUN - 4 2018

Signed:
Print Name: ALEX J. ROY
Date: 6/5/18

Attachments
cc: Central Files (SEE ATTACHED)

5740

DAVID Y. IGE
GOVERNOR OF HAWAII

SUZANNE D. CASE
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

RECEIVED
MAY 23 2018
Division of Aquatic Resources
DAR ~~5738~~ 5740

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

May 22, 2018

MEMORANDUM

RECEIVED
LAND DIVISION
2018 JUN 19 AM 10:39
DEPT. OF LAND & NATURAL RESOURCES
STATE OF HAWAII

TO: **DLNR Agencies:**
X Div. of Aquatic Resources
__Div. of Boating & Ocean Recreation
X Engineering Division
X Div. of Forestry & Wildlife
__Div. of State Parks
X Commission on Water Resource Management
X Office of Conservation & Coastal Lands
X Land Division – Oahu District
X Historic Preservation

FROM: Russell Y. Tsuji, Land Administrator
SUBJECT: Hawaii Coastal Zone Management Program Federal Consistency Review of **Mount Kaala Road Repair Project**
LOCATION: Waialua, Island of Oahu; TMK: (1) 6-8-007:002 & 6-8-001:001
APPLICANT: State of Hawaii, Office of Planning

Transmitted for your review and comment is information on the above-referenced project. We would appreciate your comments on this project which can be found at:

1. https://hawaiioimt.sharepoint.com/sites/dlnr-ld (using the Chrome browser)
2. Username: your Hawaii.gov email address
3. Password: outlook password (if you do not know it, please contact IT by email to reset and get a password)
4. Click on: Request for Comments, then click on the subject link.
5. If you cannot access the document, please scan this memo and email to Quoc Le at quoc.le@hawaii.gov to grant you access.

Please submit any comments by **June 20, 2018**. If no response is received by this date, we will assume your agency has no comments. If you have any questions about this request, please contact Lydia Morikawa at 587-0410. Thank you.

( ) We have no objections.
( ) We have no comments.
(✓) Comments are attached.

Signed:
Print Name: Brian Neilson, Acting DAR Administrator
Date: 6/19/18

Attachments
cc: Central Files

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

JEFFREY T. PEARSON, P.E.
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 AQUATIC RESOURCES
1151 PUNCHBOWL STREET, ROOM 330
HONOLULU, HAWAII 96813

Date: 06/18/18
DAR # 5740

MEMORANDUM

TO: Bruce S. Anderson, PhD
DAR Administrator

FROM: Ryan Okano, PhD RO, Aquatic Biologist

SUBJECT: Hawaii Coastal Zone Management Program Federal Consistency Review of Mount Kaala Road Repair Project

Request Submitted by: Russell Tsuji, Land Administrator

Location of Project: Waialua, Oahu

Brief Description of Project:

The Hawaii Coastal Zone (CZM) Program is conducting a federal consistency review of a proposal by the U.S. Air Force and Federal Aviation Administration to repair Mount Kaala Road at five sites, including excavation of adjacent slopes and realigning the roadway.

Comments:
☐ No Comments ☒ Comments Attached

Thank you for providing DAR the opportunity to review and comment on the proposed project. Should there be any changes to the project plan, DAR requests the opportunity to review and comment on those changes.

Comments Approved: [signature] Date: 6/19/18

for Bruce S. Anderson, PhD
DAR Administrator

DAR# 5740

Comments

Within the Hawaii CZM Federal Consistency Assessment Form on page 2 of the discussion section the applicant mentions that "all work will be conducted in accordance with all permit conditions to mitigate for any potential impacts to in-stream and downstream resources". Based on this statement it seems that resources upstream of the proposed activities are not considered. However, the Division of Aquatic Resources (DAR) would recommend that upstream resources be also considered. Hawaii's streams are highly conductive with resources moving down stream as well as upstream. In the case of Makaleha Stream, DAR data shows that Lentipes concolor (alamoo), an endemic freshwater goby has been detected in this stream. The alamoo is found at the highest elevation relative to Hawaii's other endemic gobies. This makes it conceivable that the alamoo could potentially traverse site 3 during periods of flow. With this being said DAR recommends that both downstream and upstream migrations be addressed when mitigation activities and best management practices are considered.

Additionally, erosion leading to sedimentation is one of the concerns that DAR has on this application. Throughout this region sedimentation has been identified as one of the primary land base sources of pollution that has an adverse impact on stream and near-shore aquatic resources. DAR recommend that Best Management Practices should be followed to prevent erosion and runoff into nearby ephemeral channels and storm drains which in most cases drain into streams and near-shore habitats.

Proposed Mount Kaala Road Repair Project
Mount Kaala, Waialua, Oahu, Hawaii
Federal Consistence Review Submission

Response To Comments

Commenting Agency: State of Hawaii, Department of Land and Natural Resources, Division of Aquatic Resources

Comment:
Within the Hawaii CZM Federal Consistency Assessment Form on page 2 of the discussion section the applicant mentions that "all work will be conducted in accordance with all permit conditions to mitigate for any potential impacts to in-stream and downstream resources". Based on this statement it seems that resources upstream of the proposed activities are not considered. However, the Division of Aquatic Resources (DAR) would recommend that upstream resources be also considered. Hawaii's streams are highly conductive with resources moving down stream as well as upstream. In the case of Makaleha Stream, DAR data shows that Lentipes concolor (alamoo), an endemic freshwater goby has been detected in this stream. The alamoo is found at the highest elevation relative to Hawaii's other endemic gobies. This makes it conceivable that the alamoo could potentially traverse site 3 during periods of flow. With this being said DAR recommends that both downstream and upstream migrations be addressed when mitigation activities and best management practices are considered.

Additionally, erosion leading to sedimentation is one of the concerns that DAR has on this application. Throughout this region sedimentation has been identified as one of the primary land base sources of pollution that has an adverse impact on stream and near-shore aquatic resources. DAR recommends that Best Management Practices should be followed to prevent erosion and runoff into nearby ephemeral channels and storm drains which in most cases drain into streams and near-shore habitats.

Response:
The Proponent appreciates the information provided by DAR regarding the potential that the *Lentipes concolor* may be present upstream of the proposed repair location at Site 3. The repair work involves grubbing and grading of the upstream and downstream areas in the immediate vicinity of the existing stream crossing to remove accumulated debris and vegetative overgrowth. The regrading of the intermittent stream bed will match the existing culvert inverts. The proposed work will restore unobstructed storm flow through the culverts under the stream crossing to ensure safe passage of vehicles and personnel transiting to and from the tracking station at Mount Kaala and to reduce the flood potential to the adjacent ranch’s equipment storage area. Regrading of the stream bed will not obstruct the downstream and upstream migrations of the *Lentipes concolor*. In addition, a mitigation measure will be included in the plans and specifications for the project that the work will be phased such that a portion of the existing seven culverts will be unobstructed to allow for fish migration.

The repair work for this site will be confined to the general vicinity of the stream crossing. Best Management Practices (BMPs) for the control of erosion and stormwater runoff within the work site will be employed. Permits from the U.S. Army Corps of Engineers’ Regulatory Office and the State of Hawaii’s Clean Water Branch will be required for this project that will identify the specific BMPs that will be used. In addition, the plans and specification for the project will state that the in-stream work will be conducted during the dry season to the extent practicable to reduce the potential for stormwater runoff and erosion.

Proposed Mount Kaala Road Repair Project
Mount Kaala, Waialua, Oahu, Hawaii
Federal Consistence Review Submission

Response To Comment

Commenting Agency: State of Hawaii, Department of Land and Natural Resources, Engineering Division

Comment
The rules and regulations of the National Flood Insurance Program (NFIP), Title 44 of the Code of Federal Regulations (44CFR), are in effect when development falls within a Special Flood Hazard Area (high risk areas). State projects are required to comply with 44CFR regulations as stipulated in Section 60.12. Be advised that 44CFR reflects the minimum standards as set forth by the NFIP. Local community flood ordinances may stipulate higher standards that can be more restrictive and would take precedence over the minimum NFIP standards.

The owner of the project property and/or their representative is responsible to research the Flood Hazard Zone designation for the project. Flood Hazard Zones are designated on FEMA's Flood Insurance Rate Maps (FIRM), which can be viewed on our Flood Hazard Assessment Tool (FHAT) (http://gis.hawaiinfip.org/FHAT).

Response:
The proposed Mount Kaala Road repair work is federally funded. All proposed road repair sites for this project are located within Zone D and do not fall within the Special Flood Hazard Area. The proposed work at Site 3 that involves grading and grubbing of the downstream and upstream areas immediately adjacent to the existing stream crossing. This will restore the flow regime of the intermittent stream through this area and prevent further localized flooding and overtopping of the roadway and the adjacent rancher’s storage area.

OFFICE OF PLANNING
STATE OF HAWAII

DAVID Y. IGE
GOVERNOR

LEO R. ASUNCION
DIRECTOR
OFFICE OF PLANNING

235 South Beretania Street, 6th Floor, Honolulu, Hawaii 96813
Mailing Address: P.O. Box 2359, Honolulu, Hawaii 96804

Telephone: (808) 587-2846
Fax: (808) 587-2824
Web: http://planning.hawaii.gov/

DTS201807090909NA

July 9, 2018

Colonel Daniel W. Lemon
Commander, PACAF Regional Support Center
Building 10471, Suite 265
Department of the Air Force
Headquarters Eleventh Air Force (PACAF)
Joint Base Elmendorf-Richardson, Alaska 99506

Dear Colonel Lemon:

Subject: Hawaii Coastal Zone Management Program Federal Consistency Review of Mount Kaala Road Repair Project, Mount Kaala, Waialua, Oahu; TMK: (1) 6-8-7:2; 6-8-1: 1

The Hawaii Coastal Zone Management (CZM) Program has completed the federal consistency review of the proposal to undertake road repair work at five sites along the 10.8-kilometer Mount Kaala Road (proposed activity), an asphalt paved one-lane government road that provides access to a tracking station at the summit of Mount Kaala. The Hawaii CZM Program conditionally concurs with the U.S. Department of the Air Force determination that the proposed activity is consistent to the maximum extent practicable with the enforceable policies of the Hawaii CZM Program. The following conditions shall apply to this consistency concurrence:

1. The proposed activity shall be implemented as represented in the consistency determination. Any changes to the proposal shall be submitted to the Hawaii CZM Program for review and approval. Changes to the proposal may require a full federal consistency review, including publication of a public notice and provision for public review and comment. This condition is necessary to ensure that the proposed activity is implemented as reviewed for consistency with the enforceable policies of the Hawaii CZM Program. Hawaii Revised Statutes (HRS) Chapter 205A, Coastal Zone Management, is the federally approved enforceable policy of the Hawaii CZM Program that applies to this condition.

2. As represented in the response (June 28, 2018) to comments submitted by the Department of Land and Natural Resources, Division of Aquatic Resources, regarding stream migration of the endemic freshwater goby, *Letipes concolor* (*alamoo*), "a mitigation measure will be included in the plans and specifications for the project that the work will be phased such that a portion of the existing seven culverts will be unobstructed to allow for fish migration." This condition is necessary to ensure consistency with the Hawaii CZM Program coastal ecosystems policies

established in HRS Chapter 205A, Coastal Zone Management, which is the federally approved enforceable policy that applies to this condition.

3. As represented in the response (June 28, 2018) to comments submitted by the Department of Land and Natural Resources, Division of Aquatic Resources, regarding impacts of sedimentation on stream and near-shore aquatic resources, in addition to best management practices, "the plans and specification for the project will state that the in-stream work will be conducted during the dry season to the extent practicable to reduce the potential for stormwater runoff and erosion." This condition is necessary to ensure consistency with the Hawaii CZM Program coastal ecosystems policies established in HRS Chapter 205A, Coastal Zone Management, which is the federally approved enforceable policy that applies to this condition.

If the requirements for conditional concurrences specified in 15 CFR § 930.4(a), (1) through (3), are not met, then all parties shall treat this conditional concurrence letter as an objection pursuant to 15 CFR Part 930, subpart C.

This conditional concurrence does not represent an endorsement of the proposed activity nor does it convey approval with any other regulations administered by any state or county agency. Thank you for your cooperation in complying with the Hawaii CZM Program. If you have any questions, please call John Nakagawa of our CZM Program at (808) 587-2878.

Sincerely,

Leo R. Asuncion
Director

cc: Kevin Nishimura, U.S. Army Corps of Engineers, Honolulu District
Department of Land and Natural Resources, Division of Aquatic Resources

APPENDIX E
ENVIRONMENTAL ACOUSTICAL MEASUREMENT LETTER

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970 N. Kalaheo Ave.
Suite A311
Kailua, HI 96734
www.dlaa.com
808.254.3318

March 24, 2017

Environmental Risk Analysis, LLC
905A Makahiki Way
Honolulu, Hawaii 96826

Attn: Ms. Rachel Okoji, M.S.

RE: Mount Kaala Road Improvement Project – Environmental Acoustical Measurement Services

Dear Rachel:

Thank you for the opportunity to provide our services for the Mount Kaala road improvement project. I would also like to thank Chief Yoda for his assistance in facilitating access to the road and making the measurements. We have completed our measurements and are pleased to report our findings for your further use.

We deployed three Larson Davis 831 ANSI Type 1 integrating recording Sound Level Meters in environmental cases on March 8, 2017 and retrieved them on March 16, 2017. The meters were time synchronized and the recorded data was parsed to provide comparable full-day measurement periods representative of at least five full days that encompassed three weekdays and two weekend days to illustrate both the normal environmental noises and human activities associated with normal road and property use. The meters also recorded short sound samples when a 65 dBA threshold was exceeded to allow identification of any anomalies.

Meters were deployed at Site 3 (the Makaleha stream crossing on private ranch lands), Site 2 (near culvert 32) and Site 5 (the turnaround area near the road maintenance sheds). The meters were attached to guard rails or bollards with bicycle cables and were operated on battery for the duration of the measurements. The meter microphones were deployed approximately 5' above grade. Consumer grade GPS coordinates were taken at the measurement locations and recorded on meter deployment records. Photographs of the meter locations are included in Appendix B.

The meters were programmed to collect the most common environmental noise metrics and the results are shown in Figures 1, 2 and 3 for Sites 3,2 and 5 respectively. The meters recorded these metrics on an hourly basis and the Figures are plotted also by the hour. An explanation of the environmental noise metrics presented in the Figures is included in Appendix A.

Our general observations from visual observations and meter data sources include that: at Site 3, the local noise sources included ranch land agricultural operations, tractors, vehicular traffic, chained ranch dogs, many wild peacocks, chickens, farm animals and ordinary environmental noises including wind, rain, birds and general foliage noise; at Site 2, the local noise sources included vehicular traffic, and the ordinary environmental noises; at Site 5, the local noise sources included vehicular traffic, occasional construction equipment backup alarms and the ordinary environmental noises previously mentioned.

Overall, all sites measured are quiet and typical of rural areas. Site 3 is the noisiest of the three due to the animal noises and measured Ldn 59.

The collected data shows that counterintuitively, that Site 2 is somewhat “louder” at night than would be ordinarily expected. It is common to think that the environment is always quieter at night without human activity. This general noise level increase above what is commonly expected is primarily due to the air cooling at the top of Mount Kaala in the evening, and then falling down the slopes with increased velocity and then exciting more general wind and foliage noise. This effect has been observed in previous measurements and was not unexpected by us. This effect is most clearly seen at Site 2, where the Leq, Lmax and L90 are very close in value during the nighttime hours.

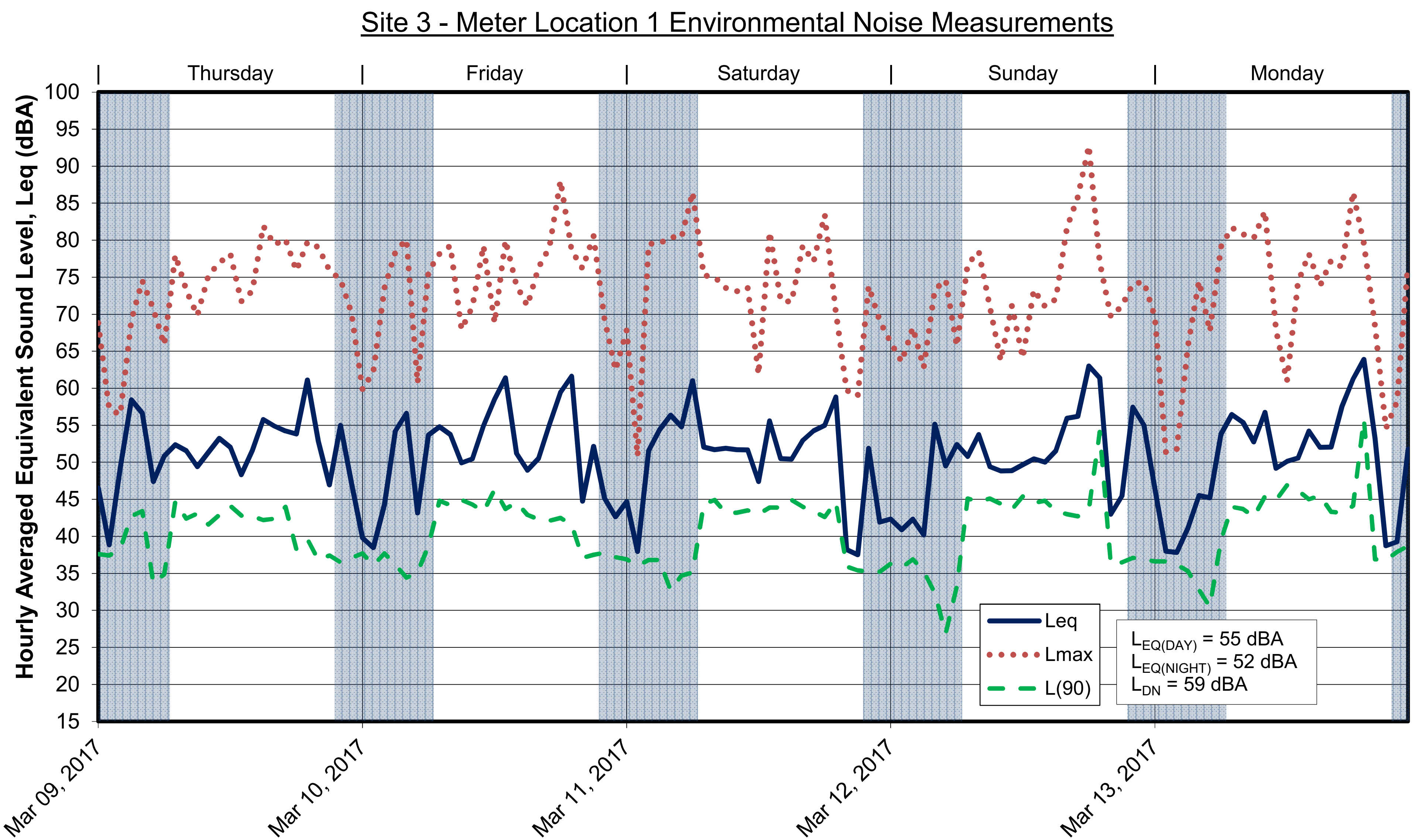
An examination of the sound recordings shows that 357 events above 65 dBA were triggered at Site 3, 49 at Site 2 and 41 events at Site 5. The majority of the sounds recorded at Site 3 were peacocks, roosters and dogs. Exceedences at Sites 2 and 5 were primarily ordinary vehicular traffic.

Thank You for the opportunity to work with you on this project. Please let me know if you have any questions.

Sincerely,

Gary L. McAuliffe
Senior Consultant

Figures
Measurement Results



Date & Time of Measurement

L_{eq}: Equivalent Sound Level - Logrithmic average of sound levels of time.
L_{max}: Maximum Noise Level - Highest noise level reached during each hourly measurement
L_{90}: Ambient Noise Level: Highest noise level exceeded 90% of each hourly recording.

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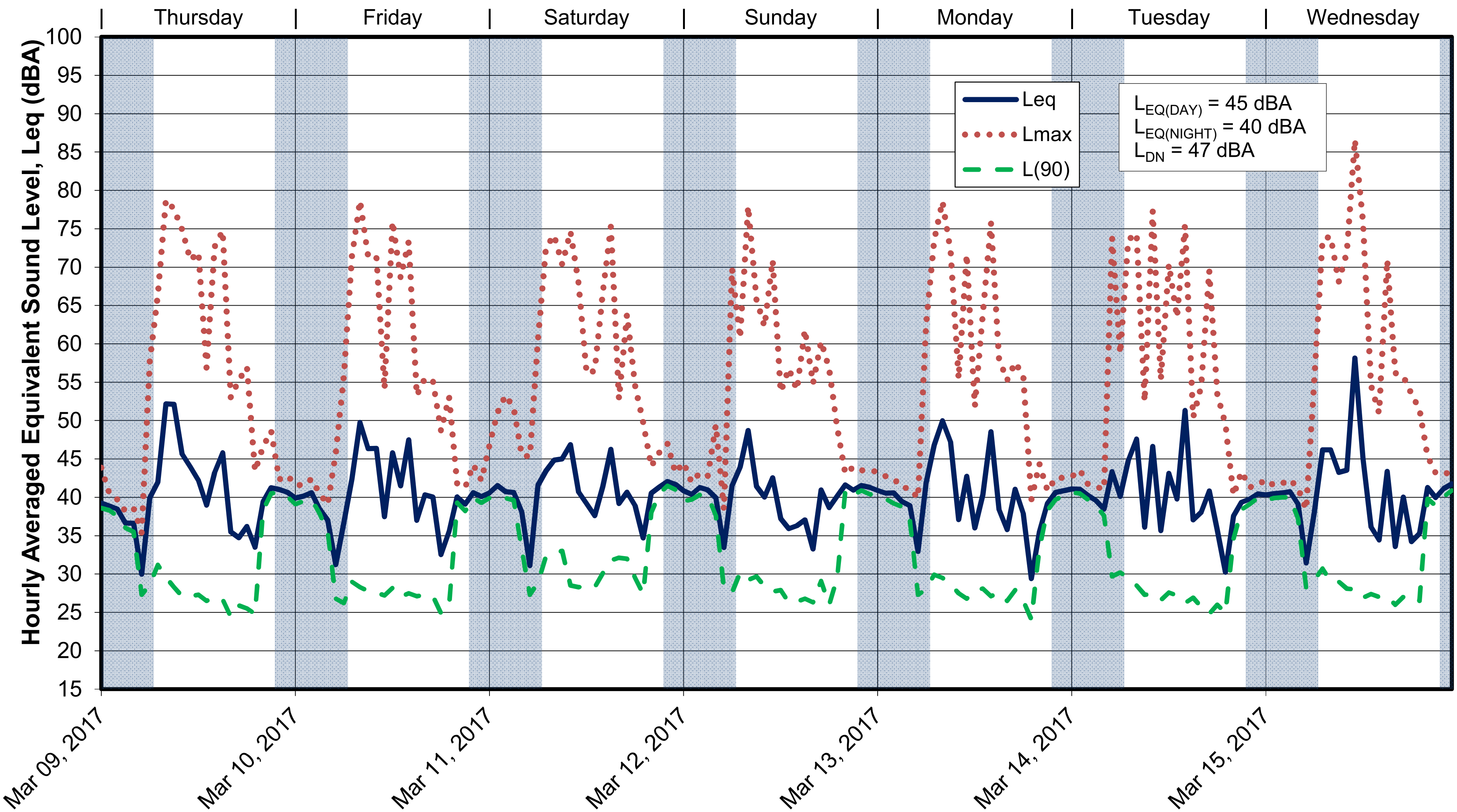
PROJECT: Mt. Kaala Road Improvements		
PROJECT NO: 17-12	DATE: March 2017	FIGURE: 1

Site 2 - Meter Location 2 Environemental Noise Measurements

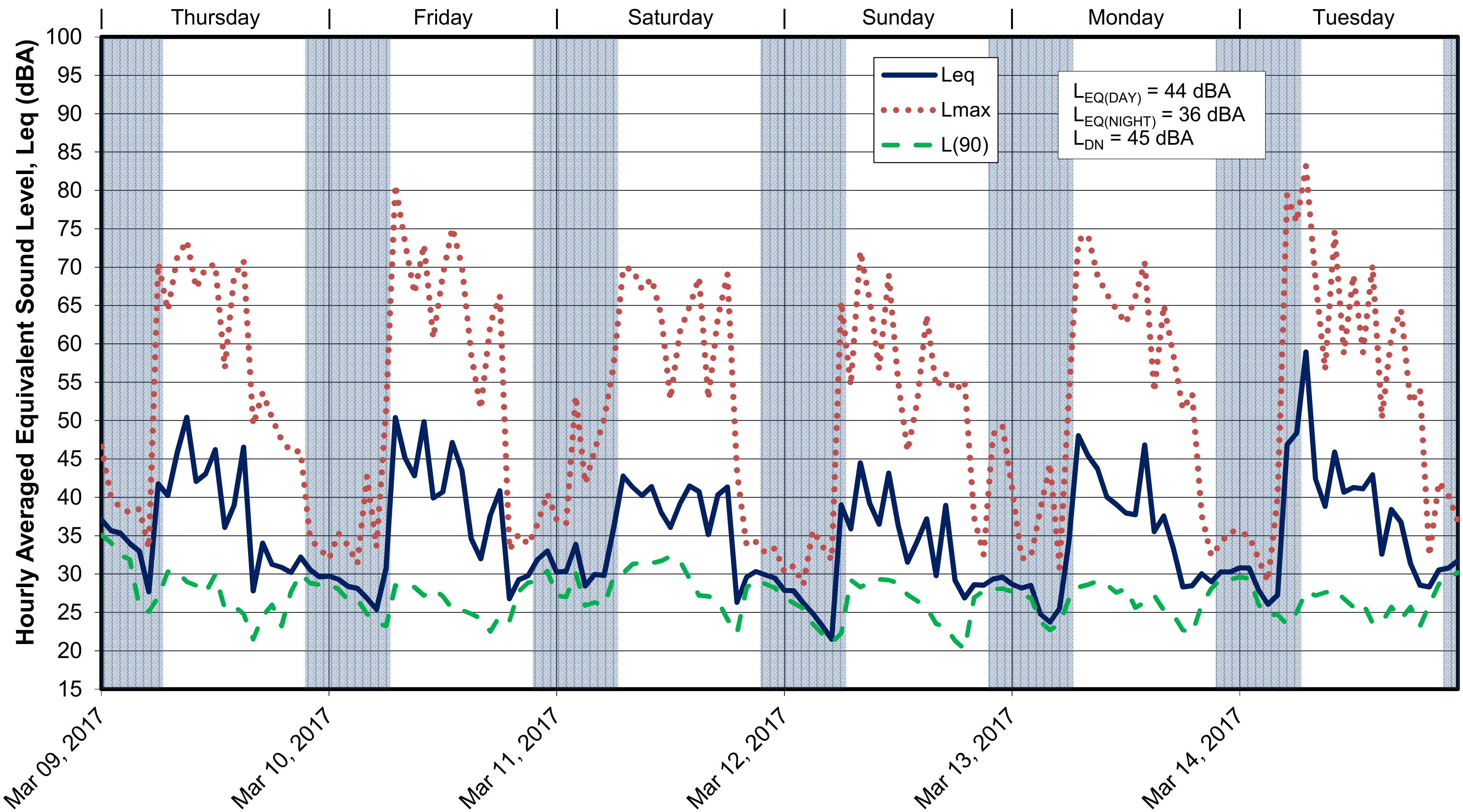


Date & Time of Measurement

L_{eq}: Equivalent Sound Level - Logrithmic average of sound levels of time.
L_{max}: Maximum Noise Level - Highest noise level reached during each hourly measurement
L_{90}: Ambient Noise Level: Highest noise level exceeded 90% of each hourly recording.

D. L. ADAMS ASSOCIATES acoustics | performing arts | technology	PROJECT: Mt. Kaala Road Improvements	
PROJECT NO: 17-12	DATE: March 2017	FIGURE: 2

Site 5 - Meter Location 3 Environmental Noise Measurements



Date & Time of Measurement

L_{eq}: Equivalent Sound Level - Logrithmic average of sound levels of time.
L_{max}: Maximum Noise Level - Highest noise level reached during each hourly measurement
L_{90}: Ambient Noise Level: Highest noise level exceeded 90% of each hourly recording.

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PROJECT: Mt. Kaala Road Improvements		
PROJECT NO: 17-12	DATE: March 2017	FIGURE: 2

Appendix A
Terminology and General Acoustics Information

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A.1. TERMINOLOGY

dB

A decibel, commonly abbreviated as dB, represents the ratio between 2 sound pressure levels. The scale used is logarithmic which is a close approximation to the response of the human ear. For reference, a difference of 3 dB is considered just perceptible to the average person, while 10 dB is considered to be twice as loud (or half as loud).

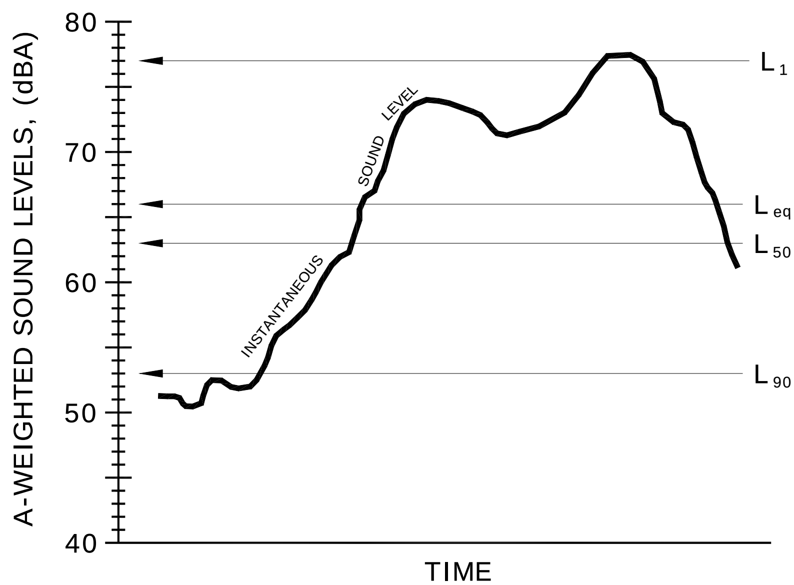
dBA

The human ear has been shown to be significantly more sensitive to some frequencies than others. The dBA weighting is a “filter” which, under typical noise levels, can be used to convert absolute noise levels at all frequencies into an approximation for human hearing. It is widely used throughout the world as the standard weighting for assessing noise complaints, hearing loss, sleep disturbance, and other issues. Typical noise levels include:

0 dBA – Threshold of human hearing
25 dBA – Soft Whisper at 3 feet
50 dBA – Typical office
70 dBA – Downtown city ambient noise
90 dBA – OSHA mandated hearing protection for 8 hour exposure
115 dBA – Loud rock concert

L_{eq}

The Equivalent Sound Level (L_{eq}) is a type of average which represents the steady level that, integrated over a time period, would produce the same energy as the actual signal. The actual *instantaneous* noise levels typically fluctuate above and below the measured L_{eq} during the measurement period. The A-weighted L_{eq} is a common index for measuring environmental noise. A graphical description of the equivalent sound level is shown in Figure A1 below.



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L_{90}, L_{10}	Statistical sound levels are the sound levels of long-term noise producing activities such as traffic movement, aircraft operations, etc., can vary considerably with time. In order to obtain a single number rating of such a noise source, a statistically-based method of expressing sound or noise levels has been developed. It is known as the Exceedance Level, L_n. The L_n represents the sound level that is exceeded for n% of the measurement time period. For example, L_{10} = 60 dBA indicates that for the duration of the measurement period, the sound level exceeded 60 dBA 10% of the time. Typically, in noise regulations and standards, the specified time period is one hour. Commonly used Exceedance Levels include L_{01}, L_{10}, L_{50}, and L_{90}, which are widely used to assess community and environmental noise. A graphical description of the equivalent sound level is shown in Figure A.1.
L_{MAX}	The maximum, instantaneous noise level recorded during a measurement period.
L_{dn}	The Day-Night Equivalent Sound Level, Ldn, is the Equivalent Sound Level, Leq, measured over a 24-hour period. However, a 10 dB penalty is added to the noise levels recorded between 10 p.m. and 7 a.m. to account for people's higher sensitivity to noise at night when the background noise level is typically lower. The Ldn is a commonly used noise descriptor in assessing land use compatibility, and is widely used by federal and local agencies and standards organizations.

Appendix B
Site Photographs

Site 3


N21-33.408
W158-09.146
SITE 3 LOOKING
DOWNHILL


UP

Site 2


N21-33.408
W158-09.146
SITE 2


ENVIRONMENTAL TESTING IN PROGRESS –
KOKUA, PLEASE DO NOT DISTURB. MAHALO!

Site 5


N21-30.902
W158-09.922
SITE 5


ENVIRONMENTAL TESTING IN PROGRESS–
KOKUA, PLEASE DO NOT DISTURB. Mahalo!
FOR INFORMATION, CONTACT
D. L. ADAMS ASSOCIATES

APPENDIX F

ARCHAEOLOGICAL INVENTORY SURVEY

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FINAL—Archaeological Inventory Survey for Proposed Road Repair Sites on Mount Ka‘ala Road, Mokulē‘ia 1 and 2 Ahupua‘a, Waialua District, O‘ahu Island, Hawai‘i

TMK (1) 6-8-001:001 por., (1) 6-8-007:002 por. and 004 por., and (1) 8-4-002:001 por.

Prepared For:

Environmental Risk Analysis, LLC
820 W. Hind Drive No.240606
Honolulu, Hawai‘i 96824

Prepared By:

Michael Desilets, MA

and

David Byerly, BA

Garcia and Associates
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Kailua, Hawai‘i 96734

Hawai‘i SHPD Permit No. 17-20

GANDA Report No. 2377-1

GANDA

6 July 2018

MANAGEMENT SUMMARY

At the request of Environmental Risk Analysis, LLC., on behalf of the U.S. Air Force, Garcia and Associates conducted an archaeological inventory survey (AIS) of five proposed road repair locales (39.61 acres) along Mount Ka‘ala Road in Mokulē‘ia 1 and 2 Ahupua‘a, District of Waialua, Island of O‘ahu, Hawai‘i (TMK [1] 6-8-001:001 por.; TMK [1] 6-8-007:002 por. and :004 por.; and TMK [1] 8-4-002:001 por.). The AIS data and findings are intended to support compliance with Section 106 of the National Historic Preservation Act, Hawaii Revised Statutes Chapter 6E, and the National and Hawaii Environmental Protection Acts.

Due to extreme slope conditions, survey could not be performed in much of the outlying buffer areas of Road Repair Locales 1, 2, 4, and 5. These areas, principally within a 50-meter buffer region around the primary repair locations, were inaccessible and are very unlikely to contain historic properties.

Pedestrian survey produced one possible historic site within the undertaking's Area of Potential Effect. This site is designated Hawai‘i State Inventory of Historic Places Site 50-80-03-08226 and consists of a 5-meter-long dry-stone retaining wall. It is most likely an historic ranch feature and could date anywhere from the late 1800s to the mid-1900s. This historic site may be significant under National Register of Historic Places Criterion D and Hawai‘i Administrative Rules (§13-284-6) Criterion "d" for its information value. Further contextual research is necessary to evaluate its contribution to the significance of a potential Mt. Kaala Ranch Historic Site or Landscape.

Site 50-80-03-08226 is not in direct conflict with planned undertaking activities and will be avoided during road repair operations. It is recommended that a 20-meter physical buffer be established around the site as the primary short-term preservation method. Implementation of this site protection measure will ensure that the undertaking has "no effect" to historic properties.

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1.0 INTRODUCTION

At the request of Environmental Risk Analysis, LLC., on behalf of the U.S. Air Force, Garcia and Associates conducted an archaeological inventory survey (AIS) of five proposed road repair locales along Mount Ka‘ala Road in Mokulē‘ia 1 and 2 Ahupua‘a, District of Waialua, Island of O‘ahu, Hawai‘i (Figures 1 and 2). The survey area includes portions of parcels owned by governmental and private entities including: TMK [1] 6-8-001:001 por.–State of Hawaii; TMK [1] 6-8-007:002 por. and :004 por.–Pioneer Hi-Bred International, Inc.; and TMK [1] 8-4-002:001 por.–City and County of Honolulu.

The purpose of the AIS was to identify, document, assess significance, and evaluate National Register of Historic Places (NRHP) eligibility for all extant historic properties within the Area of Potential Effect (APE) and provide mitigation recommendations as needed.

Michael Desilets, MA, RPA., served as the Principal Investigator for the Project. Mr. Desilets meets the professional qualifications outlined in Hawai‘i Administrative Rules §13-281-3 and is permitted to conduct archaeological investigations under State Historic Preservation Division Permit No. 16-27. Mr. Desilets also meets the Secretary of the Interior’s Professional Qualifications Standards for archaeology.

The archaeological survey was conducted on 19–22 November 2016 by a team of two archaeologists, which included the Principal Investigator.

1.1 Project Authority

The Mt. Kaala Road Repair Project is a federal “undertaking” as defined in 36 CFR 800.16(y), triggered by the utilization of U.S. federal funds. The project proponent is the U.S. Air Force, and they have retained the services of the U.S. Army Corps of Engineers to assist with various aspect of environmental compliance, including Section 106 of the National Historic Preservation Act (NHPA). This AIS is intended primarily to support Federal agency consultation required under Section 106, but may also be used to facilitate consultation under Hawaii Revised Statutes (HRS) Chapter 6E. All aspects of the AIS are in accordance with the Secretary of the Interior’s Standards and Guidelines for Archaeology and Historic Preservation.

Evaluation of impacts to cultural and historic resources for the project are also required under the National Environmental Policy Act (NEPA) (Title 42 of *United States Code* Sections 4321 to 4370 [f]) and its implementing regulations (40 CFR Parts 1500–1508).

1.2 Undertaking Description

The proposed undertaking consists of road repair work at five locales along the 10.8-kilometer-long Mount Ka‘ala Road. Mount Ka‘ala Road is a one-lane government road that provides access to a Federal Aviation Administration (FAA)-maintained tracking station at the summit of Mount Ka‘ala. The road rises from an elevation of 84 meters above mean sea level to an elevation of 1,227 m above mean sea level at the tracking station. The road is asphalt-paved and averages four meters in width. The roadway is currently restricted to government employees, contractors, and local ranchers.

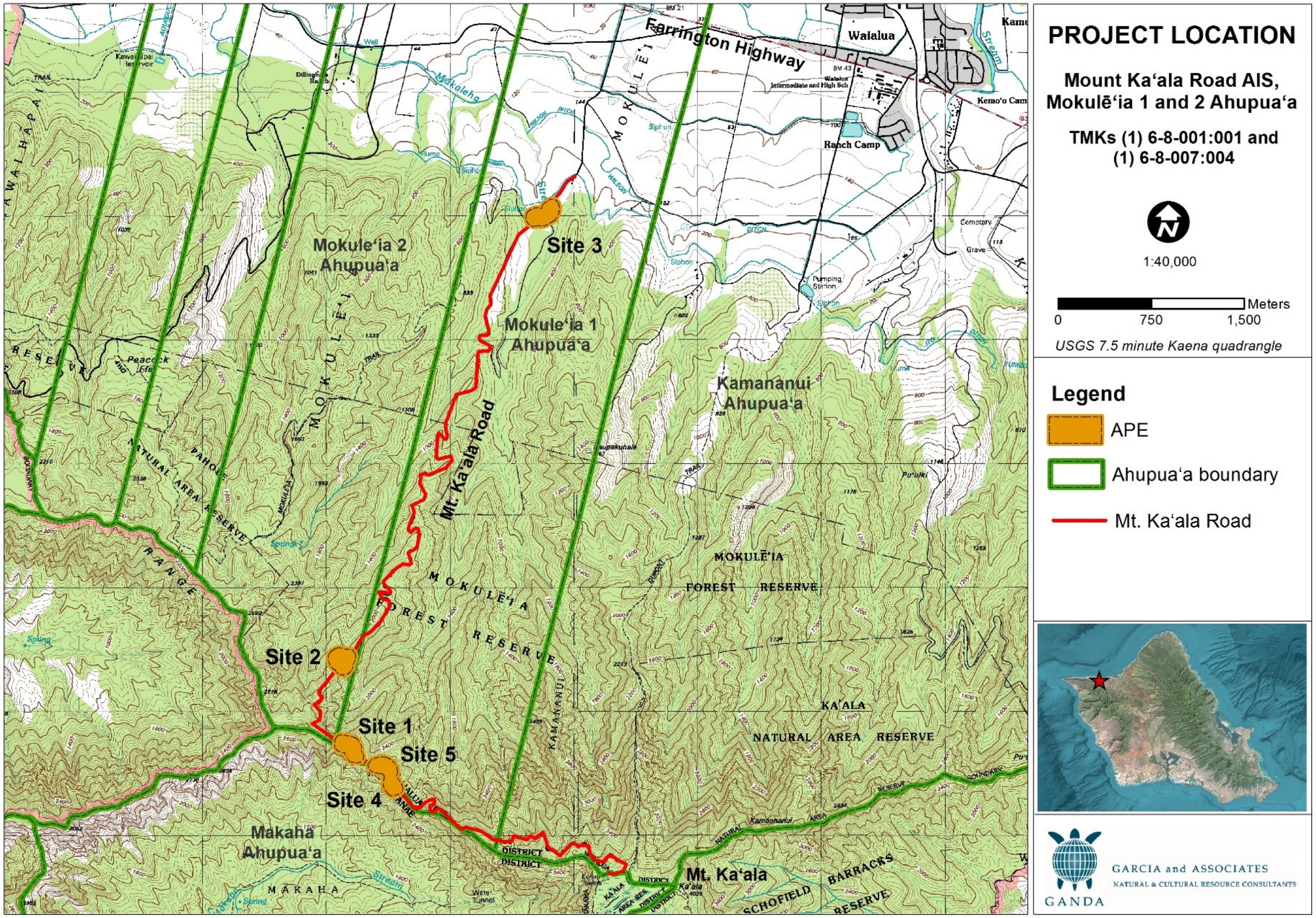

Figure 1. Five proposed road repair locales along Mt Ka‘ala Road.

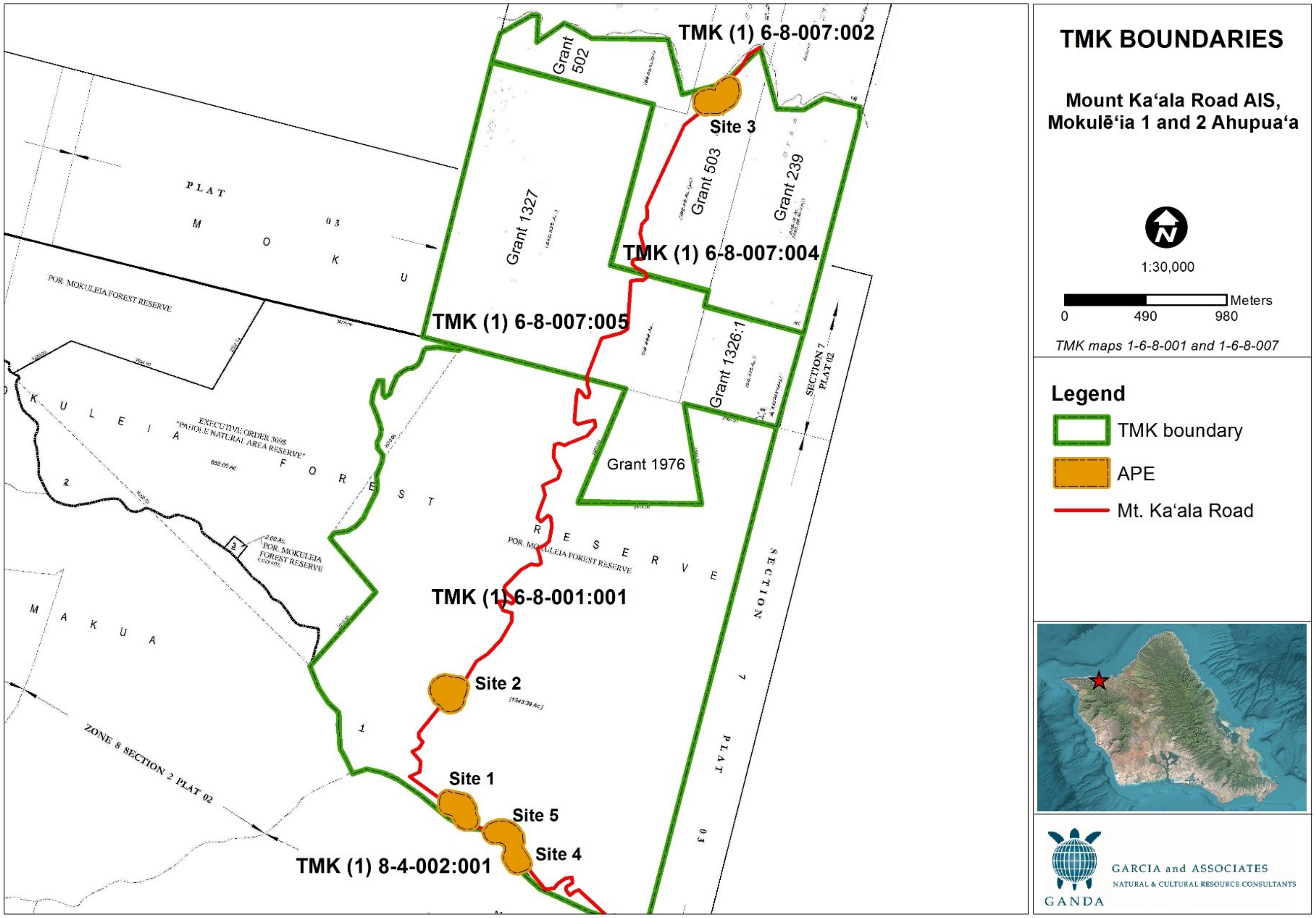

Figure 2. Project APE locales and TMK boundaries.

In 2015, the U.S. Army Corps of Engineers, U.S. Air Force, and the FAA conducted a site reconnaissance to assess existing roadway and slope conditions (USACE 2015). Five areas along the road were identified with adverse site conditions due to slope erosion, landslides, and instability that could potentially make the roadway impassable and cut off access to the FAA tracking station. Mitigation measures recommended to minimize adverse site conditions included: 1) removal of landslide material encroaching the roadway and: a) cutting back the 50 to 60-foot high slope, b) stabilizing the side mass with anchor or soil-nailed wall or, c) install a closely-spaced drill shaft wall barrier, 2) filling in areas where down slope erosion has compromised the road with compacted granular fill and, 3) removing debris on the upstream side of culverts and in the culverts, patching of washed out concrete, and miscellaneous repairs to restore the culverts to stormwater carrying capacity. These recommended activities, or some combination thereof, constitute the proposed undertaking.

The following are summary descriptions for each survey locale:

> Site 1 involves a deep landslide at the 2,700-foot elevation mark along Ka‘ala Road. The design moves and realigns the roadway away from the failed slope area. The new road realignment requires excavation of the upslope embankment to build the realigned road. Approximately 1700 cubic yards of excavated soils will be removed from the upslope embankment and then embanked at Site 3 within the new graded ramp area.
>
> Site 2 involves a landslide at the 2,200-foot elevation mark along Ka‘ala Road. The design moves and realigns the roadway away from the failed slope area. The new road realignment requires excavation of the upslope embankment to build the realigned road. Approximately 2200 cubic yards of excavated soils will be removed from the upslope embankment and then embanked at Site 3 within the new graded ramp area.
>
> Site 3 is the existing steel culvert crossing at Makaleha Stream at the 240-foot elevation mark along Ka‘ala Road. The existing stream crossing consists of seven 60-inch diameter corrugated metal pipes overlain by a 12-foot-wide asphalt paved roadway.
>
> Areas both upstream and downstream of the steam crossing will be grubbed and cleared of accumulated debris. Approximately 3900 cubic yards of excavated soils from Site 1 and 2 (combined) will be embanked along the shoulder of Ka‘ala Road to build a new graded ramp for maintenance equipment access into the streambed of Makaleha Stream. The current lack of access appears contributory to the accumulated debris and heavy vegetative overgrowth impeding stream flow through the existing steel culverts.
>
> Site 4 and Site 5 are between Culvert 40 and Culvert 42 near the 4.5-mile mark. Site 4 is about 2,665 feet in elevation and Site 5 is about 2,697 feet in elevation. Site 4 and Site 5 are in close proximity to one another with overlapping buffers and were therefore surveyed as a single area. The steep road cut on the upslope of the roadway of Site 4 and Site 5 has eroded over time, leading to an unstable slope face which constantly slides onto the roadway. The proposed road repair involves cutting back the slope to

increase stability. The areas of direct impact are about 0.68 acres for Site 4 and 1.49 acres for Site 5.

1.3 Area of Potential Effect (APE)

The APE for the Mt. Ka‘ala Road repair undertaking includes both the areas within which direct impacts are expected to occur, as well as a 50 m buffer around each area. For the purposes of Section 106 consultation, the APE for the undertaking extends to the limit of the 50 m buffer. However, it should be noted that this is a very generous buffer and the likelihood of impacts this far out are quite small. The buffer was established primarily to account for potential impacts to biological resources, including birds and land snails.

The five proposed road repair locales have a combined area of 39.61 acres (16 hectares), which includes 1.45 km of road length. Within the broader APE, direct impacts are expected to occur in a much more restricted area, on the order of 7.92 acres in total. Size data for individual repair locates is presented in Table 1 below. Note that locales 4 and 5 are combined for some statistics, as well as in many places throughout the report, since their APEs overlap. For archaeological survey purposes, they represent a single survey unit.

2.0 BACKGROUND

The following background section presents environmental, historical, and archaeological information pertinent to the project area. This information provides a contextual framework within which cultural resources identified during the archaeological inventory survey can be interpreted and evaluated for significance.

2.1 Environmental Setting

Mt. Ka‘ala Road, the principal organizing feature of the undertaking, rises from and elevation of 80 meters (m) above mean sea level (msl) to an elevation of 1,227 m above msl at the FAA tracking station. With the exception of Locale 3, which is located at on the lowlands at the

Table 1. Summary Statistics for Proposed Road Repair Locales

Locale	Area of Direct Impact (acres)	APE with buffer (acres)	Road Distance within APE (m)	Elevation (m amsl)
1	1.64	8.90	305	838
2	2.13	9.09	370	688
3	1.98	9.85	345	80
4	0.68	11.77 (combined due to overlapping buffers)	430 (combined due to overlapping buffers)	812
5	1.49			822
Total	7.92	39.61	1450	n/a

foot of the Wai‘anae Mountain Range, the road repair sites are in the middle to upper elevation zones, running along the ridglines of the Wai‘anae Mountains. In these areas, Mount Ka‘ala Road is cut into very steeply-side mountain slopes, averaging 60 degrees or greater.

Soils within the APE primarily consist of Kawaihapai very stony clay loam 0–15 percent slopes and Kemoo silty clay 12–20 percent slopes (Figure 3). The Kawaihapai soil series are characterized as being well drained soils formed in alluvium derived from basic igneous rock (Foote et al. 1972:64). Kawaihapai very stony clay loam is especially noted for the presence of enough stones to make cultivation impractical. The runoff is medium and the erosion hazard moderate. The Kemoo soil series are characterized as being well drained soil on the uplands of the island of O‘ahu that developed from material weathered from basic igneous rock (Foote et al. 1972:69). The permeability Kemoo silty clay 12–20 percent slopes is moderate to moderately rapid. Runoff is medium and the erosion hazard moderate. A small section of the western area of Locale 3 consisted of Kemoo silty clay 35–70 percent slopes. While the development of these soils is similar to Kemoo silty clay 12–20 percent, they occur on the sides of slopes and drainage ways. Runoff is rapid and the erosion hazard is severe. Rainfall data collected from *Rainfall Atlas of Hawai‘i* indicates that the foothills of the Waianae Mountains in the vicinity of Locale 3 receive a mean annual rainfall of 98.7 cm with 70 percent occurring between October and March (Giambelluca et al. 2013).

Locales 1, 2, 4, and 5 are located further up the ridge along Mt. Ka‘ala Road at elevations between 600 and 760 m. Soils along the steep ridge line consist of Rockland and the Tropohumults-Dystrandepts association. Rockland is made up of areas where exposed rock covers 25 to 90 percent of the surface. This land type can be nearly level to very steep and is characterized by having very shallow soils. The Tropohumults-Dystrandepts association occurs in the mountainous areas of the Wai‘anae Range at elevation from 1,000 to 4,000 ft (Foote et al. 1972:122). Tropohumults soils are well drained strongly acidic soils that occur on narrow ridges and have a surface and subsoil layer of silty clay underlain by saprolite. Dystrandepts soils occur on narrow ridge tops and steep side slopes. These soils formed primarily from volcanic ash mixed with colluvium. Most of this soil association is very steep and inaccessible. The mean annual rainfall in the vicinity of Locales 1, 2, 4, and 5 on the along upper ridge at an elevation of 760 m is approximately 179.7 cm (Giambelluca et al. 2013).

2.2 Pre-Contact Settlement Sequence

The following discussion of the pre-Contact Period follows the four-period chronological sequence model proposed by Kirch (2010:128). This is a reconfiguration of an earlier sequence posed by Kirch (1985:298) and is based largely on recent reviews of radiocarbon dates from key archaeological sites. This sequence is presented merely as an organizational tool under which important aspects of pre-Contact occupation can be discussed.

The four-period sequence starts with the Foundation Period (AD 1000–1200), which is characterized by initial settlement of the archipelago in ecologically favorable windward valleys and coastal areas where water and marine resources were plentiful. These sites were isolated and occupied by small populations. This is followed by the Early Expansion Period (AD 1200–1400), which is characterized by marked population increase, technological change, subsistence-based

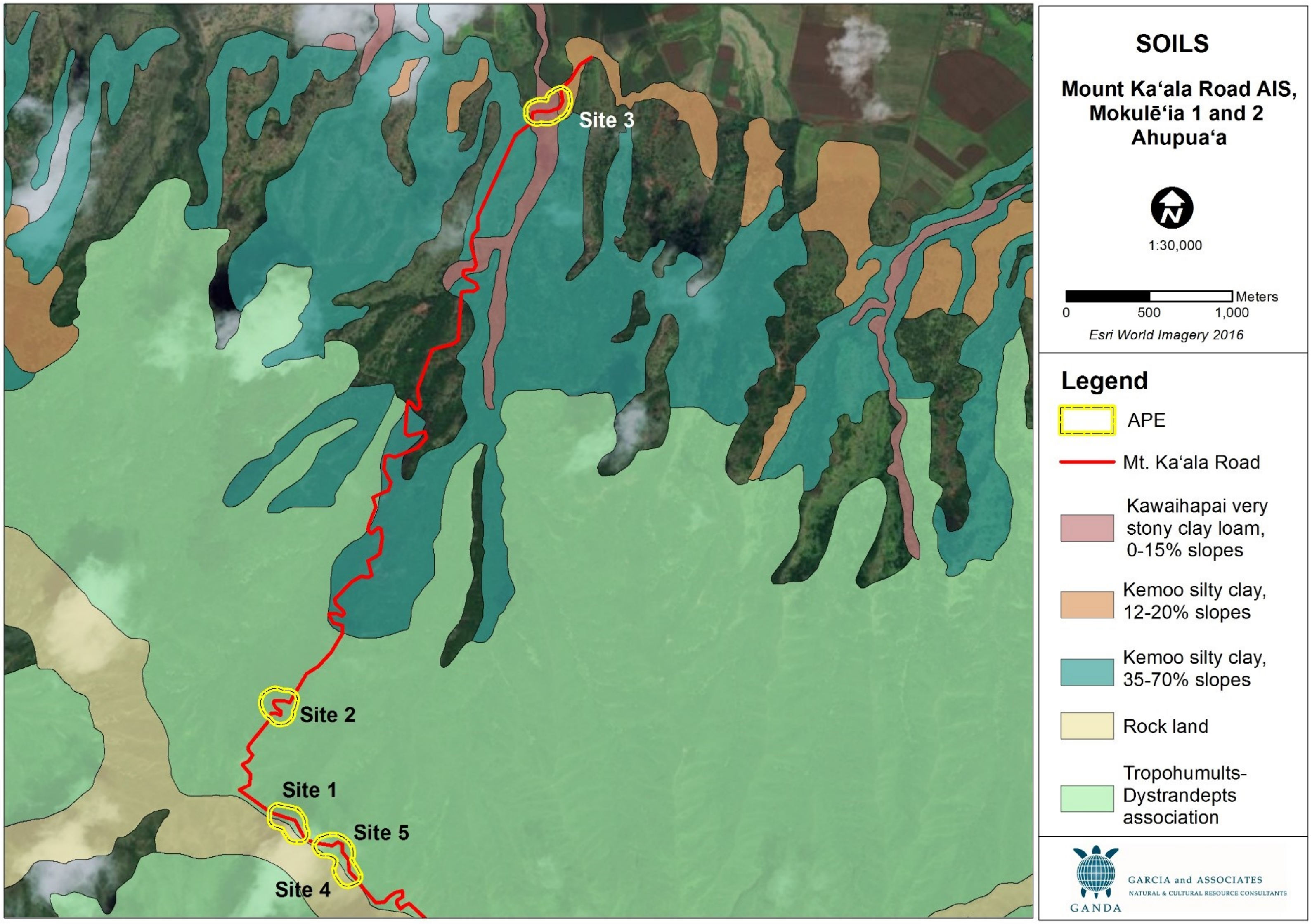

Figure 3. Project area soils.

adaptations to local environments, and the development of large irrigated taro systems. The third period is the Late Expansion Period (AD 1400–1650) and is characterized by the firm establishment of communities within the ecologically favorable and resource-rich areas of the windward coast and valleys, substantial increase in population, and the resulting socioeconomic stress as these resource-rich areas reached their carrying capacity. This period is also marked by an increase in social stratification, expansion into marginal zones of the islands, intensification of *mauka* dry land agriculture, monumental architecture, and the emergence of archaic states. The Protohistoric Period (AD 1650–1778) is the final pre-Contact period and is characterized by large stable populations with people occupying all ecological zones of the islands, intensification of the dryland field systems, and endemic conquest and warfare (Kirch 2010:128).

2.3 *Mo'ōlelo* of Mokulē'ia

According to *Place Names of Hawai'i*, Mokulē'ia literally translates as "isle [of] abundance" (Pukui et al 1974:155). Polipoli is where the first of the three streams meets the ocean in Mokulē'ia. Soft porous stones from this area were used for polishing wood surfaces and as sinkers for squid lures (Clark 1977:107). In the eastern portion of the *ahupua'a*, near Mokulē'ia Beach Colony, the *ko'a* (fishing shrine) Kolea, refers to the Hawaiian name for the Pacific Golden Plover (*Pluvialis fulva*). East of Polipoli Stream is a large bay called Kaiahulu, which translates as "the foamy seas." Two streams flow into Kaiahulu Bay: Kapala'au, "the wooden fence," and Makalena, "to look about in wonder or admiration." Alternatively, a second interpretation comes from the name *moku-leia*, from the saying "*Moena pāwehe o Mokulē'ia*" meaning "the patterned map of Mokulē'ia." This is in reference to the landscape of patterned agricultural fields covering the Mokulē'ia lowlands (Pukui 1983:161).

Mo'ōlelo about Mokulē'ia often concern marine resources, fishing practices, and ceremonial rites related to fishing. During archaeological survey of O'ahu in the 1920s and 1930s, four *ko'a* were recorded in Mokulē'ia (McAllister 1933). The Hawaiian god Kāne'aukai first revealed himself to the people in Waialua and a *mo'ōlelo* tells of the appearance of Kane'aukai before two fishermen, who then prayed to him for bountiful fish:

> One morning on going out upon the seashore they found a log of wood, somewhat resembling the human form, which they took home and set in a comer of their lowly hut, and continued their habit of praying to Kaneaukai. One evening, after having prepared a scanty supper of poi and salt, with perhaps a few roasted kukuinuts, as a relish, and a couple of cocoanut cups of awa as their usual drink, they saw a handsome young man approaching, who entered their hut and saluted them. He introduced himself by saying, "I am Kaneaukai to whom you have been praying, and that which you have set up is my image; you have done well in caring for it."
>
> He sat down, after the Hawaiian custom, as if to share their evening meal, which the two old men invited him to partake of with them, but regretted the scanty supply of awa. He said: "Pour the awa back into the bowl and divide into three." This they did and at once shared their meal with their guest.
>
> After supper Kaneaukai said to the two old men, "Go to Keawanui and you will get fish enough for the present." He then disappeared, and the fishermen

> went as instructed and obtained three fishes; one they gave to an old sorceress who lived nearby, and the other two they kept for themselves.
>
> Soon after this there was a large school of fish secured by the fishermen of Mokulēʻia. So abundant were the fish that after salting all they could, there was enough to give away to the neighbors; and even the dogs had more than they desired. [Thrum 1998:251]

The variety of marine resources available at Mokulēʻiea was also described by the fishermen:

> The fish that frequented the waters of Mokulēʻia are the aweoweo [bigeyes; Priacanthus sp.], kala [surgeonfish; Naso sp.], manini, [surgeonfish; Acanthurus sp.] and many other varieties that find their habitat inside the coral reefs. Crabs of the white variety burrowed in the sand near the seashore and were dug out by the people, young and old. The squid also were speared by the skillful fishermen, and were eaten stewed, or salted and sun-dried and roasted on the coals. [Thrum 1998:250]

The *kahala* (amberjack, *Seriola dumerili)* is also mentioned in *moʻōlelo*, such as the *Legend of Kiialiʻi* and the *Legend of Maikoha*. The word *mokulēʻia* itself is a rarely used alternate name for this fish (Pukui and Elbert 1986:252). The *Hinalea Fish Basket* also takes place in Mokulēʻia. Kalamainuʻu, a *moʻo* or goddess, who resided in a cave in the Waileʻa Valley in Mokulēʻia desired a husband. She lured Punaʻaikoaʻe, a chief of Kapaʻa, Kauaʻi, from Kauaʻi to her cave in Mokuleʻia one day when he was surfing:

> They went to her home in Makaleha where sweet potatoes and both the kihi and lapa varieties of taro grew abundantly and there was plenty of poi, ʻawa and bananas. The woman supplied the fish of that land that was usually caught by torching, the kumu, the uhu (lobster), and all kinds of fish. [Kamakau 1870, in Sterling and Summers 1978:101]

The Wind Gourd of Laʻamaomao (Nakuina 1992) tells of the offshore winds of Mokulēʻia. A special gourd contained all the winds of Hawaiʻi. On still days, these winds could be summoned by calling their names. The gourd was considered an embodiment of Lono, the Hawaiian god of fertility and agriculture, who was also associated with winds, clouds, and rain. Laʻamaomao, the Hawaiian wind goddess, passed the gourd down to her granddaughter, who then passed it thorough her lineage to Pakaʻa and his son Kaʻa Pakaʻa, attendants to the high chief, Keawenuiaumi. In Waialua:

> The wind of Ka ʻena turns in two directions,
> Hinakokea is of Mokuleʻia,
> The winds of Waialua blow,
> Moving silently at the cape of Ka ʻena [Nakuina 1992:51]

2.4 Traditional Land Use History

The traditional Hawaiian economy, which was typical throughout the islands, was focused on agricultural production, coastal exploitation of marine resources, and the collection of wild plants and animals (Kirch 1985:2-3). The native people cultivated a wide variety of cultigens, the most important being taro (*Colocasia esculenta*) and sweet potato (*Ipomoea batatas*). Taro was grown wherever there was adequate rainfall or water. River valleys, where pond fields could be irrigated, provided ideal conditions for growing taro and were among the most agriculturally productive. Dryer areas which could not support taro cultivation were planted with sweet potato. Other cultigens were also grown including arrowroot (*Tacca leontopetaloides*), sugarcane (*Saccharum officinarum*), ti (*Cordyline terminalis*), banana (*Musa paradisiacal*), and coconut (*Cocos nucifera*). The coastal exploitation of marine resources centered on fishing, the collection of *limu* (seaweed) and marine invertebrates, salt production, and aquaculture. The construction of fishponds along the coast was a unique and advanced innovation that was developed to trap and raise fish such as mullet (*Mugil cephalis*) and milkfish (*Chanos chanos*) that supplemented other resource exploitation actives. While the construction of a fishpond was a labor intensive investment, the fishponds productive yield guaranteed a steady supply of fish. The *mauka* areas beyond the limits of agriculture also provided a wide range of natural resources. Use of these upper areas included the collection of wild plants for subsistence, medicinal, and ceremonial purposes, and the collection of wild fauna. These areas were also noted as a locus for the collection of bird feathers, especially from the *ʻōʻō* (*Moho nobilis*), *ʻiʻiwi* (*Vestiaria coccinea*), and *ʻapapane* (*Himatione sanguinea*). These species provided colorful features, a particularly powerful symbol of chiefly power. Ornately decorated goods with feathers including ʻ*ahu ʻula* (feathered capes), *mahiole* (helmets), and *akua hulu manu* (feathered gods) were a direct measure of a chiefs power and influence (Valeri 1985:246).

Handy (1940) conducted a study of cultivated plants during the 1930s and described the vast terraced landscape of the Mokulēʻia lowlands:

> There are two extensive old terrace areas in Mokulēʻia on the flat land near the sea. One is just below Dillingham Ranch, watered by an underground flow from a gulch west of the ranch house. This area of old terraces is now entirely planted in Chinese bananas. The other large area, which is now planted mostly in bananas but partly in cane, is seaward of Makaleha Stream. Wild taro grows in Makaleha Valley and its subsidiaries. Kamakau speaks of the "abundance of food grown in Makaleha, of the kihi and lapa varieties of taro, of sweet potatoes, awa, bananas…" [Handy 1940:85]

In a later description of the area, Handy and Handy (1972:467) wrote:

> Beyond Waialua Bay the coast juts directly westward at a sharp angle from the northerly shoreline, and the land narrows between the sea and the northwest end of the Waiʻanae range. Essentially this was sweet-potato county, but there were at least two extensive *loi* areas in the land strip named Mokulēʻia near the sea. One of these was watered by underground flow originating in a gulch. The other received its water from Makaleha Stream, in whose valley we found an abundance of wild taro in 1935. Makaleha was once famous for its sweet potatoes, bananas and ʻ*awa*. [Handy and Handy 1972:467]

2.5 Historic Land Tenure

In 1804, following the death of Keʻeaumoku, the responsibility of the governing chief of the Waialua District was past to his son Kahekili Keʻeaumoku also known as George Cox. Kahekili Keʻeaumoku was the high chief of the Waialua District for twenty years until his death in 1824.

Waialua was inherited by Ke‘eaumoku’s sister Lydia Kekuapi‘ia Nāmāhana also known as Pi‘ia. Following her death in 1829, the Wailua District was passed to Queen Ka‘ahumau who appointed Nāmāhana’s husband La‘anui as the land overseer. Queen Ka‘ahumau passed away in 1832 willing all of her land holding to her niece, Kīna‘u. After Kīna‘u‘s death in 1839, certain lands in Waialua as well as many other lands throughout the islands were inherited by her daughter Victoria Kamāmalu (Kame‘eleihiwa 1992:106, 120-124).

In 1848, the Māhele instituted a change from the traditional Hawaiian system of land tenure to a system based on the western concept of fee-simple ownership. During the Māhele, the Hawaiian chiefs and *konohiki* were required to present their claims to the Land Commission and receive awards for the land quit-claimed to them by Kamehameha III. Until an award for these lands was issued, the title remained with the government. A land commission award (LCA) gave complete title to the lands with the exception of the government’s right to commutation. Upon satisfaction of the commutation, which could be settled by a cash payment or through the exchange of land of equal value, a Royal Patent was issued by the minister of the interior. A Royal Patent quitclaimed the government’s interest in the land and served as proof that the government’s right to commutation no longer existed. The *Kuleana* Act of 1850 provided a framework by which native commoners could apply for and be granted land to sustain their livelihood, however, the restrictions of the act made it difficult to receive a land award, thereby discouraging Hawaiians who did not actively cultivate land. The Act of August 10, 1854 provided for the dissolution of the Land Commission so that a LCA recipient was still protected if they had not obtained a Royal Patent (Chinen 1958:13–14). This act stated that “a Land Commission Award shall furnish as good and sufficient a ground upon which to maintain an action for trespass, ejectment, and other real action, against any person or persons, whatsoever, as if the claimant, his heirs or assigns, had received a Royal Patent for the same” (Chinen 1958:14). The Māhele represents a significant shift in Hawaiian land use history with the drastic change from a redistributive economy to a market based system which resulted in decline of native land tenure and opened the way for wealthy foreign investors to purchase land.

In order to satisfy the requirement to pay the government commutation for land claims, Victoria Kamāmalu surrendered her Waialua lands including Mokulē‘ia, Kamananui, Kawaihāpai, Keālia, and Ka‘ena in order to claim all of her other land holdings. These *ahupua‘a* became government lands and assigned to the government land inventory.

In 1884, certain government lands were available for purchase. A total of 27 land grants were awarded in the *ahupua‘a* of Mokulē‘ia. Land grants in the project area vicinity were long, narrow rectangular pieces of land that ran *mauka-makai*. Each contained two parcels, one from the shoreline to the forest reserve line, and a second that continued to the mountains. The missionary John Emerson advised many of the native Hawaiians in Waialua to purchase their land and withdraw from the *Māhele,* not prosecuting their claims through the Kuleana Act of 1850. This enabled them to obtain residential and agricultural lots, in addition to pasturage and upper forest lands, which were usually not awarded as *kuleana* claims (Sahlins 1992:168). In 1850, a law was passed that allowed foreigners to purchase land in fee simple. William Emerson and John T. Gulick, both descendants of missionaries, were the first foreigners to buy land in Mokulē‘ia Ahupua‘a. Over several years, Emerson purchased property in Waialua from the original grantees or later owners until he owned 2,605 acres in the district (Alameida 1993:xii).

2.6 Cattle Ranching and Commercial Agriculture

Cattle ranching and commercial agriculture, specifically sugarcane cultivation, was a major influence in the region which contributed to vast changes to the traditional landscape. Cattle were introduced to the lowlands of Waialua by the 1840s (Sahlins 1992:148). In 1897, B.F. Dillingham controlled the Kawailoa Ranch, which included over 2,000 head of cattle and over a hundred horses and mules on 10,000–acres of land (Yardley 1981:193). In addition to the ranchlands he also controlled the James Gay Estate, the Gaspar Silva Ranch, and others, giving him 7,000 acres in Waialua to lease for sugarcane production. The following year, Dillingham extended his railroad, from the southwest shore, around Ka‘ena Point, across the north shore, passing the current project area in Mokulē‘ia, to the Halstead Sugar Mill at Waialua (Yardley 1981:191–199). At the turn of the 20th century, sugarcane plantations covered the district of Waialua. Dillingham did hold on to his personal ranch "a great strip of mountainside and beaches with flat land in between and a homestead in the middle" (Yardley 1981:206), which was located directly inland from the current project area. The land continued to be used as ranch land, with sugar plantations to the east and west.

By 1922, the railroad traveled the same corridor as the current Farrington Highway. In the vicinity of the project area there was a railroad station (0.5 km to the east), several streams, and a few houses dotting the landscape between the railroad and the coast. Fences, stone walls, roads, and buildings appear throughout Mokulē‘ia and surrounding *ahupua‘a.* A large expanse of land being cultivated for sugarcane and a rail line continued inland from Mokulē‘ia Station to Dillingham's plantation.

In western Waialua, just outside the project area, the U.S. military began development at the beginning of the 20th century. Kawaihapai Military Reservation was established ca.1927 at the site of the present Dillingham Airfield. Residences also began to appear adjacent to the westside of the current project area at some point between 1927 and 1942. After the U.S. entered World War II, the Kawaihapai Military Reservation was expanded and renamed the Mokulē‘ia Airfield (Payette 2003). As the war continued the airfield was expanded, and by April 1942 contained an 8,000–foot runway, which was later expanded to 9,500 feet. The Battery Dillingham was also constructed, which was in use from 1942–1944 (Payette 2007). Mokulē‘ia Airfield became Dillingham Air Force Base when the U.S. Air Force was created in 1947. The base was deactivated in 1948 and only used for U.S. Army training activities. In 1975, the Department of the Air Force transferred ownership of Dillingham Military Reservation to the Department of the Army, who leased the airfield to the State of Hawai‘ i for management and operation of a general aviation airport. Dillingham Airfield is currently used for small private planes and commercial glider tours, and skydiving operations.

The Oahu Railway and Land Company discontinued service in 1947, which prompted the Waialua Agricultural Company to use truck transportation. This was a gradual transition until 1952 when the line closed permanently. Historic maps and aerial photographs show stagnation in development through the 1970s and indicate the current project parcel remained undeveloped (Tulchin and Hammatt 2007:34–37). Railroad lines were replaced by roads, and the lands occupied by the Crowbar Ranch, Campbell Ranch, and Dillingham Ranch were consolidated under the control of the Mokulē‘ia Land Company. The Dillingham Ranch to the south of the project area, just across Farrington Highway, is a horse and cattle ranch with equestrian stables and activity areas on the coastal plain while the foothills are used as pasture for grazing cattle. The Dillingham residence is still present, along with a coconut and palm tree farm (Tulchin and Hammatt 2007:34).

2.6.1 Mt Kaala Ranch

No history has been written of Mt Kaala Ranch, and it appears to have changed ownership and management frequently over the years. Most available information comes from an oral interview with Paniolo Eddie Silva from 2003 (Appendix A). Mr. Silva held the lease to 1,400 acres of Mt. Kaala Ranch at the time, and had been worked the land for most of the twentieth century. The land was originally under the ownership of the Medonsa Estate, but was leased to other ranchers including Ted Vierra and one of Mr. Silvas' brothers. Ultimately, the Medonsa Estate sold the lands to Castle and Cooke, who continued to lease the ranch lands. Among Hawaiʻi ranches, Mt Kaala Ranch is extremely modest, supporting no more than 200 head of cattle. Despite rain in the high elevations, the valley bottom is typically dry and water is as a perennial issue. The ranch never developed the lore associated with other important ranches, and appears to have been little more than a parcel in search of profit for most of its existence.

2.7 Accessing the Mount Kaʻala Summit

Modern efforts to access and utilize the summit of Mount Kaʻala began in 1940 when military officials concluded that there was a critical need for aircraft warning stations in Hawaiʻi. A local board of officers conducted a 10-week study of the five principle islands and determined that due to the configuration of the archipelago detecting approaching aircraft from the north, northeast, south and southwest would be difficult until the planes were very close. Their report indicated the need for three fixed radar stations and suggested they be located at Kōkeʻe, Kauaʻi; Haleakalā, Maui; and Kaʻala, Oʻahu (Dod 1966:16). In June 1940, the War Department authorized construction of the radar stations. The Mount Kaʻala station was considered the most important link within the radar chain and by September 1940, the 3rd Engineers began working on an access road to the summit. The Kaʻala station proved the most difficult of the three radar stations to construct due to the rugged, steep, and in some areas practically inaccessible terrain. The initial access road which started near the firebreak trail on the Schofield Barracks side of Mount Kaʻala was abandoned due its proximity to an active artillery range (Terrett 1954:302). In Febuary 1941, the engineers decided that the easiest way to access the summit would be to construct a cableway that could ferry construction material and personnel to the radar site. By late November 1941, the radar housing station was completed. Unfortunately, the radar station was not in operation during the Japanese attack on December 7, 1941 as the station still lacked all of the radar components (Thompson 1985:81). After the radar equipment was installed and the station operational, it was determined that the radar site was too high and unsatisfactory for close aircraft detection. Subsequently, the army abandoned the Kaʻala facility.

During the early 1960s, plans were developed to construct a new joint-use radar facility at the summit of Mount Kaʻala that would be manned by the Hawaiʻi Air National Guard and the FAA. The area of the previous radar facility was leased from the army. The daunting task proposed in the plans of the new radar station was the construction of a paved road to the summit. R. M. Towill and Associates was contracted to design and construct the access road. The seven-mile access road branches off Farrington Highway in Mokulēʻia and rises to the Mount Kaʻala summit at 1227 m. Sections of the roadway have shear drops of over 300 m on either side of the road. In many areas, construction workers had to suspend themselves over the sides of the steep slopes from ropes. Construction of the road reached the summit of Ka‘ala on May 5, 1963 (Honolulu Advertiser 1963:1:2) and on March 5, 1964 the 1.2 million dollar road was completed and ready for use (Honolulu Advertiser 1964:B1:2). On July 2, 1965, the new radar facility was dedicated as Kaala Air Force Station and manned by the 169th AC&W Squadron of the Hawai‘i Air National Guard. The Station also known as “Red Buff” had an early warning mission which involved tracking and identifying all aircraft entering their space. Station controllers could then vector friendly fighters, correct course, and speed to intercept possible enemy aircraft. The station also provided long range radar support for the Nike Missile air defense system that was deployed during the Cold War.

2.8 Previous Archaeology

Gilbert McAllister conducted one of the earliest archaeological investigations in Hawai‘i. During his island-wide survey of O‘ahu McAllister documented or noted three sites in Mokulē‘ia. These include Poloaiae Heiau (Site 194), Kolea fishing shrine (Site 195), and a village site (Site 196). These sites were described as follows:

> Site 194. On the Kaena side of Dillingham’s ranch near the plantation reservoir in the western part of Mokuleia, is said to be an old heiau site. The straggling stone wall near a group of rather large rocks is covered with a dense growth of lantana. It is doubtful that this site was ever of importance, as it suggests a house site rather than the location of a heiau. Poloaiae is the name given to me of a former Mokuleia heiau about which nothing else is known. [McAllister 1933, cited in Sterling and Summers 1978:101]
>
> Site 195. Kolea fishing shrine (ko‘a) Mokuleia.
> The shrine is located on the beach in direct line with the Dillingham stables. The stones have been removed and only an indistinct line on stones 15 feet by 30 feet remains to mark the foundation. A stone in the water in front of Kolea was known as Mokupaoa. [McAllister 1933, cited in Sterling and Summers 1978:101]
>
> Site 196. In the valley near the mountain side of the Greenfield house was once evidently a large Hawaiian settlement. Old coconut palms and the dead trunks of others, portions of house sites, isolated sections of terracing, can still be found, despite the inroads of roaming cattle. Water freshets have also obliterated many remains. These sites are thought to have furnished the stones for the numerous walls, probably of later construction, on the hillside and in the valley. [McAllister 1933, cited in Sterling and Summers 1978:101]

2.8.1 Recent Archaeological Investigations Conducted in Vicinity of the Project Area

Four of the five site areas for proposed road repairs are extremely remote with the nearest previous archaeological study being conducted 2090 m east northeast at the at the Ka‘ala summit for improvements to the Mt. Ka‘ala Radio Facility (Hammatt and Shideler 2013) Archaeological investigations conducted near the proposed repairs to the Makaleha Stream crossing (Locale 3) have been heavily concentrated within the Dillingham Ranch (Figures 4 and 5). Table 2 presents the previous archaeological investigations conducted within two km of the current project areas.

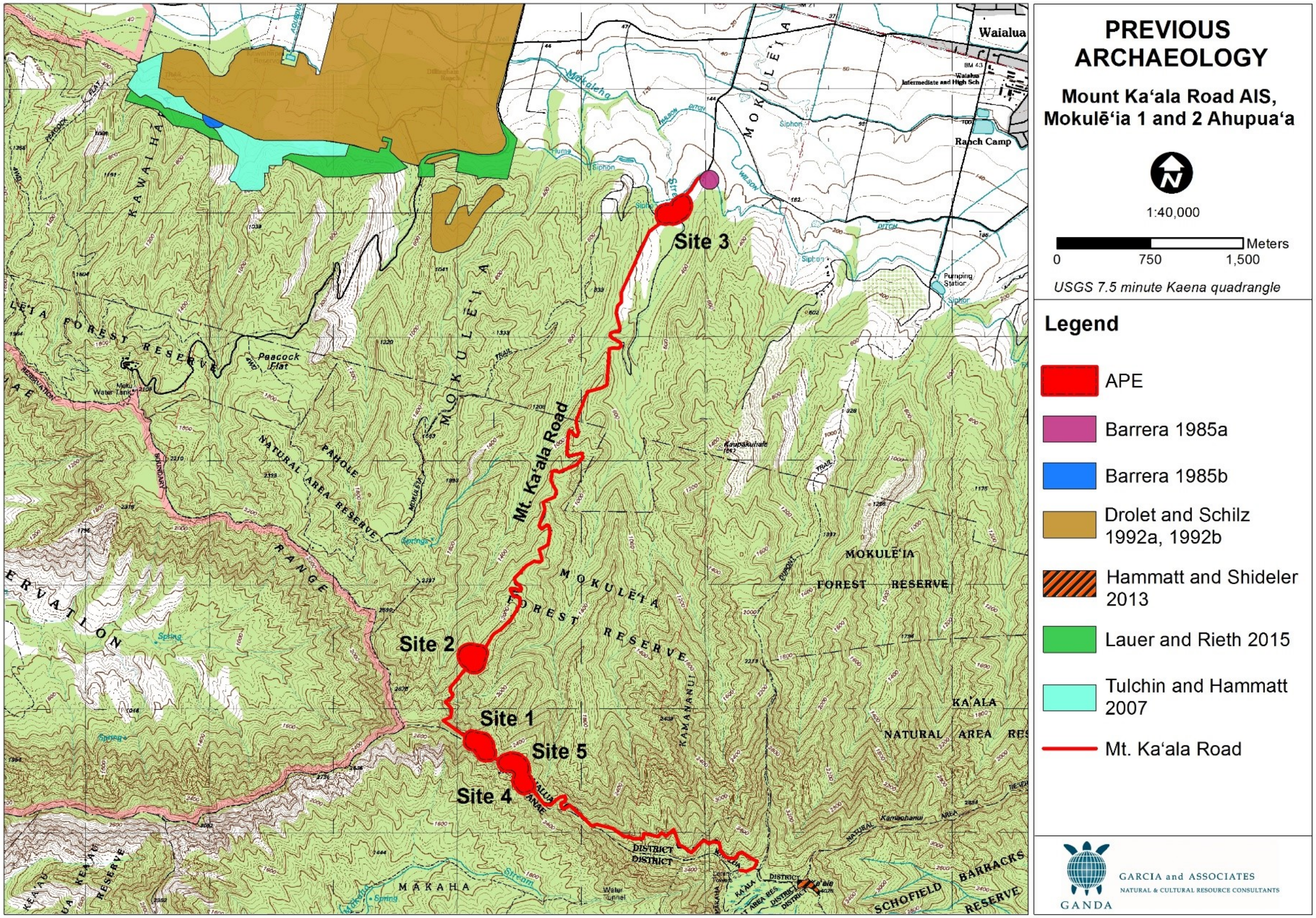

Figure 4. Previous archaeological studies in vicinity of project area.

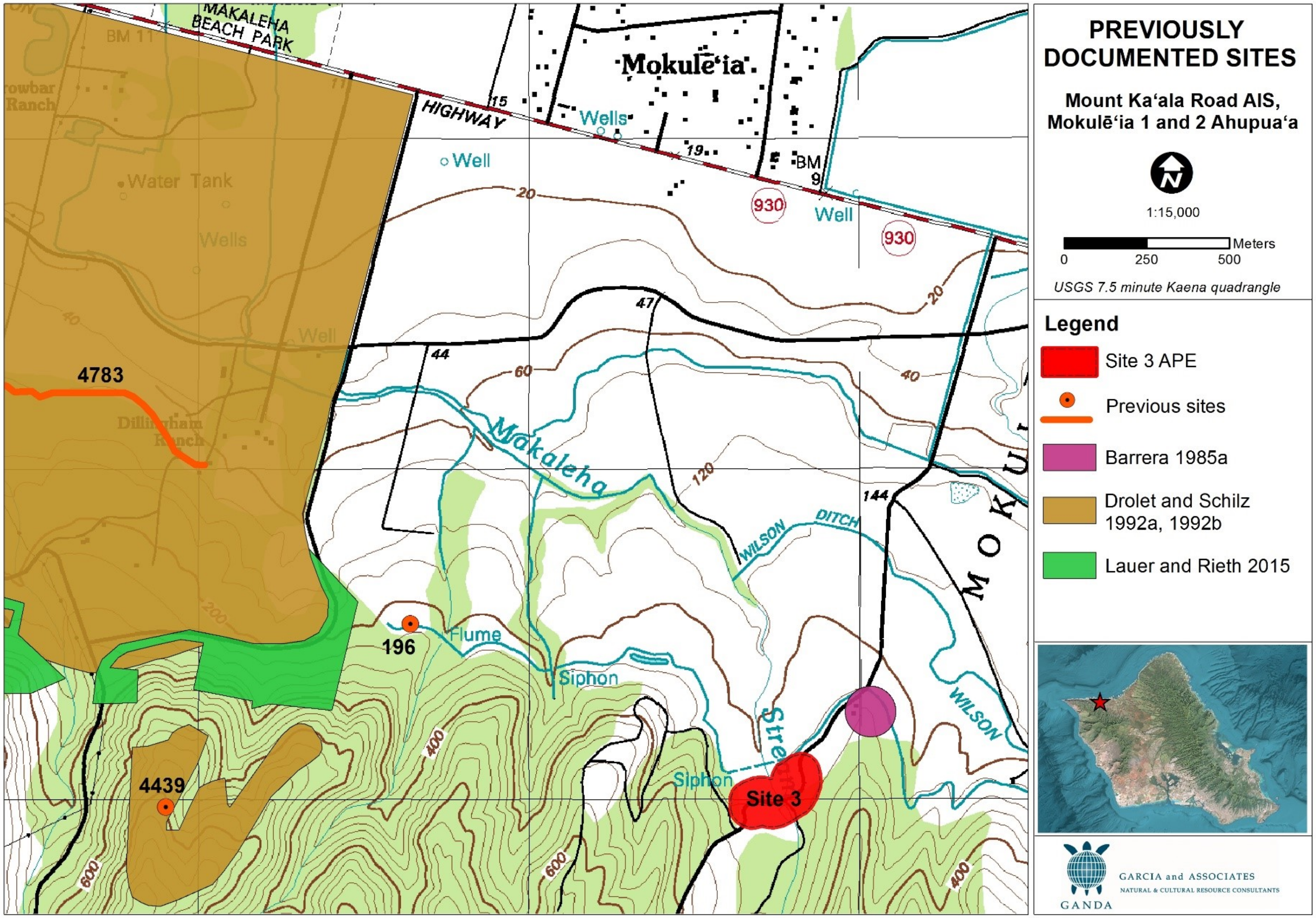

Figure 5. Previously documented sites in vicinity of the project area.

Table 2. Previous Archaeological Investigations Conducted in Vicinity of the Project Area

Reference	Nature of Study	Location	Results
Barrera 1985a	Archaeological survey	Mokulē‘ia	No findings
Barrera 1985b	Archaeological survey	Kawaihāpai	No findings
Barrera 1986	Archaeological reconnaissance survey	Dillingham Ranch	Identified two stone walls later relocated and documented by Drolet and Schilz (1992a, 1992b) and designated SIHP Nos. 50-80-03-4439 and 4785.
Kennedy 1987	Literature review and limited reconnaissance survey	Dillingham Ranch	Fieldwork noted the presence of two platforms. These were later relocated and documented by Drolet and Schilz 1992a and designated SIHP Nos. 50-80-03-4785 and 4786.
Mitchell 1987	Archaeological reconnaissance survey	Dillingham Ranch	Documented six sites. These sites were later designated and consisted of two stone walls (50-80-03-4439), a wall and a platform (50-80-03-4785), springs (McAllister Site 192), a wall and rock structures (50-80-03-4772), and terracing (50-80-03-0416).
Drolet and Schilz 1992a	Archaeological inventory survey	Dillingham Ranch	Recorded 15 sites with over 40 component features (50-80-03-4472 to 4486).
Drolet and Schilz 1992b	Archaeological inventory survey	Dillingham Ranch	Addendum survey recorded an additional four sites (50-80-03-4439 to 4442).
Tulchin and Hammatt 2007	Archaeological inventory survey	Dillingham Ranch	Documented five pre-Contact to early post-Contact sites (50-80-03-0416, 6884 to 6888).
Hammatt and Shideler 2013	Archaeological assessment	Mt. Ka‘ala Radio Facility	No findings.
Lauer and Rieth 2015	Archaeological inventory survey	Dillingham Ranch	Recorded one archaeological site consisting of four discontinuous ranching walls (50-80-03-7653) and one traditional cultural property consisting of two unmodified freshwater seeps (50-80-03-7793).

In 1986, Barrera conducted a two-day reconnaissance survey on the Dillingham Ranch property (Barrera 1986). During the survey, he identified two archaeological sites consisting of two stone walls. One wall was described as on the end of the ridge south of the ranch and the other being a portion of a historic paddock southeast of Kawaihāpai Reservoir. These sites were later rerecorded during subsequent archaeological projects (Drolet and Schilz 1992a and 1992b) and designated Hawaiʻi State Inventory of Historic Properties (SIHP) Nos. 50-80-03-4439 and 4785.

Kennedy (1987) conducted a literature review of previous archaeological studies done within and near Dillingham Ranch. The review included a two-day reconnaissance survey where two platform structures were identified and thought to be *heiau*. These sites were later recorded a second time during a subsequent archaeological project (Drolet and Schilz 1992a and 1992b) and designated SIHP Nos. 50-80-03-4439 and 4785. Based on the review of previous archaeological projects and the reconnaissance survey, Kennedy (1987), recommended that due to the high potential for archaeological resources within the Dillingham Ranch, intensive survey, subsurface testing, and historic background research be conducted prior to any development of the ranch.

In 1987, Rudy Mitchell conducted a reconnaissance survey of areas of the Dillingham Ranch that were proposed for residential development. The survey was done on horseback with local informants who knew of archaeological sites within the ranch. The reconnaissance survey identified six sites. Site 1 was a stone wall situated along a ridge south of the ranch previously documented by Barrera (1986) and later relocated by Drolet and Schilz (1992a and 1992b). Site 2 consisted of a large walled structure thought to related to WWII construction. Site 2 was located at the 1,100 ft elevation and south of the areas proposed for development. Site 3 consisted of a large walled structure and platforms situated within an enclosure south of the Kawaihāpai Reservoir previously identified by Barrera (1986) and Kennedy (1986) and subsequently documented by Drolet and Schilz (1992a and 1992b). Site 4 is described as McAllister's (1933) Site 192, the hidden water springs. Mitchell notes that the springs "were still producing water for the reservoir" (Mitchell 1987:3). Site 5 consisted of a large rock wall and numerous rock structures located south of the Kawaihāpai Reservoir. These archaeological features were based on informant information and later documented by Drolet and Schilz (1992a and 1992b). Site 6 also based on informant information is described as "a great deal of rock terracing" located at the base of the cliffs at the western end of the ranch (Mitchell 1987:4).

Drolet and Schilz (1992a) conducted the first intensive archaeological investigation at the Dillingham Ranch which included a pedestrian survey of 840-acre proposed for development and subsurface testing within the coastal plain areas of the parcel. The survey identified 15 archaeological sites consisting of 40 component features. Drolet and Schilz described the large site complexes as "settlement clusters" located in the foothills above the coastal plain to the base of the coastal cliffs. The sites documented largely consist of pre-Contact to early post-Contact habitation structures and structures associated with agricultural field systems. Drolet and Schilz noted that the settlement clusters were probably more extensive, however, past landscape changes from ranching and plantation agriculture likely removed evidence of the settlement clusters original extent. Twenty-eight trenches were excavated during the subsurface testing phase of the project. Test excavations produced no cultural material. Drolet and Schilz (1992b) conducted a subsequent addendum inventory survey of 53-acres on the Dillingham Ranch property. The survey documented four additional sites including the rock wall previously identified by Barrera (1986) assigned SIHP No. 50-80-03-4439. Three sites recorded in the western portion of the ranch include a remnant rock wall (50-80-03-4440), a 200 m stone wall with associated barbed wire fence (50-80-03-4441), and a terrace (50-80-03-4442).

Tulchin and Hammatt (2007) conducted an archaeological inventory survey of 78-acres within the Dillingham Ranch in areas not previously covered by Drolet and Schilz (1992a and 1992b) but a part of the Dillingham Ranch development plan. The survey recorded six sites consisting of 28 archaeological features. SIHP No. 50-80-03-6884 is comprised of four historic rock walls associated with ranching activities. SIHP No. 50-80-03-6885 is am agricultural complex consisting of three terraces and a retaining wall situated within a gully in the western portion of the ranch. SIHP No. 50-80-03-6886 and 6888 consist of agricultural complexes largely comprised of mounds and terraces located along a prominent hillside in the southwestern portion of the ranch. SIHP No. 50-80-03-6887 is a modified overhang shelter. The overhang was modified with the construction of a retaining wall and level terrace across the entrance of the overhang. In the northwestern portion of the project area the survey also documented six additional features of SIHP No. 50-80-03-416 previously documented by Rosendahl (1977) and Moblo (1991). The six features included rock walls, a terrace, and a mound.

In 2015, Lauer and Rieth conducted an archaeological inventory survey of three separate *mauka* areas totaling 85-acres within the Dillingham Ranch property. The survey documented one archaeological site and one traditional cultural property. SIHP No. 50-80-03-7653 consists of four discontinuous historic ranching walls. SIHP No. 50-80-03-7793 are two unmodified seeps located in the western survey parcel. These two fresh water seeps are in the general location of McAllister's (1933) Site 192, “Hidden Waters” springs and are considered a significant cultural property by some community members.

3.0 METHODOLOGY

The five proposed road repair locales were investigated using two basic archaeological survey methodologies, systematic parallel transect survey and “random-walk” survey. All survey was restricted to pedestrian inspection of the site area and ground surface and no subsurface testing was conducted.

Due to the very steep nature of the terrain surrounding the road, standard parallel transecting was not feasible for Locales 1, 2, 4 and 5. An alternative method, the random-walk approach, was utilized for these largely inaccessible areas. This randomized approach, although unstructured, provided excellent coverage of the surveyable portions of the locales, with direct inspection of nearly 100% of the surface of each locale. A randomized approach is often useful for avoiding bias against historic properties and features whose spatial structure may be in alignment with linear parallel transects. Since the surveyable portions of the road repair locales were limited in area, the randomized approach was appropriate and provided full coverage.

Locales 1, 2, 4, and 5 consisted of relatively level terrain on and near the roadway, as well as very steep terrain (often exceeding 60% slope) on the uphill and downhill sides of the road. The uphill sides typically consisted of exposed earthen slopes that were cut during road construction (Figure 6). These slopes are relatively stable, but subject to erosion and occasional collapse. The intact, vegetated tops of these cut-slopes were within the undertaking APE and were accessed whenever it was safe and practical to do so. This was the case for Locales 2, 4, and 5. The tops of the slopes consisted of very narrow ridge-lines, in some places no more than a meter wide (Figure 7). On the downhill side of the road, the APE dropped precipitously at Locales 1, 2, 4, and 5. This portion of the APE could be visually observed, but not directly accessed for safety reasons. It is safe to assume that these steep, nearly inaccessible slopes have a very low probability for containing historic properties.

Locale 3 consisted of a dry stream bed (Makaleha Stream) surrounded by a broad alluvial flood plain. This area was relatively level and suitable for a traditional transect survey methodology. Parallel, 10 meter-spaced transects were walked along a 240-degree bearing, roughly perpendicular to the axis of the stream bed. Visibility was moderate to poor due to substantial tall grass.

3.1 Site Documentation

Site recordation for this project was in accordance with the Secretary of the Interiors Standards for Archaeological Documentation. Identified historic properties were recorded at an inventory level consisting of plan-view mapping, photo-documentation, measurement, narrative description, functional and cultural affiliation assessment. Hawai'i State Site Numbers were obtained for all historic properties identified.

Figure 6. Steep slope cut (right) at Locale 5.

Figure 7. Top of uphill side of APE at Locale 4, with narrow ridge path and slope descending steeply on opposite side.

4.0 RESULTS

Five locales proposed for road repairs were surveyed. One historic site, a dry-stone retaining wall associated with historic Kaala Ranch, was recorded at Locale 3. All other road repair locales contained no evidence of historic properties. In most cases, the entire APE could not be accessed due to extreme slope conditions.

4.1 Road Repair Locale 1

The roadway at Locale 1 is oriented west/northwest by east/southeast and extends downhill turning 60 degrees to north/northwest (Figure 8). The road is bounded by a very steep to nearly vertical earthen slope on the southwestern side and a very steep downhill slope along the northeastern side (Figures 9 and 10). Survey along the northeastern side of the road was limited to narrow transects along shoulder of the road and visual inspection of the steep down slope. The shoulder along the northeastern side of the road was 1 to 3 m wide along the length of the survey area. The material that comprises the northeastern shoulder of the road appears to have been pushed over the edge likely during the initial construction of the road. Survey along the southwestern side of the road was limited to visual inspection of the slope top since there were no areas where the top of the slope could be safely accessed.

No historic properties were observed along the roadway within Locale 1.

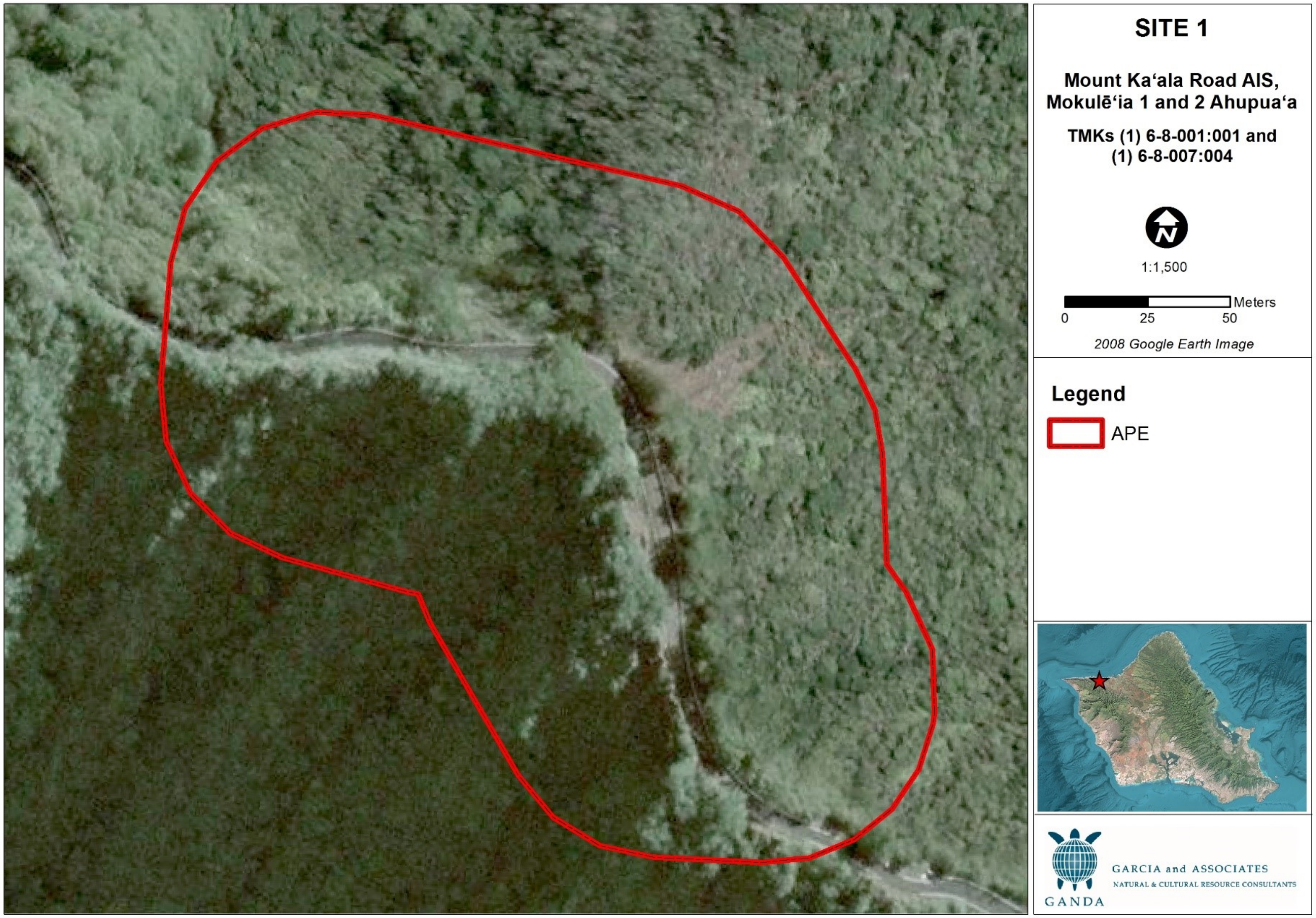

Figure 8. Aerial view of Locale 1.

Figure 9. Locale 1, view to east.

Figure 10. Locale 1, view to northwest.

4.2 Road Repair Locale 2

The roadway at Locale 2 is oriented east/west and extends downhill where the road makes a u-turn at Culvert 32 (Figure 12). The road is bounded by a steep upward slope on the southern side (Figure 11). As the road makes a U-turn at Culvert 32, the upward slope is on the northern side of the road. This area can be imagined as the inside of the u-turn. The vegetated slope top on the inside of the u-turn was safely accessed at road level and quickly rises to a height of 15 m. The top of the slope was wide at 10 m in some areas before sharply sloping to the road below on both sides. On the opposite side of the road or outside the u-turn, the road is bounded steep upward slope on the southern side of the road. This slope steeply declines where the road makes the u-turn then sharply rises on the northern side of the road. Survey along the outside of the u-turn was limited to visual inspection because there were no areas that could be safely accessed. No historic properties were observed along the roadway within Locale 2.

4.3 Road Repair Locale 3

Locale 3 is centered on an approximately 210 m-long section of Ka‘ala Road, 40 m of which is taken up by a series of six culverts spanning Makaleha Stream (Figure 13). Survey transects were walked parallel with the stream on a 240-degree bearing. The *makai*[1] side of the stream was heavily vegetated in guinea grass and haole koa (Figure 14), with a row of Java plum trees marking the outer boundary of the APE. Except for the 20-m-wide rocky stream bed, visibility was very poor. The vegetation regime is suggestive of prior ground disturbance, and areas adjacent

Figure 11. Locale 2, view to east.

[1] Toward the coast.

Figure 12. Aerial view of Locale 2.

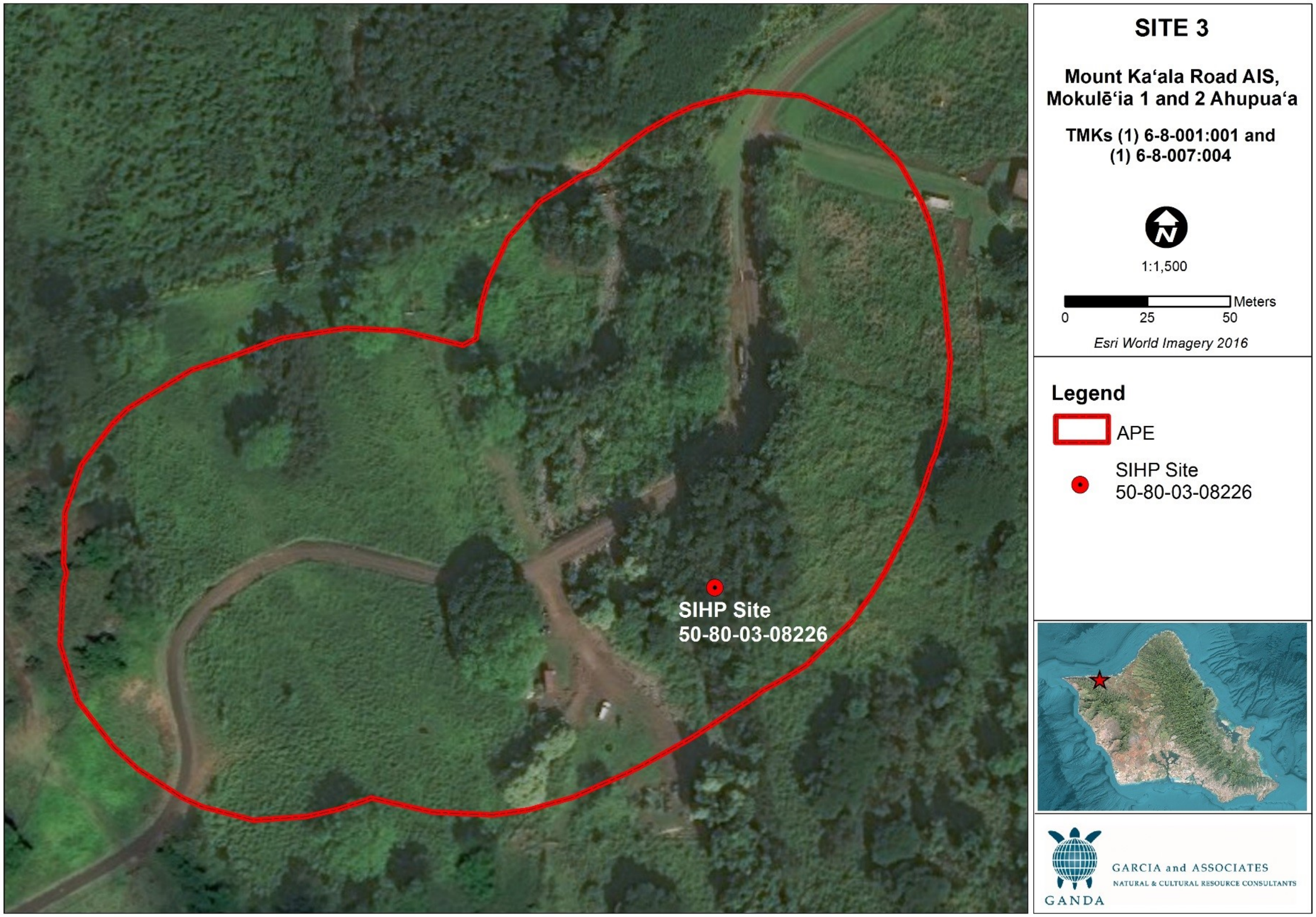

Figure 13. Aerial view of Locale 3.

Figure 14. Locale 3, *makai* side of Ka'ala Road. Red and white concrete pillars mark Makaleha Stream crossing. Note dense vegetation to left. View to east-northeast.

to the stream were clearly fenced and grazed at some time in the past. Some defunct fencing was still present within the tall grass. No historic properties were identified on the Makai side of Ka'ala Road.

Survey on the *mauka*[2] side of Ka'ala Road produced a similar vegetation regime, although visibility was better, on average, due to a more extensive canopy and thinner undergrowth. Again, the stream bed itself was bare and rocky. The stream banks and surrounding flood plain consisted of dense grassy expanses, as well some active pastureland and ranch storage structures. Survey on this side of the road produced one historic site, Hawai'i State Inventory of Historic Places (SIHP) Site 50-80-03-08226, a dry-stone retaining wall likely associated with historic Kaala Ranch. This site is described in the following section.

4.3.1 SIHP Site 50-80-03-08226

Site 50-80-03-08226 is a dry-stone retaining wall that appears to be associated with ranching operations at historic Kaala Ranch (Figures 15 and 16). The site is 5 meters (m) long, 70 centimeters (cm) wide, and 48 cm in maximum height. It is constructed in four courses of dry-laid stone (Figure 17). Constituent stones consist of round to sub-round cobbles and boulders derived from the adjacent streambed. The stones range from 25 to 65 cm in diameter. The retaining wall runs along a 10 degree bearing.

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[2] Inland, mountain-facing.

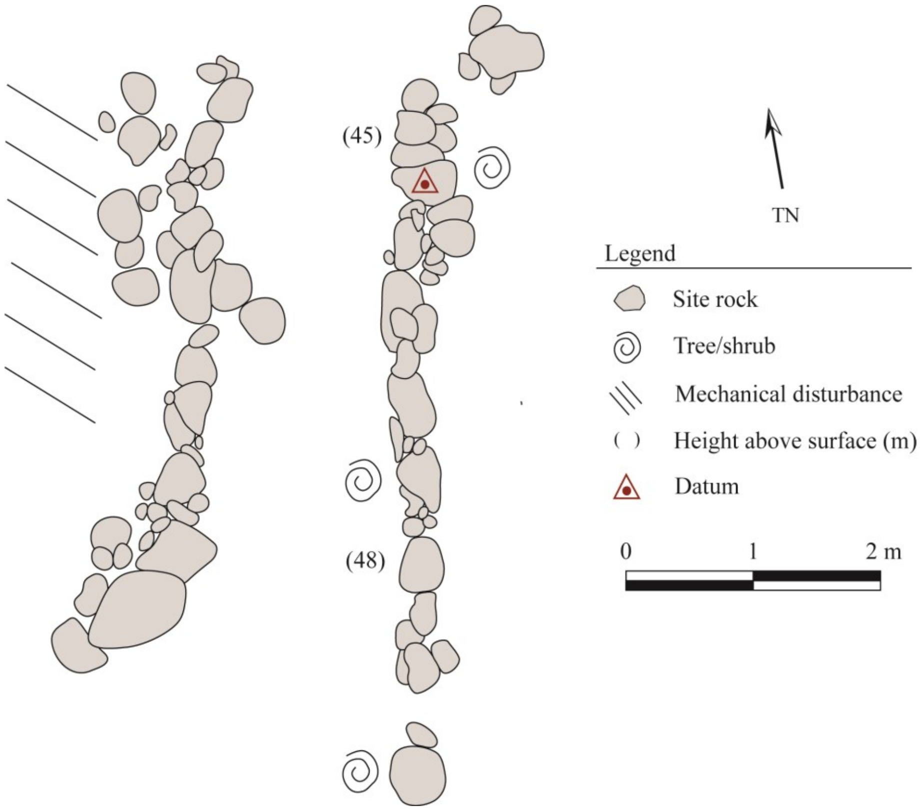

Figure 15. Site 50-80-03-08226 stone retaining wall. Alignment to left side appears similar, but is actually the edge of a berm of mechanically-pushed material.

Figure 16. Site 50-80-03-08226 retaining wall, view to southeast. Scale bar in 10 cm increments.

Figure 17. Detail of Site 50-80-03-08226, showing stonework. Scale bar in 10 cm increments.

The wall supports a hill-slope on one side and functions to retain soil. It appears to have been built to prevent slope erosion. Notably, there is fencing running along the upper part of the slope, where it levels out into a pasture. Preventing this pasture land and its fencing from falling into the Makaleha Stream bottom would likely have been important to ranch operators. Exploration further upstream, outside the APE, produced other possible bank retaining features, but none as clearly constructed as at Site 50-80-03-08226.

Although the feature cannot be clearly dated, its structure and location indicate a likely association with historic ranching sometime between the late 1800s and the mid-1900s. Although a traditional Hawaiian cultural affiliation is also possible, it does not seem likely given the extensive utilization and modification of the local landscape during the (ongoing) ranching period.

4.4 Road Repair Locales 4 and 5

Locales 4 and 5 were surveyed together due to their proximity and overlapping survey boundaries (Figure 18). The roadway near Locale 4 is oriented northwest by southeast and extends downhill into Locale 5 where the road turns to the west. The road is flanked by a very steep to nearly vertical earthen slope on the southern side and a very steep 60° downhill slope along the northern side (Figures 19–23). Survey along the northern side of the road was limited to narrow transects along shoulder of the road and visual inspection of the steep down slope. The shoulder along the northern side of the road was 1 to 3 m wide along the along most the locale. The largest area surveyed on the northern side of the road that could be safely accessed was behind the Bobcat

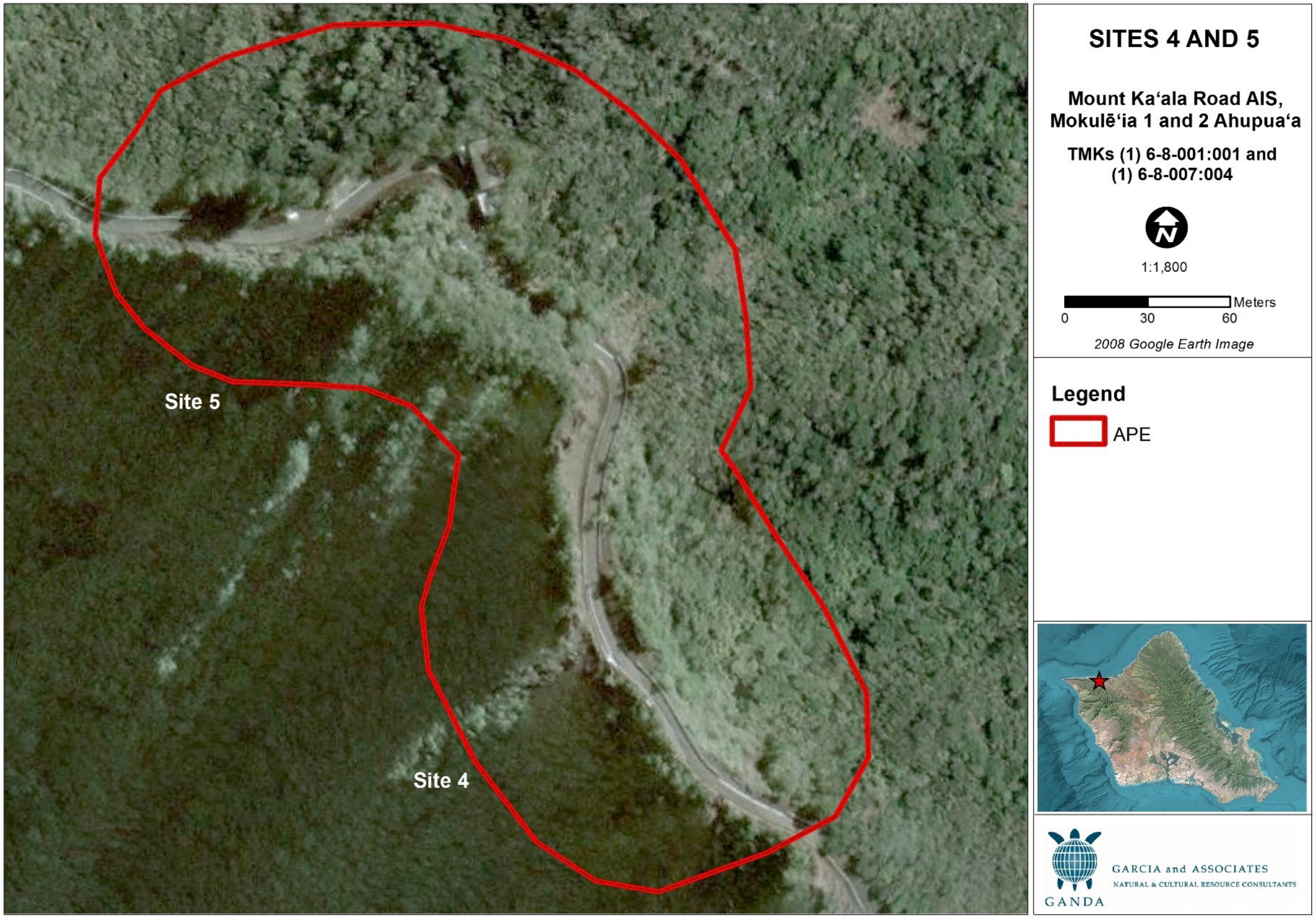

Figure 18. Aerial view of Locales 4 and 5.

Figure 19. Locale 4, view to northeast.

Figure 20. Locale 4, view to east.

Figure 21. Locale 5, view to west.

Figure 22. Locale 5 view to southeast.

Figure 23. Locale 5, view to east.

maintenance and storage building at the turn in the road within Locale 5 (Figure 23). A ridge extends from behind the building to the northeast. At road level, the ridge area is 40 m wide with steep slopes to the east and west. The top of the ridge quickly narrows towards the northeast becoming unsafe to survey 34 m down slope. It is important to note that the shoulder of the roadway appears to have been constructed from material that was pushed over the edge during the initial construction of the road. Survey along the southern side of the road was limited to the vegetated top of the slope cut paralleling the road. The top of the slope was safely accessed at road level and quickly rises to 10 to 15 m above the road. Generally, there was very little level ground on the top of the slope which tended to slope to the south towards Makaha Valley. The accessible survey area on top of the slope varied depending on the steepness of the slope and the width which ranged from less than a meter in some areas to 10 m. No historic properties were observed along the roadway within Locales 4 and 5.

5.0 Summary and Conclusions

Archaeological inventory survey was conducted at five proposed road repair locates on the federally owned and operated Mt. Kaala Road in Mokulēʻia 1 and 2 Ahupuaʻa, District of Waialua, Island of Oʻahu. All accessible areas within the road repair undertaking's APE were surveyed. This excluded a significant acreage, due to extremely steep slopes. Although these areas could not be directly inspected, the likelihood of historic properties being present in these extreme conditions is considered very low.

One historic site was documented in at Road Repair Locale 3, a dry-stone retaining wall associated with historic Kaala Ranch. The historical significance, integrity, and National and Hawai‘i Register of Historic Places eligibility of this site are discussed below.

5.1 Site 50-80-03-08226: National Register Significance Evaluation and Eligibility

Site 50-80-03-08226 is a 5-m-long, .7-m-wide dry-stone retaining wall constructed against the sidewall of a dry streambed. Because of its proximity to other ranch features, including barbed-wire fencing, pastures, and a nearby lowland watering station, this site is most likely associated with ranching operations sometime in the late nineteenth to mid-twentieth century. There are no temporal diagnostic attributes to provide a more precise date, unfortunately. As is often the case, dry-stone walls give the appearance of antiquity. However, this basic stacking technique has been employed right through to the present day around the world. The only clue to the date of this feature is the degree to which the stones have been covered with vegetation, including slow-growing mosses and lichens. These features suggest that the retaining wall has been in place for at least several decades, and potentially up to a century or more.

Functionally, the retaining wall supports the northern bank of the dry stream bed. It appears to be very specifically related to improving the stability of the slope, which supports a pasture on the terrace above the stream channel.

The following sections evaluate the significance of the historic site according to the four National Register of Historic Places (NRHP) significance criteria:

Criterion A: Associated with events that have made a significant contribution to the broad patterns of American history

Site GTE-2377-1 does not exhibit any evidence of association with events that have made a significant contribution to the broad patterns of regional or national history. The site is an isolated feature designed and constructed to perform a very specific operational ranch function on the parcel. It has no known ties to broader events or patterns of events. Site 50-80-03-08226 is not significance under NRHP Criterion A.

Criterion B: Associated with the lives of persons significant in our past

Site 50-80-03-08226 does not appear to be associated with persons significant in Hawaiian or U.S. national history. The original constructor of the feature is unknown, but presumably was a late nineteenth to mid-twentieth century ranch operator or ranch hand. Site 50-80-03-08226 is therefore not significant under NRHP Criterion B.

Criterion C: Embody distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction

Site 50-80-03-08226 does not embody distinctive characteristics of a type, period, or method of construction, or represent the work of a master, or possess high artistic values, or represent a significant and distinguishable entity whose components lack individual distinction

Criterion D: Have yielded, or may be likely to yield, information important in prehistory or history

As of this time, Site 50-80-03-08226 has not clearly yielded important historical information on late nineteenth to mid-twentieth century ranching operations at Kaala Ranch. However, its antiquity and role in the operation of the ranch lands remains unclear. The surrounding ranch lands have not been surveyed for other historical ranch-related features, so much remains unknown. Specifically, it is presently unclear to what degree the current dry stream bed was modified—up and down its length—to ensure the stability of adjacent slopes and prevent erosion of the surrounding pasture lands. With more detailed information on the arrangement of similar dry-stone features up and down the drainage, it is possible that larger-scale landscape patterns may become apparent. Site 50-80-03-08226 therefore has the potential to yield information regarding the perennial struggle with seasonal water flow and erosion within narrowly confined valley ranch environments. Site 50-80-03-08226 may be significant under NRHP Criterion D for its potential to yield information important in local and regional ranching history. Further contextual research is necessary to evaluate its contribution to the significance of a potential Mt. Kaala Ranch Historic Site or Landscape.

5.2 Hawaii State Register Significance and Eligibility Evaluation

Evaluation procedures and requirements for determining the significance of historic properties under the Hawaiʻi Revised Statutes (HRS) Chapter 6E consultation process is contained in Hawaiʻi Administrative Rules (HAR) §13-284-6. Unlike federal historic preservation,[3] historic properties at the state level are first defined as such based on antiquity (≥50 years old), and only then evaluated for significance. Historic properties found to be significant and retaining integrity are then evaluated for effect from a given undertaking.

Since significance Criteria "a"–"d" in HAR §13-284-6 are exactly the same as NRHP Criteria A–D, the same basic arguments and rationales presented in Section 5.1 above apply to Site 50-80-03-08226 under state-level evaluation. In addition to "a"–"d," however, Hawaiʻi regulations also include a Criterion "e." Criterion "e" applies to historic properties that:

> Have an important value to the native Hawaiian people or to another ethnic group of the state due to association 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.

Site 50-80-03-08226, a cobble retaining wall associated with historic ranching activities, does not qualify as significant under Criterion "e." It is not known to have, nor can it reasonably be expected to possess, important value to the native Hawaiian people or to another ethnic group. It also is very unlikely to have an association with cultural practices important to an ethnic group's

[3] Title 54 of the United States Code (54 U.S.C. §3003008) defines a property as: ". . . the term ''historic property'' means any prehistoric or historic district, site, building, structure, or object included on, or eligible for inclusion on, the National Register, including artifacts, records, and material remains relating to the district, site, building, structure, or object."

cultural identity. Site 50-80-03-08226 remains possibly significant under Criterion “d” for its potential information value, but is not significant under any other state-level criteria.

5.3 Integrity Assessment

Site 50-80-03-08226 retains excellent historical integrity. The feature is in its original position on the landscape, retains its original construction materials, and shows no evidence of disturbance or modification. Overall, the site retains its integrity of location, design, setting, materials, workmanship, feeling, and association. There is no evidence that the historic integrity of the site has been compromised in any way.

5.4 Effect Determination Recommendation

Pursuant 36 CFR 800.4(d)(1), our effect determination recommendation is “no historic properties affected.” Although within the APE, Site 50-80-03-08226 is well outside the area planned for active road repair and construction activities. There is no need to disturb this site to complete the undertaking. Therefore, with proper precautions (see site protection measures enumerated in Section 5.4.1 below), undertaking activities at Road Repair Locale 3 will have no effect on Site 50-80-03-08226.

5.4.1 Recommended Site Protection Measures

In order to ensure that there is no effect to Site 50-80-03-08226, the following site protection measures are recommended:

1. Surround the site with high visibility orange construction fencing, placed at a 20-meter distance from the feature.
2. Ensure that the site locations and its buffer fence are clearly marked on engineering and construction plans.
3. Brief construction crews as to the presence of the historic site and the requirement for strict avoidance.
4. Monitor the condition of the site before, during, and after completion of the road repair work.

Implementation of these measures will ensure the safety and integrity of the historic site.

5.5 Summary

Site 50-80-03-08226, a late nineteenth to mid-twentieth century dry-stone retaining wall, may be significance under NRHP Criterion D and HAR §13-284-6. It retains all aspects of its historic integrity. Site 50-80-03-08226 is not in direct conflict with planned undertaking activities and can be avoided during road repair operations. It is recommended that a 20-meter physical buffer be established around the site as the primary short-term preservation method. In addition to the stipulations listed in Section 5.4.1 above, this will ensure that the undertaking has “no effect” to historic properties.

Table 3. Significance Evaluation

SIHP Site Number	Site Type	Site Function	NRHP Significance Criteria	HAR §13-284-6 Significance Criteria	Recommended Treatment
50-80-03-08226	Dry-stone retaining wall	Slope retention	Possible D	Possible "d"	Preservation

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APPENDIX G
STATE HISTORIC PRESERVATION DIVISION CONSULTATION CORRESPONDENCE

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DEPARTMENT OF THE AIR FORCE
PACIFIC AIR FORCES

611th Civil Engineer Squadron
10471 20th St Ste 302
Joint Base Elmendorf-Richardson, AK 99506-2200

21 February 2018

Alan Downer, PhD, Administrator
State Historic Preservation Division
601 Kamokila Blvd, Rm 555
Kapolei, HI 96707

Re: Proposed Road Repair Sites on Mount Ka'ala Road, Waialua District, Oahu, HI

Dear Dr. Downer

The US Air Force and the Federal Aviation Administration propose to repair four areas along the Mount Ka'ala Road. Find attached a SHPD 6-E form, filled out as transmittal for a federal National Historic Preservation Act section 106 undertaking. Garcia and Associates conducted an archaeological survey along a wide area on each side of the road in areas to be repaired, dependent on topography, as documented in *FINAL-Archaeological Inventory Survey for Proposed Road Repair Sites on Mount Ka'ala Road, Mokule'ia 1 and 2 Ahupua'a Waialua District, Oahu, Hawai'i* by Michael Desilets and David Byerly, Garcia and Associates, December 2017 (attachment 2).

There survey located one stone wall feature near road repair site 3 (attachment 3). A 5-meter-long dry-stone retaining wall designated GTS-2377-1 is outside of the Area of Potential Effect and was not evaluated for historic significance as part of this survey. A proper evaluation of significance would need to consider its context within the history and landscape of Mt. Kaala Ranch, which is outside of the scope for this project. GTS-2377-1 is located over 100 feet from the road and will be protected in place during road repairs and culvert replacement. The road repairs will have no adverse effect on historic properties or potential historic properties.

Areas to be repaired are detailed in *Final Drawings: Repair Kaala Road, Project No QZSX16003* (attachment 4), as requested on the 6-E form. This may come in a separate email.

We hope that you concur with our recommendation of finding of no adverse effect in accordance with 36 CFR 800.5(b). Please contact me at (907) 552-5057, write or email at karlene.leeper@us.af.mil if you would like more information.

Sincerely

Karlene Leeper

KARLENE LEEPER
Cultural Resources Program Manager/
Archaeologist

Attachments:
1) SHPD 6-E Transmittal Form (in lieu of NHPA section 106 transmittal form)
2) FINAL-Archaeological Inventory Survey for Proposed Road Repair Sites on Mount Ka'ala Road, Mokule'ia 1 and 2 Ahupua'a Waialua District, Oahu, Hawai'i by Michael Desilets and David Byerly, Garcia and Associates, December 2017.
3) Map Road repair site 3
4) Repair Kaala Road, Project No QZSX16003, prepared for the US Army Corps of Engineers Honolulu District (in separate email because of file size)

Cc: Office of Hawaiian Affairs

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES

STATE HISTORIC PRESERVATION DIVISION
KAKUHIHEWA BUILDING
601 KAMOKILA BLVD, STE 555
KAPOLEI, HAWAII 96707

April 23, 2018

IN REPLY REFER TO:
Log No.: 2018.00519
Doc. No.: 1804SH06
Archaeology

Karlene Leeper
U.S. Department of the Air Force
611th Civil Engineer Squadron
10471 20th St., Ste 302
Joint Base Elmendorf-Richardson, AK 99506-2200
Email: karlene.leeper@us.af.mil

Dear Karlene Leeper:

SUBJECT: **Chapter 6E-8 and National Historic Preservation Act (NHPA) Section 106 Review – Archaeological Inventory Survey for Proposed Road Repair Sites on Mount Ka'ala Road Mokule'ia 1 and 2 Ahupua'a, Waialua District, Island of O'ahu**
TMK: (1) 6-8-001:001 por., (1) 6-8-007:002 por. and 004 por., and (1) 8-4-002:001 por.

The State Historic Preservation Division (SHPD) received a submittal dated February 21, 2018 from the United States Department of the Air Force to initiate Hawai'i Revised Statutes (HRS) Chapter 6E-8 review and Section 106 consultation for a proposed project to repair five areas along the Mount Ka'ala Road on the island of O'ahu. SHPD received this submittal on February 28, 2018.

The proposed project is receiving federal funds and is therefore a federal undertaking as defined in 36 CFR 800.16(y). The project also is subject to HRS Chapter 6E-8 review due to the involvement of County and State property. The scope of work consists of road repair work at five locations along the 10.8 kilometer-long Mount Ka'ala Road. Mount Ka'ala Road is a one lane asphalt paved government road that provides access to a Federal Aviation Administration (FAA) maintained tracking station at the summit of Mount Ka'ala. The five proposed road repair locations comprise a total area of 39.61 acres that include 1.45 km of road length.

Garcia and Associates conducted an archaeological inventory survey (AIS) and prepared a report of their findings to support the historic preservation review process; the report was included as documentation submitted by the U. S. Air Force. The AIS defines the area of potential effect (APE) to include both the areas within which direct impacts are expected to occur, as well as a 50-meter buffer around each area.

The SHPD has reviewed the submitted information and per 36 CFR 800.11, requests the following information:

- Please clarify the effect determination, as the packet submitted states both *no adverse effect* and *no historic properties affected* as the effect determination. Please revise the documentation throughout, as needed, for consistency and to ensure that 36 CFR 800.11 is satisfied per the agency's effect determination.
- Provide a description of the consultation efforts conducted for the proposed undertaking.
- Submit to SHPD a request for a State Inventory of Historic Places site number for GTS-2377-1
- Revise the AIS to indicate it was prepared on behalf of the lead agency.
- Assess whether GTS-2377-1 is eligible for the National Register of Historic Places.

The SHPD looks forward to continuing the Section 106 process for the proposed project.

The United Stated Air Force is the office of record for this undertaking. Please maintain a copy of this letter with your environmental review record for this undertaking.

Please contact Stephanie Hacker, Oahu Archaeologist, at (808) 692-8046 or at Stephanie.Hacker@hawaii.gov for matters regarding archaeological resources or this letter.

Aloha,

Alan Downer

Alan S. Downer, PhD
Administrator, State Historic Preservation Division
Deputy State Historic Preservation Officer

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LAND
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STATE HISTORIC PRESERVATION DIVISION
KAKUHIHEWA BUILDING
601 KAMOKILA BLVD, STE 555
KAPOLEI, HAWAII 96707

July 3, 2018

IN REPLY REFER TO:
Log No.: 2018.01326
Doc. No.: 1807SH03
Archaeology

Karlene Leeper
U.S. Department of the Air Force
611th Civil Engineer Squadron
10471 20th St Ste 302
Joint Base Elmendorf-Richardson, AK 99506-2200
Email: karlene.leeper@us.af.mil

Dear Karlene Leeper:

SUBJECT: **Chapter 6E-8 and National Historic Preservation Act (NHPA) Section 106 Review – Revised Draft Archaeological Inventory Survey for Proposed Road Repair Sites on Mount Ka'ala Road and Request for Concurrence with the Effect Determination Mokule'ia 1 and 2 Ahupua'a, Waialua District, Island of O'ahu TMK: (1) 6-8-001:001 por., 6-8-007:002 por., 6-8-007:004 por. and 8-4-002:001 por.**

The State Historic Preservation Division (SHPD) received a submittal dated June 4, 2018 from the United States Department of the Air Force to initiate Hawai'i Revised Statutes (HRS) Chapter 6E-8 review and Section 106 consultation for a proposed project to repair five areas along the Mount Ka'ala Road on the island of O'ahu. SHPD received this submittal on June 7, 2018.

The proposed project is receiving federal funds and is therefore a federal undertaking as defined in 36 CFR 800.16(y). The project is described as consisting of road repair work at five locations along the 10.8 kilometer-long Mount Ka'ala Road. Mount Ka'ala Road is a one lane asphalt paved government road that provides access to a Federal Aviation Administration (FAA) maintained tracking station at the summit of Mount Ka'ala. The five proposed road repair locations comprise a total area of 39.61 acres that include 1.45 km of road length.

Garcia and Associates conducted an archaeological inventory survey (AIS) and prepared a report of their findings to support the historic preservation review process; the report was included as documentation submitted by the U. S. Air Force. The AIS defines the area of potential effect (APE) to include both the areas within which direct impacts are expected to occur, as well as a 50-meter buffer around each area. One historic property was identified outside the APE during the survey, a 5-meter long dry-stone retaining wall that has been designated State Inventory of Historic Places (SIHP) number 50-80-03-08226. The wall is not eligible for the Hawai'i or National Register of Historic Places, however the Air Force indicates the feature could be considered for the National Register of Historic Places (NRHP) within the context of the history and landscape of Mt. Ka'ala Ranch, which is outside the scope for this project. SIHP 50-80-03-08226 is located over 100 feet from Mt. Ka'ala Road and will be protected in place with fencing during the road repairs and culvert replacement.

Per our previous letter, **please revise the final AIS to indicate** it was prepared on behalf of the Department of the Air Force. The AIS meets the requirements of HAR §13-276 and the Secretary of the Interior's Standards for Archaeological Documentation. **It is accepted**. Please send one hardcopy of the document, clearly marked FINAL, along with a text-searchable PDF version to the Kapolei SHPD office, attention SHPD Library.

The SHPO concurs with the Department of the Air Force's determination of *no historic properties affected.*

The United Stated Air Force is the office of record for this undertaking. Please maintain a copy of this letter with your environmental review record for this undertaking.

Please contact Stephanie Hacker, Historic Preservation Archaeologist IV, at Stephanie.Hacker@hawaii.gov or at (808) 692-8046 for matters regarding archaeological resources or this letter.

Aloha,

Alan Downer

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