FILE COPY
JUL 23 2016

UNIVERSITY of HAWAI'I MĀNOA

Office of the Chancellor

July 13, 2016

RECEIVED
'16 JUL 12 A9:21
OFC. OF ENVIRONMENTAL QUALITY CONTROL

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

Dear Director:

With this letter, the University of Hawai'i, Institute for Astronomy (UH IfA) hereby transmits the Draft Environmental Assessment and anticipated Finding of No Significant Impact (DEA-AFONSI) for the proposed Polarized Light from Atmospheres of Nearby Extra-Terrestrial Systems (PLANETS) Telescope Facility, situated in TMK (2) 2-2-007:008, at the Haleakalā High Altitude Observatory Site, Waiakoa, Makawao District on the island of Maui for publication in the next available edition of the Environmental Notice.

Enclosed is a completed OEQC Publication Form, a hard copy of the DEA-AFONSI, a searchable PDF file of the same, and an electronic copy of the publication form in MS Word.

If there are any questions, please contact Mike Maberry at 808-573-9528.

Sincerely,

Robert Bley-Vroman

Robert Bley-Vroman
Chancellor

Enclosures

2500 Campus Road, Hawai'i Hall 202
Honolulu, Hawai'i 96822
Telephone: (808) 956-7651
Fax: (808) 956-4153

An Equal Opportunity/Affirmative Action Institution

17-012

FILE COPY
JUL 2 3 2016

AGENCY PUBLICATION FORM

Project Name:	Draft Environmental Assessment for the Polarized Light from Atmospheres of Nearby Extra-Terrestrial Systems (PLANETS) Telescope Facility, Haleakalā, Maui, Hawai'i
Project Short Name:	PLANETS Telescope Facility DEA (AFNSI)
HRS §343-5 Trigger(s):	Use of land in a Conservation District
Island(s):	Maui
Judicial District(s):	Haleakalā
TMK(s):	(2) 2-2-007:008
Permit(s)/Approval(s):	Conservation District Use Permit, Haleakalā National Park Special Use Permit
Proposing/Determining Agency:	The University of Hawai'i, Institute for Astronomy (UH IfA)
Contact Name, Email, Telephone, Address	Mike Maberry, maberry@hawaii.edu, 808-573-9528, 34 Ohia Ku St. Room 216 Pukalani, Hawaii 96768
Accepting Authority:	(for EIS submittals only)
Contact Name, Email, Telephone, Address	
Consultant:	KC Environmental, Inc.
Contact Name, Email, Telephone, Address	Dr. Charlie Fein, Charlie@kcenv.com, 808-573-1903, P.O. Box 1208, Makawao, HI 96768

Status (select one)	**Submittal Requirements**
__X__ DEA-AFNSI	Submit 1) the proposing agency notice of determination/transmittal letter on agency letterhead, 2) this completed OEQC publication form as a Word file, 3) a hard copy of the DEA, and 4) a searchable PDF of the DEA; a 30-day comment period follows from the date of publication in the Notice.
____ FEA-FONSI	Submit 1) the proposing agency notice of determination/transmittal letter on agency letterhead, 2) this completed OEQC publication form as a Word file, 3) a hard copy of the FEA, and 4) a searchable PDF of the FEA; no comment period follows from publication in the Notice.
____ FEA-EISPN	Submit 1) the proposing agency notice of determination/transmittal letter on agency letterhead, 2) this completed OEQC publication form as a Word file, 3) a hard copy of the FEA, and 4) a searchable PDF of the FEA; a 30-day comment period follows from the date of publication in the Notice.
____ Act 172-12 EISPN ("Direct to EIS")	Submit 1) the proposing agency notice of determination letter on agency letterhead and 2) this completed OEQC publication form as a Word file; no EA is required and a 30-day comment period follows from the date of publication in the Notice.
____ DEIS	Submit 1) a transmittal letter to the OEQC and to the accepting authority, 2) this completed OEQC publication form as a Word file, 3) a hard copy of the DEIS, 4) a searchable PDF of the DEIS, and 5) a searchable PDF of the distribution list; a 45-day comment period follows from the date of publication in the Notice.
____ FEIS	Submit 1) a transmittal letter to the OEQC and to the accepting authority, 2) this completed OEQC publication form as a Word file, 3) a hard copy of the FEIS, 4) a searchable PDF of the FEIS, and 5) a searchable PDF of the distribution list; no comment period follows from publication in the Notice.
____ FEIS Acceptance Determination	The accepting authority simultaneously transmits to both the OEQC and the proposing agency a letter of its determination of acceptance or nonacceptance (pursuant to Section 11-200-23, HAR) of the FEIS; no comment period ensues upon publication in the Notice.
FEIS Statutory Acceptance	Timely statutory acceptance of the FEIS under Section 343-5(c), HRS, is not applicable to agency actions.
____ Supplemental EIS Determination	The accepting authority simultaneously transmits its notice to both the proposing agency and the OEQC that it has reviewed (pursuant to Section 11-200-27, HAR) the previously accepted FEIS and determines that a supplemental EIS is or is not required; no EA is required and no comment period ensues upon publication in the Notice.

____ Withdrawal Identify the specific document(s) to withdraw and explain in the project summary section.

____ Other Contact the OEQC if your action is not one of the above items.

Project Summary
Provide a description of the proposed action and purpose and need in 200 words or less.

UH IfA is proposing to establish and operate the PLANETS telescope facility (proposed Project) located within the Haleakalā High Altitude Observatory Site (HO), near the summit of Haleakalā in Waiakoa, Makawao District, on the island of Maui. The proposed Project would be specifically designed for low scattered light and high-contrast nighttime observations and would house the world's highest-contrast optical telescope. The proposed Project involves the reuse and renovation of an existing structure that was formerly the University of Chicago Neutron Monitor Station to accommodate the proposed PLANETS telescope facility. The proposed Project was specifically designed to fit within the existing facility with minimal alterations in order to reduce potential impacts to environmental and cultural resources.

The purpose of the proposed Project is to establish the world's most innovative and powerful instrument designed to study the atmospheres of planets around the sun and other stars. The proposed Project would provide unprecedented scientific capabilities in the sciences of polarimetry and coronagraphy, and would have the potential to lead to discoveries in areas related to exoplanet detection, circumstellar environments, and extrasolar planetary atmospheres. No other telescopes currently exist that have these capabilities and are able to provide such a high level of contrast in low scattered light and during nighttime observations.

Draft Environmental Assessment

Polarized Light from Atmospheres of Nearby Extra-Terrestrial Systems (PLANETS) Telescope Facility
Haleakalā, Maui, Hawai‘i

July 2016

Prepared for:

University of Hawai‘i, Institute for Astronomy
2680 Woodlawn Drive
Honolulu, HI 96822

Prepared by:

KC Environmental, Inc.
PO Box 1208
Makawao, HI 96768

ERM-West, Inc.
1277 Treat Boulevard, Suite 500
Walnut Creek, California 94597

1132 Bishop Street, Suite 501
Honolulu, HI 96813

TABLE OF CONTENTS

LIST OF FIGURES ***v***

LIST OF TABLES ***vi***

LIST OF ACRONYMS AND ABBREVIATIONS ***vii***

EXECUTIVE SUMMARY ***ES-1***

1.0 INTRODUCTION ***1***

1.1 BACKGROUND ***1***

1.2 IDENTIFICATION OF AGENCIES PROPOSING THE ACTION ***1***

1.3 PURPOSE AND NEED ***2***

1.4 PROPOSED PROJECT LOCATION ***3***

1.5 LAND USE CONFORMITY ***6***

2.0 DESCRIPTION OF THE PROPOSED ACTIONS AND ALTERNATIVES ***7***

2.1 PROPOSED ACTION ***7***
2.1.1 Proposed Facility Design *7*
2.1.2 Proposed Construction Plan *14*
2.1.3 Operations and Personnel Requirements *15*

2.2 NO-ACTION ALTERNATIVE ***15***

2.3 ALTERNATIVES ELIMINATED FROM FURTHER CONSIDERATION ***15***
2.3.1 Geographic Alternatives *15*
2.3.2 Design Alternatives *17*

3.0 AFFECTED ENVIRONMENT ***19***

3.1 LAND USE ***19***

3.2 AESTHETICS AND VISUAL RESOURCES ***19***

3.3 BIOLOGICAL RESOURCES ***20***

3.4 CULTURAL RESOURCES 22

3.5 ROADWAYS AND TRAFFIC 23

3.6 PUBLIC SERVICES AND UTILITIES 23
3.6.1 Water Supply 23
3.6.2 Wastewater 24
3.6.3 Power and Electricity 24
3.6.4 Solid Waste 24

3.7 WATER RESOURCES AND HYDROLOGY 25
3.7.1 Groundwater and Water Quality 25
3.7.2 Surface Water 25
3.7.3 Storm Water and Drainage 26

3.8 GEOLOGY, SOILS, AND TOPOGRAPHY 27

3.9 HAZARDOUS MATERIALS AND WASTES 27

3.10 AIR QUALITY 28

3.11 NOISE 29

3.12 SOCIOECONOMICS AND ENVIRONMENTAL JUSTICE 30

4.0 ENVIRONMENTAL CONSEQUENCES 32

4.1 LAND USE 33
4.1.1 Proposed Action Alternative 33
4.1.2 No-Action Alternative 34
4.1.3 Cumulative Impacts 34

4.2 AESTHETICS AND VISUAL RESOURCES 34
4.2.1 Proposed Action Alternative 35
4.2.2 No-Action Alternative 38
4.2.3 Cumulative Impacts 39

4.3 BIOLOGICAL RESOURCES 39
4.3.1 Proposed Action Alternative 40
4.3.2 No-Action Alternative 42
4.3.3 Cumulative Impacts 42

4.4 CULTURAL RESOURCES 43
4.4.1 Proposed Action Alternative 44

4.4.2 No-Action Alternative 46
4.4.3 Cumulative Impacts 46

4.5 ROADWAYS AND TRAFFIC ***47***
4.5.1 Proposed Action Alternative 47
4.5.2 No-Action Alternative 48
4.5.3 Cumulative Impacts 48

4.6 PUBLIC SERVICES AND UTILITIES ***49***
4.6.1 Proposed Action Alternative 50
4.6.2 No-Action Alternative 50
4.6.3 Cumulative Impacts 51

4.7 WATER RESOURCES AND HYDROLOGY ***51***
4.7.1 Proposed Action Alternative 52
4.7.2 No-Action Alternative 53
4.7.3 Cumulative Impacts 53

4.8 GEOLOGY, SOILS AND TOPOGRAPHY ***54***
4.8.1 Proposed Action Alternative 54
4.8.2 No-Action Alternative 55
4.8.3 Cumulative Impacts 55

4.9 HAZARDOUS MATERIALS AND WASTES ***56***
4.9.1 Proposed Action Alternative 57
4.9.2 No-Action Alternative 57
4.9.3 Cumulative Impacts 57

4.10 AIR QUALITY ***58***
4.10.1 Proposed Action Alternative 58
4.10.2 No-Action Alternative 59
4.10.3 Cumulative Impacts 59

4.11 NOISE ***59***
4.11.1 Proposed Action Alternative 60
4.11.2 No-Action Alternative 61
4.11.3 Cumulative Impacts 61

4.12 SOCIOECONOMICS AND ENVIRONMENTAL JUSTICE ***62***
4.12.1 Proposed Action Alternative 63
4.12.2 No-Action Alternative 63
4.12.3 Cumulative Impacts 64

5.0 OTHER REQUIRED ANALYSES ***65***

5.1 RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF THE ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY 65

5.2 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES 66

5.3 UNAVOIDABLE ADVERSE IMPACTS 66

6.0 REFERENCES 68

7.0 LIST OF PREPARERS 72

APPENDIX A – BOTANICAL AND FAUNAL SURVEY, STARR ENVIRONMENTAL, NOVEMBER 2015

APPENDIX B – FINAL ARCHAEOLOGICAL INVENTORY SURVEY INTERNATIONAL ARCHAEOLOGY, APRIL 2016

APPENDIX C – CHAPTER 6E-8 HISTORIC PRESERVATION REVIEW CONCURRENCE LETTER, MARCH 30, 2016

LIST OF FIGURES

1-1	*Haleakalā High Altitude Observatories*	*5*
2-1	*Proposed Modifications to Current Facility*	*8*
2-2	*Proposed PLANETS Telescope Facility*	*10*
2-3	*View of Existing Chicago Neutron Monitor Station from the South*	*12*
2-4	*View of Proposed Project Modification to the Facility from the South*	*12*
2-5	*View of Existing Chicago Neutron Monitor Station from the West*	*13*
2-6	*View of Proposed Project Modification to the Facility from the West*	*13*
2-7	*Original Proposed PLANETS Telescope Facility Dome Design*	*18*
4-1	*Line of Sight from Red Hill Overlook without Proposed PLANETS Telescope Facility (Before)*	*37*
4-2	*Line of Sight from Red Hill Overlook with Proposed PLANETS Telescope Facility (After)*	*37*
4-3	*Line of Sight Cross-Section View from Red Hill Overlook with Proposed PLANETS Telescope Facility*	*38*

LIST OF TABLES

ES-1	***Summary of Project Impacts***	***ES-7***
2-1	***Proposed Equipment, Vehicles, and Crews by Phase***	***14***
3-1	***Air Quality on Maui***	***29***
3-2	***Typical Noise Sources at the HO Complex***	***30***
7-1	***List of Preparers***	***72***

LIST OF ACRONYMS AND ABBREVIATIONS

µg/m^3	Micrograms per cubic meter
AEOS	Advanced Electro-Optical System
CDUP	Conservation District Use Permit
dBA	A-weighted decibels
DKIST	Daniel K. Inouye Solar Telescope
DOE	U.S. Department of Energy
EA	Environmental Assessment
FAA	Federal Aviation Administration
FONSI	Finding of No Significant Impact
GEODSS	Ground-based Electro-Optical Deep Space Surveillance
HAR	Hawai‘i Administrative Rules
HC&S	Hawaiian Commercial & Sugar Company
HO	Haleakalā High Altitude Observatory Site
HVAC	Heating, ventilating, and air conditioning
IA	International Archaeology, LLC
IfA	Institute for Astronomy
KCE	KC Environmental, Inc.
kVA	Kilovolt-amperes
mph	Miles per hour
MSSS	Maui Space Surveillance Site
NAFTA	North American Free Trade Agreement
NEPA	National Environmental Policy Act
NSF	National Science Foundation
Park Road	Haleakalā National Park Road
PLANETS	Polarized Light from Atmospheres of Nearby Extra-Terrestrial Systems
PM_{10}	Particulate matter up to 10 micrometers in size
$PM_{2.5}$	Particulate matter smaller than 2.5 micrometers in size

PTF	PLANETS Telescope Foundation
SQG	Small-quantity generator
SR	State Route
UH	University of Hawai‘i

EXECUTIVE SUMMARY

Proposing Agency: The University of Hawai‘i, Institute for Astronomy (UH IfA)

Location of Proposed Action: Haleakalā High Altitude Observatory Site, Waiakoa, Makawao District, Maui; TMK (2) 2-2-007:008

Project Summary: Environmental Assessment (EA) for the implementation of the Polarized Light from Atmospheres of Nearby Extra-Terrestrial Systems (PLANETS) telescope facility to house the world's highest-contrast optical telescope, designed specifically for low scattered light and high-contrast nighttime observations.

Legal Authority: Hawai‘i State Environmental Policy Act (Chapter 343, Hawai‘i Revised Statutes)

Applicable Environmental Assessment Review Trigger: UH is the lead state agency for the proposed Project and the decision-maker for this Project. This action requires compliance with Hawai‘i Revised Statutes Chapter 343 because if the proposed Project is approved:

- UH IfA would be a scientific partner of the proposed Project as part of the PLANETS Telescope Foundation (PTF);
- The proposed Project would occur on State land within an area designated as a conservation district and would require a Conservation District Use Permit (CDUP); and
- UH IfA would continue to own the newly renovated facility.

Agency Determination: After review and consideration of the comments received on this draft EA, UH will either issue a Finding of No Significant Impact (FONSI)/Decision Document or, if appropriate, issue a decision to go forward with an Environmental Impact Statement.

Consultants:

KC Environmental, Inc.
P.O. Box 1208
Makawao, HI 96768
Charlie Fein, Ph.D., President
(808) 281-7094

ERM-West, Inc.
1277 Treat Boulevard, Suite 500
Walnut Creek, California 94597
Leslie Tice, Program Director
(925) 482-3299

ES.1 INTRODUCTION

UH IfA is proposing to establish and operate the PLANETS telescope facility (proposed Project) located within the Haleakalā High Altitude Observatory Site (HO), near the summit of Haleakalā in Waiakoa, Makawao District, Maui. The proposed Project involves the reuse and renovation of an existing structure that was formerly the University of Chicago Neutron Monitor Station to accommodate the proposed PLANETS telescope facility. The proposed Project would be specifically designed for low scattered light and high-contrast nighttime observations and would house the world's highest-contrast optical telescope.

ES.1.1 Agencies Proposing the Action

UH is the lead state agency for the proposed Project and would be a scientific partner for the proposed Project as a part of the PTF if approved. UH IfA would continue to own the newly renovated facility and would enter into a Scientific Cooperation Agreement for the operations of PTF. The proposed Project would also require a CDUP due to its location within a designated conservation district. Consequently, this action requires an environmental review pursuant to the Hawai'i State Environmental Policy Act (Chapter 343, Hawai'i Revised Statutes).

ES.1.2 Purpose and Need

The purpose of the proposed Project is to establish the world's most innovative and powerful instrument designed to study the atmospheres of planets around the sun and other stars. The proposed Project would provide unprecedented scientific capabilities in the sciences of polarimetry and coronagraphy, and would have the potential to lead to discoveries in areas related to exoplanet detection, circumstellar environments, and extrasolar planetary atmospheres. No other telescopes currently exist that have these capabilities and are able to provide such a high level of contrast in low scattered light and during nighttime observations.

To operate successfully, the proposed Project would require a facility that accommodates the size and configuration of the proposed telescope and associated equipment; infrastructure suitability that supports remote operations including the ability to connect and transfer large volumes of data without constant onsite presence; a location in close proximity to the equator, which would provide adequate observational characteristics; and a facility that would be suitable for scientific collaboration among the scientists of the PTF.

ES.1.3 Project Location

The Proposed Action Alternative would be located approximately 9,965 feet above mean sea level near the summit of Haleakalā in the HO complex in Waiakoa, Makawao District, Maui. The proposed Project site is designated as Conservation District within the 18.166-acre UH HO complex. The HO, including the proposed Project site, has been set aside under Executive Order 1987 to UH for scientific research (KC Environmental, Inc. 2010). Access to the site is provided by Haleakalā Highway and Haleakalā National Park Road (Park Road).

ES.2 PROPOSED ACTION AND ALTERNATIVES

The proposed PLANETS telescope would be a 1.85-meter off-axis telescope highly polished to reduce scatter from mirror roughness. The off-axis design would eliminate the potential for beam obstructions, which would allow for greater contrast and reductions in diffraction and scattered light (UH IfA 2010).

ES.2.1 Project Alternatives

Proposed Action Alternative

The Proposed Action Alternative would involve the renovation of an existing 1,619.67-square-foot structure formerly occupied by the University of Chicago Cosmic Ray Neutron Monitor Station, which was decommissioned in 2004. This alternative was specifically designed to fit within the existing facility with minimal alterations, to reduce potential impacts to environmental and cultural resources.

The existing structure would require alterations to house the proposed PLANETS telescope and associated instrumentation. Specifically, the flat portion of the existing roof would be removed and replaced with a 3,966-cubic-foot roll-off enclosure measuring 6 feet, 5.5 inches taller than the highest point of the existing roof. Rails and posts (set in footings) for the roll-off roof frame would be installed by excavating column footings within the existing concrete slab and would extend an additional 23 feet, 4.25 inches from the existing structure, but the frame would remain within the existing concrete slab.

Other exterior work would involve the installation of a rollup door on the southern side. Modifications to the existing structure would primarily occur in the interior and on the foundation of the building. Interior work would include the removal of interior walls and the construction of a

telescope pedestal within the interior foundation. Aside from the small foundation replacement, which consists of replacement of an approximately 2-foot by 2-foot segment of the foundation to install the telescope pedestal, and the excavation of exterior column footings within the existing concrete slab, no new earth movement, excavation, or change in footprint would occur.

The proposed PLANETS telescope facility improvements would take approximately 120 days to complete. The minimal exterior and interior ground-disturbing work for footings and interior pedestal work would occur between 15 November and 15 March to avoid Hawaiian petrel nesting season. Heavy equipment needed for construction would be delivered on a flatbed truck. No wide loads or oversized vehicles are proposed. The proposed PLANETS telescope would be operated remotely; no onsite operators would be required. Approximately once per week, one crew member or visiting scientist would visit the site in a private vehicle to service or interact with instrumentation.

No-Action Alternative

No renovations to the current University of Chicago facility are proposed under the No-Action Alternative. The existing structure would continue to be used for storage and emergency quarters, and the PLANETS telescope facility would not be established within the HO complex.

ES.3 SUMMARY OF IMPACTS

Impact determinations for the Proposed Action Alternative and the No-Action Alternative are summarized on Table ES-1. Impacts are described by the level of intensity, categorized as major, moderate, minor, negligible, or no impact. Impacts are also quantifiable by the duration of the impact. A short-term impact is one that would only occur during build-out or construction. A long-term impact would continue into the operations of the facility.

Impacts during construction and operation would remain at a negligible to minor level. No moderate or major impacts are anticipated. Potential impacts associated with the Proposed Action Alternative would primarily occur during the construction phase and be associated with air emissions from construction vehicles and equipment, traffic from construction vehicles, and noise generated by construction equipment. Construction vehicles would require the use of Haleakalā Park Road, which also provides access to Haleakalā National Park. However, no oversized vehicles or loads are proposed and construction vehicles associated with

the proposed Project are not expected to cause substantial traffic congestion. Furthermore, construction vehicles and equipment would be staged onsite during contiguous phases of construction and heavy equipment needed for construction would be delivered on a flatbed truck to minimize potential traffic impacts. There is potential for impacts to biological and cultural resources under the Proposed Action Alternative; however, no federally listed, special status, or vulnerable plants or animals were identified onsite during biological surveys, and no sensitive habitats are known to occur onsite. Likewise, there would be no increase in project footprint or new earthwork and no restrictions to site access by Native Hawaiians during either construction or operations.

Because the proposed Project facility would be operated remotely and activities would be very similar to past and surrounding scientific operations, potential impacts of the project during operations would be negligible.

ES.3.1 Cumulative Effects

Cumulative impacts are defined as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency or person undertakes such other actions" (Hawai'i Administrative Rules [HAR] Section 11-200-2).

From a cumulative impact perspective, it is worth noting that previous public input for new projects at HO strongly recommended reuse of existing structures, for the primary purpose of minimizing additional impacts to the environment and to cultural resources. Reutilization of existing facilities is specifically included in the HO Management Plan and was considered in the development of the proposed Project. The former University of Chicago building was identified as an existing available facility that could potentially accommodate the proposed Project. The proposed Project design team then re-engineered the telescope and instrumentation to fit within the building and minimize structural changes so as to minimize the potential for impacts to environmental, visual, and cultural resources.

The cumulative impacts analysis considered past and present facilities in the proposed Project area. Reasonably foreseeable future actions were the completion of current construction at HO and the future operation of facilities at HO. Negligible to minor cumulative impacts associated with past, present, and reasonably foreseeable future actions in the areas surrounding the Proposed Action Alternative location were identified. No

moderate or major cumulative impacts were identified under the Proposed Action Alternative. While past development and present facilities have had a moderate and adverse impact on aesthetics and visual resources, the contribution of the proposed PLANETS telescope facility would be minimal, short term, and would not measurably alter the existing visual landscape. Likewise, while past activities have substantially affected cultural resources, the contribution of the proposed PLANETS telescope facility would be minimal due to the fact that very minor ground-disturbing activities are proposed, the majority of the construction activities would be modifications to the existing structure rather than the introduction of new construction, and proposed Project activities would not hinder access to HO by Native Hawaiians.

Negligible to minor cumulative impacts would relate to biological resources; roadways and traffic; public services and utilities; water resources and hydrology; geology, soils, and topography; hazardous materials and waste; air quality; and noise.

Table ES-1 Summary of Project Impacts

Resource Area	**Proposed Action Alternative**	**No-Action Alternative**
Land Use	*Construction and Operations*: No Impact	No Impact
Aesthetics and Visual Resources	*Construction*: Negligible to minor, adverse, direct, and short-term impacts *Operations:* Negligible, adverse, direct, and long-term impacts	No Impact
Biological Resources	*Construction and Operations:* Minor, adverse, direct and indirect, and long-term impacts (Invasive Species and Plants). Minor, adverse, direct, and short-term impacts (Wildlife)	No Impact
Cultural Resources	*Construction*: Negligible, adverse, direct and potentially indirect, and short-term impacts *Operations*: No Impact	No Impact
Roadways and Traffic	*Construction*: Minor, adverse, direct, and short-term impacts *Operations:* Negligible, adverse, direct, and long-term impacts	No Impact
Public Services and Utilities	*Construction*: No Impact on Water Supplies and Wastewater Treatment. Minor, adverse, direct, and short-term impacts (Solid Waste). Minor, adverse, direct, and long-term impacts (Power and Energy) *Operations:* No Impact (Water Supplies, Wastewater Treatment or Solid Waste management or volumes). Minor, adverse, direct, and long-term impacts (Power and Energy)	No Impact
Water Resources and Hydrology	*Construction*: Minor, adverse, direct, and short-term impacts *Operations*: No Impact	No Impact

Resource Area	**Proposed Action Alternative**	**No-Action Alternative**
Geology, Soils, and Topography	*Construction and Operations*: No Impact (Topography, Geology, and Soils). Negligible, adverse, direct, short-term, and localized impacts with erosional controls (Erosional Effects). Negligible, adverse, direct, and long-term impacts (to proposed Project from Seismic Ground Shaking)	No Impact
Hazardous Materials and Wastes	*Construction and Operations*: Negligible, adverse, direct, and long-term impacts	No Impact
Air Quality	*Construction*: Minor, adverse, direct, short-term, and local impacts *Operations:* Negligible, adverse, direct, and long-term impacts	No Impact
Noise	*Construction:* Minor, adverse, direct, local, and short-term impacts. *Operations:* No Impact	No Impact
Socioeconomics and Environmental Justice	*Construction and Operations*: No Impact	No Impact

ES.4 OTHER REQUIRED ANALYSES

Section 4.0, Environmental Consequences, provides a detailed analysis of the potential direct and indirect environmental impacts of the Proposed Action and No-Action Alternatives. In addition to these analyses, the Hawai‘i Environmental Policy Act requires consideration of the proposed Project’s impacts on the relationship between local short-term uses of the environment and long-term productivity, irreversible or irretrievable commitment of resources, and unavoidable adverse impacts (HAR Section 11-200-17[j-l]).

ES.4.1 Relationship between Local Short-Term Uses of the Environment and Long-Term Productivity

Impacts associated with the Proposed Action Alternative would primarily occur during the construction phase, as summarized in Section ES.3 and on Table ES-1. Construction activities under the Proposed Action Alternative would neither use nor impact sensitive environmental resources in a manner that would preclude the long-term value or productivity of that resource.

Construction under the Proposed Action Alternative would primarily consist of modifications to an existing structure, would not require ground disturbing activities, and would not require the introduction of a new structure from the ground up. Construction activities would also occur on a short-term basis and would terminate after a period of approximately 120 days. As such, impacts during construction would primarily be short term and would remain at a negligible to minor level. During operations, impacts from such resource areas as noise, traffic, air quality, and aesthetics would have a negligible effect on current conditions.

The Proposed Action Alternative would function similarly to the nine other observatories that surround the site during operations. Additionally, the proposed Project would be operated remotely and would not require onsite operators. Based on these factors, any potential impacts during operations would remain at a negligible to minor level. The proposed Project and associated advanced algorithms and technologies would result in positive long-term effects during operations, including the advancement of scientific capabilities in the fields of polarimetry and coronagraphy. Advancements in these fields would have the potential to lead to discoveries in areas related to exoplanet detection, circumstellar environments, and extrasolar planetary atmospheres. No other telescope in the world has the capacity and technologies necessary to provide such a high level of contrast in low scattered light and during nighttime

observations. Furthermore, a number of school programs visit the summit of Haleakalā annually for scientific educational opportunities. The Proposed Action Alternative would provide additional educational opportunities related to astronomy and science for local schools.

ES.4.2 Irreversible and Irretrievable Commitments of Resources

The Hawai'i Environmental Policy Act requires consideration of how the proposed Project might commit non-renewable resources to uses that would not be irreversible or irretrievable to future generations Other than the use of petroleum, oils, and fuels by equipment and vehicles, there would be no other irreversible or irretrievable commitment of resources associated with the Proposed Action Alternative or No-Action Alternative.

ES.4.3 Unavoidable Adverse Impacts

Although unavoidable adverse impacts were identified under the Proposed Action Alternative, no major or moderate unavoidable adverse long- or short-term impacts were identified. Adverse impacts associated with noise or traffic could be offset with erosion controls, best management practices, and scheduling of construction deliveries and mobilization around high traffic times could minimize adverse traffic impacts.

ES.4.4 Agency Consultation and Public Involvement

A literature review and archaeological inventory survey was performed at and around the proposed Project site on October 20, 2015, by International Archaeology, LLC, and submitted to the State Historic Preservation Office. This study and the eligibility recommendation of the facility were submitted to the State Historic Preservation Office in January 2016. A response was provided on March 30, 2016 stating concurrence with the finding that the proposed Project would have an effect on historic structures, however this study and architectural reconnaissance-level survey documentation provides sufficient mitigation. No monitoring would be required for the minor level of proposed ground disturbance. No further mitigation is required.

1.0 INTRODUCTION

The University of Hawai‘i, Institute for Astronomy (UH IfA) is proposing to establish and operate the Polarized Light from Atmospheres of Nearby Extra-Terrestrial Systems (PLANETS) telescope facility near the summit area of Haleakalā, and within the Haleakalā High Altitude Observatory Site (HO) in the Waiakoa Makawao District, Maui (proposed Project). The proposed PLANETS telescope facility would house the world's highest-contrast optical telescope, which would be designed specifically for low scattered light and high-contrast nighttime observations. The proposed Project would involve the reuse and renovation of an existing structure that was previously occupied by the University of Chicago Cosmic Ray Neutron Monitor Station to accommodate the proposed PLANETS telescope facility.

1.1 BACKGROUND

The existing facility was constructed in the mid-1950s and was originally occupied by the Baker-Nunn satellite tracking facility. In 1991, the University of Chicago Cosmic Ray Neutron Monitor Station took over site operations to expand its network of high-altitude neutron monitor stations capable of covering far-reaching geomagnetic latitudes (KC Environmental, Inc. [KCE] 2010a). Operations were discontinued in 2004 and the facility has been used for storage and personnel quarters since that time.

The UH IfA is part of a consortium for the proposed Project, the PLANETS Telescope Foundation (PTF), which includes Tohoku University in Japan, the Kiepenheuer Institute for Solar Physics in Germany, and the National Autonomous University of Mexico. The PTF was established to explore the atmosphere of planets and planetary systems with new and unexplored technologies. With this mission in mind, the PTF is proposing the reuse of the University of Chicago Cosmic Ray Neutron Monitor Station site by renovating the current facility.

1.2 IDENTIFICATION OF AGENCIES PROPOSING THE ACTION

UH is the lead state agency for the proposed Project. This action requires an environmental review pursuant to the Hawai‘i Environmental Policy Act (Chapter 343, Hawai‘i Revised Statutes), because, if the proposed Project is approved:

- UH IfA would be a scientific partner for the proposed Project as part of the PTF;
- The proposed Project would occur within the HO property, requiring a Conservation District Use Permit (CDUP); and
- UH IfA would continue to own the newly renovated facility.

Ultimately, there are three decisions to be made as a result of this environmental review:

1. The Chancellor of UH Mānoa would be the decision-maker on whether to move forward with the proposed Project;
2. The Hawai‘i Board of Land and Natural Resources would be the decision-maker on whether to approve and issue the CDUP; and
3. The UH IfA would enter into a Scientific Cooperation Agreement with the PTF for use of the newly renovated facility for the PLANETS telescope facility operations.

There would be no federal funding or resources required for the construction or operations of the proposed Project. Although a Special Use Permit would be required from the National Park Service for commercial use of the Haleakalā National Park Road (Park Road) during construction, this use has been reviewed programmatically for potential environmental effects and would not require a Project-specific review other than what is provided herein. As such, the proposed Project is not subject to a review under the National Environmental Policy Act (NEPA).

1.3 PURPOSE AND NEED

The purpose of the proposed Project is to establish the world's most innovative and powerful instrument designed to study the atmospheres of planets around the sun and other stars. This telescope would have the potential to lead to discoveries in areas related to exoplanet detection, circumstellar environments, and extrasolar planetary atmospheres, given the new technologies and instrumentation techniques involved in its development. Specifically, the proposed PLANETS telescope facility would provide unprecedented scientific capabilities in the sciences of polarimetry and coronagraphy, which allow for clear observation of smaller and fainter objects and signals within exo-atmospheres that are currently unobservable with current technology. New algorithms and technologies associated with coronagraphy and polarimetry would allow scientists to better understand planet atmospheres and how Earth's atmospheric layer might facilitate life-giving potential.

The establishment of this telescope would require the application of expertise and pairing of technologies from various fields such as adaptive optics from astronomical communities, along with polishing and high-contrast imaging from solar physics. Together, the application of these various areas of expertise and the research from the partner institutions involved would allow for substantial advances in a number of scientific fields (IfA 2016). This is the basis of the PTF partnership introduced in Section 1.1. The partnership created by this group is paramount to the success of the proposed Project, since each brings unique scientific expertise and interests. The collaborative premise of this consortium is arguably as important to the potential scientific advancement as the instrumentation and science itself.

To fulfill this purpose and need in a way that optimizes scientific output and potential, the PTF identified five key criteria:

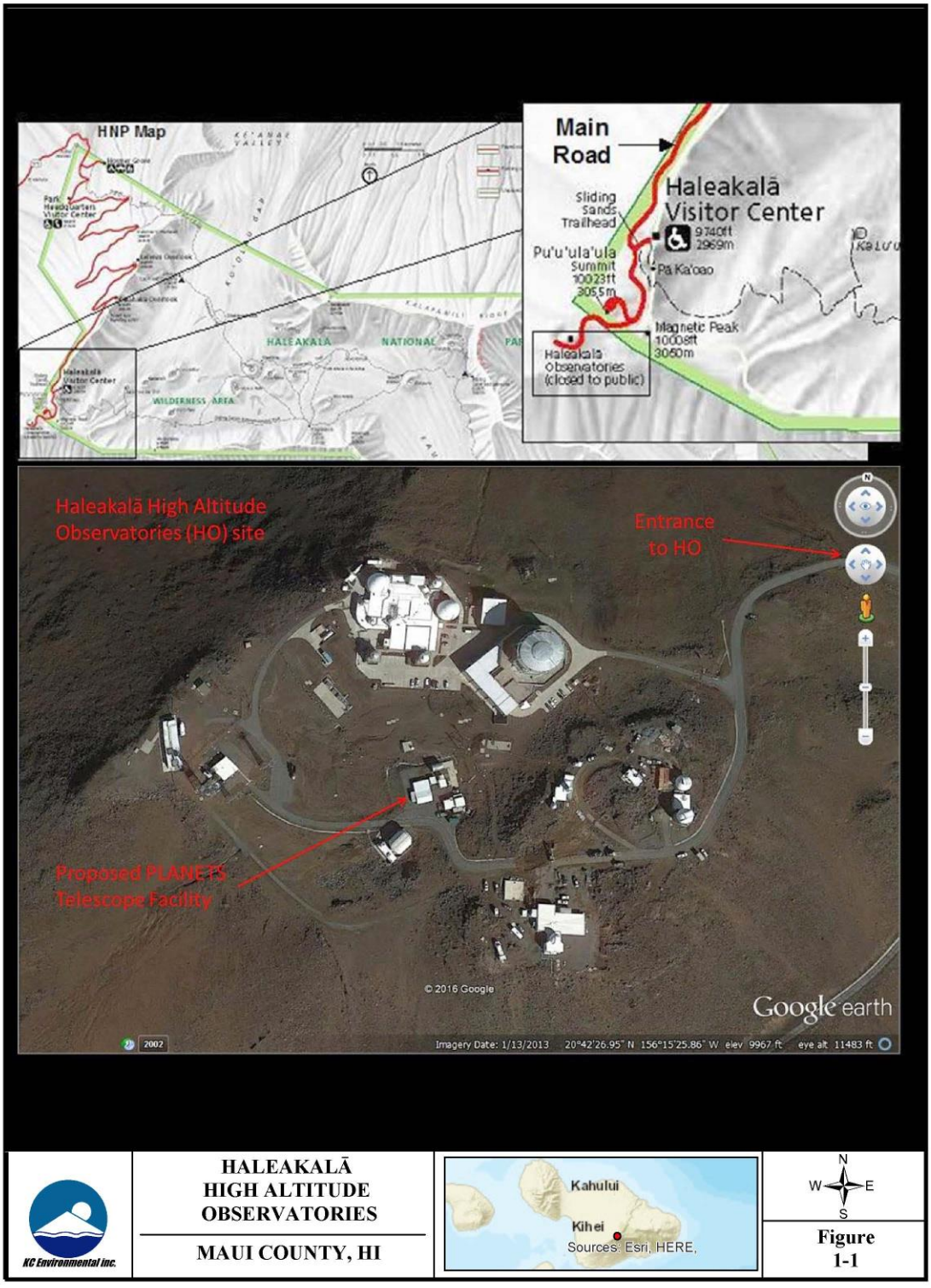
- The telescope should be housed in a facility that accommodates the size and configuration of the unusual optic design of the proposed telescope and that is protective of the sensitive equipment.
- Remote operation would also require infrastructural suitability for this facility, e.g., the ability to connect and transfer large volumes of data without constant onsite presence.
- The facility should be sited in a location close to the equator, which generally results in reduced atmospheric turbulence and provides the most number of days per year for nighttime observation.
- This location should further provide adequate observational characteristics, including low aerosol content, which allow for optimal viewing.
- To be successful, facility operations must be suitable for optimal scientific collaboration among the PTF scientists.

1.4 PROPOSED PROJECT LOCATION

The proposed Project would be located in the Waiakoa, Makawao District, Maui, within the 18.166-acre UH IfA HO complex (Figure 1-1). The site is located at approximately 9,965 feet above mean sea level (Google, Inc. 2016) near the summit of Haleakalā in the Puʻu Kolekole volcanic cinder cone. The proposed Project site is located within a General subzone of a State Conservation District, and within HO property, which was set aside under Executive Order 1987 to UH for astronomical research (KCE 2010a).

The proposed Project site is currently developed with a 1,619.67-square-foot structure formerly occupied by the University of Chicago Cosmic Ray

Neutron Monitor Station. The proposed Project site is located in the western part of the HO complex amid nine other observatories. Specifically, the site is southwest of the Air Force Maui Space Surveillance Complex and east of properties owned by the U.S. Department of Energy (DOE) and Federal Aviation Administration (FAA). Access to the property is provided by Haleakalā Highway (State Route [SR] 37) and SR 378, which traverses approximately 10 miles from its junction with SR 37, to the entry of Haleakalā National Park property.


HNP Map
Main Road
Haleakalā Visitor Center
9740ft
2969m
Sliding Sands Trailhead
Pu'u'ula'ula Summit
10023ft
3055m
Pa Ka'oao
Magnetic Peak
10008ft
3050m
Haleakala Observatories (closed to public)
HALEAKALA NATIONAL
WILDERNESS AREA
Haleakalā High Altitude Observatories (HO) site
Entrance to HO
Proposed PLANETS Telescope Facility
© 2016 Google
Google earth
Imagery Date: 1/13/2013 20°42'26.95" N 156°15'25.86" W elev 9967 ft eye alt 11483 ft
KC Environmental inc.
HALEAKALĀ HIGH ALTITUDE OBSERVATORIES
MAUI COUNTY, HI
Kahului
Kihei
Sources: Esri, HERE,
N
W
E
S
Figure 1-1

1.5 LAND USE CONFORMITY

The proposed PLANETS telescope facility would be located on land set aside by Executive Order 1987 to UH specifically for scientific research. The proposed property is also located within the General subzone of the State Land Use Conservation District and was previously occupied by the University of Chicago Cosmic Ray Neutron Monitor Station. Other existing developments in the vicinity of the proposed Project site are similar in nature and include:

- Mees Solar Observatory to the southeast;
- Las Cumbres Observatory Global Network Telescope to the south;
- Ground-based Electro-Optical Deep Space Surveillance (GEODSS), Maui Space Surveillance Site (MSSS), and the Advanced Electro-Optical System (AEOS) to the north;
- Zodiacal Observatory, Tohoku T60 Telescope, Airglow Facility and Pan-STARRS Observatory to the east; and
- The Daniel K. Inouye Solar Telescope (DKIST) facility, currently under construction to the southeast.

Because the proposed Project would reuse an existing structure, the number of observatories within HO would not increase. Facility reuse, replacement, renovation, or upgrade is a central tenet of the HO Management Plan. In recognition of public input during past planning processes, limiting the overall number of facilities allows scientific exploration to continue while minimizing adverse effects on the environment or cultural resources of the summit area.

FAA and DOE properties are present west of the proposed Project site. Operations at the proposed PLANETS telescope facility would be consistent with current land uses in the area and would conform to mandates set forth by Executive Order 1987, and amended by Executive Order 4452, correcting the description of an access road easement within HO. Proposed operations are also consistent with the 2010 Board of Land and Natural Resources-approved Management Plan for the UH IfA HO site (KCE 2010a).

2.0 DESCRIPTION OF THE PROPOSED ACTIONS AND ALTERNATIVES

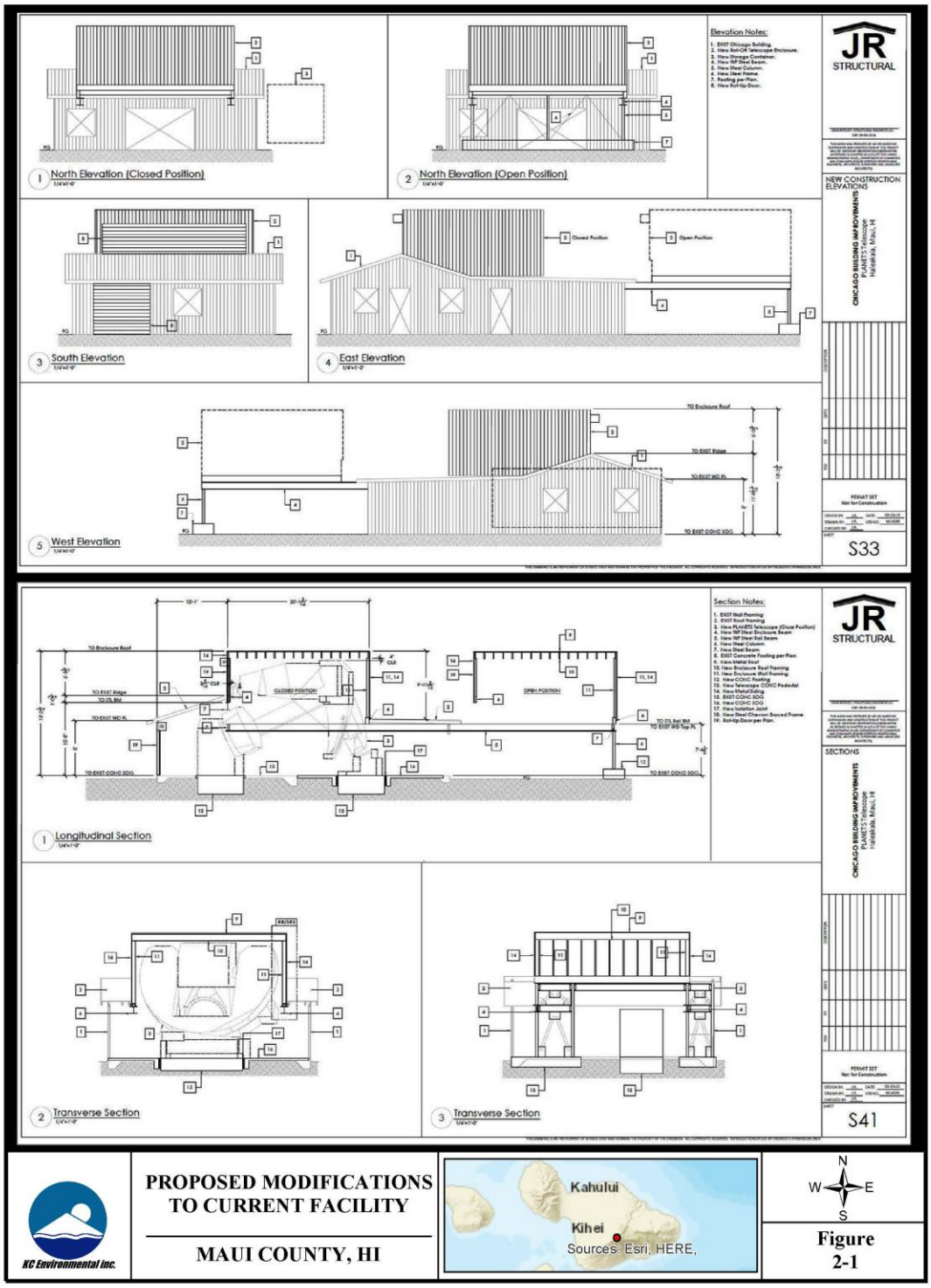
2.1 PROPOSED ACTION

UH IfA proposes to establish the proposed PLANETS telescope facility within the HO site. The PLANETS telescope would be a 1.85-meter off-axis telescope, highly polished to reduce diffuse scatter from mirror roughness. The off-axis design allows for greater contrast and reductions in diffraction and scattered light, given the elimination of the potential for beam obstructions due to such elements as secondary mirror supports (IfA 2010).

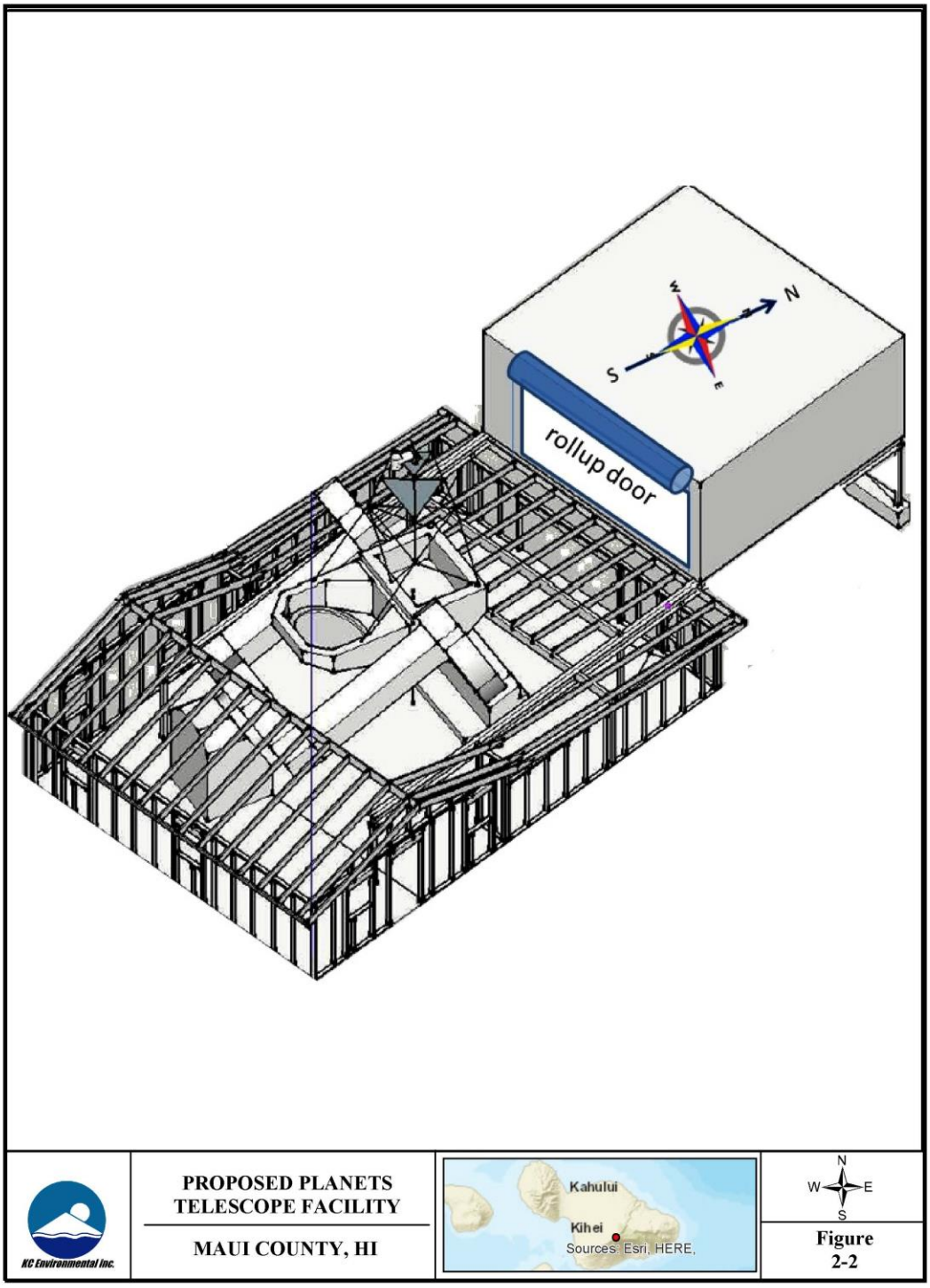
2.1.1 Proposed Facility Design

Rather than constructing a new facility on the existing site, UH IfA proposes to renovate an existing facility, specifically the University of Chicago Cosmic Ray Neutron Monitor Station, which was established in the 1950s and decommissioned in 2004. This opportunity not only saves substantial cost to the proposed Project, but also takes specific input provided during previous planning processes to reduce the impact on environmental and cultural resources. With this in mind, the facility was specifically designed to fit the current facility with minimal alterations.

Figure 2-1 shows the current facility with proposed modifications. The proposed renovations would require moderate alterations to the existing 1,619.67-square-foot facility. To house the telescope instrument, the current flat portion of the roof of the existing structure would be removed and replaced with a 3,966-cubic-foot roll-off enclosure. The top of the roll-off enclosure would be 6 feet, 5.5 inches taller than the highest point of the existing roof ridge. The addition of the rails and posts (set in footings) for the roll-off roof would extend from the present structure a total of 23 feet, 4.25 inches. However, the roll-off roof structure would remain within the existing concrete slab. This new component is not a solid structure but rather a skeletal frame for the roll-off roof.

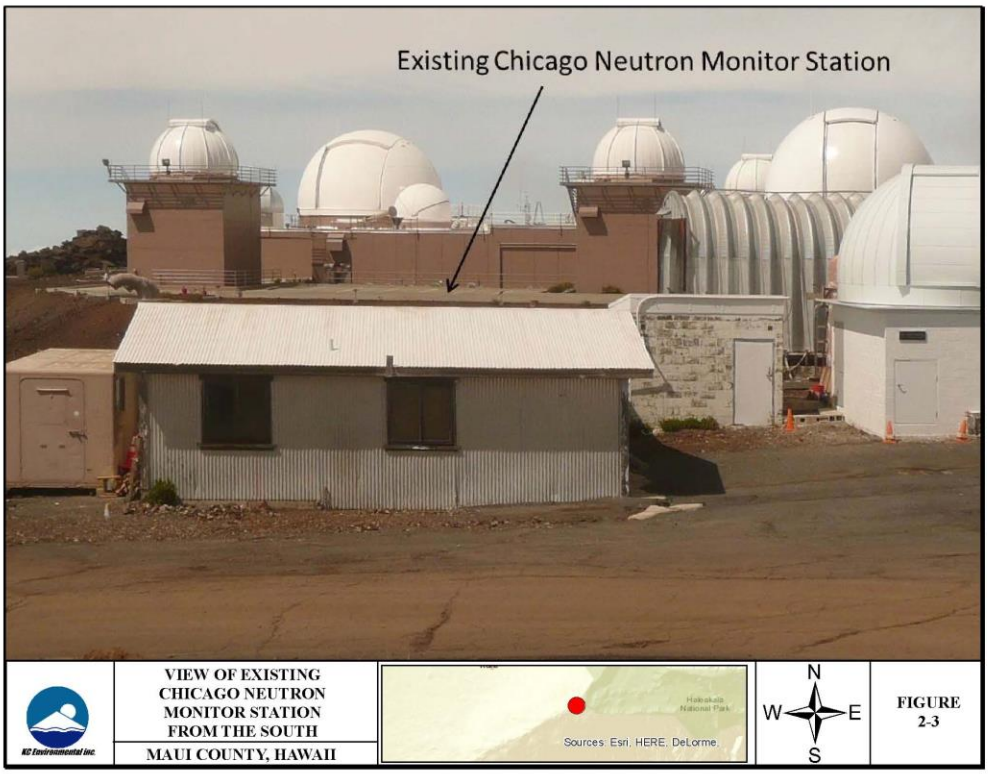

Elevation Notes:
1 North Elevation (Closed Position)
2 North Elevation (Open Position)
3 South Elevation
4 East Elevation
5 West Elevation
JR STRUCTURAL
NEW CONSTRUCTION ELEVATIONS
CHICAGO BUILDING IMPROVEMENTS
PLANETS Telescope
Haleakala, Maui, HI
S33
Section Notes:
1 Longitudinal Section
2 Transverse Section
3 Transverse Section
SECTIONS
S41
PROPOSED MODIFICATIONS TO CURRENT FACILITY
MAUI COUNTY, HI
KC Environmental Inc.
Kahului
Kihei
Sources: Esri, HERE,
N
W
E
S
Figure 2-1

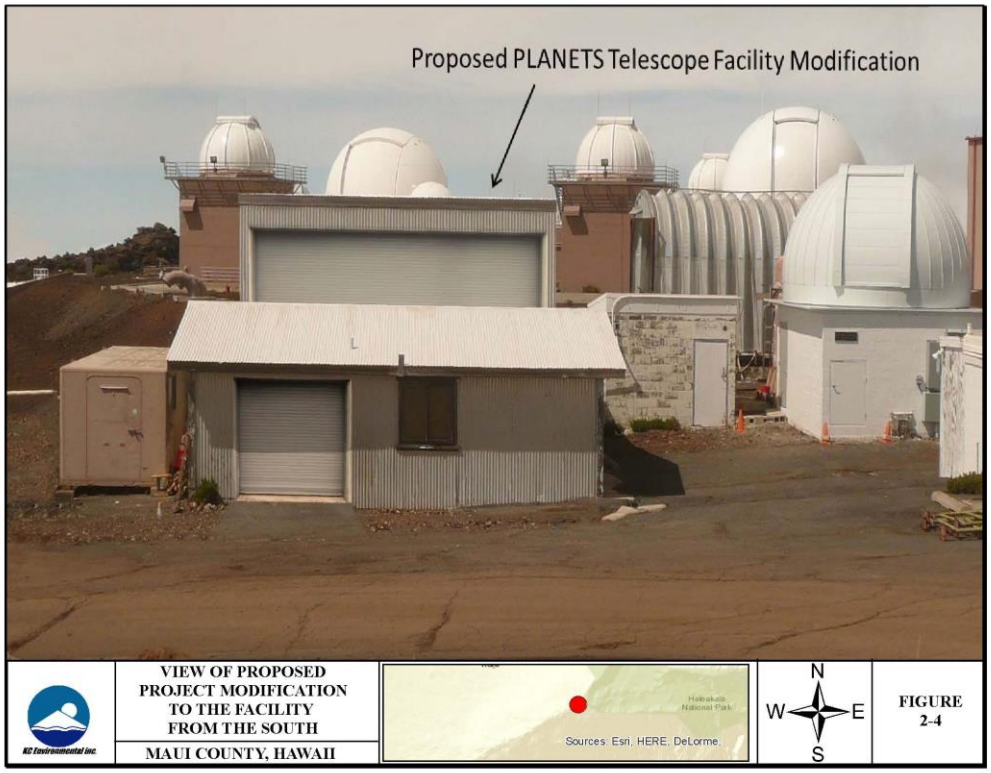
Other exterior work would include the installation of the roll-off steel frame requiring excavation of column footings on an existing concrete slab, and installation of a rollup door on the southern side of the structure. Removal of interior walls and construction of a telescope pedestal and foundation on the interior of the structure would also take place. Specifically approximately 2x2-meter and 2x4-meter areas would be cut out of the existing concrete foundation and replaced to support the telescope pedestal. Modifications would be made primarily on the interior of the existing structure and foundation. With the exception of the foundational replacement and the excavation of exterior column footings within the existing concrete slab described above, no new exterior earth movement, excavation, or change in footprint would occur, and the exterior appearance of the original wall structure would remain largely unchanged. Figure 2-2 is a schematic showing how the proposed roll-off roof and telescope would be incorporated into the existing structure.

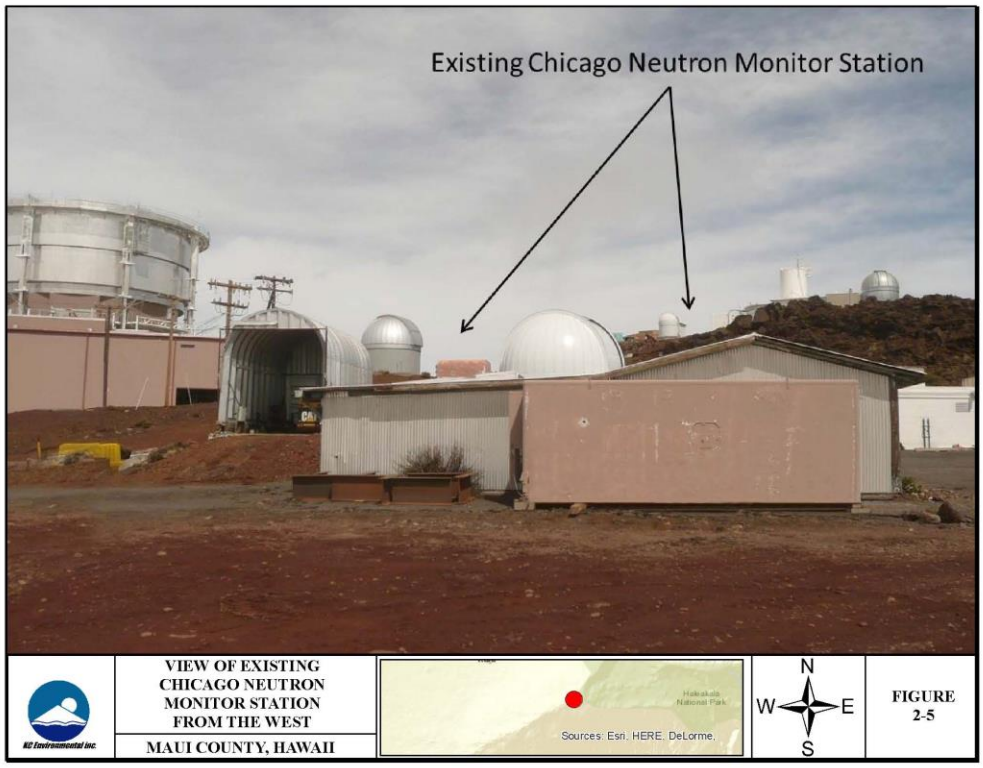

rollup door
N
S
KC Environmental Inc.
PROPOSED PLANETS TELESCOPE FACILITY
MAUI COUNTY, HI
Kahului
Kihei
Sources: Esri, HERE,
N
W
E
S
Figure 2-2

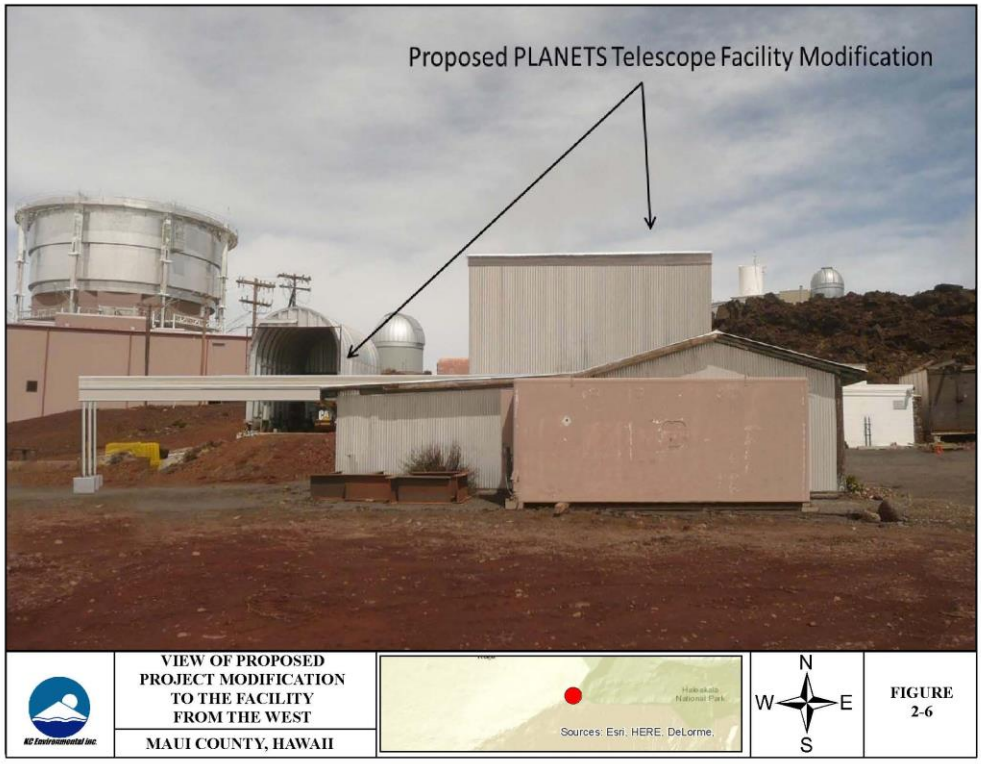
The existing concrete slab adjacent to the existing building would provide a small construction staging area for off-loading shipping containers and hardware assembly for the proposed roll-off enclosure.

Figures 2-3 and 2-5 show the structure as it currently exists. Figures 2-4 and 2-6 are renderings of what the proposed modification would look like when completed.


Existing Chicago Neutron Monitor Station
VIEW OF EXISTING CHICAGO NEUTRON MONITOR STATION FROM THE SOUTH
MAUI COUNTY, HAWAII
Sources: Esri, HERE, DeLorme
N
W
E
S
FIGURE 2-3


Proposed PLANETS Telescope Facility Modification
VIEW OF PROPOSED PROJECT MODIFICATION TO THE FACILITY FROM THE SOUTH
MAUI COUNTY, HAWAII
Sources: Esri, HERE, DeLorme
N
W
E
S
FIGURE 2-4


Existing Chicago Neutron Monitor Station
VIEW OF EXISTING CHICAGO NEUTRON MONITOR STATION FROM THE WEST
MAUI COUNTY, HAWAII
Sources: Esri, HERE, DeLorme,
N
W
E
S
FIGURE 2-5


Proposed PLANETS Telescope Facility Modification
VIEW OF PROPOSED PROJECT MODIFICATION TO THE FACILITY FROM THE WEST
MAUI COUNTY, HAWAII
Sources: Esri, HERE, DeLorme,
N
W
E
S
FIGURE 2-6

2.1.2 Proposed Construction Plan

Table 2-1 summarizes the proposed construction schedule and outlines the probable vehicles, equipment and crew by phase. The proposed PLANETS telescope facility improvements would take approximately 120 days to complete based on the Construction Work Plan outlined below. The minimal exterior and interior ground-disturbing work for footings and interior pedestal work would occur between November 15 and March 15 to avoid Hawaiian petrel nesting season.

Heavy equipment required for the proposed renovations would be delivered on a flatbed truck to avoid damage to the roads. No oversized vehicles or wide loads are proposed.

Table 2-1 Proposed Equipment, Vehicles, and Crews by Phase

Project Activity	Timeframe	Equipment/ Vehicles	No. of Round Trips	Crew Onsite
Phase 1 • Commencement Preparation • External Building Preparation • Internal Building Preparation • Demolition and Removal of Existing Roof and Interior Walls	Approx. 21 Days	Crew van Pickup trucks Dump truck Hand tools: • Drills • Saws • Sledgehammers	18 9 9	3
Phase 2 • Slab Demolition for Footings • Excavation for Footings • Grading • Construction of Piers • Roll-off Roof Frame Foundation Construction • Forming North Slab-on-Grade • Roll-off Roof Steel Frame Construction • Roll-off Roof Construction	Approx. 47 Days	Crew van Dump trucks Cement truck Flatbed truck Jack hammer Backhoe Grader Compactor Crane Rivet gun Impact wrench	28 8 6 16	4

Project Activity	Timeframe	Equipment/ Vehicles	No. of Round Trips	Crew Onsite
Phase 3	Approx. 20 Days	Crew van	20	4
• General Exterior Work		Pickup truck	16	
• General Interior Work		Flatbed truck		
• Equipment Installation		Crane		
• Demobilization		Hand drill		

2.1.3 Operations and Personnel Requirements

The proposed PLANETS telescope would be operated remotely; no onsite operators would be required. Specifically, information collected through the telescope would be primarily imagery and spectropolarimetry data obtained using narrow field instrumentation and shared via low bandwidth data link to the IfA offices in Pukalani and Mānoa and potentially anywhere in the world. Existing fiber-optic infrastructure is adequate to support this data transfer.

Approximately once per week, one crew member or visiting scientist would visit the site in a private vehicle to service or interact with instrumentation.

2.2 NO-ACTION ALTERNATIVE

Under the No-Action Alternative, the proposed PLANETS telescope facility would not be established within the HO complex. There would be no renovation to the current structure under the No-Action Alternative and the existing University of Chicago facility would continue to be used for storage and emergency quarters.

2.3 ALTERNATIVES ELIMINATED FROM FURTHER CONSIDERATION

Two types of alternatives were considered: geographic and design.

2.3.1 Geographic Alternatives

As indicated in Section 1.3, the following criteria were considering in identified reasonable alternative locations for the proposed PLANETS telescope facility based on the type of observing that would be conducted:

- Infrastructural suitability and feasibility
- Observational capability

- Atmospheric compatibility
- Suitable for optimal scientific collaboration

Two locations were identified as meeting these criteria: the HO complex on Maui, Hawai'i, and El Observatorio Astronómico Nacional at San Pedro Mártir (San Pedro Mártir Observatory), located on the Baja Peninsula of Mexico.

The San Pedro Mártir Observatory is set on a mountain range in the Baja State of Mexico at an elevation of 2,830 meters (9,280 feet) above sea level in a relatively isolated location. Although the San Pedro Mártir Observatory met the initial criteria, this site ultimately proved to be an inferior site to Haleakalā for several reasons:

- This observatory location is further north at 31 degrees north latitude, and at a lower elevation with heightened atmospheric turbulence.
- The higher latitude of San Pedro Mártir also means that the telescope would not be able to see some northern latitude stellar targets.
- This area offers photometric quality observation capability on only 56 percent of the nights, which means atmospheric scatter and absorption would degrade the imaging the rest of the year. The remainder of the year, the region experiences heightened water vapor in the atmosphere, which deteriorates the observation capability.
- The San Pedro Mártir Observatory does not have an existing telescope enclosure that can be reused. This location would require a new facility as there are no existing observatories or facilities that could be reused or renovated.
- The San Pedro Mártir Observatory does not have shared infrastructure like that of the HO complex. The new facility construction would require full utility and data line installation, which would be a substantial cost to the proposed Project.
- The premise of the proposed Project and the PTF partnership is founded on the independent accessibility of each partner matched with the scientific collaboration to bring optimal advances related to the experiments and observations of this facility. Although the operations at the proposed PLANETS telescope facility, wherever it is sited, would be largely remote, accessibility for semi-regular instrument calibrations and testing is critical to the success and effectiveness of the overall mission. Because the San Pedro Mártir Observatory is remote and not part of a larger research complex where the PTF partnership has local resources or interests beyond those of the PLANETS

telescope facility, accessing the site for periodic maintenance and calibrations on the instrumentation would be logistically complicated and add costs to the proposed Project.

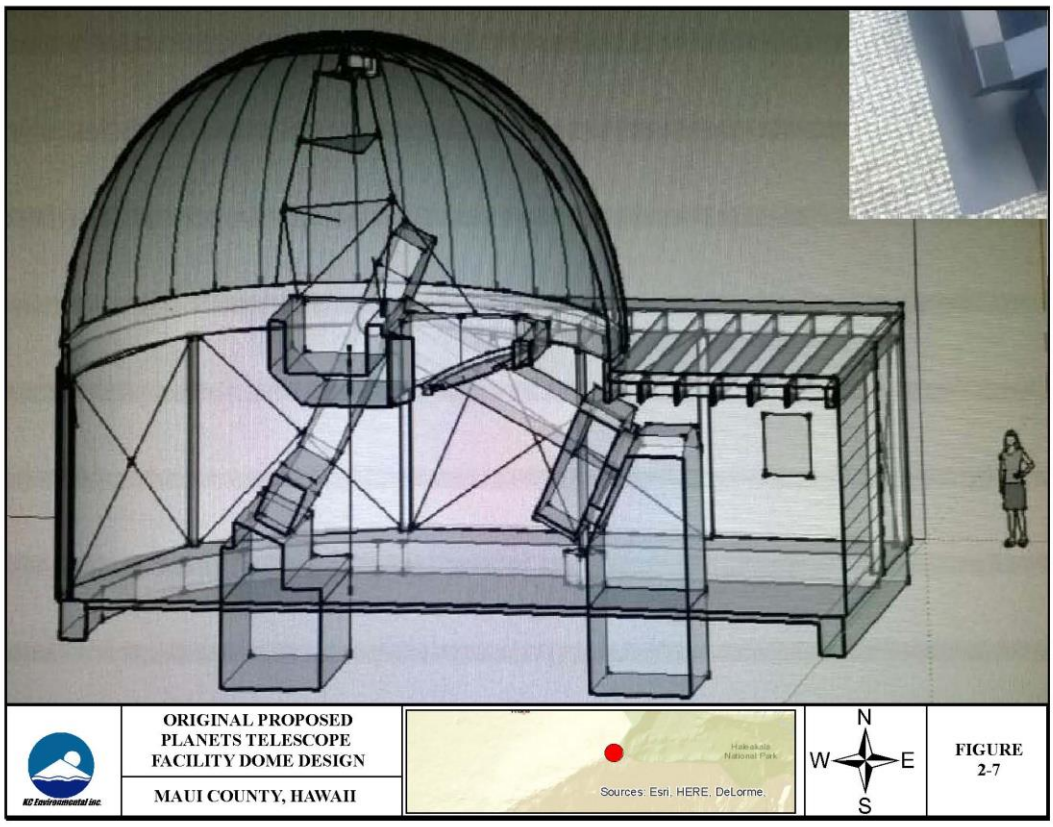
- Finally, the San Pedro Mártir Observatory location is within the region regulated by the North American Free Trade Agreement (NAFTA) between the United States, Canada, and Mexico. This agreement requires the operators of the facility to pay a tariff on the facility annually or relinquish ownership to the country of Mexico.

Ultimately, the atmospheric properties made this location insufficient in meeting the overall proposed Project objectives while the infrastructural and logistical limitations proved infeasible to meeting the PTF's mission. This alternative was considered, but not carried forward for the full analysis.

2.3.2 Design Alternatives

Aside from the geographic alternative consideration, UH IfA considered alternative designs for the facility. Alternative designs were considered for the type, design, and layout of equipment so as to make the best use of the existing space within the current facility to minimize the need for structural improvements. The designs also considered making the given space the most efficient without compromising the capability of the telescope instrumentation. An early design is shown in Figure 2-7 in which a dome roof was considered allowing for 360-degree rotation. However, the dome roof design stood approximately 6 feet higher than the revised roll-off roof design (24 feet, 6 inches as compared to 18 feet and 2.25 inches). The alternative of a roll top allows the roof to roll back and the telescope to be raised for premium observation without requiring a permanently taller structure.

Although a complete design alternative analysis was completed, the final layout and design, as portrayed on Figure 2-2, minimizes the need to expand the facility foundation while accommodating the telescope instrumentation within the lowest possible height, and avoids conflict with the astronomical line of sight of neighboring observatory facilities. This design, as described in Section 2.1.1, provides for the most productive observations with the least environmental alternation or impact. As such, only the final design was carried forward for full environmental review.


ORIGINAL PROPOSED
PLANETS TELESCOPE
FACILITY DOME DESIGN
MAUI COUNTY, HAWAII
Sources: Esri, HERE, DeLorme,
N
W
E
S
FIGURE
2-7

3.0 AFFECTED ENVIRONMENT

This section provides an overview of the baseline physical, biological, cultural, and social conditions that occur within the study areas, as defined in Section 1.4, Proposed Project Location. Each resource section includes a discussion of the existing conditions related to the proposed Project site located at and surrounding the former University of Chicago Cosmic Ray Neutron Monitor Station site within the HO complex near the summit of Haleakalā, Maui, Hawai‘i.

3.1 LAND USE

The land use analysis considers current zoning and land use designations at the proposed Project site and surrounding properties as established by the State Department of Land and Natural Resources.

The proposed Project is located within the 18.166-acre UH IfA HO complex (Figure 1-1), which lies within the General subzone of the State Land Use Conservation District. The proposed property has been set aside under Executive Order 1987 for astronomical research (KCE 2010a). Nine other observatories are part of the UH IfA HO complex and immediately surround the proposed PLANETS telescope facility to the north, east, south, and west (Google, Inc. 2016). The FAA and DOE also own property west and southwest of the proposed Project location. The HO complex is otherwise surrounded by state land with the exception of a private commercial landowner abutting the northern boundary of the complex. The Haleakalā National Park occupies over 33,000 acres including various forest reserves, such as the Kula Forest Reserve and Kahikinui Forest Reserve. The Park Road corridor is the only access road leading up to HO. The National Park Service has exclusive jurisdiction over the Park Road, which begins at 6,800 feet above sea level. This portion of the Park Road, which is used to access HO, is historically important and eligible for listing on the National Register of Historic Places. Haleakalā Highway (SR 37) is a 37-mile-long road between central Maui's main town of Kahului and the summit of Haleakalā. Up to the Park entrance, the road is a State Route (SR 378), built prior to the Park Road corridor.

3.2 AESTHETICS AND VISUAL RESOURCES

This section identifies aesthetic resources, scenic corridors, and open space resources near the proposed Project site.

The proposed Project is not located within a scenic corridor as designated by the County of Maui Department of Planning and is surrounded by nine other observatories within the HO complex that are similar in structure. The Park Road, however, which provides access to the proposed Project site, has been designated as a scenic corridor by the County of Maui Department of Planning (County of Maui Department of Planning 2009). The summit and northwestern slopes of Haleakalā, in particular, which includes the HO complex and the proposed Project area, are considered visitor visual resources.

Haleakalā offers numerous lookouts and vantage points for its picturesque vistas and attracts over one million visitors annually (National Science Foundation [NSF] 2009). The HO complex is located at one of the highest vantage points on Haleakalā and observatories there are visible from the Haleakalā National Park entrance and visitor center; portions of the Park Road corridor near the summit; and Puʻu Ulaʻula (Red Hill Overlook), which is located within 0.33 mile of the proposed Project site within Haleakalā National Park (NSF 2009). Figure 1-1 shows the location of the former University of Chicago Cosmic Ray Neutron Monitor Station, which is the site of the proposed PLANETS telescope facility, as well as an inset of the visual appearance of the building from all sides. As shown on this figure, the facility is within a cluster of observatories obscured from direct view from Red Hill Overlook.

Looking down from Haleakalā, views of the scenic west Maui Mountains, Mauna Kea, and Mauna Loa are also visible (NSF 2009). Other noteworthy, non-designated scenic resources that can be seen from the Makawao-Pukalani-Kula region include the islands of Kahoʻolawe and Lanai, and the Pacific Ocean (Maui County Council 1996).

3.3 BIOLOGICAL RESOURCES

The biological resources analysis considers threatened and endangered species of flora and fauna within the vicinity of the proposed Project area.

A botanical and faunal survey in the proposed Project area was performed by Starr Environmental in November 2015 (Appendix A). Survey results showed that the proposed Project area is largely devoid of vegetation, with the exception of scattered plants growing between cracks in the deteriorating asphalt. The proposed Project area has been heavily impacted by previous human disturbance and is currently developed with an existing building and asphalt pavement.

Onsite vegetation is sparse and includes a mix of native and non-native species commonly found in the summit region of Haleakalā. Native species growing onsite include kupaoa (*Dubautia menziesii*), alpine hairgrass (*Deschampsia nubigena*), and enaena (*Pseudognaphalium sandwicensium* var. *sandwicensium*). Non-native species found onsite include black medic (*Medicago lupulina*), dandelion (*Taraxacum officinale*), annual bluegrass (*Poa pratensis*), and fescue (*Festuca* sp.). No federally listed plants, other special-status plants, or sensitive habitats occur in the proposed Project area. Haleakalā silverswords (*Argyroxiphium sandwicense* ssp. *macrocephalum*, a federally listed as threatened species, are known to occur on the HO property; however, none occur on or near the proposed Project area (Starr Environmental 2015; Appendix A).

With the exception of a few insects, no wildlife species were observed or heard during the faunal survey. Please refer to Appendix A for a complete list of insect species observed on the proposed Project site. No listed insects are known or expected to occur on the proposed Project site.

Daytime and evening bat surveys were conducted. Along with visually scanning the sky, active and passive ultrasonic bat detectors were used. No bats were observed or detected. Although no bats were observed during the surveys, they may forage in the proposed Project area. The absence of trees and other vegetation makes it unlikely that bats roost in the proposed Project area. Hawaiian hoary bats (*Lasiurus cinereus semotus*) have not been documented from HO, but have been seen at 2,750 meters (9,000 feet) on the southern slope of Haleakalā, and may utilize episodically abundant insects anywhere on Maui (Starr Environmental 2015; Appendix A). No other mammals were observed onsite.

Daytime and evening bird surveys were conducted in the proposed Project area. No birds were observed; however, birds may utilize the proposed Project area for transit and foraging (Starr Environmental 2015; Appendix A). The absence of trees and other vegetation makes it unlikely that avian species nest in the proposed Project area. One notable exception is the Hawaiian petrel (ʻuaʻu, *Pterodroma sandwichensis*), which seasonally occupies pre-existing or bird excavated burrows under lava shelves to nest in. Hawaiian petrels are federally listed as endangered and are known to nest in the area. Hawaiian petrels on the HO property are extensively monitored as a mitigation measure developed for the DKIST project. No burrows are known to occur in or adjacent to the proposed Project site. The nearest known petrel burrows are approximately 300 feet away from the proposed Project site (KCE 2015). No other listed avian species are expected to utilize the proposed Project site.

3.4 CULTURAL RESOURCES

The cultural resources analysis considers historic, prehistoric, cultural, and archaeological resources that have been discovered in the vicinity of the proposed Project area.

An archaeological inventory survey for the proposed PLANETS telescope facility was performed by International Archaeology, LLC (IA) in October 2015. During the surface survey no significant pre-Contact features were identified and no traditional Hawaiian surface features were present. Existing structure and pavement make up 100 percent of the ground cover at the proposed site (IA 2016). The archaeological inventory survey report is included in this report as Appendix B.

The existing structure at the proposed Project site, formerly used as the University of Chicago Cosmic Ray Neutron Monitor Station, is one of the earliest astronomical observatories on the summit of Haleakalā and is associated with Project Vanguard, one of the nation's earliest satellite tracking programs. The structure is eligible for listing on the Hawai'i Register of Historic places under Criteria A and D and is considered significant under HAR Section 13-284-6 Criteria "a" and "d" (IA 2016; Appendix B). The original Baker Nunn facility included a roll-off roof similar to that proposed to accommodate its telescope. This was later removed when the University of Chicago took over the site and established the Cosmic Ray Neutron Monitor Station.

The archaeological inventory survey identified documented archaeological sites that have been discovered within 1 kilometer of the proposed Project site. The findings suggest that the broad region of Haleakalā, and specifically the summit area, was traditionally used for adze-making, religious ceremonies by kahuna, and a burial site for the umbilical cords of newborn infants. Previous surveys in this area also suggest that this broad region was utilized for habitation, ritual purposes, and hunting uses; however, it is unlikely that a large population ever settled in the area pre-1950. Wood, bird feathers, and forest products were historically collected below the summit of Haleakalā and rock was quarried along the western rim of Haleakalā Crater (IA 2016; Appendix B). Although these uses and practices have been documented in the region, none of the related resources or practices above has been associated with the proposed Project site itself.

The Park Road, which is used to access the HO complex, is historically important and eligible for listing on the National Register of Historic Places.

The archaeological inventory survey for the proposed PLANETS telescope facility was submitted to the State Historic Preservation Office in January 2016 (IA 2016).

3.5 ROADWAYS AND TRAFFIC

The roadways and traffic analysis discusses the characteristics of current roadways, highways, and intersections surrounding the proposed PLANETS telescope facility. Roadway and highway characteristics discussed in this section include road orientation, posted speed limits, number of lanes, and signalized and unsignalized intersections.

The Park Road corridor is the only access road leading up to the HO complex and the proposed Project site (State of Hawai'i Department of Transportation 2015). The National Park Service has exclusive jurisdiction over the Park Road. Haleakalā Highway (SR 37) is a 37-mile-long road between central Maui's main town of Kahului and the summit of Haleakalā. Up to the Park entrance, the road is State Route (SR) 378, built prior to the Park Road corridor. SR 378 (also known as Haleakalā Crater Road) is an extension of Haleakalā Highway. It is a 2-lane highway that extends from the Haleakalā Highway/Kekaulike Avenue intersection to the National Park boundary and is approximately 10.19 miles in length (AA Roads 2016).

The posted speed limit on SR 378 is 30 miles per hour (Fehr & Peers/Kaku Associates 2007). A study by the Federal Highway Administration reported that approximately 190,000 total vehicle trips were taken along Route 378 between 2004 and 2008. During this time, an average of 443 daily passenger car trips and 30 daily bus trips was reported. According to a traffic study performed in 2003, an average of 48 vehicles enters and leaves UH IfA HO daily (NSF 2009).

3.6 PUBLIC SERVICES AND UTILITIES

The public service and utilities analysis considers the utilities that serve the area surrounding the HO complex. Utility services discussed in this section include solid waste, potable water and water treatment, wastewater, power, and electricity.

3.6.1 Water Supply

Kamole Weir is the primary water treatment facility serving the area surrounding the proposed PLANETS telescope facility. Kamole Weir treats water originating from Wailoa Ditch and has the ability to pump

treated water to service areas over 4,500 feet in elevation, such as Haleakalā Acres. Kamole Weir is one of the largest surface water microfiltration facilities in the United States and has an average daily production of approximately 3.6 million gallons per day (County of Maui Department of Water Supply 2015).

Water at UH IfA HO is often stored in catchment systems during rain events for future use. Trucks also transport water to users located near the summit of Haleakalā to be stored onsite. Private collection systems, individual pumping systems, distribution systems and storage tanks are often maintained by private users (KCE 2010a).

3.6.2 Wastewater

There are no central sewage or waste collection systems at the summit of Haleakalā; therefore, septic tanks are the primary means of sewage disposal at UH IfA HO (NSF 2009). Wastewater from the septic systems is discharged to a leach field (Tetra Tech, Inc. 2006).

3.6.3 Power and Electricity

Power and electricity for the proposed Project site and surrounding HO complex is provided by Maui Electric Company. Maui Electric has oil-fired power plants located in Māʻalaea, Kahului, Lanai, Molokaʻi, and Hana. Hawaiian Commercial & Sugar Company (HC&S) also independently produces power for Maui Electric through hydro, coal, oil and recycled oil, although this arrangement will end in 2016. Maui Electric and HC&S have a total energy generating capacity of approximately 290.1 megawatts (Maui Electric Company 2013).

A Maui Electric substation is currently located within the HO complex, which has a reserve energy capacity of approximately 1,900 kilovolt-amperes (kVA), enough to support existing and proposed energy loads within the HO complex. However, Maui Electric engineers have deemed the equipment at the substation obsolete. As such, the substation at the HO complex is connected to a 3,750/4,688 kVA transformer located at the Kula substation, which serves as the primary energy supplier for the proposed Project area (NSF 2009).

3.6.4 Solid Waste

Building maintenance personnel at each individual observatory are responsible for trash collection within the HO complex. Non-hazardous waste is transported to a licensed landfill. Maui Demolition and

Construction Landfill, located in Māʻalaea on North Kīhei Road, is the primary landfill for commercial construction and demolition debris serving the HO complex. Maui Demolition and Construction Landfill is privately operated and accepts residential and commercial construction and demolition materials (County of Maui Department of Environmental Management 2015).

Waste from the proposed PLANETS telescope facility may also be transported to Central Maui Landfill in Puʻunēnē or Hana Sanitary Landfill in Hana (NSF 2009). Central Maui Landfill processes approximately 550 tons of waste per day and is expected to reach capacity by 2026 (Gershman, Brickner & Bratton, Inc. 2012). Hana Sanitary Landfill accepts approximately 3 tons per day and is expected to reach capacity in 2055 (NSF 2009).

Hazardous wastes are handled separately (NSF 2009). See Section 3.9 for more information on proper treatment and disposal of hazardous waste within the HO complex.

3.7 WATER RESOURCES AND HYDROLOGY

The water resources and hydrology section assesses sources of groundwater and surface water on the proposed Project site, existing hydrologic flow across the site, and water quality. Potential impacts of the proposed Project are then analyzed.

3.7.1 Groundwater and Water Quality

The proposed Project site is served by the Kamole and Makawao Aquifer Systems within the Central Aquifer Sector, and the Lualailua and Nakula Aquifer Systems within the Kahikinui Aquifer Sector. Within these systems are two unconfined, freshwater, perched aquifers located one on top of the other. These aquifers contain less than 250 milligrams per liter of chloride and can be used as drinking water. The upper aquifer has a high contamination potential, while the lower aquifer has a moderate contamination potential. No drinking water wells exist within 11 miles of the summit of Haleakalā (KCE 2010a).

3.7.2 Surface Water

Annual rainfall at the HO complex is considered average, with approximately 41 inches of precipitation per year. The majority of rainfall occurs during winter and it only snows at the proposed Project site once every few years (Starr Environmental 2015; Appendix A). The *drainage*

basin is the basic hydrologic unit used for characterizing streamflow. The Waiakoa and Manawainui Gulch watersheds are the main sources of surface water serving the proposed Project area and act as the drainage basin boundaries of the proposed site. No bodies of water are present directly at UH IfA HO; however, there is an infiltration basin located at the western end of the HO complex where storm water runoff collects. Waikamoi Stream, located approximately 1.9 miles from the UH IfA HO, downslope of the Mees Solar Observatory, is the stream nearest the proposed Project site. Given the permeable characteristics of the lava terrain, the majority of the streams on Haleakalā are intermittent. Polipoli Springs is a water system located within the aquifer system associated with the proposed Project site that serves a nearby park cabin and a campground area. It is located in the Kahikinui Forest Reserve and owned and operated by the State of Hawai‘i (KCE 2010a).

3.7.3 Storm Water and Drainage

Storm water within the HO complex is generated from the impervious surfaces from buildings, roads and parking areas at the individual observatories (Tetra Tech, Inc. 2006). The storm water runoff collection system at UH IfA HO is made up of concrete channels and culverts. The system follows a natural drainage path that conveys water to an infiltration basin located at the western end of the HO complex. This infiltration basin has the capacity to store approximately 1.5 acre-feet of water (Tetra Tech, Inc. 2006). Kolekole cinder cone is located at a lower level within the UH IfA HO and also acts as an area for storm water ponding and infiltration (KCE 2010a). Approximately 10 main storm water flow paths were identified within the HO complex (Tetra Tech, Inc. 2006). Storm water runoff generally flows from east to west at the proposed Project site and within the greater HO complex in general (NSF 2009).

At some locations within the HO complex, storm water discharges onto the slopes of Haleakalā (Tetra Tech, Inc. 2006). The upper soils on the slopes of Haleakalā are highly permeable and characteristic of cinder material. Consequently, precipitation easily permeates through the soil until it reaches the less permeable basalt layers located 5 to 21 feet below the soil surface. The movement of water below the surface is influenced by gravity. This subsurface water continues to flow down through the cinder and basalt layers until it resurfaces and becomes a spring or stream. Precipitation originating from the summit of Haleakalā follows natural drainage courses through such bodies of water as the Manawainui Gulch (KCE 2010a).

UH IfA requires that all facilities located within the HO complex, including the proposed Project site, implement the *Haleakalā High Altitude Observatory Stormwater Management Plan* (Tetra Tech, Inc. 2006).

3.8 GEOLOGY, SOILS, AND TOPOGRAPHY

This section discusses the characteristics, composition, and origin of the geology and soil resources on and surrounding the proposed Project site. Topography and seismic character of the site are also discussed.

The UH IfA HO is located at an elevation of approximately 10,000 feet (3,000 meters) above sea level, near the summit of Haleakalā. Peak elevations near the summit of Haleakalā vary dramatically, dropping to approximately 3,600 feet above sea level within a 4-mile radius of the UH IfA HO. The average slopes near the summit are greater than 30 percent (KCE 2010a). The topography of the HO complex is characteristic of an asymmetric volcanic cone with steeper slopes around the western and northwestern extents of the complex. The eastern and southern slopes are much gentler. The northern slope and central crater of the HO complex are relatively flat (KCE 2015).

Much of the ground at and near the HO complex is barren due to significant human disturbance and about half is currently paved with asphalt or concrete. However, the soils that are present are volcanic, composed of ash, cinders, pumice, and lava from the Kula and Hana Volcanic Series (Starr Environmental 2015; Appendix A). These volcanic soils are susceptible to erosion (NSF 2012). Most of the UH IfA HO is situated on Cinder Land (rCl). In the northern portions of UH IfA HO, the shallower cinder is situated on top of approximately 5 feet of volcanic clinker and 16 feet of volcanic cinder. The last eruption at Haleakalā was between 1650 and 1790 (KCE 2010a).

3.9 HAZARDOUS MATERIALS AND WASTES

This section discusses the management and handling of hazardous materials and generation of hazardous waste at the proposed Project site and within HO.

Hazardous wastes and petroleum products generated at various facilities within the HO complex are first separated from other waste streams and then handled separately as well (NSF 2009). Observatories have varying amounts of hazardous waste at their facilities and some are considered small quantity generators (SQGs) or have no hazardous materials at their

facility at all. SQGs generate 220 to 2,205 pounds of hazardous waste per month (NSF 2009).

Hazardous waste from SQGs is stored in waste storage units. A waste disposal contractor first samples and analyzes the hazardous waste before collecting and disposing of the waste at a permitted disposal facility. Hazardous waste is collected at the HO complex two to three times per year. There are no hazardous waste disposal facilities in the state of Hawai‘i. As such, hazardous waste must be shipped to the continental U.S. for proper disposal (NSF 2009). The 2015 UH Hazardous Materials Management Program (University of Hawai‘i at Mānoa 2015) governs handling of hazardous materials for the HO complex and complies with all applicable federal, state, and local regulations concerning hazardous wastes and disposal (NSF 2009). All accidental spills must be reported to the onsite IfA supervisor and facility managers must follow spill remediation methods approved by the UH Environmental Health and Safety Office prior to cleanup (KCE 2010a).

3.10 AIR QUALITY

This section discusses air quality associated with the proposed Project site, federal and state attainment statuses near the proposed Project site, and the main sources of emissions.

Hawai‘i enforces the National Ambient Air Quality Standards established under the Clean Air Act as well as the Hawai‘i Ambient Air Quality Standards. The air pollutants regulated under Hawai‘i and National Ambient Air Quality Standards include carbon monoxide, lead, nitrogen dioxide, particulate matter up to 10 micrometers in size (PM_{10}), particulate matter smaller than 2.5 micrometers in size ($PM_{2.5}$), ozone, sulfur dioxide and hydrogen dioxide (Hawai‘i State Department of Health 2015). Haleakalā, the location of the proposed Project, has a Class 1 classification under the Clean Air Act Prevention of Significant Deterioration Program, which was established to preserve the air quality of the most pristine areas of the country (KCE 2010b).

There are three air monitoring stations on the Island of Maui and 14 in the entire state. The air monitoring stations in Maui are located in Kīhei, Kahului, and Paia (Hawai‘i State Department of Health 2015). Data from these monitoring stations showed that the entire state of Hawai‘i was found in attainment of National and State Ambient Air Quality Standards (Hawai‘i State Department of Health 2015). This is partially due to the fact that emissions in Hawai‘i are often quickly dispersed due to the high trade winds (County of Maui Department of Housing and Human

Concerns 2014). The main constituent monitored in Hawai'i is $PM_{2.5,}$ fine particulate matter, due to the fact that this constituent can be characteristic of toxic organic compounds and heavy metals. Because fine particulate matter is lighter, it has the ability to travel farther and stay in the air longer than larger particulates such as $PM_{10.}$ Fine particulate matter may also result in adverse health effects given that it is easily inhaled and has the ability to pass through smaller airways (Air Info Now 2015). Hawai'i currently adopts federal standards for $PM_{2.5}$; there are no separate limits for $PM_{2.5}$ under the Hawai'i Ambient Air Quality Standards. The current Federal Primary Standards for $PM_{2.5}$ 24-hour block average and $PM_{2.5}$ annual average are 35 micrograms per cubic meter **(**µg/m^3) and 15 µg/m^3, respectively (Hawai'i State Department of Health 2015). Table 3-1 shows a typical sampling of Maui air quality relative to particulate matter on January 26, 2016.

Table 3-1 Air Quality on Maui

Station	Date and Time	$PM_{2.5}$ µg/m^3	Wind Speed (mph)	Wind Direction (degrees)
Kahului	1/26/2016, 1:00 p.m.	12.0	N/A	30
Kīhei	1/26/2016, 1:00 p.m.	12.0	8.2	237
Paia	1/26/2016, 1:00 p.m.	3.0	2.1	11

Key:
$PM_{2.5}$ = fine particulate matter
µg/m^3 = micrograms per cubic meter
mph = miles per hour
Source: Hawai'i State Department of Health 2015

3.11 NOISE

The noise analysis provides current noise levels and the main sources of noise generation in the vicinity of the proposed property.

The UH IfA HO is zoned as a Class A noise district, the most restrictive of allowable ambient noise levels, in accordance with HAR Section 11-46-4, *Maximum permissible sound levels in dBA* (KCE 2010b). Typically, noise levels in the Class A zoning district can be no more than 55 A-weighted decibels (dBA) between the hours of 7:00 a.m. and 10:00 p.m., and no more than 45 dBA between the hours of 10:00 p.m. to 7:00 a.m. (Hawai'i State Department of Health 1996).

Previous noise level measurement studies revealed that trucks are the primary sources of mobile noise at the HO complex. Heating, ventilating, and air conditioning (HVAC) units are the primary sources of stationary noise. Table 3-2 shows other sources of noise likely to be heard at the HO complex and their approximate noise level generation potentials.

Table 3-2 Typical Noise Sources at the HO Complex

Source	Noise Level Generation Potential (decibels)	Distance from HO Complex (feet)
Absent wind	0 – 10	0
Moderate winds	45 – 50	0
HVAC	60-70	100
Construction vehicles	82 – 93	50

Sources: KCE 2010b; Philip Habib & Associates/Sandstone Environmental Associates, Inc. 2009

No residences, schools, hospitals, or other permanent noise sensitive human receptors are located near the proposed Project site. Puʻu Ulaʻula Overlook and the Haleakalā Summit Visitor Center are the public areas nearest the proposed Project site and are located 0.33 mile and 0.5 mile from UH IfA HO, respectively (KCE 2010b).

3.12 SOCIOECONOMICS AND ENVIRONMENTAL JUSTICE

This section discusses the demographics and the main drivers of the economy in the proposed Project area. It also includes a discussion of environmental justice, which describes the distribution of minorities, Native Hawaiians, children, and schools in the vicinity of the proposed Project site.

The population in Maui County in 2014 was approximately 163,019 and increased by 5.3 percent from 2010 population counts. In Maui County in 2014, children under 5 years of age represented 6.2 percent of the population and persons under 18 years of age represented 22.3 percent of the population. Approximately 15.1 percent of the population in Maui County was 65 years and over (U.S. Census Bureau 2015).

Native Hawaiians and other Pacific Islanders made up 10.7 percent of the population, while 68.7 percent of the population in Maui County was minorities or people with a racial background other than Non-Hispanic White (U.S. Census Bureau 2015). Persons below the poverty level

between 2008 and 2012 in Maui County represented 10.3 percent of the population (County of Maui Office of Economic Development 2013).

Tourism is the largest driver of the economy in Maui, followed by agriculture. Tourism accounts for approximately 40 percent of the county's gross domestic product, and ranks first in tourism relative to other counties in Hawai'i. Visitors from the east and west coasts of the United States and Canadians account for 85 percent of the visitors entering Maui (First Hawaiian Bank 2015). In terms of agriculture, the largest crop currently grown in the county was sugar cane; however, in January 2016, Alexander and Baldwin announced that it is transitioning out of farming sugar and will instead pursue a diversified agricultural model for its 36,000-acre HC&S plantation on Maui. Sugar operations will be phased out by the end of 2016, and the transition to a new model will occur over a multi- year period (HC&S 2016). In addition to tourism and agriculture, Haleakalā Observatory and Maui Research and Technology Park are pointed out as specific economic drivers for Maui by the First Hawaiian Bank. According to economic forecasts by First Hawaiian Bank, the observatory facilities on Haleakalā have an operating budget of $40.4 million and support 167 county-based staff members (First Hawaiian Bank 2015).

There are no schools in the vicinity of the proposed Project site (Google, Inc. 2016) and no minority or low-income populations reside in the vicinity of the HO complex (NSF 2009).

UH IfA and the HO facilities support local educational programs by inviting students and teachers to the summit throughout the year for specific learning programs. Up to 1,200 people, approximately 80 percent of which are students, visit HO annually.

4.0 ENVIRONMENTAL CONSEQUENCES

This section evaluates the potential direct and indirect environmental impacts of the Proposed Action and No-Action Alternatives. This section goes on to consider cumulative impacts. This analysis is defined based on the context and intensity of potential impacts. Context generally refers to the setting, whether beneficial or adverse, short term or long term, and direct or indirect. Intensity then refers to the severity and duration of the impact. Impact intensity is categorized as either major, moderate, minor, negligible, or no impact. These intensities are defined at the beginning of each resource section and each of these qualifiers is identified in the subsequent analysis. Mitigation is identified when it can reduce an impact level from major or is found to be otherwise environmentally preferable to employ.

Cumulative impacts are defined as the impact on the environment, which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (HAR Section 11-200-2).

Impacts to each resource were considered within the same or connected geographic footprint as the alternative action. This includes the area near where renovation or construction and ultimate operations would occur for each alternative as well as access routes and other locations connected to the considered activities. Likewise, temporally, activities are considered from the mid-1950s when the original Baker-Nunn facility (site of the proposed renovation) was constructed, the proposed renovation, and ultimately through the anticipated 30-year operational lifespan of the proposed Project.

Present and reasonably foreseeable future actions are ongoing activities at the summit including operations of the nine existing observatories within HO and adjacent land uses, use of the Park Road, and visitation within the Haleakalā National Park. Construction of the DKIST Project is also considered. The DKIST Project is approximately 350 feet southeast of the existing Chicago Building, where the PLANETS telescope facility renovations are proposed, and access to the site would share the main observatory road. Finally, subsequent to the DKIST Project, no new facility construction is anticipated at HO within the reasonably foreseeable future.

4.1 LAND USE

This impact analysis focuses on the potential for the Proposed Action or the No-Action Alternatives to affect land use, either beneficially or adversely, directly or indirectly—in other words, measures that may change the use of or develop the land; require approvals or confirmation of compliance with laws, regulations, or plans; or change or hinder activities on that land. The incremental impact of the Proposed Action when added to other past, present, and reasonably foreseeable future activities within the same region of influence is also evaluated.

Impacts are described by the level of intensity, categorized as major, moderate, minor, negligible, or no impact. For this analysis, these terms are defined as follows:

- A major impact would result in a noticeable change to land use; the change would be measurable and result in a severely adverse or highly beneficial impact.
- A moderate impact would result in a measurable change to land use.
- A minor impact would result in a change to land use, but would be small, localized, and of little consequence.
- A negligible impact would result in a minimal change to land use, or a minimal change so small it would not be measurable or perceivable.
- No impact means the proposed Project would result in no change in land use.

The duration of impacts is described as either a short-term impact, one that would occur only during construction, or a long-term impact, one that would continue into the operation of the facility.

4.1.1 Proposed Action Alternative

The proposed Project site is located within the General subzone of the State Land Use Conservation District and the necessary permit would be obtained from the State of Hawai‘i Department of Land and Natural Resources before proposed Project activities begin. The proposed land uses under the Proposed Action Alternative would conform to mandates set forth by Executive Order 1987 and amended by Executive Order 4452 that correct the description of an access road easement within the HO, which has reserved the proposed property for astronomical research. Proposed operations are also consistent with the 2010 Board of Land and Natural Resources-approved Management Plan for the UH IfA HO site. The proposed Project is immediately surrounded by nine other

observatories, and operations under the Proposed Action Alternative would be similar in nature to those at the surrounding observatories. Land uses at the bordering Haleakalā National Park would not be impacted by proposed Project activities; however, construction and operations under the Proposed Action Alternative would require use of the Park Road and SR 378 to access the site. As such, a special use permit would be obtained from Haleakalā National Park for use of the roadway during construction. With necessary permits in place, there would be no direct or indirect impact on current land uses.

4.1.2 No-Action Alternative

Under the No-Action Alternative, there would be no alterations proposed at the existing University of Chicago building and the building would continue to be used for storage and emergency quarters. Therefore, there would be no impact to current land uses.

4.1.3 Cumulative Impacts

Because the Proposed Action Alternative would have no impact on land use, by definition there would be no potential for a cumulative effect on this resource.

4.2 AESTHETICS AND VISUAL RESOURCES

This impact analysis focuses on the potential for the Proposed Action or the No-Action Alternatives to affect aesthetics and/or visual resources, either beneficially or adversely, directly or indirectly—in other words, would the proposed activities result in changes in the viewshed to or from the proposed Project area, the landscape, or otherwise impair the visual quality of the region? The incremental impact of the Proposed Action when added to other past, present, and reasonably foreseeable future activities within the same region of influence is also evaluated.

The intensity of the impact to views was assessed and categorized as major, moderate, minor, negligible, or no impact, as defined below.

- A major impact would result in a substantial change to the visual quality of the landscape in the region. Extensive mitigation measures would be needed to offset any adverse effects and their success would not be guaranteed.
- A moderate impact would impact the visual quality of the landscape; this impact would be readily detectable, be localized, and have

consequences at the regional level. Mitigation measures would be necessary to offset adverse impacts and would likely be successful.

- A minor impact would result in a detectable change to the visual quality of the landscape; this change would be localized, small, and of little consequence to the observer.
- A negligible impact would either not impact the visual quality of the landscape, or changes would be so slight that there would be no measurable or perceptible consequence to the observer.
- No impact means the proposed Project would result in no change to the visual character, viewshed, or landscape.

The duration of impacts is described as either a short-term impact, one that would occur only during construction, or a long-term impact, one that would continue into the operation of the facility.

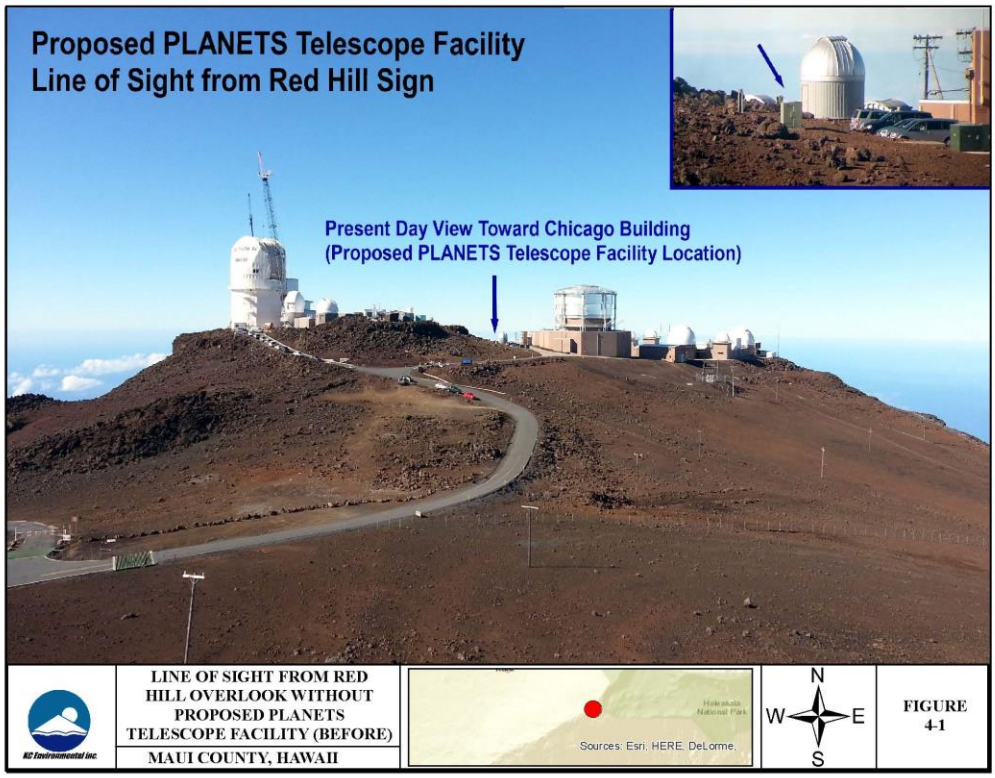
4.2.1 Proposed Action Alternative

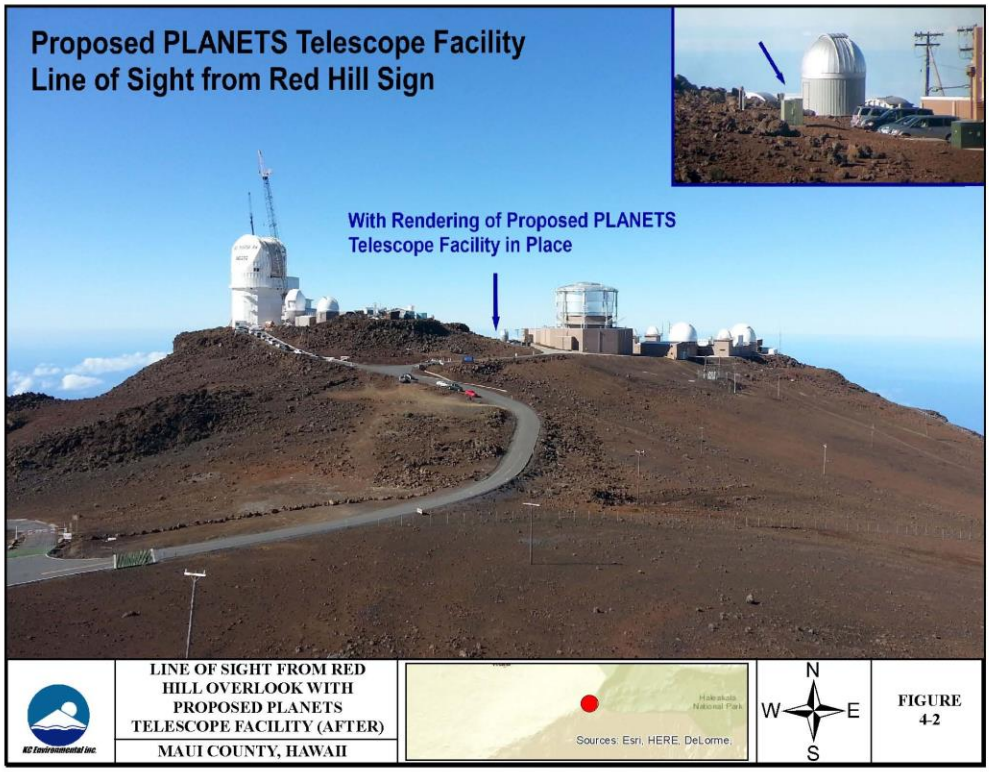
The proposed Project site is not located within a scenic corridor; however, the Park Road, which provides access to the proposed site, has been designated as a scenic corridor by the County of Maui Department of Planning (2009). During operations, one crew member or visiting scientist would utilize the Park Road approximately once per week to service or interact with instrumentation. Given that the increase in vehicle traffic along the Park Road would be so slight that there would be no measurable or perceptible consequence to the observer, impacts along the Park Road during operations would be negligible, adverse, direct, and long term.

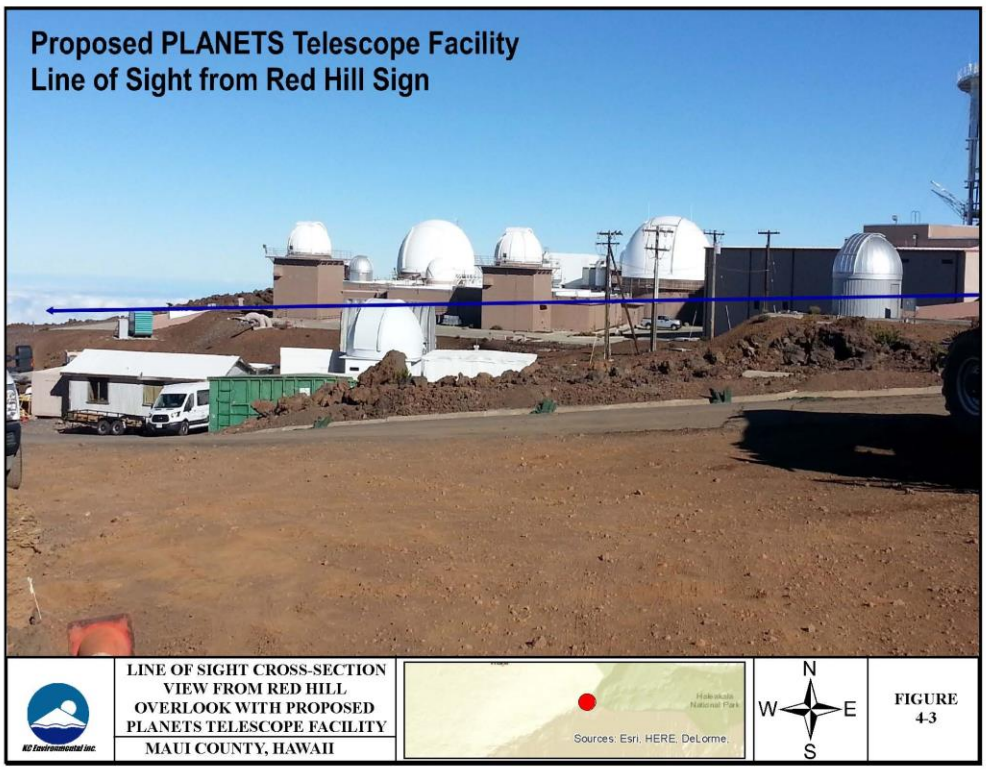
The HO complex, which is the location of the Proposed Action Alternative, is a viewpoint of visitor vista points along the Park Road. The Proposed Action Alternative would be sited in the location of the former University of Chicago Cosmic Ray Neutron Monitor Station (Figure 2-1). Renovations would require alterations to the existing facility that would increase the height by approximately 6.5 feet. No new major structures are proposed under the Proposed Action Alternative that would substantially alter the existing views and visual character toward or from the site.

The Proposed Action Alternative location is surrounded by nine other observatories of similar structure and visual character. The HO complex can be seen from Puʻu ʻUlaʻula (Red Hill Overlook), the visitor vista point within Haleakalā National Park nearest the Proposed Action Alternative. Figures 4-1, 4-2, and 4-3 provide a viewshed analysis of the likely visibility of the proposed facility as seen from Puʻu ʻUlaʻula. The very top of the

new building might be visible from certain angles; however, it would be within a cluster of observatories largely obscured from direct view from the Red Hill Overlook. Based on the topographic position and location among surrounding structures, the proposed facility would not be visible from other vantage points. As such, impacts to the aesthetic value of the HO complex would be negligible, adverse, direct, and long term.


Proposed PLANETS Telescope Facility
Line of Sight from Red Hill Sign
Present Day View Toward Chicago Building
(Proposed PLANETS Telescope Facility Location)
LINE OF SIGHT FROM RED HILL OVERLOOK WITHOUT PROPOSED PLANETS TELESCOPE FACILITY (BEFORE)
MAUI COUNTY, HAWAII
Sources: Esri, HERE, DeLorme,
N
W
E
S
FIGURE 4-1


Proposed PLANETS Telescope Facility
Line of Sight from Red Hill Sign
With Rendering of Proposed PLANETS Telescope Facility in Place
LINE OF SIGHT FROM RED HILL OVERLOOK WITH PROPOSED PLANETS TELESCOPE FACILITY (AFTER)
MAUI COUNTY, HAWAII
Sources: Esri, HERE, DeLorme,
N
W
E
S
FIGURE 4-2



During the construction phase, construction equipment might be visible from different vantage points within Haleakalā National Park and portions of the Park Road corridor near the summit; however, vehicles and equipment would remain within the former University of Chicago site, meaning at the same topographic range and proximity as other features in the area. As such, although it is possible that a small crane and the taller equipment might be visible when erect, those periods would be intermittent and short term. Construction vehicles would require the use of Haleakalā Highway to access the site. These activities could temporarily alter the visual character of the surrounding area; however, the expected duration of construction is approximately 120 days and it is not anticipated that heavy construction equipment would be required for structure modifications. Therefore, impacts to aesthetic or visual resources during construction would be negligible to minor, adverse, direct, and short term.

4.2.2 *No-Action Alternative*

No internal or external modifications to the existing structure are proposed under the No-Action Alternative. Thus, the existing visual quality of the site would remain unchanged and there would be no impact to aesthetic or visual resources.

4.2.3 Cumulative Impacts

Although HO is not within a scenic corridor, it is a viewpoint from Puʻu ʻUlaʻula located nearby within the Haleakalā National Park. As seen in Figures 4-2 and 4-3, the proposed Project fits within the current setting. If visible at all either during construction or operation, the view would be similar to the surrounding environment.

The DKIST facility, shown on the left side of the viewshed analysis figures with cranes and construction vehicles in place, was noted in its project Environmental Impact Statement (NSF 2009) to be readily detectible in the view from the Overlook and although it would be consistent with the surrounding setting and character, the construction equipment and facility would noticeably alter the visual landscape. These impacts were found to be moderate, adverse, and short term. Other existing facilities in the area have been in place for many decades and, although the establishment of the HO complex changed the visual character at the summit of Haleakalā, current operations are long standing and the incremental contribution of the proposed renovation would not alter the collective visual landscape. The cumulative impact of the proposed PLANETS telescope facility would be minimal and would not tip the scale of significance or measurably exacerbate visual conditions in the area.

4.3 BIOLOGICAL RESOURCES

The methods used to determine whether the Proposed Action or the No-Action Alternative might have an impact on biological resources include reviewing and evaluating the potential for buildout, construction, or operation to result in diminished health, diversity, or population of biological resources. Compliance with applicable federal, state, and county regulations was also evaluated.

The assessment of effects on natural and biological resources considered direct and indirect impacts to threatened or endangered species, designated critical habitat, or otherwise ecologically sensitive areas. Impacts were assessed based on whether the proposed Project would result in any of the following: (1) potential "take" of a threatened or endangered species, as defined by the Endangered Species Act and Hawaiʻi Revised Statutes Chapter 195D; (2) loss or impairment of sensitive or other native habitats, including wetlands or riparian corridors; (3) interference with the movement of any native resident or migratory wildlife; or (4) introduction or spread of invasive or otherwise undesirable non-native species.

The incremental impact of the Proposed Action when added to other past, present, and reasonably foreseeable future activities within the same region of influence is also evaluated.

The level of intensity of an impact is described as major, moderate, minor, negligible, or no impact, as defined below.

- A major impact would result in substantial change to the character of the biological resource over a large area. Extensive mitigation would be required to offset major adverse impacts.
- A moderate impact would result in an apparent change to biological resources over a wide area. Mitigation measures would be necessary to offset moderate adverse impacts.
- A minor impact would result in a detectable change, but it would be small, localized, and of little consequence.
- A negligible impact would be below the lower levels of detection.
- No impact means the proposed Project would not impact biological resources.

The duration of impacts is described as either a short-term impact, one that would occur only during construction, or a long-term impact, one that would continue into the operation of the facility.

4.3.1 Proposed Action Alternative

The proposed Project area has been previously developed and is mostly barren. The height of the existing building would be increased a little more than 6 feet; however, the existing footprint of development would not change.

Invasive Species

The introduction of invasive species into the vicinity of the proposed Project area could impact existing native populations. Invasive species of concern on the Hawaiian Islands include a variety of plant, insect, and mammal species. The DKIST Project employs extensive predator grids for small mammals such as rats (*Rattus* spp.), cats (*Felis catis*), and mongoose (*Herpestes auropunctatus*), which results in fewer numbers of these predators in the area. Feral ungulates are absent from the proposed Project site, which was fenced in 2013 as a mitigation measure for DKIST construction (KCE 2015).

Invasive plant and insect threats gain entry to a project site as hitchhikers on people and vehicles. Proposed Project activities would temporarily increase human traffic, and thus increase the potential for invasive species introduction. In turn, the proliferation of invasive species would have the potential to threaten native plant, insect, and wildlife populations.

All construction practices, as outlined in the HO Management Plan (KCE 2010a) would be applied to the proposed Project. These construction practices specify that any equipment, supplies, and containers with construction materials that originate from elsewhere, i.e., the other islands or the mainland, must be checked for infestation by unwanted species by a qualified biologist or agricultural inspector prior to being transported to the summit. Specimens of non-native species found in these inspections are to be offered to the State for curation, and those not wanted are to be destroyed. All construction vehicles that are used off paved surfaces must be steam-cleaned/pressure-washed before they travel or are transported through Haleakalā National Park. Additional construction practices include frequent trash removal, defining areas for equipment parking and material storage, and briefing contractors on the damage that can be done by unwanted introductions.

Taking preventive steps outlined in the HO Management Plan would minimize the potential for the introduction and proliferation of invasive plant, insect, and wildlife species on and around the proposed Project site. By implementing the measures stipulated in the HO Management Plan, these impacts would be minor, adverse, direct and indirect, and long term.

Plants

No listed plant species occur on or adjacent to the proposed Project area. The native plant species in the proposed Project area are locally common and of no special conservation concern. The listed Haleakalā silversword occurs elsewhere on the HO property, but does not occur near the proposed Project area and, because staging would occur on onsite paved surfaces and vehicles would remain on established roadways, the silversword would not be directly or indirectly impacted by the proposed Project. The introduction and spread of invasive plant species could negatively impact botanical resources in and around the proposed Project area; however, the construction practice requirements outlined in the HO Management Plan, and summarized above, will minimize impacts to floral species. By complying with these measures, impacts on floral species would be minor, adverse, direct and indirect, and long term.

Wildlife

Endangered Hawaiian petrels occupy burrows in the cinder on the upper slopes of Haleakalā from late February to early November. This species is only found on Haleakalā during the nesting season, and travels elsewhere for the winter. Petrels are night-flying birds, leaving their burrows to search for food during the nesting and fledgling season. Petrel burrows are located on slopes below the proposed PLANETS telescope facility and do not occur on the proposed Project site. The nearest burrows are over 300 feet away. In addition, the proposed Project would require very minimal ground disturbance, all of which would be done outside of the petrel-nesting season, thereby minimizing or even eliminating the risk of collision with construction equipment or disturbance to burrow habitat from noise or vibrations. Thus, no impacts to nesting petrels, petrel burrows, or their habitat would be anticipated as a result of proposed Project-related activities.

As night-flyers, petrels navigate using the moon, stars, and land features. Bright lights can disorient the birds. Other avian species, as well as bats, may also fly over the proposed Project site at night. The proposed Project would not involve the installation of any outdoor lighting; therefore, it would not disorient bats, petrels, or other night-flying native seabirds. By implementing all requirements outlined in the HO Management Plan, and conducting construction activities outside of the Hawaiian petrel nesting season, the proposed Project would not be expected to have a negative impact on the faunal resources in this part of Maui. Impacts on faunal species would be minor, adverse, direct, and short term.

4.3.2 No-Action Alternative

No construction or change in operations is proposed under the No-Action Alternative. There would be no adverse direct or indirect impacts on biological resources under the No-Action Alternative.

4.3.3 Cumulative Impacts

The Proposed Action Alternative would result in minor, adverse impacts to plants and invasive species during construction and operations. No federally or state listed plants were identified at the Proposed Action Alternative location and none would be directly impacted. The introduction of invasive species, however, would have the potential to result in minor, adverse, direct and indirect, and long-term cumulative impacts to plants and invasive species on HO. Activities associated with other operations within HO could affect plants and would have a similar

potential for introduction of invasive species. However, all operations have the requirement of compliance with measures set forth in the HO Management Plan with the specific intent to prevent the introduction of invasive exotic weed species.

Although there are no burrows on the proposed Project site and activities are not specifically anticipated to affect the Hawaiian Petrel or other listed or native faunal species, the Proposed Action Alternative could contribute to a negligible to minor cumulative impact, specifically because of the potential for these species, and specifically the Hawaiian Petrel, to occur around the proposed Project area. The Hawaiian Petrel and other faunal species common to HO would presumably continue to occur within the area and could be affected by proposed renovation, ongoing construction at adjacent facilities, ongoing and future maintenance, and general human presence and operational activities associated with current and future HO activities. Likewise, while the proposed access along the Park Road is not anticipated to be substantial, cumulatively all access to HO and the rest of Haleakalā National Park has the potential to impact nests along the side of the road and affect birds, including the nēnē, bats known to frequent the area, and plants and insects that have been observed in the area. Measures have been developed between UH IfA, the HO facilities, and the National Park Service to prevent or otherwise minimize the potential for impact. As such, the potential cumulative effect to biological resources would be minor, adverse, direct and indirect, local, and long term.

4.4 CULTURAL RESOURCES

Information to evaluate impacts relevant to this section has been obtained through review of existing documentation on cultural, historic, and archeological resources and by conducting an additional cultural resource survey of the proposed Project area. The information obtained has been considered in determining the level of impacts on cultural, historic, and archeological resources. The incremental impact of the Proposed Action when added to other past, present, and reasonably foreseeable future activities within the same region of influence is also evaluated.

Impacts are described by the level of intensity of impacts on cultural, historic, and archeological resources, and are categorized as major, moderate, minor, negligible, or no impact. For this analysis, these terms are defined as follows:

- A major impact would result in the disturbance of the proposed Project site and in loss of integrity, and impact(s) would alter resource conditions. There would be a barrier to, or great effect on, traditional

access, site preservation, or the relationship between the resource and the affiliated group's body of practices and beliefs, to the extent that the survival of a group's practices and/or beliefs would be jeopardized. Measures to minimize or mitigate adverse effects cannot be agreed upon that would reduce the intensity of impacts from major to moderate.

- A moderate impact would result in loss of integrity, and impact(s) would be apparent and would alter resource conditions. There would be an interference with traditional access, site preservation, or the relationship between the resource and the affiliated group's practices and beliefs, even though the group's practices and beliefs would survive. Also included are major impacts that have been mitigated to reduce their intensity from major to moderate.
- A minor impact would result in little, if any, loss of integrity and would be slight but noticeable, but would neither appreciably alter resource conditions, such as traditional access or site preservation, nor the relationship between the resource and the affiliated group's body of practices and beliefs.
- A negligible impact is at the lowest levels of detection, though still detectible, with minimal, adverse, or beneficial consequences to resource conditions, such as traditional access or site preservation, or the relationship between the resource and the affiliated group's body of practices and beliefs.
- No impact means the proposed Project would have no detectible adverse or beneficial consequences and would neither alter resource conditions, such as traditional access or site preservation, nor the relationship between the resource and the affiliated group's body of practices and beliefs.

The duration of impacts is described as either short term (would occur only during proposed Project construction) or long term (would continue after construction).

4.4.1 Proposed Action Alternative

Previous public input for new projects at HO on Haleakalā strongly recommended reuse of existing structures, for the primary purpose of minimizing additional impacts to the environment and to cultural resources. Reutilization of existing facilities is specifically included in the HO Management Plan and was considered early in the development of the proposed Project. In other words, the former University of Chicago building was identified as an existing available facility that could

potentially accommodate the proposed Project. The proposed Project design team then re-engineered the telescope and instrumentation to fit within the building and minimize structural changes, so as to minimize the potential for impacts to environmental and cultural resources. There would be minimal ground disturbance and renovations would be fully contained within the existing footprint. Moreover, operations of the proposed PLANETS telescope facility would be consistent with surrounding land uses.

The archaeological inventory survey for the Proposed Action Alternative site performed by IA in October 2015 (Appendix B) returned no evidence of significant pre-Contact features or traditional Hawaiian surface features. The ground at the site is currently entirely covered by pavement and an existing building. The existing building, the former University of Chicago Cosmic Ray Neutron Monitor Station, is eligible for listing on the Hawai‘i Register of Historic Places under criteria A and D and is also considered significant under HAR Section 13-284-6 Criteria “a” and “d” (IA 2016; Appendix B). This study found that the proposed Project would affect these historic structures. On March 30, 2016, the State Historic Preservation Office responded concurring with this finding and stating that this archaeological inventory survey and architectural reconnaissance-level survey documentation provides sufficient mitigation to offset any impact. No monitoring would be required for the minor level of proposed ground disturbance. No further mitigation is required.

The former University of Chicago building would be renovated to increase the height by 6 feet, 5.5 inches to house the proposed telescope under the Proposed Action Alternative. With the exception of the foundational replacement and the excavation of exterior column footings within the existing slab area, no new exterior earth movement, excavation, or change in footprint would occur, and the exterior appearance of the original wall structure would remain largely unchanged. The majority of renovations, such as foundation work for the telescope pedestal, would take place on the interior of the existing structure. Renovations to the former University of Chicago building would not compromise the historical significance of the building and furthermore would bring an element of the original Baker Nunn facility back by integrating a roll-off roof to its function. Because there would be little ground disturbance and renovations are largely modification of the existing facility, the proposed construction activities associated with the development of the Proposed Action Alternative would not be expected to encounter new historic or archaeological artifacts; however, in the event of an encounter, work would stop and the State Historic Preservation Division would be contacted.

Archaeological sites were discovered within 1 kilometer of the Proposed Action Alternative location; however, all proposed Project activities would be performed within the boundaries of the proposed Project site and would not directly or indirectly impact outside archaeological, cultural, or historic resources. Pursuant to the HO Management Plan, access to HO by Native Hawaiians would be maintained to allow access for cultural practitioners. Additionally, operation of construction vehicles would only occur on paved roads so as to not disturb archaeological or cultural resources. Access to the site would require use of the Park Road, which is a historic roadway; however, the level of use would be low, short term, and consistent with allowable uses. Therefore, while unlikely, impacts to cultural and historic resources under the Proposed Action Alternative would be negligible, adverse, direct and potentially indirect, and short term during construction. No impacts to cultural and historic resources are anticipated during operation under the Proposed Action Alternative.

4.4.2 No-Action Alternative

The No-Action Alternative would not require construction or ground-disturbing activities. The former University of Chicago building would continue to be used for storage and emergency quarters, and no historic, cultural, or archaeological resources would be impacted.

4.4.3 Cumulative Impacts

Because the Proposed Action Alternative would have no impact on cultural resources during operations, by definition there would be no contribution to or potential for a cumulative effect on this resource.

During construction, the Proposed Action Alternative would have minimal ground-disturbing activities and the majority of construction activities would be modifications to the existing structure. Further, the proposed Project, like other existing activities, would not hinder access to HO by Native Hawaiians. Moreover, the genesis of the proposed Project included input from the community, asking that new proposals reuse existing facilities, rather than introduce new construction with additional impact on cultural resources. While the contribution to cumulative cultural impacts from the proposed Project is difficult to quantify, the Proposed Action Alternative would not tip the scale of significance and would not exacerbate the current cultural setting. As such, while measurable impacts exist to cultural resources as a result of past activities, the cumulative impact of the proposed Project during construction would not contribute considerably to cumulative impacts to these resources and

the potential cumulative effect would be minor, adverse, direct, and short term.

4.5 ROADWAYS AND TRAFFIC

This impact analysis focuses on the potential for the Proposed Action or the No-Action Alternative to affect roadways or traffic, either beneficially or adversely, directly or indirectly. In other words, would the proposed activities require new roadways or result in increases or reductions in traffic on local roadways? The incremental impact of the Proposed Action when added to other past, present, and reasonably foreseeable future activities within the same region of influence is also evaluated.

The intensity of impacts is described as major, moderate, minor, negligible, or no impact, as defined below.

- A major impact would result in substantial change to existing traffic levels, require new roadways, or substantially impair existing roadways, with severe adverse or beneficial impacts.
- A moderate impact would result in a measurable and consequential change in traffic, roadways, access, or/and transportation corridors.
- A minor impact would result in a small, localized change of little consequence.
- A negligible impact would result in a minimal change in existing traffic or roadway conditions.
- No impact means that the resulting effect would be too small to have any measurable or perceptible consequence.

Impacts may be short term or long term. A short-term impact would only occur during construction. A long-term impact would continue into the operation of the proposed facility.

4.5.1 Proposed Action Alternative

The construction and operation of the proposed Project facility would require use of SR 378 and the Park Road, which is under the jurisdiction of Haleakalā National Park, to access the summit of Haleakalā. As such, the proposed Project would require a Special Use Permit from Haleakalā National Park for use of the Park roadway. The proposed Project applicant would obtain a permit for use of this roadway prior to proposed Project activities, including necessary measures to offset traffic congestion or delays such as scheduling of construction vehicles around peak visitation periods. Proposed construction is anticipated to occur on a

short-term basis, over a period of approximately 120 days. Table 2-1 summarizes the types of equipment and vehicles that might be used during each phase of proposed Project construction. This table also summarizes the number of round trips during each phase of the proposed Project.

Construction vehicles and equipment accessing the site would be temporarily staged onsite. Equipment needed for contiguous phases would be staged so as to minimize traffic on the surrounding roadways. No oversized vehicles or loads are proposed. Heavy equipment needed for construction would be delivered on a flatbed truck. Operations of the facility would be primarily remote and would not noticeably alter traffic volumes along the Park Road.

Given the short duration and small, local increase in traffic volumes and levels of service along SR 378 and the Park Road during construction, impacts would be minor, adverse, direct, and short term. The proposed Project would be operated remotely; no site operators would be required. Approximately once per week, one crew member or visiting scientist would visit the site in a private vehicle to service or interact with instrumentation. As such, during operations, impacts to traffic along the Park Road and SR 378 would be negligible, adverse, direct, and long term.

4.5.2 No-Action Alternative

No additional vehicle trips or alterations to roadways are proposed under the No-Action Alternative. As such, there would be no impact to roadways or traffic level of service.

4.5.3 Cumulative Impacts

Construction under the Proposed Action Alternative has the potential to contribute to traffic congestion on the Park Road on a short-term basis, given the increase in trips from construction vehicles. Other sources of impacts to roadways and traffic would be damage to roadways caused by heavy vehicle traffic during construction of surrounding developments, and interference with visitor traffic during peak travel times (NSF 2009). However, vehicles and equipment used for consecutive phases of construction under the Proposed Action Alternative would be staged onsite, which would reduce the potential for impacts. No wide loads are proposed for the proposed Project and deliveries would be coordinated with HALE and with the DKIST Project team to minimize congestion. Although measurable, the change in traffic flow and roadway conditions during construction would have minimal contribution when added to the

effects of other present and reasonably foreseeable uses in the area. As such, the Proposed Action Alternative would have minor, adverse, direct and short-term cumulative effect on current roadway conditions.

Operations at the site would be primarily remote and the slight percentage increase in daily and weekly vehicle trips would have a negligible, adverse, direct, and long-term cumulative impact on traffic conditions along the Park Road and other surrounding roadways.

4.6 PUBLIC SERVICES AND UTILITIES

This impact analysis focuses on the potential for the Proposed Action or No-Action Alternatives to affect public services and utilities, either beneficially or adversely, directly or indirectly. In other words, would the proposed activities impose a change in the demand placed on or otherwise impair local or regional services or utilities? The incremental impact of the Proposed Action Alternative when added to other past, present, and reasonably foreseeable future activities within the same region of influence is also evaluated.

The intensity of impacts is described as major, moderate, minor, negligible, or no impact, as defined below.

- A major impact would result in substantial change to existing service or utility systems, substantially impair or improve functionality of existing systems, or require an expansion of an existing system or establishment of a new system.
- A moderate impact would result in a measurable and consequential change in existing service or utility systems.
- A minor impact would result in a small, localized change of little consequence well within the capacity of the current system.
- A negligible impact would result in a minimal change or a minimal demand on existing service or utility systems.
- No impact means that no additional demand would be placed on the existing service or utility system.

Impacts may be short term or long term. A short-term impact would only occur during construction. A long-term impact would continue into the operation of the proposed facility.

4.6.1 Proposed Action Alternative

The contractor would be responsible for supplying necessary water and power to the site for construction and build-out activities. Likewise, the contractor would be responsible for managing wastewater and solid waste collection and disposal needs. Proposed construction activities under the Proposed Action Alternative would not place an increased demand on local service and utility systems. Solid waste generation would not be expected to measurably increase demand on the local landfill and no hazardous waste would be generated. The impact on solid waste generation would be negligible.

The existing bathroom would be removed from the facility during renovations and no new facilities would be installed. Operations would be largely remote. Solid waste generated while at the site would be brought down the mountain with the visiting scientist or crew. There would be no impact to water supplies, wastewater treatment, or solid waste generation.

Estimated energy needs for the Proposed Action Alternative during construction would be minimal; energy would primarily be needed for hand tools used in building modifications. This is estimated at an average of approximately 2 kilowatt-hours per day during the construction period. Operational power needs are anticipated to fluctuate based on the observations taking place, but there would be only a small, intermittent electrical draw required for mount control and for sensor operations each week, which is estimated to be less than 10 percent of the maximum carrying capacity of the system for this site. Power and electrical services under the Proposed Action Alternative would be provided by Maui Electric. Under the Proposed Action Alternative, old wires would be replaced with new wires and would conform to all electrical codes set forth by the State of Hawai‘i. Impacts to power and energy sources under the Proposed Action Alternative would be minor, adverse, direct, and long term.

4.6.2 No-Action Alternative

No changes in operation are proposed under the No-Action Alternative and no construction activities are proposed. As such, there would be no additional demand on current public services and utilities and there would be no impact.

4.6.3 Cumulative Impacts

During construction of the Proposed Action Alternative the contractor would be responsible for managing water, wastewater, solid waste and energy; therefore, there would be no impact to local utilities and public services. Likewise, there would be no impact to water supplies, wastewater treatment, or solid waste generation during operations. By definition there would be no potential for a cumulative effect on this resource.

The Proposed Action Alternative would result in minor, adverse impacts to power and energy sources during operations. The Maui Electric electrical grid is currently operating below capacity and is able to accommodate past, present and reasonably foreseeable future activities. During operations, the Proposed Action Alternative would require minimal amounts of energy and would utilize less than approximately 10 percent of the maximum carrying capacity for the site. Other activities within the grid area have been accounted for with Maui Electric Company and are not anticipated to grow beyond capacity. As such, the cumulative effect on power and electricity would be minor, adverse, direct and indirect, regional, and long term.

4.7 WATER RESOURCES AND HYDROLOGY

This analysis focuses on the effects, whether beneficial or adverse, direct or indirect, of the Proposed Action Alternative or No-Action Alternative on water and hydrologic features near the proposed Project area. The incremental impact of the Proposed Action Alternative when added to other past, present, and reasonably foreseeable future activities within the same region of influence is also evaluated. Impacts are described by the level of intensity of impacts on water resources and hydrology, and are categorized as major, moderate, minor, negligible, and no impact. For this analysis, these terms are defined as follows:

- A major impact would result in a substantial change to the surface or groundwater features, hydrologic flow, or water quality. Extensive mitigation measures to offset adverse impacts would be needed and their success could not be guaranteed.
- A moderate impact would result in a measurable and consequential change to the surface or groundwater features, hydrologic flow, or water quality. Mitigation may be needed to offset adverse impacts and would be relatively simple to implement and likely to be successful.

- A minor impact would result in a detectable change to the surface or groundwater features, hydrologic flow, or water quality, but the change would be small, localized, and of little consequence.
- A negligible impact would result in a minimal change so small it would not be measurable or perceivable.
- No impact means the proposed Project would result in no change to surface or groundwater features, hydrologic flow, or water quality.

The duration of impacts is described as either short term (would occur only during proposed Project construction) or long term (would continue into operation of the proposed facility).

4.7.1 Proposed Action Alternative

There are no surface water features on the Proposed Action Alternative site or within the greater HO complex and the Proposed Action Alternative is not anticipated to affect groundwater quality. The only intermittent body of water within the HO complex is an infiltration basin where storm water runoff collects at the western end of the HO complex. Aside from this infiltration basin, there would be no impact to Waikamoi Stream, which is located approximately 1.9 miles downslope of the Mees Solar Observatory. This stream would not be affected by the proposed activities.

The Proposed Action Alternative is not subject to the National Pollutant Discharge Elimination System permit requirement for construction activities. With the exception of the excavation of exterior column footings that would occur within the existing slab area, construction activities would take place primarily within the interior of the existing structure. Any foundation work and grading would not result in changes to the hydrologic characteristics. There would be no change in hydrologic flow as a result of operation of the proposed Project facility. If construction activities, such as equipment placement or staging, alter storm water flow, interim detours would be put into place to avoid impact. However, the Proposed Action Alternative would comply with the HO Management Plan (KCE 2010a) and HO Storm Water Management Plan (Tetra Tech, Inc. 2006) through a Scientific Cooperation Agreement. The need for additional permanent storm water infrastructure would not be needed and increases in runoff toward neighboring properties are not anticipated. Additionally, external staging and access would only use paved surfaces to mitigate potential impacts to water resources.

There could be a detectable change to the surface or groundwater features during the construction phase that might temporarily alter surface hydrologic flow requiring interim measures. By employing the required measures laid out in the HO Management Plan and Storm Water Management Plan, potential impacts would be small, localized, and of little consequence during construction and therefore considered minor, adverse, direct, and short term.

During operation, there would be no impact to water resources or hydrologic flow and storm water infrastructure would be maintained for property function.

4.7.2 No-Action Alternative

The No-Action Alternative would not require construction; therefore, there would be no increase in impervious surface that could otherwise lead to increased storm water runoff. Changes in operation are not proposed under the No-Action Alternative; therefore, impacts on water resources and hydrology are not anticipated. As such, there would be no direct or indirect impacts on surface water, groundwater, or drainage patterns with implementation of the No-Action Alternative.

4.7.3 Cumulative Impacts

Because the operation of the Proposed Action Alternative would have no impact on water resources, storm water, or hydrologic flow, by definition there would be no potential for a cumulative effect on these resources after construction is complete.

The Proposed Action Alternative would potentially have minor, adverse, direct, and short-term impacts during the proposed construction phase. Construction within HO has the potential to increase soil erosion and change infiltration routes and drainage patterns (NSF 2009). While no impervious surfaces or external grading are proposed under the Proposed Action Alternative, the staging of construction equipment could have a small and incremental effect on storm water flow and drainage in the area. However, impacts would be short term and would be reduced through the implementation of interim detours and by complying with the HO Storm Water Management Plan and HO Management Plan. All activities within HO must also comply with such plans and regulations (NSF 2009). As such, impacts to water resources and hydrologic conditions within HO would be monitored and contained and the cumulative impacts associated with the Proposed Action Alternative would be minor, adverse, direct and short term.

4.8 GEOLOGY, SOILS AND TOPOGRAPHY

This analysis focuses on the effects, whether beneficial or adverse, direct or indirect, of the Proposed Action Alternative or the No-Action Alternative on topography, geology, and soils within the proposed Project area. The incremental impact of the Proposed Action Alternative when added to other past, present, and reasonably foreseeable future activities within the same region of influence is also evaluated.

Impacts are described by the level of intensity of impacts on topography, geology, and soils and are categorized as major, moderate, minor, negligible, or no impact. For this analysis, these terms are defined as follows:

- A major impact would result in a substantial change to the topography, geology, or soils. Extensive mitigation measures to offset adverse impacts would be needed and their success could not be guaranteed.
- A moderate impact would result in a measurable and consequential change to the topography, geology, or soils. Mitigation may be needed to offset adverse impacts and would be relatively simple to implement and likely to be successful.
- A minor impact would result in a detectable change to the topography, geology, or soils, but the change would be small, localized, and of little consequence.
- A negligible impact would result in a minimal change so small it would not be measurable or perceivable.
- No impact means the proposed Project would result in no change to topography, geology, or soils.

The duration of impacts is described as either short term (would occur only during proposed Project construction) or long term (would continue after construction).

4.8.1 Proposed Action Alternative

The existing geologic and topographic conditions under the Proposed Action Alternative impose no notable constraints on the proposed Project. Eruptions at Haleakalā are extremely rare in terms of human life span, and only expected to occur every 200 to 500 years (U.S. Geological Survey 2010). The majority of the ground at and near the HO complex is paved with asphalt and barren due to substantial human disturbance and development. The soils that are present onsite are volcanic soils from the

Kula and Hana volcanic series, which are susceptible to erosion. Minimal ground-disturbing activities are proposed under the Proposed Action Alternative. Therefore, impacts to current topography, soils, and geologic conditions are not anticipated.

Proposed modifications to the facility including foundation work and grading would not result in additional erosion. Construction vehicles and equipment would use existing paved roads and surfaces; however, because isolated areas of erosion could still result given the nature of construction, erosional controls would be put into place to reduce potential effects. There would be no change to topography, geology, and soils, and any erosional effects would be negligible, adverse, direct, short-term, and localized. Storm water infrastructure is proposed to minimize operational erosional effects in the long term.

The Proposed Action Alternative location is on land classified as Seismic Design Category D, which is characteristic of structures of ordinary occupancy that could experience very strong shaking. The proposed Project itself would not pose a new ground-shaking risk, but the proposed facility could be affected by seismic activity in the area. As such, facility modifications would conform to international building codes. The risk of ground-shaking and impact on the building would remain unchanged. This impact, though unchanged, is considered negligible, adverse, direct, and long term because of the continued use of the site.

4.8.2 No-Action Alternative

There would be no new construction or changes to operations under the No-Action Alternative. As such, there would be no erosional effects or impact on the topography, soils, or geologic conditions.

4.8.3 Cumulative Impacts

Because there would be no impacts to topography, geologic conditions, and soils under the Proposed Action Alternative during construction and operations, there would be no potential for cumulative effects to these resources when added to other past, present, or reasonably foreseeable future actions in the area. There would, however, be the potential for negligible adverse erosional effects as discussed in the proposed Project analysis and effects on the project from seismic ground-shaking based on the existing seismic land classifications. Other past actions within HO have altered the topography of the land within HO and have resulted in erosional effects over time (NSF 2009). The proposed Project activities would not change this type of degradation; however with erosional

controls the functionality of the landscape would be maintained. The Proposed Action Alternative would also conform to all relevant building codes. As such, cumulative impacts to erosional effects would be minor, adverse, direct and indirect, local and long term during construction and operations.

4.9 HAZARDOUS MATERIALS AND WASTES

This analysis focuses on the effect, whether beneficial or adverse, direct or indirect, of the Proposed Action Alternative or the No-Action Alternative on the volume of hazardous materials or waste generated onsite or how hazardous materials or wastes are handled or managed onsite. The incremental impact of the Proposed Action Alternative when added to other past, present, and reasonably foreseeable future activities within the same region of influence is also evaluated.

Impacts are categorized by the level of intensity of impacts on hazardous materials or wastes as major, moderate, minor, negligible, or no impact. For this analysis, these terms are defined as follows:

- A major impact would result in a substantial increase in hazardous material handling or waste generation or otherwise risk or impair the handling of these materials as a result of the action. Extensive mitigation measures to offset adverse impacts would be needed and their success could not be guaranteed.
- A moderate impact would result in a measurable and consequential change in the volume of wastes generated or how materials are handled and managed. Mitigation may be needed to offset adverse impacts and would be relatively simple to implement and likely to be successful.
- A minor impact would result in a measurable change in the volume of wastes generated or how materials are handled and managed, but the change would be small, localized, and of little consequence.
- A negligible impact would be so small that it would not have any measurable consequence.
- No impact means the proposed Project would not add new sources of hazardous waste and there would be no change in how hazardous materials are handled or managed.

The duration of impacts is described as either short term (would occur only during proposed Project construction) or long term (would continue into the operation of the facility).

4.9.1 Proposed Action Alternative

The proposed Project would operate under a Scientific Cooperation Agreement with UH IfA and conform to the 2015 UH Hazardous Materials Management Program (University of Hawai‘i at Mānoa 2015). Materials such as oils and lubricants used by construction equipment would be present during proposed renovation activities. Similar materials might be used during operational maintenance. No hazardous materials would be stored onsite. No other hazardous wastes are anticipated to be generated from the construction or operation of the proposed Project.

The PTF and its entire construction crew would be responsible for enforcing the measures of the Hazardous Materials Management Program by all staff and visitors to the site to avoid the release of materials or unsanctioned use, storage, or handling of materials. The PTF and its entire construction crew would follow all procedures outlined in the UH Hazardous Materials Management Program and would comply with all regulations set forth by applicable federal, state, and local regulating bodies concerning the proper storage, treatment, and disposal of hazardous materials.

Additionally, The PTF or its crew would report all spills to the onsite IfA supervisor and facility managers and would follow spill remediation methods approved by the UH Environmental Health and Safety Office. Because of the type of operation proposed, the likelihood of release is low; however, with the adoption of these procedures, environmental and health-related impacts associated with hazardous materials under the Proposed Action Alternative would be negligible, adverse, direct, and long term.

4.9.2 No-Action Alternative

The No-Action Alternative would not require construction or changes in operation. No additional hazardous waste or materials would be accumulated onsite under the No-Action Alternative; therefore, there would be no impact.

4.9.3 Cumulative Impacts

Existing facilities on HO will continue to use hazardous materials for mirror coating and cleaning, lubrications, refrigerants etc. As such there would be potential for release of these hazardous materials (NSF 2009). However, hazardous material and waste handling at HO is considered excellent and is regulated under the 2015 UH Hazardous Materials Management Program.

Additionally, there has not been an Environmental Protection Agency-reportable spill on HO for more than 30 years (NSF 2009).

The Proposed Action Alternative would not typically manage hazardous materials onsite and the potential for impacts would be negligible and adverse during construction and operations. The cumulative impact on hazardous materials would be negligible, adverse, direct, and long term.

4.10 AIR QUALITY

This analysis focuses on the effect, whether beneficial or adverse, direct or indirect, of the Proposed Action Alternative or the No-Action Alternative on air quality. The incremental impact of the Proposed Action Alternative when added to other past, present, and reasonably foreseeable future activities within the same region of influence is also evaluated.

Impacts are categorized by the level of intensity of impacts on air quality as major, moderate, minor, negligible, or no impact. For this analysis, these terms are defined as follows:

- A major impact would result in a substantial change in air quality. Extensive mitigation measures to offset adverse impacts would be needed and their success could not be guaranteed.
- A moderate impact would result in a measurable and consequential change in air quality. Mitigation may be needed to offset adverse impacts and would be relatively simple to implement and likely to be successful.
- A minor impact would result in a detectable change in air quality, but the change would be small, localized, and of little consequence.
- A negligible impact would be so small that it would not have any measurable or perceptible consequence.
- No impact means the proposed Project would not result in a change in air quality.

The duration of impacts is described as either short term (would occur only during proposed Project construction) or long term (would continue into the operation of the facility).

4.10.1 Proposed Action Alternative

Construction activities associated with the Proposed Action Alternative, predominantly from the operation of construction equipment but also from the movement of materials and building modifications, would have

the potential to create localized emissions over a period of approximately 120 days. These activities would be phased, meaning that emissions and other effects would be intermittent over this duration and vary by activity. Construction activities would also be largely isolated, given that the majority of the renovations on the existing building would occur internally. Construction-related air emissions would not change the attainment status of the criteria pollutants for the federal, state, or local area and therefore would be minor, adverse, direct, short term, and local. Best management procedures such as watering exposed soil or erecting dust screens would be implemented during the construction phase to minimize the potential for particulate emissions.

The main source of operational air emissions near the Proposed Action Alternative site would be from vehicle emissions. Approximately once per week, one crew member or visiting scientist would visit the site in a private vehicle to service or interact with instrumentation. This minimal increase in vehicle emissions would have a negligible, adverse, direct, and long-term effect on federal and state air quality.

4.10.2 No-Action Alternative

The No-Action Alternative would not require construction or changes in current operations. There would be no direct or indirect impacts on existing air quality conditions.

4.10.3 Cumulative Impacts

Past and present activities have not degraded the air quality on Maui or in Hawai‘i. There are no reasonably foreseeable future actions that, when combined with present actions and the Proposed Action Alternative, would result in emissions that could change the attainment status. In the unlikely event of a substantial emissions increase from an unknown source, the characteristic high trade winds would quickly dissipate emissions, making it unlikely that any activity would potentially alter the attainment status within the air basin. No such cumulative effect is anticipated and the potential contribution from the Proposed Project Alternative would be so minimal that the cumulative effect would be negligible, adverse, both direct and indirect, regional, and long term.

4.11 NOISE

This analysis focuses on the potential noise impacts, whether beneficial or adverse, direct or indirect, of the Proposed Action Alternative or the No-Action Alternative. The incremental impact of the Proposed Action

Alternative when added to other past, present, and reasonably foreseeable future activities within the same region of influence is also evaluated.

The intensity of impacts is categorized as major, moderate, minor, negligible, or no impact, as defined below.

- A major impact would substantially change noise conditions. Mitigations could be implemented to offset these changes; however, success is not guaranteed.
- A moderate impact would result in substantial changes to noise conditions. Mitigations could be implemented to offset these changes and success could be measured.
- A minor impact would result in changes in noise conditions that are local and of small consequence. No mitigation would be necessary to offset changes.
- A negligible impact would result in minimal changes in noise levels.
- No impact means the proposed Project would create no noise-generating activities and no change in noise levels.

The duration of impacts is described as either short term (would occur only during proposed Project construction) or long term (would continue into the operation of the facility).

4.11.1 Proposed Action Alternative

Construction activities associated with the Proposed Action Alternative, such as the operation of jack hammers, backhoes, compactors, graders, sledgehammers, hand drills, saws, and construction vehicles, would likely result in short-term increases in noise levels above the allowable daytime noise levels for Class A zoning districts, which is 55 dBA. These activities, however, would be phased over the approximately 120-day construction period, meaning that heightened noise levels would be intermittent and vary by activity. HAR Section 11-46-4 (c), Maximum permissible dBA sound levels stipulate that established noise levels may be exceeded on a short-term, temporary basis during construction with proper permitting. As such, appropriate noise permits would be obtained prior to construction for any activities likely to exceed noise limits for an extended period of time (beyond that excluded by HAR Section 11-46-4). In accordance with the HO Management Plan, the following management practices will be followed:

1. Obtain noise permit as specified under HAR Section 11-46-7 and any conditions imposed by the permit.

2. Implement general construction noise control measures that require the contractor to ensure all equipment is in good working order, adequately muffled, and maintained in accordance with the manufacturers' recommendations.
3. Utilize appropriately sized equipment for each task. Where feasible, utilize smaller/quieter equipment.
4. Locate equipment away from any potential sensitive receptors.
5. Prohibit unnecessary idling of construction vehicles and equipment.
6. Shield noise sources where possible.

The proposed Project would comply with all noise limits and stipulations established in the HAR noise rules. Although construction activities would have the potential to create temporary noise level increases above permissible levels at a localized level, these levels would be reduced, shortened, and the potential effect on surrounding areas limited by implementing the practices listed above. By complying with HAR noise rules, this impact during construction is considered minor, adverse, direct, local, and short term.

For this assessment, noise measurements were obtained from a similar roll-off roof at HO at a distance of 50 feet in each of the four cardinal compass directions. The highest noise level recorded during roof motion was 47.5 dBA, which was indistinct from ambient wind and normal operational noises at HO. Therefore, during operations, noise levels would be expected to return to pre-construction conditions and would be consistent with other facilities located with the HO complex. Operational impacts would comply with applicable noise rules. As such, there would be no impact to noise levels during operations under the Proposed Action Alternative.

4.11.2 No-Action Alternative

No construction or changes in operations are proposed under the No-Action Alternative; therefore, there would be no changes to current noise levels in the vicinity of the property and no direct or indirect impacts on noise.

4.11.3 Cumulative Impacts

Noise levels during operation under the Proposed Action Alternative would have no impact on current noise levels, and therefore would have no potential for cumulative effect.

During construction activities, however, noise levels would be elevated intermittently over a period of approximately 120 days. These activities might occur at the same time as other noise-generating operations within HO including generator use, HVAC units, facility enclosure noises, human voices, and traffic. The sound of wind would remain a primary noise source. Noise levels, while additive in type, are not additive by decibel; therefore, noise levels will only be as loud as the greatest noise generating source. Additionally, the buffer area for noise dissipation is based on the highest decibel level. The proposed construction activities under the Proposed Action Alternative would contribute to these noise impacts for a limited duration, resulting in a minor, direct, local, and short-term cumulative impact.

4.12 SOCIOECONOMICS AND ENVIRONMENTAL JUSTICE

This analysis focuses on the potential effect, whether beneficial or adverse, direct or indirect, of the Proposed Action Alternative or the No-Action Alternative on demographics, the economy, population, housing, minority or low-income populations, or children. The incremental impact of the Proposed Action Alternative when added to other past, present, and reasonably foreseeable future activities within the same region of influence is also evaluated.

The intensity of impacts is categorized as major, moderate, minor, negligible, or no impact, as defined below.

- A major impact would result in housing displacement or a substantial change in the local economy, housing demand, or population; or effects on the safety of children. Mitigations could be implemented to offset these changes; however, success is not guaranteed.
- A moderate impact would result in substantial changes to these stated socioeconomic conditions, burden to minority or low-income populations, or effects on the safety of children. Mitigations could be implemented to offset these changes and success could be measured.
- A minor impact would result in changes to socioeconomic conditions or effects on minority or low-income populations or the safety of children that are local and of small consequence. No mitigation would be necessary to offset these effects.
- A negligible impact would result in minimal changes in socioeconomic conditions or effects on minority or low-income populations or the safety of children.
- No impact means the proposed Project would have no effect on local populations, the economy, or the safety of children.

The duration of impacts is described as either short term (would occur only during proposed Project construction) or long term (would continue into the operation of the facility).

4.12.1 Proposed Action Alternative

The Proposed Action Alternative would be operated remotely; no onsite operators would be required. Approximately once per week, one crew member or visiting scientist would visit the proposed Project property to service or interact with instrumentation. As such, the proposed operations would not require new or replace existing housing. Construction and operations under the Proposed Action Alternative would not negatively impact the economy in Maui, but would have the potential to advance opportunities related to scientific research and discovery. As stated in Section 3.12, the proposed PLANETS telescope facility would offer additional educational opportunities for visiting students.

Construction required under the Proposed Action Alternative would also provide short-term opportunity for construction crews. Proposed Project activities would not impact economic growth specifically related to agriculture in Maui.

Construction activities under the Proposed Action Alternative would result in temporary increases in traffic along roadways shared by tourists travelling to Haleakalā National Park. However these small traffic increases are not expected to impact economic growth related to tourism in Maui.

There are no schools, hospitals, or other sensitive receptors near the Proposed Action Alternative site. There would be no direct or indirect impacts on population, housing, or the local economy as a result of construction or operations under the Proposed Action Alternative. There would be no disproportionate effects on low-income populations, minorities, or children as a result of these activities.

4.12.2 No-Action Alternative

The No-Action Alternative would not require construction or changes to current operations; therefore, this alternative would have no adverse direct or indirect impacts on socioeconomics or environmental justice in the region.

4.12.3 Cumulative Impacts

Because there would be no potential for adverse impacts under the Proposed Action Alternative during construction or operations, by definition there would be no potential for cumulative effects on socioeconomic conditions or disproportionate cumulative effects on minority or low-income populations or children. The proposed Project would, however, contribute beneficially to the local educational programs related to scientific research and discovery.

5.0 OTHER REQUIRED ANALYSES

In addition to the analyses discussed in Section 4.0, Environmental Consequences, the Hawai‘i Environmental Policy Act requires consideration of the proposed Project's impacts on the relationship between local short-term uses of the environment and long-term productivity, irreversible or irretrievable commitment of resources, and unavoidable adverse impacts (HAR Section 11-200-17[j-l]).

5.1 RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF THE ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

Impacts associated with the Proposed Action Alternative would primarily occur during the construction phase associated with air emissions from construction vehicles and equipment, traffic from construction vehicles and noise generated by construction equipment. Construction of the Proposed Action Alternative would require the use of Haleakalā Park Road corridor, a road under National Park Service jurisdiction, which also provides access to Haleakalā National Park. The proposed Project team would coordinate with Haleakalā National Park staff to schedule deliveries and overall road use during construction activities so as to minimize or avoid interruption to traffic flow during peak hours or add congestion. Construction vehicles and equipment needed for contiguous phases would be staged onsite and heavy equipment needed for construction would be delivered on a flatbed truck to minimize traffic on the surrounding roadways. Additionally, no wide loads or oversized vehicles would be anticipated. As such, the volume of traffic projected would not measurably alter traffic conditions.

While there would be a potential for impacts to biological and cultural resources, no federally listed, special-status, or vulnerable plants or animals were observed on the Proposed Action Alternative site and no sensitive habitats occur onsite. Likewise there would be no increase in project footprint or new earthwork and no proposed Project-related restrictions on site access by Native Hawaiians during construction or operations. Hazardous materials such as lubricants and oils would be used on construction equipment during renovations and equipment maintenance during operations. No hazardous materials would be stored onsite and any waste would be taken down the mountain the same day. The PTF would conform to the 2015 UH Hazardous Materials Management Program (University of Hawai‘i at Mānoa 2015). As such,

the potential for release of hazardous materials would be low and potential impacts would be negligible.

Construction activities under the Proposed Action Alternative would neither use nor impact any sensitive environmental resource in a manner that would preclude the long-term value or productivity of that resource.

During operations, the Proposed Action Alternative would function similarly to surrounding properties and observatories on HO and would be of similar visual quality. The proposed Project would be operated remotely; no onsite operators would be required. As such, during operations, impacts from such resource areas as noise, traffic, air quality, and aesthetics would have a negligible effect on current conditions. The proposed Project and associated advanced algorithms and technologies would result in positive long-term effects during operations, including the advancement of scientific capabilities in the fields of polarimetry and coronagraphy. Advancements in these fields would have the potential to lead to discoveries in areas related to exoplanet detection, circumstellar environments, and extrasolar planetary atmospheres. Additionally, no other telescope in the world has the capacity and technologies necessary to provide such a high level of contrast in low scattered light and during nighttime observations. Furthermore, a number of school programs visit the summit of Haleakalā annually for scientific educational opportunities. The Proposed Action Alternative would provide additional educational opportunities related to astronomy and science for local schools.

5.2 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

The Hawai‘i Environmental Policy Act requires consideration of how the proposed Project might commit non-renewable resources to uses that would not be irreversible or irretrievable to future generations. This analysis considers the potential commitments of the Proposed Action Alternative. Other than the use of petroleum, oils, and fuels by equipment and vehicles, there would be no other irreversible or irretrievable commitment of resources associated with the Proposed Action Alternative.

5.3 UNAVOIDABLE ADVERSE IMPACTS

Unavoidable adverse impacts include both short- and long-term impacts. No major or moderate unavoidable adverse impacts were identified as a result of the Proposed Action Alternative. While there would be the potential for minor short-term impacts associated with such resources as

biological resources, noise and traffic flow, these could be minimized or potentially eliminated through scheduling of construction deliveries and mobilizations in close coordination with the Haleakalā National Park to avoid peak visitation periods. Additionally, best management practices such as equipment cleaning would be employed to avoid the spread of noxious species and noise suppression technologies on construction equipment and tools.

6.0 REFERENCES

AA Roads. 2016. *Maui State Roads*. Accessed January 19, 2016. Retrieved from: http://www.aaroads.com/guide.php?page=mauihi.

Air Info Now. 2015. *What is Particulate Matter?* Accessed: December 8, 2015. Retrieved from: http://www.airinfonow.org/html/ed_particulate.html.

County of Maui. 2015. *Water Treatment Facilities*. Accessed: October 1, 2015. Retrieved from: http://www.co.maui.hi.us/index.aspx?NID=775.

County of Maui Department of Environmental Management. 2015. Landfill Information. Accessed January 19, 2016. Retrieved from: http://www.co.maui.hi.us/index.aspx?nid=765.

County of Maui Department of Housing and Human Concerns. 2014. *Joint NEPA-HEPA Draft Environmental Assessment – Kulamalu Affordable Housing, Pukalani, District of Makawao, Maui, Hawai'i*. January 17, 2014.

County of Maui Department of Planning. 2009. Cultural Resources Overlay/Scenic Corridor Protection Map. March 12, 2009. Retrieved from: http://www.mauicounty.gov/DocumentCenter/Home/View/10500.

County of Maui Department of Planning. 2012. *Maui Island Plan, Island of Maui General Plan 2030*. December 28, 2012. Retrieved from: http://www.co.maui.hi.us/index.aspx?nid=1503.

County of Maui Department of Public Works. 2010. *Maui County Downhill Bicycle Tour Study*. June 2010. Retrieved from: http://www.mauicounty.gov/DocumentCenter/Home/View/11411.

County of Maui Department of Water Supply. 2015. *Kamole Weir*. Accessed: January 19, 2016. Retrieved from: http://www.co.maui.hi.us/index.aspx?NID=567.

County of Maui Office of Economic Development. 2013. *Maui County Data Book 2013*. Accessed: December 16, 2015. Retrieved from: http://hisbdc.org/Portals/0/MCDB/2013/2013%20Maui%20Data%20Book.pdf.

Fehr & Peers/Kaku Associates. 2007. *Proposed Roadway Development Program*. January 2007. Retrieved from: http://www.co.maui.hi.us/DocumentCenter/Home/View/10493.

First Hawaiian Bank. 2015. *Economic Forecast Maui Edition 2014-2015*. Accessed December 16, 2015. Retrieved from: https://www.fhb.com/en/assets/File/Marketing/2014_Maui_EconForecast.pdf.

Gershman, Brickner & Bratton, Inc. 2012. *County of Maui Hawai'i Integrated Solid Waste Management Plan*. September 27, 2012. Retrieved from: http://gbbinc.com/speaker/BricknerUSVICAC2012-Maui.pdf

Google, Inc. 2016. 20°42'29.63" N 156°15'26.13" W; Haleakalā Observatories. Google Earth Pro, version # 7.1.5.1557. Imagery Date January 13, 2013. Accessed March 17, 2016.

Hawai'i State Department of Health. 1996. *Title 11 Hawai'i Administrative Rules, Chapter 46 Community Noise Control*. September 12, 1996. Retrieved from: http://health.hawaii.gov/opppd/files/2015/06/11-46.pdf

Hawai'i State Department of Health. 2015. *Maui Quick Look Report*. Accessed: October 1, 2015. Retrieved from: http://emdweb.doh.hawaii.gov/air-quality/.

Hawaiian Commercial & Sugar Company (HC&S). 2016. "Alexander & Baldwin Announces Transition of Hawaiian Commercial & Sugar Company to a Diversified Farm Model." January 6, 2016. Retrieved from: http://hcsugar.com/2016/01/alexander-baldwin-announces-transition-hawaiian-commercial-sugar-company-diversified-farm-model/.

Institute for Astronomy (IfA). 2010. Telescope Design. University of Hawai'i. August 29, 2010. Retrieved from: http://kopiko.ifa.hawaii.edu/planets/techno.html.

IfA. 2016. PLANETS Japan Hawai'i Europe Telescope. University of Hawai'i. Accessed: February 11, 2016. Retrieved from: http://www.ifa.hawaii.edu/haleakalānew/planets/.

International Archaeology, LLC (IA). 2016. *Final Archaeological Inventory Survey for the Proposed PLANETS Optical Telescope at the Haleakalā High Altitude Observatory, Pāpa'anui Ahupua'a, Makawao District, Maui TMK: (2) 2-2-007:008* (Portion). April 2016.

KC Environmental, Inc. (KCE). 2010a. *Haleakalā High Altitude Observatory Site Management Plan*. Prepared for UH IfA. June 8, 2010.

KCE. 2010b. *Final Environmental Assessment for the Haleakalā High Altitude Observatory Site, Maui, Hawaii Management Plan*. Prepared for UH IfA. October 25, 2010.

KCE. 2015. *Conservation District Use Application (CDUA).* May 12, 2015.

Maui County Council. 1996. *Makawao-Pukalani Kula Community Plan Update*. July 1996. Retrieved from: http://www.co.maui.hi.us/DocumentCenter/Home/View/1714.

Maui Electric Company. 2013. *About Us*. Accessed: October 1, 2015. Retrieved from: http://www.mauielectric.com/meco/About-Us.

National Science Foundation (NSF). 2009. *Final Environmental Impact Statement for the Advanced Technology Solar Telescope*. July 2009. Retrieved from: http://dkist.nso.edu/FEIS.

NSF. 2012. *Final Supplemental Environmental Assessment Advanced Technology Solar Telescope Project Haleakalā, Maui, Hawaii.* February 10, 2012.

Philip Habib & Associates/Sandstone Environmental Associates, Inc. 2009. *Final Environmental Impact Statement for the 770 Eleventh Avenue Mixed-Use Development Rezoning*. March 2009. Retrieved from: http://www.nyc.gov/html/dcp/pdf/env_review/770_11thavenue/16_feis.pdf.

Starr Environmental. 2015. *Botanical and Faunal Survey for the Proposed Polarized Light from Atmospheres of Nearby Extra-Terrestrial Systems Telescope, Haleakalā, Maui*. November 2015.

State of Hawai'i Department of Transportation. 2015. *Maui State Roads and Highways*. Accessed December 1, 2015. Retrieved from: http://hidot.hawaii.gov/highways/home/maui/maui-state-roads-and-highways/.

Tetra Tech, Inc. 2006. *Haleakalā High Altitude Observatory Stormwater Management Plan*. March 2006. Retrieved from: http://www.ifa.hawaii.edu/Haleakalānew/LRDP/images/SWMP.pdf.

U.S. Census Bureau. 2015. *Quick Facts Maui County, Hawai'i.* Accessed: March 22, 2016. Retrieved from: http://www.census.gov/quickfacts/table/PST045215/15009.

U.S. Geological Survey. 2010. Should Maui residents be concerned about lava flows? June 3, 2010. Retrieved from:

http://elsei.wr.usgs.gov/volcanowatch/archive/2010/10_06_03.html.

University of Hawai‘i at Mānoa. 2015. *Hazardous Material Management Program*. November 2015. Retrieved from: http://www.hawaii.edu/ehso/hazmat/UHHMMP01.pdf.

Appendix A
Botanical and Faunal Survey
Starr Environmental
November 2015

BOTANICAL AND FAUNAL SURVEY

PROPOSED POLARIZED LIGHT FROM ATMOSPHERES OF NEARBY EXTRA-TERRESTRIAL SYSTEMS TELESCOPE

HALEAKALA, MAUI

Prepared By:
FOREST & KIM STARR
STARR ENVIRONMENTAL

Prepared For:
KC ENVIRONMENTAL

NOVEMBER 2015

BOTANICAL AND FAUNAL SURVEY
PROPOSED POLARIZED LIGHT FROM ATMOSPHERES OF NEARBY EXTRA-TERRESTRIAL SYSTEMS TELESCOPE
HALEAKALA, MAUI

INTRODUCTION

The University of Hawaii Institute for Astronomy (UH IfA) proposes to reuse an existing structure at the Haleakala Observatories (HO) for the proposed Polarized Light from Atmospheres of Nearby Extra-Terrestrial Systems (PLANETS) Telescope project.

PLANETS is a novel 2 meter aperture telescope uniquely designed to achieve extremely high photometric dynamic range. Its science goals range from studying the tenuous atmospheres of solar system planets and satellites to exploring extrasolar planets and the circumstellar environments of other stars.

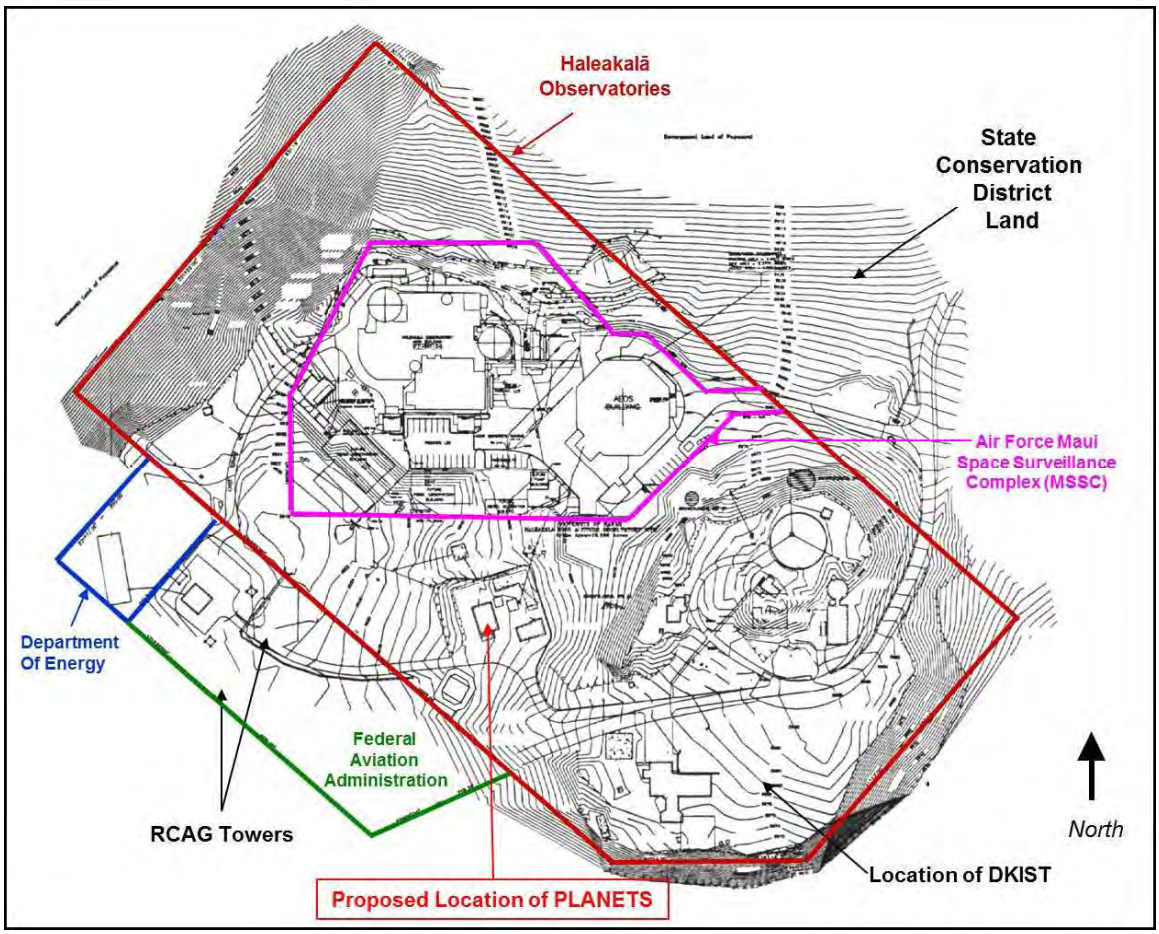
Most modifications would take place primarily within the existing structure and foundation and the exterior appearance of the original wall structure would remain largely unchanged. Once modifications were completed, this facility would be operated remotely, requiring no operators on-site aside from periodic maintenance.

The site lies within HO, Haleakala, Maui (TMK 222007008). HO is largely within the Kolekole cinder cone, and is roughly rectangular in shape. It is mostly surrounded by State Conservation District lands, with a small adjoining Federal property on the southwest boundary, and Haleakala National Park nearby to the East. This study was initiated to gather information about the flora and fauna of the project area.

SITE DESCRIPTION

HO is located near the summit of Haleakala, around 3000 m (10,000 ft) elevation. Average annual rainfall is a moderate 1,037 mm (41 in), occurring primarily during the winter months (Giambelluca et al. 2013). Temperatures can be cold at the site, and occasionally dip below freezing, with average annual temperature at the summit of Haleakala ranging from 43-50 degrees F (6-10 degrees C), and once every few years it will snow (County of Maui, 1998). The soils are volcanic, a mixture of ash, cinders, pumice, and lava (RTS, 2002).

The proposed PLANETS site has been developed and in use since the 1950's. The site currently has an existing building that will be reused, and an apron of asphalt, which is mostly barren. A few native and non-native plants have become established in cracks in the deteriorating asphalt, but the site is mostly barren.



Proposed PLANETS project site, HO, Maui.

BIOLOGICAL HISTORY

About 128,000 years ago the site where HO now sits would have been the active cinder cone Kolekole, (Sherrod *et al*., 2003; Terry, 2005) with lava flows pouring from the highest point of HO, the former Reber Circle telescope site, and fountains of lava creating the cinder and lava bombs found scattered across HO today. At this point in time, there would have been no vegetation on Kolekole.

After the volcanic activity passed at Kolekole, vegetation would have slowly started reappearing from nearby areas that weren't covered with lava. Many of the native plants in this aeolian zone are wind dispersed. Visiting birds would also leave seeds in their droppings when passing through the area. Eventually, though sparse, vegetation would come to occupy much of Kolekole and nearby areas.

During pre-contact times, Hawaiians used the Kolekole area, as evidenced by wind-shelters, and other sites found in the general area (Maxwell, 2006; Fredericksen, 2006). Despite this, the area probably remained relatively unchanged floristically, until development for astronomy began, with the building of a radio telescope at Reber Circle in 1951 (KC Environmental, Inc., 2009).

Since 1950, much of the surface of Kolekole has been reworked by heavy machinery to develop the Haleakala Observatories site, removing much of the original vegetation that occupied the site. In areas that hadn't become impermeable through development, plants returned. Often these plants were native, though occasionally they were non-native. Today, though sparse, Kolekole appears to support more vegetation than nearby areas, presumably from ground disturbance and runoff from structures.

SURVEY OBJECTIVES

The objectives of the survey were to:

- Document what plant and animal species occur on the site or may likely occur in the existing habitat.
- Document the status and abundance of each species.
- Determine the presence or likely occurrence of any native flora and fauna, particularly any that are Federally listed as Threatened or Endangered. If such occur, identify what features of the habitat may be essential for these species.
- Determine if the project area contains any special habitats which if lost or altered might result in a significant negative impact on the flora and fauna in this part of the island.

Proposed PLANETS project site and surrounding areas, HO, Maui.

BOTANICAL SURVEY

SURVEY METHODS

A walk-through botanical survey method was used. Given the small size, the entire site was covered multiple times. Notes were made on plant species, distribution and abundance. Extra emphasis was placed on areas with high diversity and areas where management was most feasible and likely. The site was surveyed on November 6, 2015.

The site is mostly barren with a few locally common plants.

DESCRIPTION OF VEGETATION

What little vegetation there is on the site is a mix of native and non-native species commonly found in the summit region of Haleakala. The plants are growing out of cracks in the deteriorating asphalt.

There are a few clumps of the native shrub kupaoa (*Dubautia menziesii*) and the native haigrass (*Deschampsia nubigena*), especially up against the building. There was also a single plant of enaena (*Pseudognaphalium sandwicensium var. sandwicensium*).

Also on the site are a few plants of the non-native herbs black medic (*Medicago lupulina*) and dandelions (*Taraxacum officinale*), and the non-native annual bluegrass (*Poa pratensis*) and fescue (*Festuca* sp.).

DISCUSSION AND RECOMMENDATIONS

The entire project area has been heavily impacted by previous human disturbances and is currently developed, covered by a building and an apron of asphalt. The few native plant species found on the site are locally common and of no special conservation concern.

No Haleakala Silverswords (*Argyroxiphium sandwicense* subsp. *macrocephalum*) or other rare plants were found on the site. No special native plant habitats occur on the project site. The proposed project is not expected to have a significant negative impact on the botanical resources in this part of Maui.

PLANT SPECIES LIST

Following is a checklist of all those vascular plant species inventoried during the field studies. Taxonomy and nomenclature of the flowering plants are in accordance with Wagner et al. (1999).

For each species, the following information is provided:

- Scientific name
- Common English or Hawaiian name.
- Bio-geographical status. The following symbols are used:
    - Endemic = Native only to the Hawaiian Islands; not naturally occurring anywhere else in the world.
    - Indigenous = Native to the Hawaiian Islands and also to one or more other geographic area(s).
    - Non-native = All those plants brought to the islands intentionally or accidentally after western contact.
- Abundance of each species within the project area:
    - Dominant = Forming a major part of the vegetation within the project area.
    - Common = Widely scattered throughout the area or locally abundant within a portion of it.
    - Occasional = Scattered sparsely throughout the area or occurring in a few small patches.
    - Rare = Only a few isolated individuals within the project area.

PLANT SPECIES LIST

Scientific names	Common names	Status	Abundance
Dubautia menziesii	Kupaoa	Native	Occasional
Deschampsia nubigena	Hairgrass	Native	Common
Festuca sp.	Fescue grass	Non-native	Rare
Medicago lupulina	Black medic	Non-native	Rare
Poa pratensis	Annual bluegrass	Non-native	Occasional
Pseudognaphalium sandwicensium var. sandwicensium	Ena ena	Native	Rare
Taraxacum officinale	Dandelion	Non-native	Rare

A kupaoa bush growing from the base of the building at the proposed site.

FAUNAL SURVEY

SURVEY METHODS

A walk-through survey method was conducted in conjunction with the botanical survey. Field observations were made with the aid of binoculars and by listening to vocalizations. Notes were made on species, abundance, activities and location as well as observations of trails, tracks, scat and signs of feeding.

Conspicuous insects were noted. Previous invertebrate surveys of HO and subalpine areas of Haleakala were reviewed.

An evening visit was made to record crepuscular activities and vocalizations and to look for presence of Hawaiian Hoary Bats (*Lasiurus cinereus semotus*) and Hawaiian Petrels (*Pterodroma sandwichensis*). Along with visually scanning the sky for bats and birds, active and passive ultrasonic bat detectors were used. The site was surveyed on November 6, 2015.

Surveying for bats at sunset, using both visual searches and ultrasonic bat detectors. No bats were observed or detected.

BATS

Hawaiian Hoary Bats (*Lasiurus cinereus semotus*) have not been documented from HO, but have been seen at 2750 m (9,000 ft) on the south slope of Haleakala, and may utilize episodically abundant insects anywhere on Maui.

During the night survey of the proposed site, no bats were observed, and no ultrasonic bat calls were detected. There are no trees on the site or in nearby areas.

NON-NATIVE MAMMALS

No non-native mammals were observed on the site.

There are no feral ungulates within the area, which was fenced in 2013. However, goats (*Capra hircus*), pigs (*Sus scrofa*), and axis deer (*Axis axis*), reside in adjacent areas.

DKIST employs extensive predator grids for rats (*Rattus* spp.), cats (*Felis catis*), and mongoose (*Herpestes auropunctatus*), which results in fewer numbers of these predators in the area.

BIRDS

No birds were observed or heard on the site.

There are very few birds at HO. A noteable exception are the Hawaiian Petrels (*Pterodroma sandwichensis*), which seasonally occupy pre-existing or bird excavated burrows under lava shelves to nest in.

Occasionally other birds are seen at HO, especially chukars (*Alectoris chukar*) which are in the summit area year round, and red-billed leiothrix (*Leiothrix lutea*) which disperse from wet forest breeding areas in the fall and often end up at the summit.

DKIST employs intensive monitoring for Hawaiian Petrels at HO, and recent trends show an increasing number of fledglings. No burrows are known from the proposed PLANETS site. All the chicks known from HO had fledged for the year by the time of this survey.

INSECTS

A complete inventory of the insects on this site was beyond the scope of this survey. Conspicuous insects were noted and special effort was made to look for native insects of conservation concern. Additionally, invertebrate checklists from previous surveys at HO and subalpine areas of Haleakala were reviewed.

A little over 100 insect taxa have been reported from HO, about half of which were native. This is relatively rich in natives compared to lowland areas, but less rich than similar less disturbed areas nearby.

Most of the insects observed were associated with the plants on the site, such as kupaoa (*Dubautia menziesii*) bushes. Native Tephritid flies (*Trupanea cratericola*) had eaten out and pupated in the seeds of the kupaoa. Seed bugs (*Nysius* spp.) were also utilizing the kupaoa seeds for food. In the leaf litter of the kupaoa was *Trechus obtusus*, a newly introduced beetle that has quickly spread over much of subalpine East Maui.

The native hairgrass (*Deschampsia nubigena*) also supported numerous insects seeking refuge and sustenance, as did the areas under stones, where the native wolf spider (*Lycosa hawaiensis*) lives and hunts prey.

Pupae of native Tephritid fly, likely *Trupanea cratericola*, in kupaoa seeds.

DISCUSSION & RECOMMENDATIONS

The entire project area has been heavily impacted by previous human disturbances and is currently developed, covered by a building and an apron of asphalt.

Hawaiian Petrels (*Pterodroma sandwichensis*) are not known from the project site, but are known to breed nearby. After feeding at sea during the day, the birds fly up to the mountain burrows at night, using the moon, stars, and land features for navigation. Bright lights can disorient the birds.

Facilities at HO are designed to minimize light at night, given the nature of the work requiring dark skies. In the event that lights are used on the outside of the building, using downward facing lights will help minimize distractions to night flying birds.

A number of the native insects observed on the proposed project site are known only from subalpine East Maui, but all are commonly found beyond HO. No state or federally listed threatened or endangered insects are known or were observed on the site.

The biggest concern at this site is introduction of invasive non-native ants, such as the Argentine ant (*Linepithema humile*) which are currently absent from the summit area of Haleakala. Taking prevention steps outlined in other construction projects at HO will minimize the potential for negative impacts to the native insect fauna at the site.

By using downward facing lights so as to not disorient night flying native seabirds, and by taking appropriate measures to minimize potential for introduction of non-native plants, insects, and mammals, the proposed project is not expected to have a significant negative impact on the faunal resources in this part of Maui.

INSECT SPECIES LIST

Order	Family	Species	Status
Araneae	Lycosidae	Lycosa hawaiiensis	Native
Araneae	Linyphiidae	Unknown	Unknown
Coleoptera	Carabidae	Trechus obtusus	Non-native
Coleoptera	Coccinellidae	Rhyzobius lophanthae	Non-native
Diptera	Sciaridae	Unknown	Unknown
Diptera	Tephritidae	Trupanea cratericola	Native
Heteroptera	Lygaeidae	Nysius spp.	Unknown
Heteroptera	Miridae	Hyalopeplus pellucidus	Non-native
Heteroptera	Miridae	Orthotylus sp.	Native
Heteroptera	Miridae	Unknown	Unknown
Homoptera	Delphacidae	Nesosydne sp.	Native
Homoptera	Cicadellidae	Unknown	Unknown
Homoptera	Psyllidae	Unknown	Unknown
Hymenoptera	Apidae	Apis mellifera	Non-native
Hymenoptera	Vespidae	Vespula pensylvanica	Non-native

REFERENCES

Brenner, G. 2013. Programmatic Arthropod Monitoring at the Haleakala High Altitude Observatories and Haleakala National Park Maui, Hawaii.

Giambelluca, T.W., X. Shuai, M.L. Barnes, R.J. Alliss, R.J. Longman, T. Miura, Q. Chen, A.G. Frazier, R.G. Mudd, L. Cuo, and A.D. Businger. 2014. Evapotranspiration of Hawaii. Final report submitted to the U.S. Army Corps of Engineers - Honolulu District, and the Commission on Water Resource Management, State of Hawaii.

Giambelluca, T.W., Q. Chen, A.G. Frazier, J.P. Price, Y.-L. Chen, P.-S. Chu, J.K. Eischeid, and D.M. Delparte, 2013: Online Rainfall Atlas of Hawai‘i. *Bull. Amer. Meteor. Soc.* 94, 313-316, doi: 10.1175/BAMS-D-11-00228.1.

Krushelnycky, P.D., L.L. Loope, and R.G. Gillespie. 2007. Inventory of Arthropods of the West Slope Shrubland and Alpine Ecosystems of Haleakala National Park. Pacific Cooperative Studies Unit, University of Hawaii at Manoa. Technical Report 148.

Liebherr, J.K. and R. Takumi. 2002. Introduction and Distributional Expansion of *Trechus Obtusus* (Coleoptera: Carabidae) In Maui, Hawaii. *Pacific Science* vol. 56, no. 4, 365-375.

Nishida, G.M. 2002. Hawaii Arthropod Checklist Fourth Edition. Bishop Museum Technical Report 22: iv+313 pp.

Palmer, D.D. 2003. Hawaii's Ferns and Fern Allies. University of Hawaii Press, Honolulu, HI.

Pyle, R.L., and P. Pyle. 2009. The Birds of the Hawaiian Islands: Occurrence, History, Distribution, and Status. B.P. Bishop Museum, Honolulu, HI, U.S.A. Version 1 (31 December 2009) http://hbs.bishopmuseum.org/birds/rlp-monograph

Wagner, W.L., D.R. Herbst, and S.H. Sohmer. 1999. Manual of the Flowering Plants of Hawaii. Univ. of Hawaii Press and Bishop Museum Press, Honolulu, HI.

Appendix B
Final Archaeological Inventory Survey
International Archaeology
April 2016

— Final —

Archaeological Inventory Survey for the Proposed PLANETS Optical Telescope at the Haleakalā High Altitude Observatory, Pāpa‘anui Ahupua‘a, Makawao District, Maui

TMK: (2) 2-2-007:008 (Portion)

Prepared by:

Adam J. Lauer

Prepared for:

KC Environmental, Inc.
P.O. Box 1208
Makawao, HI 96768

INTERNATIONAL ARCHAEOLOGY, LLC

APRIL 2016

— FINAL —

ARCHAEOLOGICAL INVENTORY SURVEY FOR THE PROPOSED PLANETS OPTICAL TELESCOPE AT THE HALEAKALĀ HIGH ALTITUDE OBSERVATORY, PĀPAʻANUI AHUPUAʻA, MAKAWAO DISTRICT, MAUI TMK: (2) 2-2-007:008 (PORTION)

Prepared by:

Adam J. Lauer Ph.D.

Prepared for:

KC Environmental, Inc.
P.O. Box 1208
Makawao, HI 96768

International Archaeology, LLC
2081 Young Street
Honolulu, HI 96826

April 2016

ABSTRACT

At the request of KC Environmental, Inc., International Archaeology, LLC (IA) completed an archaeological inventory survey (AIS) of a portion of TMK [2] 2-2-007:008 at the Haleakalā High Altitude Observatory, Pāpa‘anui Ahupua‘a, Makawao District, Maui (Fig. 1). The 0.0767-acre (0.031-hectare [ha]) project area is part of the 18.166 acres of land set aside by Executive Order (EO) 1987 by Hawaii's Governor Quinn to the University of Hawai‘i, which owns the property (University of Hawai‘i, Institute for Astronomy, 2680 Woodlawn Drive, Honolulu, Hawai‘i 96822). The project area is also considered the area of potential effect (APE). It is being proposed for the construction of the Polarized Light from Atmospheres of Nearby Extra-Terrestrial Systems (PLANETS) optical telescope. Construction of the telescope will entail modifications to the existing structure with moderate alterations resulting in more than a 10-percent increase but no more than a 50-percent increase in the structure's size. Proposed alterations are 1) removal of a section of the existing flat portion of the roof, which would be replaced by a roll-off enclosure to house the telescope; 2) installation of the roll-off steel frame, which requires excavation of column footings on an existing concrete slab, and installation of a roll-up door on the south side of the structure; and, 3) removal of interior walls and construction of a telescope pedestal and foundation within the interior of the structure. The AIS was undertaken to identify surface archaeological and significant historical features prior to the proposed construction of the PLANETS telescope. The archaeological inventory survey fieldwork and reporting fulfill the requirements specified in Hawaii Administrative Rules (HAR) §13-275 and Hawai‘i Revised Statute Chapter 6E-8.

One historic structure was identified during the survey and has been designated as Site 50-50-15-8302. This structure is a single story wood frame building with corrugated metal sheeting on the exterior walls and roof, built on a concrete slab. This structure, a component of the earliest permanent optical telescope operations on Haleakalā, is evaluated as significant under Hawaii Administrative Rule (HAR) §13-284-6 Criterion "a" and "d": association with events that have made a significant contribution to broad patterns of our Hawaiian and American history, and the potential to provide important information about history. This building is one of the earliest astronomical observatories on the Haleakalā summit and is associated with early United States' space launch and satellite programs (Project Vanguard).

In accordance with HAR §13-284-7, the proposed determination of effect is "effect, with agreed upon mitigation commitments." Current documentation, including a reconnaissance level historic resource inventory form, is sufficient and no further mitigation is required. Minor ground disturbing construction activities within the existing footprint for the installation of footings will be conducted as part of the proposed facility modifications, as the ground disturbing activities will be within previously disturbed areas no archaeological monitoring is warranted. However, if significant cultural features or materials are encountered during construction activities, all work in the vicinity should stop and the SHPD should be notified.

TABLE OF CONTENTS

ABSTRACT iii

LIST OF FIGURES vi

LIST OF PHOTOGRAPHS vii

LIST OF TABLES viii

INTRODUCTION 1
- Project Location 1
- Project Personnel and Dates of Fieldwork 1
- Disposition of Field Notes and Other Materials 1

BACKGROUND 5
- Geology and Natural History 5
- Traditional History 6
- Previous Archaeological Research 8
- Twentieth-Century History 15
- Summary and Expectations 16

RESEARCH METHODS 17
- Research Questions 17
- Fieldwork Methods 17

RESULTS 19
- Site 50-50-15-8302, Outbuilding for the Baker-Nunn Satellite Tracking Station 19

DISCUSSION 31

CONCLUSIONS AND RECOMMENDATIONS 33

REFERENCES 35

APPENDIX A: HISTORIC RESOURCE INVENTORY FORM-RECONNAISSANCE LEVEL 39

LIST OF FIGURES

1. Location of the project area. 2
2. Location of the project area with TMK (Tax Map Key) areas in the vicinity. 3
3. Detail of the project area with *ahupua‘a* (traditional sub-district land units) boundaries. 7
4. Previous archaeological projects within 1 km of the project area. 11
5. Archaeological sites within 1 km of the project area. 12
6. Overlay of the project area on an orthophotograph 18

LIST OF PHOTOGRAPHS

1. South façade with surrounding buildings. 20
2. South and west (portion) façade. 21
3. Detail southwest corner. 22
4. East façade. 23
5. Detail of east façade. 24
6. Detail of east façade. 25
7. North façade. 26
8. Detail of north façade. 27
9. Detail of north façade loading door. 28
10. West façade. 29
11. Roof. 30

LIST OF TABLES

1. Previous Archaeological Investigations within 1 km of the Project Area. 8
2. Previously Identified Archaeological Sites within 1 km of the Project Area. 13

INTRODUCTION

At the request of KC Environmental, Inc., International Archaeology, LLC (IA) completed an archaeological inventory survey (AIS) of a portion of TMK [2] 2-2-007:008 at the Haleakalā High Altitude Observatory, Pāpa‘anui Ahupua‘a, Makawao District, Maui (Fig. 1). The 0.0767 acre (0.031 hectare [ha]) project area is part of the 18.166 acres of land set aside by Executive Order (EO) 1987 by Hawai‘i’s Governor Quinn to the University of Hawai‘i, which owns the property (University of Hawai‘i, Institute for Astronomy, 2680 Woodlawn Drive, Honolulu, Hawai‘i 96822). The project area is also considered the area of potential effect (APE). It is being proposed for the construction of the Polarized Light from Atmospheres of Nearby Extra-Terrestrial Systems (PLANETS) optical telescope. Construction of the telescope will entail modifications to the existing structure with moderate alterations resulting in more than a 10-percent increase but no more than a 50-percent increase in the structure’s size. Proposed alterations are 1) removal of a section of the existing flat portion of the roof, which would be replaced by a roll-off enclosure to house the telescope; 2) installation of the roll-off steel frame, which requires excavation of column footings on an existing concrete slab, and installation of a roll-up door on the south side of the structure; and, 3) removal of interior walls and construction of a telescope pedestal and foundation within the interior of the structure. The AIS was undertaken to identify surface archaeological and significant historical features prior to the proposed construction of the PLANETS telescope. The archaeological inventory survey fieldwork and reporting fulfill the requirements specified in Hawaii Administrative Rules (HAR) §13-275 and §13-284.

PROJECT LOCATION

The project area is near the summit area of Haleakalā in the Haleakalā High Altitude Observatory (HO), Pāpa‘anui Ahupua‘a, Makawao District, island of Maui (Figs. 1 and 2). The area surveyed is in the center of the densely developed HO, approximately 63 meters (m) south of the United States Air Force Maui Space Surveillance site, 148 m west of the Pan-STARRS telescopes, 125 m northwest of the Daniel K. Inouye Solar Telescope (DKIST) (currently under construction), and 31 m northeast of the Faulkes Telescope North, Las Cumbres Observatory.

PROJECT PERSONNEL AND DATES OF FIELDWORK

Timothy Rieth, M.A., was the Principal Investigator (PI) for this project and was responsible for overall management, providing direction and oversight, and ensuring research standards were maintained. Adam Lauer, M.A., was the Project Director (PD) and was responsible for completing the fieldwork and writing the report. The PD was assisted in the field by Field Technician Daniel Knecht, M.A. Fieldwork was completed on October 20, 2015.

DISPOSITION OF FIELD NOTES AND OTHER MATERIALS

Project field notes and electronic files are stored at the IA Honolulu office. The final disposition of the materials will be determined through consultation with the landowner and the State Historic Preservation Department (SHPD).

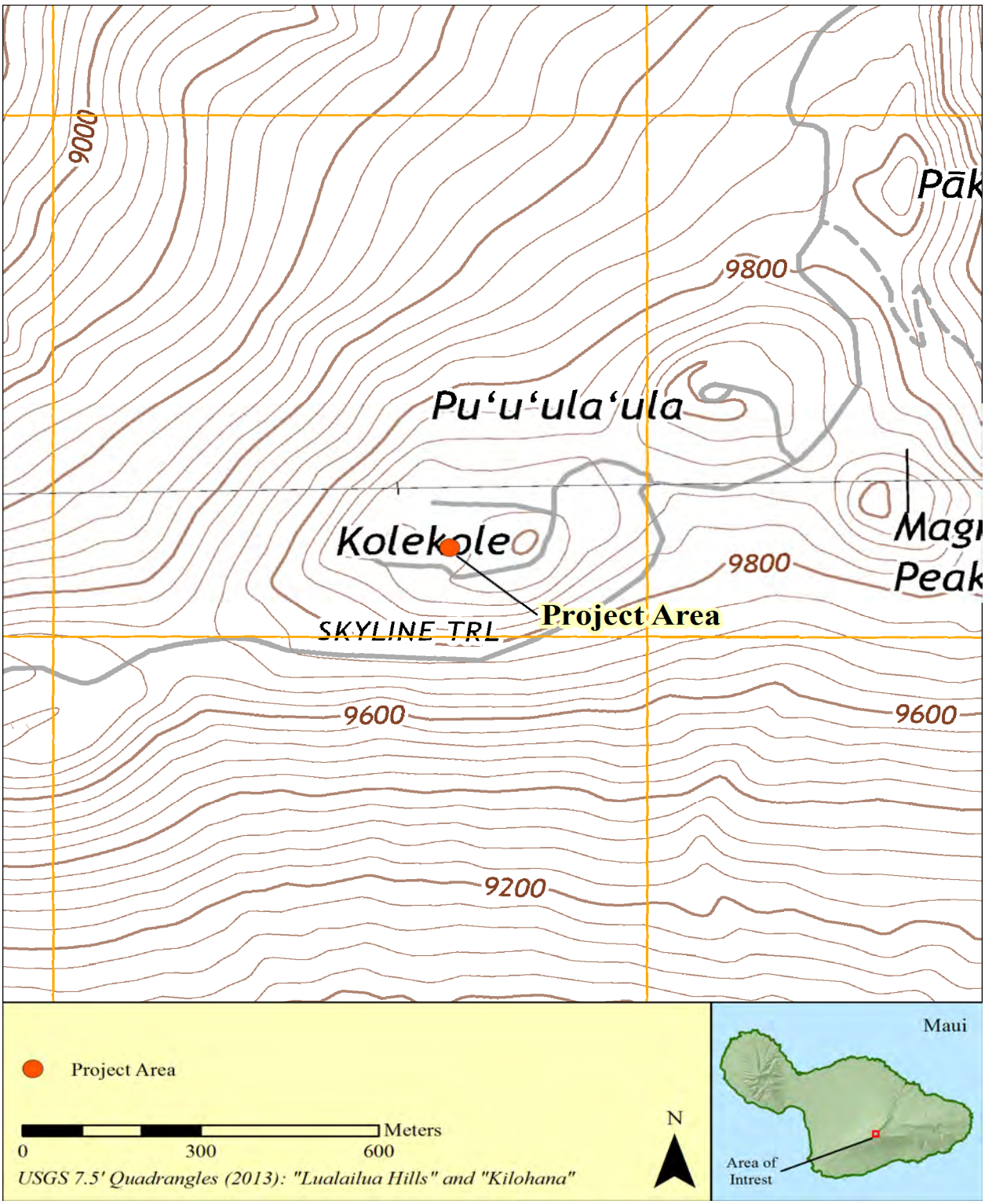


Figure 1. Location of the project area (base map is 1:24,000 USGS Lualailua Hills and Kilohana quadrangle maps [2013]).

Figure 2. Location of the project area with TMK (Tax Map Key) areas in the vicinity.

BACKGROUND

This section presents background environmental, historical, and archaeological information for the general area of the project. It is excerpted from Cochrane (2013:3–6, 23) with some modifications to tailor the information for the current project area.

GEOLOGY AND NATURAL HISTORY

East Maui is connected to the western half of the island by a broad plain and is formed by the dormant Haleakalā Volcano rising 3,055 m (10,025 ft) to the island's highest point, the Puʻu ʻUlaʻula (Red Hill) cinder cone, immediately to the east of the project area. Haleakalā's crater lies a bit further east, actually an erosional feature, formed through wind and water breaking down the headwalls of Keʻanae and Kaupō Valleys to create an oval-shaped basin. The westernmost point of the crater rim is closest to the project area and consists of a cluster of cinder cones, Puʻu ʻUlaʻula and Puʻu Keokeo[1] (White Hill), all within the Haleakalā National Park boundaries, and Puʻu Kolekole, which is outside the park and within the general location of the HO.

The project area is within the HO complex at approximately 3,037 m (9,964 ft). It is within the Rock land-Rough mountainous land association and the two local soil types are cinder land (rCI) and very stony land (rVS) (Foote et al. 1972:9). Cinder land is comprised of ash, pumice and cinders, all of black, red, yellow, brown or variegated color. There is little to no soil development. Very stony land is comprised of aa lava with an ash covering in places, sometimes thickly deposited within crevices or depressions. The project area lies between the 1250 mm (49.2 in.) and 1000 mm (39.4 in.) annual rainfall isohyets (Giambelluca et al. 1986), considerably dryer than the northeastern, windward, flank of Haleakalā. There are no watercourses, permanent or seasonal, near the project area.

Vegetation near the project area is very sparse and classified as Alpine Dry Shrubland based on elevation, moisture and plant types. Starr and Starr (2015a) observed 33 plant species within the 18.17-acre (7.35–hectare) HO site including shrubs, herbs, grasses, ferns, and non-native weeds. Fourteen of the identified species are native and 19 are non-native. Several Haleakalā silverswords (*Argyroxiphium sandwicense* subsp. *macrocephalum*) were also identified. This plant is federally listed as threatened (USDA NRCS 2010). Several species noted in the Starrs' botanical survey were likely introduced during the multiple phases of construction at HO and may be extant through continued human presence.

Vegetation within the project area is very sparse and a mix of common native and non-native species (Starr and Starr 2015b:4). Native species include kupaoa (*Dubautia menziesii*), native haigrass (*Deschampsia nubigena*), and a single enaena (*Pseudognaphalium sandwicensium var. sandwicensium*).

Fauna near the project area and surrounding environment is also limited. Native species include the Hawaiian Petrel (*Pterodroma sandwichensis*) or *ʻuaʻu*. These nocturnal birds are federally listed as endangered and use ground nesting sites during the day in and around the HO, as well as the western crater rim of Haleakalā. Other birds previously identified around the project area include the Hawaiian goose (*Branta sandvicensis*) or *nēnē*, Chukars (*Alectoris chukar*),*ʻiʻiwi* (*Vestiaria coccinea*), Golden Plover

1 According to the *Hawaiian Dictionary* (Pukui and Elbert 1986), "white" is Keʻokeʻo, and on some maps and text (e.g., Carson and Mintmier 2007), White Hill is called Pakaʻoao.

(*Pluvialis dominica*) or *kōlea*, Red-billed Leiothrix (*Leiothrix* lutea) and a variety of introduced birds (Hawaiian Audubon Society 1993; Henshaw 1902, Starr and Starr 2015c). Mammals found near the project area are introduced and include feral cats and goats, rats, mongoose, and Axis deer (Whiteaker 1980). These predators are actively controlled with extensive predator grids and no predators were noted in the most recent biological survey of the HO (Starr and Starr 2015c). Arthropods, including spiders, ants, flies, beetles and other insects are also found throughout the summit area (Brenner 2003). The recently introduced *Trechus obtusus*, a beetle rapidly spreading over much of subalpine East Maui, was observed in the project area (Starr and Starr 2015b).

TRADITIONAL HISTORY

The project area is within the former Honua‘ula District, now Makawao District, and the upland segment of the discontinuous Pāpa‘anui Ahupua‘a (Fig. 3). The highest point of Haleakalā, Pu‘u ‘Ula‘ula, is approximately 580 m (1,903 ft) east of the project area. Haleakalā is typically translated in English as “house [used by] the sun” (Pukui and Elbert 1986:36) although there are other translations including Aheleakala, rays of the sun, and Ala Hea Kālā derived from the Hawaiian words “to call” and “sun,” among others (Allen 2010:3). The solar reference in the name of the island’s highest point is certainly an allusion to the demigod Māui’s snaring of the sun to slow its transit across the sky and therefore lengthen the day (Tomonari-Tuggle and Tuggle 2007:37-38). Pu‘u Kolekole, upon which the HO is built, also played an important role in at least one version of the story. Maxwell (2003:5) was told that during his exploit Māui stood with his feet on Kolekole and Hanakauhi, northwest across the crater.

The summit area of Haleakalā, including the project area, certainly exists within the sacred *ke kuahiwi wao*. *Wao* are traditional circumferential island vegetation and cultural zones, defined largely by vegetation types (and thus elevation, rainfall, and sediments). *Ke kuahiwi* is the uppermost *wao*, a place of the gods and avoided by commoners (Allen 2010:5). This area would, however, be visited by *ali‘i* (chiefs) and *kāhuna* (religious specialists). Pu‘u Kolekole and the summit area were an ancient learning center used by *kāhuna*, a place where they prayed and acquired spiritual energy. *Kāhuna* were also trained at Kolekole in healing and in navigation by the stars and constellations; the ancient Hawaiians felt close to the universe when they visited the summit of Haleakalā (Maxwell 2003:3, 5; Pukui and Elbert 1986:377).

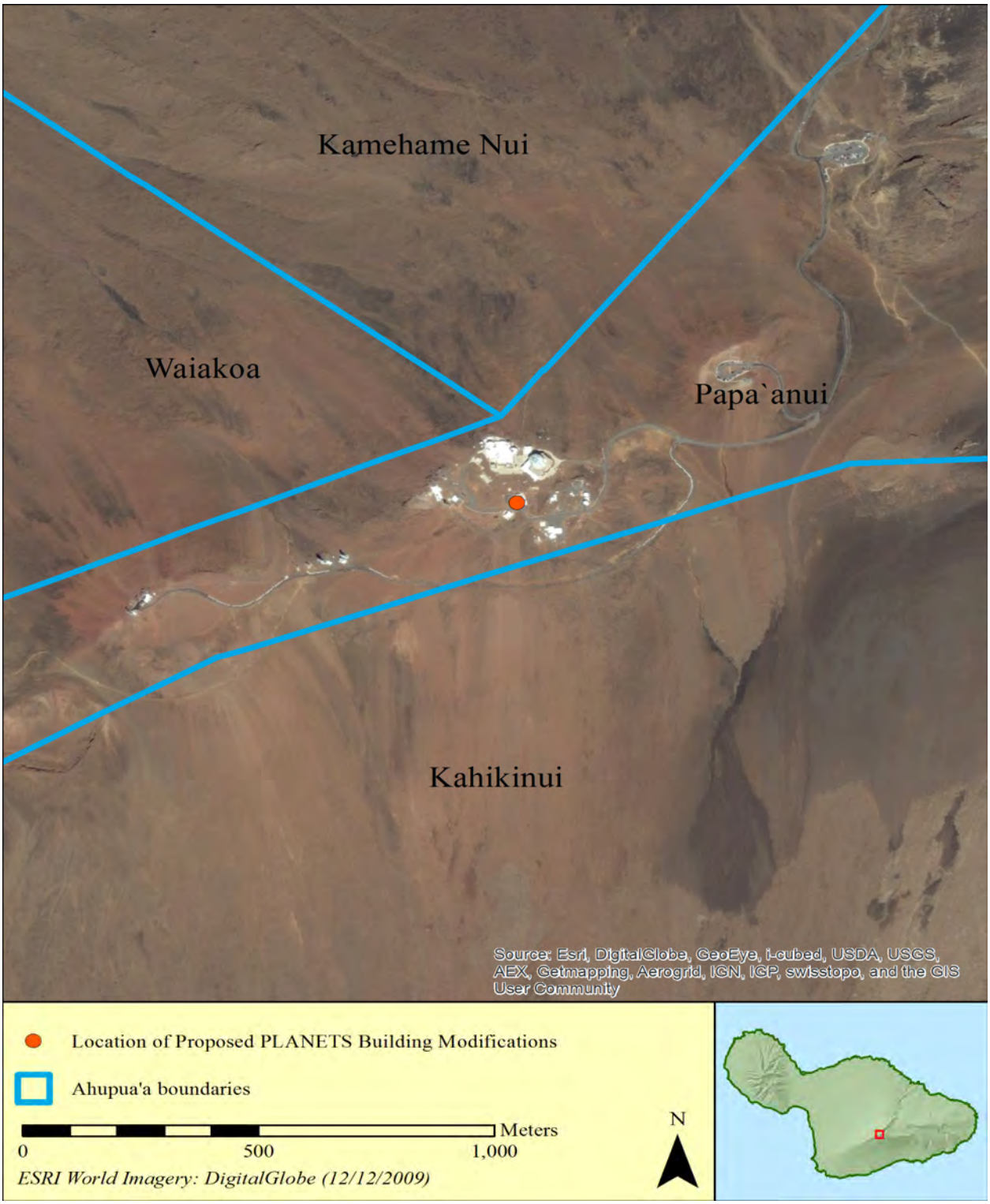


Figure 3. Detail of the project area with *ahupua‘a* (traditional sub-district land units) boundaries.

PREVIOUS ARCHAEOLOGICAL RESEARCH

Several archaeological studies have been undertaken within 1 kilometer (km) of the project area (Fig. 4). Table 1 summarizes these projects. Reports concerning work within 1 km of the project area include Bushnell and Hammatt (2000), Carson and Mintmier (2007), Chatters (1991), Cochrane (2010, 2013), Fredericksen and Fredericksen (2003, 2006), Masterson et al. (1995), and Rosendahl (1975) (Fig. 4). The project area was investigated by Bushnell and Hammatt (2000) and Fredericksen and Fredericksen (2003).

Table 1. Previous Archaeological Investigations within 1 km of the Project Area.

Ahupua'a	**Reference**	**Nature of Study**	**Findings**
Pāpa'anui	Bushnell and Hammatt (2000)	Reconnaissance survey	Sites 50-50-11-3835, 4836. Fire pits, terraces and enclosure.
	Carson and Mintmier (2007)	Inventory survey, testing	Re-located a number of sites in western Haleakalā National Park. Within 1 km of the project area Sites 50-50-11-2511, 3637, and 3645-3647 are temporary habitation and hunting sites.
	Chatters (1991)	Inventory survey	Sites 50-50-11-2805-2808. Temporary habitation sites.
	Fredericksen and Fredericksen (2003)	Inventory survey, testing	Sites 50-50-11-5438-5443, re-locate Sites 50-50-11-2805-2508. Temporary habitation sites, petroglyphs, possible burial, ceremonial function, radio telescope base.
	Fredericksen (2006)	Field inspection	none
	Masterson et. al. (1995)	Reconnaissance survey	Sites 50-50-15-4098-4102. Ritual or boundary marker sites and wall segments
	Rosendahl (1975)	Reconnaissance survey	Located seven sites along the road corridor though the national park including a platform and cave. Within 1 km of the project area Sites 50-50-11-3645-3647 are temporary habitation and hunting sites.
Kahikinui, Pāpa'anui, and Waiakoa	Cochrane 2010	Inventory survey, testing	Sites 50-50-11-5438-40. Temporary habitation and hunting sites, ritual or boundary marker sites, and temporary habitation sites.
	Cochrane 2013	Inventory survey, testing	Sites 50-50-11-5438-5440, 50-50-11-7176-7192. Temporary habitation and hunting sites, ritual or boundary marker sites, and temporary habitation sites.

Archaeological sites in the summit region of Haleakalā indicate that the area was used traditionally by specialists for adze-making, by *kāhuna* for religious ceremonies, and by commoners in connection with burials and disposal of the *piko* (umbilical cord) of newborn infants (Fig. 5). Rock was quarried at locations along the west rim of Haleakalā crater, and the forested slopes below the summit were used for the collection of wood, bird feathers, and other forest products.

The Hawaiian Islands were colonized by populations from east-central Polynesia sometime between A.D. 940-1130 (95-percent highest posterior density estimate [HPD]), and most probably between A.D. 1000-1100 (67-percent HPD) (Athens et al. 2014). The earliest settled areas were most likely the ecologically favorable and well-watered windward valleys of the islands. On Maui, early settlement of some coastal and upcountry areas is suggested by a few radiocarbon dates. In coastal Palauea, between Wailea and Mākena, charcoal from a pit feature at a permanent habitation site yielded an A.D. 680-1020 date range (Donham 1990; summarized by Allen 2010:14). Another date estimated at A.D. 650-1150 (see Kolb et al. 1997:Fig. 6.2) comes from a firepit at a temporary habitation site in Kēōkea, on the lower slopes of Haleakalā (elevation 680 m asl). However, a reevaluation of radiocarbon dates by Duarte (2012) rejects these early dates. Using only high precision radiometric techniques on identified, short lived, taxa Duarte finds a settlement date for Maui around AD 1214-1255 (Duarte 2012)

Carson and Mintmier (2007) re-visited a number of archaeological sites on the upper western slope of Haleakalā and near the western crater rim. Their work, and that of the original researchers who identified the sites, describes an array of site types—enclosures, caves, cairns, platforms, and quarrying sites—that represent traditional Hawaiian activities. Although none of these sites are within the project area, they are indicative of the kinds of sites found in the general area.

Two of the sites examined by Carson and Mintmier nearest the project area, 50-50-11-3646 and 3647[2], are about 2,963 m (9,720 ft) asl, 650 m northeast of the HO, and consist of basalt cobble enclosures or C-shapes, respectively. Carson and Mintmier (2007:71-74) suggest these were likely camps for temporary habitation at undetermined dates. A few pieces of tabular gray basalt were found at Site 3646.

A third site, approximately 600 m at its nearest point from the project area and about 2,957 m (9,700 ft) asl, designated Site 3637, consists of 110 rock-walled enclosures of various forms, most oval in plan-view, but also comprising C-shapes. Carson and Mintmier (2007:50) note that the site is associated with a chief named Kaoao (alternatively Ka‘oao, Aoao, or a similar name) who was defeated in battle at or near this site. Alexander (1870:44), who visited the site in the late 19th century, stated that some shelters were covered with slate roofs. Carson and Mintmier (2007:50-60) excavated a single test unit in three enclosures and recovered a cache of six slingstones, uniformly sized and shaped waterworn pebbles, and charcoal from two firepits. The charcoal returned calibrated dates of A.D. 1480-1660 and 1460-1650 (2 σ) (Carson and Mintmier 2007:195).

Cochrane (2010, 2013) conducted reconnaissance surveys of a 14 m-wide fence line corridor and, later the general area within the fenceline surrounding, but not including, the current project area (see Fig. 5). He recorded 22 features, mostly rock structures for temporary habitation and rock mounds. Five isolated artifacts, including slingstones and basalt fragments, were also found.

Several projects in and around the HO have documented a number of archaeological features and sites. Emory (1921:254) was the first archaeologist to report on work around Pu‘u ‘Ula‘ula and Kolekole, noting 25 shelters on Pu‘u ‘Ula‘ula and “between Red Hill [Pu‘u ‘Ula‘ula] and Kolekole hill another group of 8 or 9 with a great many small ahus [sic].” These structures, however, have not been re-identified.

2 The subsequent site numbers in this document follow the State Inventory of Historic Places numbering system and begin with 50-50-11-#### with the last four numbers given in the text.

Fredericksen (2006) conducted a field inspection of primary and alternate locations for the planned DKIST facility. The sites identified by Fredericksen (2006) contain 59 separate features, and several of the features have multiple components (e.g., a wall, an alignment, and a level area).

As Table 2 indicates, the main site use in the past on Puʻu Kolekole, as is true for most areas at the summit, has been for temporary habitation, with rock walls, outcrops, and shallow caves providing shelter from the area's winds and cold. One radiocarbon date is available for the previously documented sites within or near the HO. The *Santalum haleakalae* charcoal recovered from an excavation at Feature 20 (a temporary habitation feature) of Site 7180 returned a calibrated date of A.D. 1270-1410 (2 σ) (Cochrane 2013:16). The great majority of the rock-walled shelters, shelters enclosed by rock alignments, and walled overhangs, appear traditionally constructed and could predate Contact or date to the Contact era. Others such as the rock mounds could be either traditional or historical. Several have clearly been used since Contact, some very recently. Most of the artifacts and other portable finds that have been reported are 20th-century items discarded as refuse.

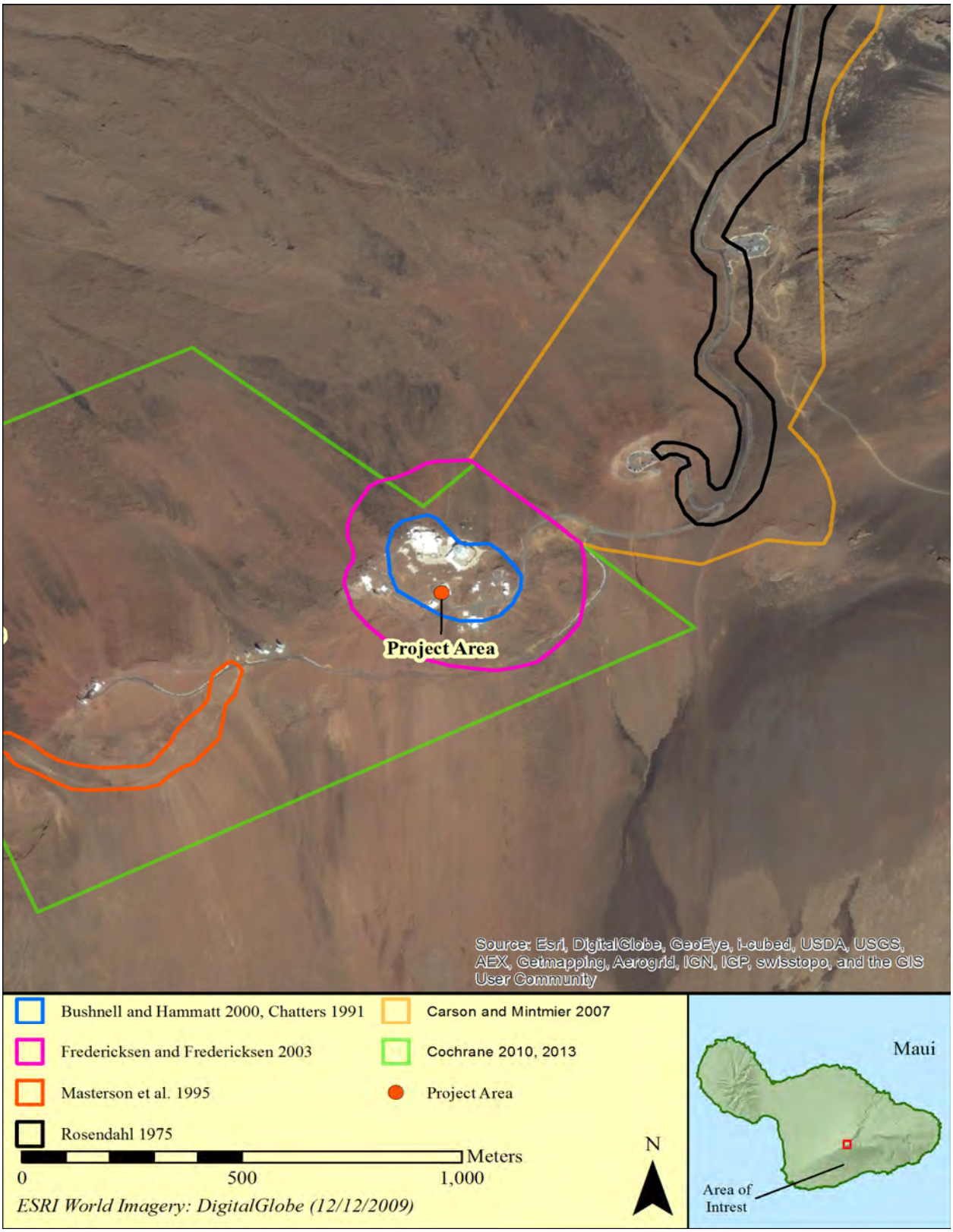


Figure 4. Previous archaeological projects within 1 km of the project area.

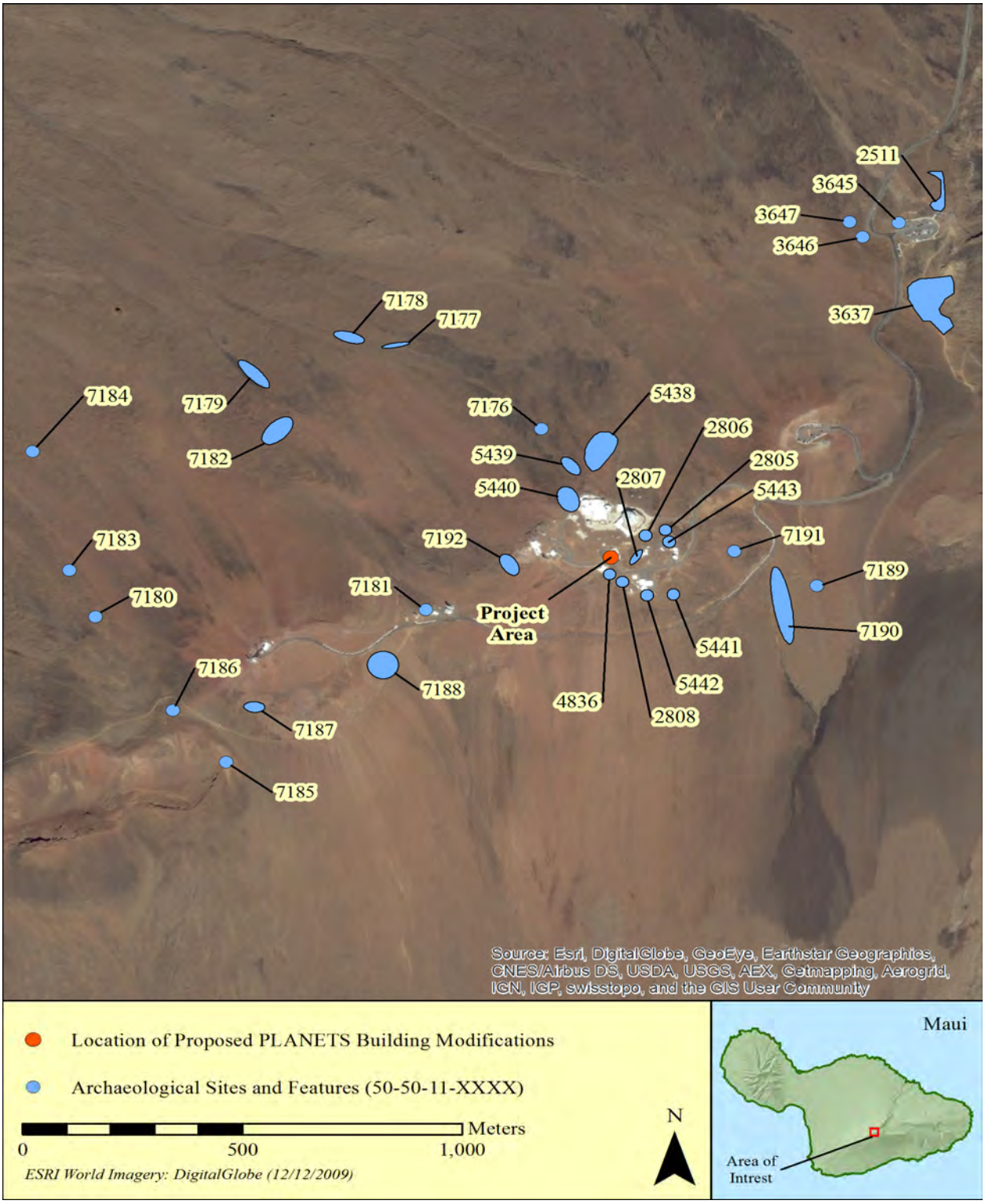


Figure 5. Archaeological sites within 1 km of the project area.

Table 2. Previously Identified Archaeological Sites within 1 km of the Project Area.

Site Designation (50-50-11-)	Basic Site Description	Possible Function	Comments	Reference
2511	Rock-walled enclosures	temporary habitation	18 rock-walled enclosures, oval and rectangular	Carson and Mintmier (2007:29)
2805	Rock-walled enclosure	temporary habitation	level interior floor covered w/ black sand, cinders; no testing	Chatters (1991); Fredericksen & Fredericksen (2003:76)
2806	Rock-walled rockshelter	temporary habitation	interior floor covered w/ black sand, cinders; no testing	Chatters (1991);Fredericksen & Fredericksen (2003:78-79)
2807	16 enclosures, few small overhangs, each with wall or alignment	temporary habitation	aa uprights in some shelters; many floors covered w/ cinders, sand; 20th-century artifacts at some features; slingstone noted in 1991; no testing	Chatters (1991); Fredericksen & Fredericksen (2003:80-89)
2808	Enclosures with walls or rock mounds	temporary habitation	level areas covered w/ cinders, angular pebbles, and/or black sand; ‘opihi shell south of Feature A; no testing	Chatters (1991); Fredericksen & Fredericksen (2003:89-92)
3637	Rock-walled enclosures	temporary habitation	110 rock-walled enclosures, oval and C-shaped; sling stones; fire pits found during testing	Carson and Mintmier (2007:50)
3645	Rock-walled enclosures	temporary habitation	six rock-walled enclosures, oval and c-shaped.	Carson and Mintmier (2007:69)
3646	Rock-walled enclosures	temporary habitation	four C-shaped shelters	Carson and Mintmier (2007:71-74)
3647	Rock-walled enclosures	temporary habitation	two C-shaped shelters	Carson and Mintmier (2007:71-74)
4835	Rock-walled enclosures built against two large outcrops	refuse-burning pits	interiors covered w/ cinders, soil, ash, burnt post-Contact refuse; no testing	Bushnell & Hammatt (2000:15-16, Fig. 5)
4836	3 terraces & rock-walled enclosure, rock wall & linear leveled area	temporary habitation; wind-break, & trail	modern refuse in terrace feature; wire nail found 2 cmbs (centimeters below surface) during testing in terrace	Bushnell and Hammatt (2000:16-17, Fig. 5 [Fe A-C]); Fredericksen and Fredericksen (2003:94, Fig. A24 [Fe A-F])
5438	Rock-walled enclosure, 4 terraces, rock mound	temporary habitation	testing in enclosure recovered no cultural materials	Fredericksen & Fredericksen (2003:16-17, 35-41, Fig. A1, Table 2); Cochrane (2013:9, Table A1)
5439	Rockshelters, rock-walled/ outlined level areas, rock mound, C-shaped enclosures	temporary habitation	coral found 0-4 cmbs during testing in rockshelter; C-shape testing, no cultural materials	Fredericksen & Fredericksen (2003:17-18, 41-53, Fig. A3, Table 2); Cochrane (2013:10, Table A1)

Table 2. Previously Identified Archaeological Sites within 1 km of the Project Area (continued).

Site Designation (50-50-11-)	Basic Site Description	Possible Function	Comments	Reference
5440	Rock-walled or outlined level areas, C-shaped enclosures, platform, petroglyphs	temporary habitation, possible burial (platform), ritual	walled shelter with two rooms; anthropomorphic and turtle (?) petroglyphs both pecked in boulders; testing revealed no cultural materials	Fredericksen & Fredericksen (2003:18-20, 54-68. Fig. A8, Table 2); Cochrane (2013:10, Table A1)
5441	Rock-walled level areas	temporary habitation	2 leveled areas, 1 m apart, on ground that descends steeply to the SE	Fredericksen & Fredericksen (2003:20, 69-71, Fig. A17, Table 2)
5442	Rock-walled enclosure	temporary habitation	damaged by grading	Fredericksen & Fredericksen (2003:20-21, 72-73, Fig. A18, Table 2)
5443	Concrete ring, rock concentrations	Radio telescope foundation	Reber Circle	Filimoehala & Reith (2013) Fredericksen & Fredericksen (2003:21, 73-75, Fig. A19, Table 2); Fredericksen (2005)
7167	Rock-walled enclosures	temporary habitation, hunting	walled shelter and *ʻuaʻu* trap	Cochrane (2013:11, Table A1)
7177	Rock walls and piles	temporary habitation & boundary markers	rock wall wind break and rock boundary marker	Cochrane (2013:11, Table A1)
7178	Rock walls and piles	temporary habitation & boundary markers	rock wall & C-shaped shelters, boundary markers	Cochrane (2013:12, Table A1)
7179	Uprights/*ahu* and rock piles	ritual/ boundary markers	ritual/boundary markers & hunting	Cochrane (2013:12, Table A1)
7180	Rock-walled enclosures	temporary habitation	rock retaining walls	Cochrane (2013:12, Table A1)
7181	Rock-walled enclosures	temporary habitation	rock enclosure, modern petrel monitoring nest	Cochrane (2013:12, Table A1)
7182	Rock piles	location markers	locations for *ʻuaʻu* nests	Cochrane (2013:12, Table A1)
7183	Rock wall	location marker/ritual	rock wall location maker/ritual marker	Cochrane (2013:13, Table A1)
7184	Rock-walled enclosure	temporary habitation	rock retaining walls	Cochrane (2013:13, Table A1)
7185	Rock pile	location marker	rock pile location marker/ritual marker	Cochrane (2013:13, Table A1)
7186	Rock-walled enclosure	temporary habitation	circular rock enclosure	Cochrane (2013:13, Table A1)

Table 2. Previously Identified Archaeological Sites within 1 km of the Project Area (continued).

Site Designation (50-50-11-)	Basic Site Description	Possible Function	Comments	Reference
7187	Rock wall and piles	ritual & temporary habitation	ritual *ahu* and rock-walled shelter	Cochrane (2013:13, Table A1)
7188	Rock walls and piles	temporary habitation & hunting	rock-walled enclosures and hunting blinds	Cochrane (2013:14, Table A1)
7189	Rock pile	hunting	hunting blind	Cochrane (2013:14, Table A1)
7190	Road	road building	bleached coral and bitumen road material	Cochrane (2013:14, Table A1)
7191	Rock wall and pile	ritual	Rock *ahu* and wall	Cochrane (2013:14, Table A1)
7192	Rock-walled enclosures	temporary habitation	rock walls and alignments distributed in a "C" shaped area	Cochrane (2013:15, Table A1)

TWENTIETH-CENTURY HISTORY

Astronomy activities began on the summit of Haleakalā with the construction of a radio antenna on Pu'u Kolekole (Steiger n.d.). This radio antenna, known as the Reber Radio Telescope, was located on what became known as Reber Circle, was built on a circular track by Grote Reber in 1951-1952. The radio antenna collapsed after an ice storm in 1957 and the circular base was removed in 2012 (Filimoehala and Rieth 2013)

Haleakalā was later nominated as a location for the optical satellite tracking system proposed for Project Vanguard, the program responsible for launching the United States' first orbital satellite (Green and Lomask 1969). In 1956 the Smithsonian Astrophysical Observatory (SAO), the primary government contractor for the optical satellite tracking systems of Project Vanguard, asked Dr. C.E. Kenneth Mees, formerly of the Eastman Kodak Company and developer of astrophotography films, to secure a site in Hawai'i for a satellite observatory. The University of Hawai'i used $15,000 in donated Kodak stock from Dr. Mees to secure ca. 18 acres on the summit area of Haleakalā, which eventually became the HO science preserve (Steiger n.d.).

The satellite tracking facility was completed July 1, 1957. The building on the project parcel was a part of this construction. Its original use was for living accommodations for the observers using the Baker-Nunn satellite tracking camera (Steiger n.d.). The Baker-Nunn satellite tracking camera was installed six months later in the building that now houses the Tohoku T60 optical telescope, a few meters from the project building. These original facilities were enlarged and improved over the years (Steiger n.d.).

The HO was officially established by Executive Order from Governor William Quinn in 1961 (Clifford et al. 2013). This area, also known as Science City, began to see the planning and construction of various observatories through the University of Hawai'i (UH), United States Air Force (USAF), National Aeronautics and Space Administration (NASA), other United States defense agencies, and various university and research corporation consortiums (Steiger n.d.; Clifford et al. 2013).

The Baker-Nunn telescope and the SAO Satellite Tracking Station in Hawai‘i were closed in 1980 and the facilities, including the building in the current project area, were turned over to the University of Hawai‘i (Smithsonian Institution Archives 1980).

The University of Chicago Cosmic Ray Neutron Monitor Station began operation out of the project building in February 1991. These operations ended in 2007 (University of Hawai‘i Institute for Astronomy 2010). The building is now used for storage.

The HO is currently an area of active research and construction activities. The project parcel is bordered by construction storage and lay-down yards and the Tohoku University T60 optical telescope. The Tohoku telescope is in a re-purposed Baker-Nunn facility (Imada 2014).

SUMMARY AND EXPECTATIONS

The sites documented in the HO area relate to both pre- and post-Contact temporary habitation, ritual and hunting uses. The lack of permanent habitation sites suggests there was never a large population in the region prior to the 1950’s when the HO was started. Subsequent construction activities for the original Baker-Nunn satellite tracking facility at the HO have likely destroyed any archaeological sites that may have been in the immediate vicinity of the proposed PLANETS facility. Based on current information, particularly the graded and paved surfaces of the project area, no archaeological resources were anticipated. However, it was recognized that the existing structure within the project area is a significant historical structure that would require documentation.

RESEARCH METHODS

This section presents the project's field methods and the research questions that directed data generation.

RESEARCH QUESTIONS

Two site-specific research questions were formulated for the current project area.

1) Are traditional Hawaiian cultural surface features present? If so, what activities are represented? Evidence may be encountered for traditional activities such as temporary habitation or ritual use. Nearby shelters, *ʻuaʻu* hunting mounds, and ritual markers have demonstrated the area was visited for cultural reasons.

2) Is the existing structure on the site, currently used as storage, a significant historical resource? The project parcel was originally prepared and the existing structure was built as part of the early telescope activities on the summit. It is possible that this structure qualifies as a historic property.

FIELDWORK METHODS

Adam Lauer, M.A., was the Project Director (PD) with Daniel Knecht, M.A., assisting as a Field Technician. Fieldwork was completed on October 20, 2015. The pedestrian survey covered 100 percent of the project area. The survey included visual inspection for archaeological features and artifacts as well as historical and modern land alteration. Ground visibility was 90-100 percent (Fig. 6). The surface is paved with asphalt. Photographs were taken in RAW format with a Lumix LF1 12.1 megapixel digital camera. No subsurface testing was conducted since the project area is either a prepared (graded and compacted) cinder surface, paving, or is occupied by the existing structure.

Locations of the project area were recorded using a professional-grade Trimble GEOXH Global Positioning System (GPS) unit using North American Datum of 1983 (NAD 83) in Universal Transverse Mercator Zone 4 North (UTM 4N); the resulting spatial data were differentially corrected for submeter accuracy.

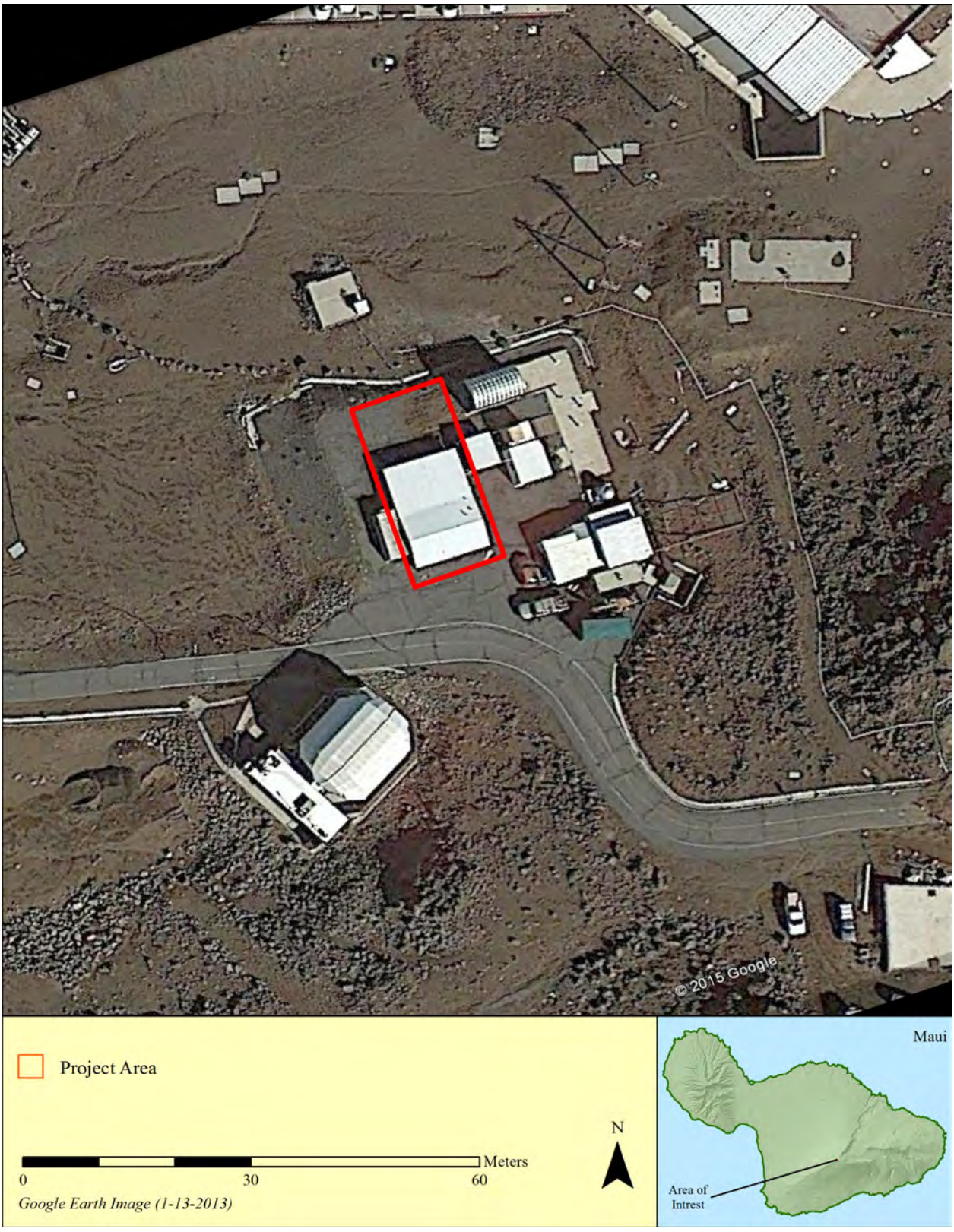


Figure 6. Overlay of the project area/APE on an orthophotograph (2013) of the project area.

RESULTS

This section presents the results of the fieldwork. No traditional Hawaiian features were identified. The proposed PLANETS structure is a historic structure and has been designated as Site 50-50-15-8302. It is evaluated as significant under Criteria "a" and "d," and is also recommended as being eligible for listing on the Hawai'i Register of Historic Places under Criteria A and D. This building is part of the earliest building phase of astronomical observatories on the Haleakalā summit. It is also a part of the early phases of the United States' space launch and satellite programs (Project Vanguard).

The Historic Resource Inventory Form – Reconnaissance Level is presented as Appendix A. This form has also been submitted as a stand-alone document to the SHPD Architecture Branch.

SITE 50-50-15-8302, OUTBUILDING FOR THE BAKER-NUNN SATELLITE TRACKING STATION

Site 50-50-15-8302 is a single story structure in good condition. It is a rectangular building 14.09 m long by 10.33 m wide and approximately 3 m high. The roof and exterior walls are corrugated metal sheeting, which is attached to a wood frame (Photos 1-11). Sash and sliding (both vertical and horizontal windows) are present along the north, south, east, and west façades (the window along the north façade is boarded over). The building has a concrete slab foundation. One stove pipe chimney and two vents are present. No lanai is present.

This structure is an outbuilding built for the Baker-Nunn Satellite Tracking Station, which was part of the satellite tracking program of the SAO. The University of Hawai'i built the satellite tracking camera facility and its living quarters (the current project building) by July 1, 1957 (Clifford et al. 2013, Steiger n.d.). The Baker-Nunn satellite tracking camera was installed in February 1958 in the building that now houses the Tohoku T60 telescope. The buildings were in use, and enlarged and improved, until the facility was closed in 1980. The facilities were returned to UH by the SAO after the transfer of the Baker-Nunn camera to the Air Force (Smithsonian Institution Archives 1980).

The project area building was used as a Cosmic Ray Neutron Monitor Station by the University of Chicago from 1991 until 2007. The building is currently used as storage.

Photo 1. South façade with surrounding buildings. Tohoku University 60 cm telescope (T60) is the dome to the right (east) of the building. The Air Force Advanced Electro-Optical System (AEOS) telescope is in the background. View to the north.

Photo 2. South and west (portion) façade. View to the northeast.

Photo 3. Detail southwest corner. Note eaves and structural elements. View to the northeast.

Photo 4. East façade. FAA and Coast Guard towers in the background. View to the west.

Photo 5. Detail of east façade. View to the west.

Photo 6. Detail of east façade. Door. View to the west.

Photo 7. North façade. Faulkes telescope North, Las Cumbres Observatory dome in the background. View to the south.

Photo 8. Detail of north façade. Downspout, window frame, and eaves detail. Note loading door. View to the west.

Photo 9. Detail of north façade loading door. View to the south.

Photo 10. West façade. Note current construction materials for the Daniel K Inouye Solar Telescope (DKIST) are in front of the project building. Background right, next to the crane, is the DKIST, center right is the Zodiacal Observatory, center left is Tohoku T60 telescope, left is AEOS.

Photo 11. Roof. View to the south. Faulkes telescope North, Las Cumbres Observatory dome in the background.

DISCUSSION

No pre-Contact features were found within the project area during survey. A historic building (Site 50-50-15-8302) associated with early satellite tracking and the establishment of the HO is present in the project area. It is likely that construction activities for the early satellite tracking facility outbuilding on the property destroyed evidence of earlier activities in project parcel (if they had occurred).

In summary, with regards to the project's research questions, the following can be stated:

1) Are traditional Hawaiian cultural surface features present? If so, what activities are represented? No traditional Hawaiian surface features are present. Only modern and historic-era construction and buildings are present.

2) Is the current structure on the site, used as storage, a significant historic-era cultural resource? Yes. The current structure is associated with the United States' earliest satellite tracking program and one of the earliest phases of the HO. This structure is evaluated as significant under HAR §13-284-6 Criteria "a" and "d," and is considered eligible for listing on the Hawai'i Register of Historic Places per Criteria A and D. It is also considered significant under Criteria A and D of the National Register of Historic Places. This building is part of the earliest buildup of astronomical observatories on the Haleakalā summit and is associated with early United States' space launch and satellite programs (Project Vanguard), and events associated with the Cold War.

CONCLUSIONS AND RECOMMENDATIONS

International Archaeology, LLC (IA) completed an archaeological inventory survey of a portion of TMK (2) 2-2-007:008 for the proposed Polarized Light from Atmospheres of Nearby Extra-Terrestrial Systems (PLANETS) facility. No significant pre-Contact features were encountered during the surface survey. The area has one structure covering approximately 90 percent of the project area, and pavement covering the remaining 10 percent. This structure, a portion of the earliest optical telescope operations on Haleakalā, has been designated as Site 50-50-15-8302. It is evaluated as significant under HAR §13-284-6 Criteria "a" and "d," and is considered eligible for listing on the Hawai'i Register of Historic Places per Criteria A and D. This building is part of the earliest buildup of astronomical observatories on the Haleakalā summit and is associated with early United States' space launch and satellite programs (Project Vanguard), and has the potential to provide important information about history.

In accordance with definitions in HAR §13-5-2, the proposed facility modifications would be a moderate alteration to the existing structure, resulting in more than a 10-percent increase, but no more than a 50-percent increase, in the size of the structure. The proposed alterations would include removal of a section of the existing flat portion of the roof, which would be replaced by a roll-off enclosure to house the telescope. Other exterior work would include the installation of the roll-off steel frame requiring excavation of column footings on an existing concrete slab and installation of a roll-up door on the south side of the structure. Removal of interior walls and construction of a telescope pedestal and foundation on the interior of the structure would also take place.

The proposed determination of effect, in accordance with HAR §13-284-7, is evaluated as "effect, with agreed upon mitigation commitments." Current documentation, including a reconnaissance level historic resource inventory form, is sufficient and no further mitigation is required. Minor ground disturbing construction activities within the existing footprint for the installation of footings will be conducted as part of the proposed facility modifications, as the ground disturbing activities will be within previously disturbed areas no archaeological monitoring is warranted. However, if significant cultural features or materials are encountered during construction activities, all work in the vicinity should stop and the SHPD should be notified.

REFERENCES

Alexander, W. D.
1870 On the Crater of Haleakala, Island of Maui, Hawaiian Group. *American Journal of Science and Arts, Second Series* 49: 43-48.

Allen, S. Jane
2010 *Cultural Background Information, Proposed Pan-STARRS Site, Haleakalā (TMK 2-2-07).* Preliminary draft report prepared for Group 70 International. International Archaeological Research Institute, Inc., Honolulu.

Athens, J. Stephen, Timothy M. Rieth, and Thomas S. Dye
2014 A Paleoenvironmental and Archaeological Model-Based Estimate for the Colonization of Hawai‘i. *American Antiquity* 79:144-155.

Brenner, Gregory
2003 *Appendix D, Arthropod Inventory and Assessment Haleakalā High Altitude Observatory Site Maui, Hawai‘i*. In *Haleakalā High Altitude Observatory Site Long Range Development Plan*. http://www.ifa.hawaii.edu/haleakalanew/LRDP/ (accessed November 27, 2015).

Bushnell, K. W., and H. H. Hammatt
2000 *An Archaeological Inventory Survey of 1.5 Acres of the University of Hawai‘i Facility at Haleakalā, Papa‘anui Ahupua‘a, Makawao District, East Maui (TMK 2-2-07: 8)*. Prepared for KC Environmental, Inc., Makawao, Maui. Cultural Surveys Hawaii, Kailua, O‘ahu.

Carson, Mike T., and Melanie A. Mintmier
2007 *Archeological Survey of Previously Recorded Sites in Front Country Areas in the Summit District of Haleakalā National Park, Maui Island, Hawai‘i*. Prepared for National Park Service Pacific West Region, Haleakalā National Park, Makawao, Hawai‘i. International Archaeological Research Institute, Inc., Honolulu.

Chatters, J.C.
1991 *Cultural Resources Inventory and Evaluation for Science City, Conducted for Expansion of the Maui Space Surveillance Site, Haleakala, Maui, Hawaii*. Prepared for the U. S. Air Force Headquarters Space Division Air Systems Command, Los Angeles Air Force Base. Prepared by the Pacific Northwest Laboratory (Batelle Memorial Institute).

Clifford, Megan, Dave Baiocchi, and William Welser IV
2013 *A Sixty-Year Timeline of the Air Force Maui Optical and Supercomputing Site*. Prepared for United States Air Force. RAND Project Air Force, RAND Corporation, Santa Monica.

Cochrane, Ethan E.
2010 *Archaeological Survey for the Predator Exclusion Fence Proposed as a Mitigation Measure for the Haleakalā Advanced Technology Solar Telescope (ATST) Haleakalā High Altitude Observatory Site*. Prepared for KC Environmental, Inc. International Archaeological Research Institute, Inc., Honolulu.

Cochrane, Ethan E.
2013 *Hunters of Haleakalā: Archaeological Inventory Survey of Unencumbered Lands Surrounding the Haleakalā High Altitude Observatory Site; Waiakoa, Papa‘anui, and Kahikinui Ahupua‘a, Kula, Honua‘ula, and Kahikinui Districts, Maui*. Prepared for KC Environmental, Inc. International Archaeological Research Institute, Inc., Honolulu.

Donham, Theresa K.
1990 *Archaeological Inventory Survey, Palauea Development Parcel, Land of Palauea, Makawao District, Island of Maui*. Prepared for Kihara Development (Hawaii), Honlulu. Paul H. Rosendahl, Ph.D., Inc., Hilo, Hawai‘i.

Duarte, Trever
2012 “Colonization and Prehistory on the Island of Maui: a Radiocarbon Synthesis of Maui Island.” Unpublished M.A. thesis, Department of Anthropology, University of Hawai‘i at Mānoa, Honolulu.

Emory, Kenneth P.
1921 An Archaeological Survey of Haleakala. *Bishop Museum Occasional Papers* 7:1-23.

Filimoehala, Christopher and Timothy Rieth
2013 *Final No Findings Letter Report for Archaeological Monitoring of Reber Circle Demolition at the Haleakalā High Altitude Observatory site, Papa‘anui Ahupua‘a, Makawao District, Maui, Hawai‘i (TMK: 2-2-007-008 [Portion]).* Prepared for KC Environmental, Inc. International Archaeological Research Institute, Inc., Honolulu.

Foote, D. E., E. L. Hill, S. Nakamura, and F. Stephens
1972 *Soil Survey of the Islands of Kauai, Oahu, Maui, Molokai, and Lanai*. Soil Conservation Service, U.S. Department of Agriculture. U.S. Government Printing Office, Washington, D.C.

Fredericksen, E.
2005 *An Archaeological Data Recovery Plan for Site 50-50-11-5443 18.1-acre parcel known as Science City, Haleakalā Crater, Papa‘anui Ahupua‘a, Makawao District, Maui Island (TMK: 2-2-07: portion of 8).* Prepared for KC Environmental, Inc. Xamanek Researches, LLC, Pukalani, Hawaii.

2006 *An Archaeological Field Inspection of the Primary and Alternate Locations for the planned Advanced Technology Solar Telescope (ATST) Facility, located within the 18.1-acre parcel Science City complex, Haleakalā Crater, Papa‘anui Ahupua‘a, Makawao District, Maui Island (TMK: 2-2-07: portion of 8).* Report prepared for KC Environmental, Inc. Xamanek Researches, LLC, Pukalani, Hawaii.

Fredericksen, Erik, and D. Fredericksen
2003 *Archaeological Inventory Survey of 18.1 acre parcel at Science City, Haleakalā Crater, Papa‘anui ahupua‘a, Makawao District, Maui Island (TMK: 2-2-07:por. 8).* Report prepared for KC Environmental, Inc. Xamanek Researchers, Pukalani, Hawaii.

Giambelluca, Thomas Warren, Michael A. Nullet, and Thomas A. Schroeder
1986 *Rainfall Atlas of Hawai‘i*. State of Hawaii, Department of Land and Natural Resources, Division of Water and Land Development, Honolulu.

Green, Constance M. and Milton Lomask
1969 *Vanguard, A History*. NASA SP-4202. The NASA Historical Series. NASA Historical Reference Collection, NASA History Office, NASA Headquarters, Washington, DC. http://history.nasa.gov/SP-4202/chapter9.html.

Hawaii Audubon Society
1993 *Hawaii's Birds* (4th ed.). Hawaii Audubon Society, Honolulu.

Henshaw, Henry W.
1902 *Birds of the Hawaiian Islands*. Thos. G. Thrum, Honolulu.

Imada, Lee
2014 *Long-standing cooperation aids science program.* Maui News. http://www.mauinews.com/page/content.detail/id/589741/Long-standing (accessed November 20, 2015).

Kolb, Michael J., Valerie Nagahara, and Ross Cordy
1997 Social Organization and Settlement in Kula. In *Kula: The Archaeology of Upcountry Maui Waiohuli and Kēōkea*, edited by Michael J. Kolb, Patty J. Conte, and Ross Cordy, pp. 268-292. Prepared for the Department of Hawaiian Home Lands. Historic Preservation Division, State Department of Land and Natural Resources.

Masterson, Ian, William Folk, and Hallett Hammatt
1995 *An Archaeological Inventory Survey and Subsurface Testing of the Proposed Kalepeamoa Transmitter Site, Makawao District, East Maui (TMK 2-2-07:8).* Prepared for MCM Planning. Cultural Surveys Hawaii, Kailua.

Maxwell, C.
2003 *"Kū I ka Mauna." Upright at the Mountain: Cultural Resources Evaluation for the Summit of Haleakalā*. Prepared for KC Environmental, Inc. CKM Cultural Resources, Pukalani, Maui.

Pukui, Mary Kawena, and Samuel H. Elbert
1986 *Hawaiian Dictionary: Hawaiian-English, English-Hawaiian* (Revised edition). University of Hawaii Press, Honolulu.

Rosendahl, Paul
1975 *Archaeological Reconnaissance Survey of the Haleakala Highway Road Alignment Corridor, Haleakala National Park, Maui.* Prepared for the National Park Service. Department of Anthropology, B.P. Bishop Museum, Honolulu.

Smithsonian Institution Archives
1980 Record Unit 371, Box 3, "The Torch," November, 1980, p. 4.

Starr, Forest, and Kim Starr
2015a *Botanical Survey Haleakala Observatories Spring 2015*. Prepared for KC Environmental, Inc. Starr Environmental, Makawao.

2015b *Botanical and Faunal Survey Proposed Polarized Light from Atmospheres of Nearby Extra-Terrestrial Systems Telescope, Haleakala, Maui*. Prepared for KC Environmental, Inc. Starr Environmental, Makawao.

2015c *Faunal Survey Haleakala Observatories Spring 2015*. Prepared for KC Environmental, Inc. Starr Environmental, Makawao.

Steiger, Walter

n.d. *Origins of Astronomy in Hawai‘i.* Institute for Astronomy, University of Hawai‘i. https://www.ifa.hawaii.edu/users/steiger/introduction.html (accessed November 18, 2015).

Tomonari-Tuggle, M. J., and H. David Tuggle

2007 *Archaeological Overview and Assessment for Haleakalā National Park, Island of Maui*. Prepared for National Park Service, Haleakalā National Park, Makawao, Hawai‘i. International Archaeological Research Institute, Inc., Honolulu.

University of Hawai’i Institute for Astronomy

2010 *Haleakalā High Altitude Observatory Site Haleakalā, Maui, Hawai‘i Management Plan*. Prepared by KC Environmental, Inc., Makawao, Hawai‘i. Prepared for University of Hawai’i Institute for Astronomy.

U.S. Department of Agriculture, Natural Resources Conservation Service (USDA NRCS)

2010 *The PLANTS Database*. http://plants.usda.gov/ (accessed April 14, 2010). National Plant Data Center, Baton Rouge, LA.

U.S. Geological Survey

2013 [map] Kilohana Quadrangle, Hawaii-Maui County. 7.5-Minute Series (Topographic). Scale 1:24,000. U.S. Geological Survey in cooperation with National Imagery and Mapping Agency. Available from U.S. Geological Survey, Denver CO.

2013 [map] Lualailua Hills Quadrangle, Hawaii-Maui County. 7.5-Minute Series (Topographic). Scale 1:24,000. U.S. Geological Survey in cooperation with National Imagery and Mapping Agency. Available from U.S. Geological Survey, Denver CO.

Whiteaker, Louis D.

1980 *The Vegetation and Environment in the Crater District of Haleakala National Park.* Technical Report 35, Cooperative National Park Resources Studies Unit, University of Hawai‘a at Mānoa, Honolulu.

APPENDIX A: HISTORIC RESOURCE INVENTORY FORM-RECONNAISSANCE LEVEL

HAWAII STATE HISTORIC PRESERVATION DIVISION
HISTORIC RESOURCE INVENTORY FORM – Reconnaissance Level

FOR SHPD USE ONLY:	Site # Click here to enter text.	TMK # Click here to enter text.

I. GENERAL INFORMATION

Common / Present Name: University of Chicago Cosmic Ray Neutron Monitor Station
Historic Name: Baker-Nunn Satellite Tracking Facility
Property Owner: University of Hawaii
Address: Kula, Hawaii 96790
City/ Town/ Location: Haleakalā High Altitude Observatory, Pāpa'anui Ahupua'a
County: Maui
TMK [(X)-X-X-XXX:XXX)]: (2)-2-2-007:008
Subdivision/Neighborhood: Haleakalā High Altitude Observatory
Latitude: 20.70730
Longitude: -156.2573
Parcel Number: 008
Historic District: None
Original Use: Baker-Nunn Satellite Tracking Facility outbuilding
Current Use: Storage
Architect/ Builder (if known): Ed Ige, Kahului, Maui (Builder)
Date of Construction (if known): 1 July 1957

II. Photograph of Resource

III. CONDITION ASSESSMENT

Prepared By: Adam J. Lauer Consulting Firm: International Archaeology, LLC
Address: 2081 Young St. Honolulu, Hawaii 96826
Telephone Number: 808/946-2548 Email:alauer@iarii.org Date: 11/24/2015

Category (select all that apply):

FOR SHPD USE ONLY:	**Site #**Click here to enter text.	**TMK #** Click here to enter text.

☒Building(s)
☐Residential ☐Commercial ☐Educational ☒Public/Civic ☐Religious
☒Structure(s)
☐Object(s)
☐Site(s)/Landscape(s)
☐Archaeology or potential for archaeology (Please provide a description of the potential for archaeology within VI. Description of Resource Features below.)

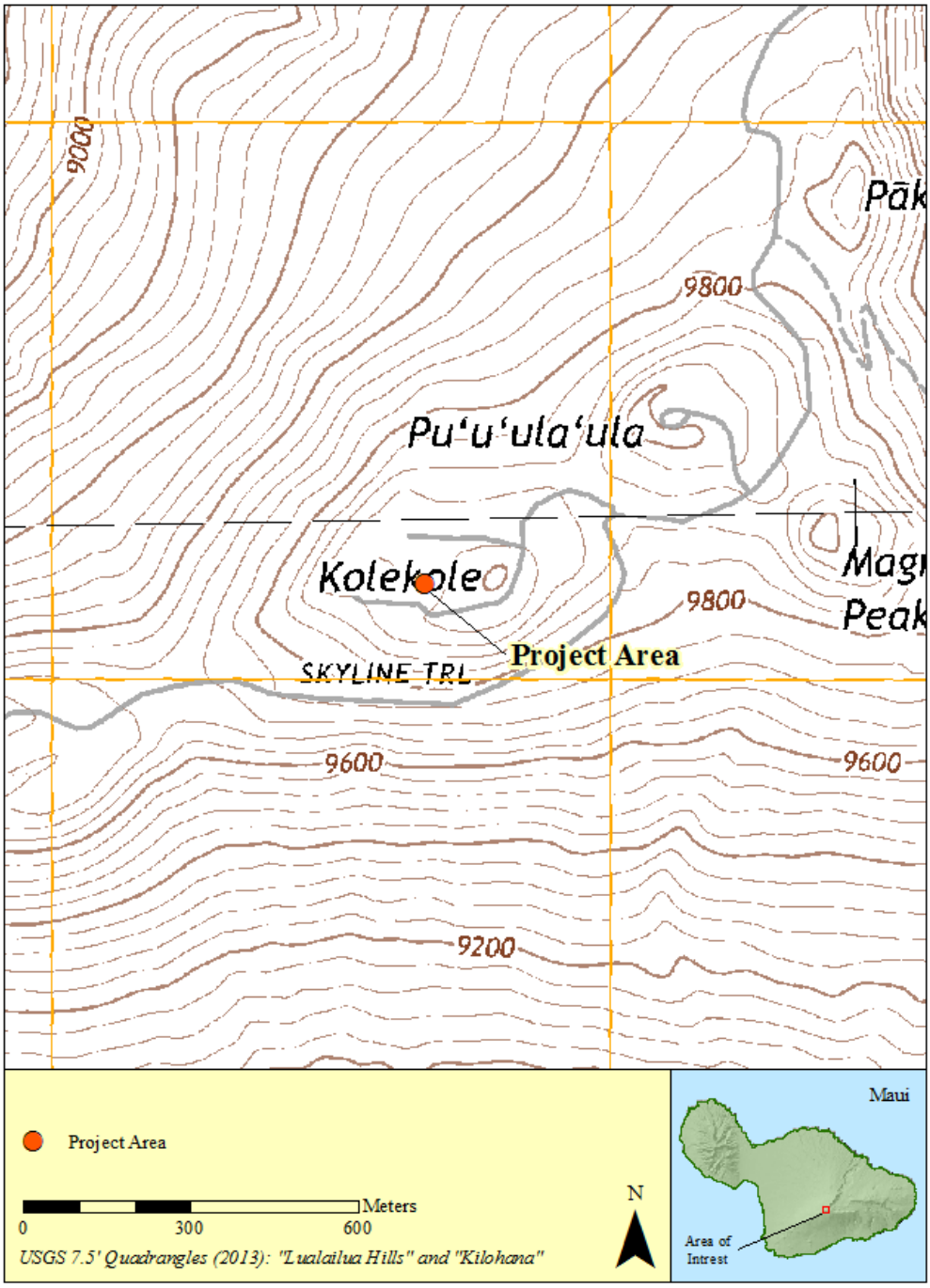
Condition:
☐Excellent
☒Good
☐Fair

Eligibility (select all that apply):
☒National Register of Historic Places
☒State Register of Historic Places
☐Not Eligible
☒Eligible
☐Listed
☐Contributing to Historic District:
Name of District: Click here to enter text.
☐Unknown

Criteria of Significance (select all that apply)
☒A: Associated with Events
☐B: Associated with Significant Person(s)
☐C: Distinctive characteristics of a type, period or method of construction; work of a master; possess high artistic values (Architecture, Engineering, Design)
☒D: Have yielded or may be likely to yield information important to history or prehistory.

IV. MAP

FOR SHPD USE ONLY:	Site #Click here to enter text.	TMK # Click here to enter text.



FOR SHPD USE ONLY: **Site #**Click here to enter text. **TMK #** Click here to enter text.

V. DESCRIPTION

Materials (please check those materials that are visible):

Height

☒Stories: 1 ☐Other: Click here to enter text.
☐Below Ground ☐N/A

Exterior Walls (siding):

☐Aluminum Siding	☒Metal	☐Plywood
☐Asbestos	☐Shingles-Asphalt	☐OSB
☐Brick	☐Shingles-Wood	☐Fiberboard
☐Ceramic	☐Stone	☐Fiber Cement
☐Concrete	☐Stucco	☐Vinyl Siding
☐Horizontal Wood Siding	☐Vertical Wood Siding	☐Other:
☐Log	☐Engineered Siding	Click here to enter text.

Roof:

☐Asphalt, shingle	☐Slate	☐Wood Shingle
☐Asphalt, roll	☐Built Up	☐None
☒Metal	☐Ceramic Tile	
☐Other: Click here to enter text.		

Foundation:

☐Brick	☒Concrete Slab	☐Stone
☐Concrete Block	☐Poured Concrete	☐Raised/Pile
☐Other: Click here to enter text.		

Structural Support:

☐Baled Hay	☒Frame-wood	☐Puddled Clay
☐Concrete Block	☐Frame-metal/steel	☐Rammed Earth
☐Concrete Framed	☐Brick-load bearing	☐Sod
☐Concrete Poured	☐Stone-load bearing	
☐Other: Click here to enter text.		

Windows:

☐Double Hung Sash	☐Jalousie	☐Stained Glass
☐Single Hung Sash	☐Glass Block	☐Replacement
☐Casement	☐None/Unknown	☐Aluminum
☐Fixed	☐Ribbon	☐Vinyl
☒Other: Sash (unknown if single or double) and sliding windows		

Lanai(s)

☐Arcade	☐Recessed	☐Wrap-around
☐Balcony	☐Stoop	☐Verandah
☐Porte-Cochere	☐Portico	☒None
☐Other: Click here to enter text.		

Chimney

☐Brick	☐Stuccoed Masonry	☒Stove Pipe
☐Concrete	☐Stone	☐Siding
☐None	☒Other: vent	

FOR SHPD USE ONLY:	Site #Click here to enter text.	TMK # Click here to enter text.

X. Continuation Sheet

Please use this sheet those that follow to attach additional information about the site; including, but not limited to additional floor plans, drawings, photographs, maps, etc.

Site 50-50-15-8302 is a single story structure in good condition. It is a rectangular building 14.1 m long by 10.3 m wide and approximately 3 m high. The roof and exterior walls are corrugated metal sheeting, which is attached to a wood frame (Photos 1-15). Sash and sliding (both vertical and horizontal windows) are present along the north, south, east, and west façades (the window along the north façade is boarded over). The building has a concrete slab foundation. One stove pipe chimney and two vents are present. No lanai is present.

This structure is an outbuilding built for the Baker-Nunn Satellite Tracking Station, which was part of the satellite tracking program of the Smithsonian Astrophysical Observatory (SAO). The University of Hawai‘i built the satellite tracking camera facility and its living quarters (the current project building) by July 1, 1957 (Clifford et al. 2013, Steigler n.d.). The Baker-Nunn satellite tracking camera was installed in February 1958. The buildings were in use, and enlarged and improved, until the facility was closed in 1980. The facilities were returned to UH by the SAO after the transfer of the Baker-Nunn camera to the Air Force (Smithsonian Institution Archives 1980).

The project area building was used as a Cosmic Ray Neutron Monitor Station by the University of Chicago from 1991 until 2007. The building is currently used as storage.

Astronomy activities began on the summit of Haleakalā with the construction of a radio antenna on Pu‘u Kolekole (Steiger n.d.). This radio antenna, known as Reber Circle, was built on a circular track by Grote Reber in 1951-1952. The radio antenna collapsed after an ice storm in 1957 and the circular base was removed in 2012 (Filimoehala and Rieth 2013)

Haleakalā was later nominated as a location for the optical satellite tracking system proposed for Project Vanguard, the program responsible for launching the United States’ first orbital satellite (Green and Lomask 1969). In 1956 the SAO, the primary government contractor for the optical satellite tracking systems of Project Vanguard, asked Dr. C.E. Kenneth Mees, formerly of the Eastman Kodak Company and developer of astrophotography films, to secure a site in Hawai‘i for a satellite observatory. The University of Hawai‘i used $15,000 in donated Kodak stock from Dr. Mees to secure ca. 18 acres on the summit area of Haleakalā, which eventually became the Haleakalā High Altitude Observatory (HO) site (Steiger n.d.).

The satellite tracking facility was completed July 1, 1957. The building on the project parcel was a part this construction. Its original use was for living accommodations for the observers using the Baker-Nunn satellite tracking camera (Steiger n.d.). The Baker-Nunn satellite tracking camera was installed six months later in the building that now houses the Tohoku T60 optical telescope, a few meters from the project building. These original facilities were enlarged and improved over the years (Steiger n.d.).

The HO was officially established by Executive Order from Governor William Quinn in 1961 (Clifford et al. 2013). This area, also known as Science City, began to see the planning and construction of various observatories through the University of Hawaii (UH), United States Air Force (USAF), National Aeronautics and Space Administration (NASA), other United States defense agencies, and various university and research corporation consortiums (Steiger n.d.; Clifford et al. 2013).

The Baker-Nunn telescope and the SAO Satellite Tracking Station in Hawai‘i were closed in 1980 and the facilities, including the building in the current project area, were turned over to the University of Hawai‘i (Smithsonian Institution Archives 1980).

The University of Chicago Cosmic Ray Neutron Monitor Station began operation out of the project building in February 1991. These operations ended in 2007 (University of Hawai‘i Institute for Astronomy 2010). The building is now used for storage.

The HO is currently an area of active research and construction activities. The project parcel is bordered by construction storage and lay-down yards and the Tohoku University T60 optical telescope. The Tohoku telescope is in a re-purposed Baker-Nunn facility (Imada 2014).

Clifford, Megan, Dave Baiocchi, and William Welser IV
2013 *A Sixty-Year Timeline of the Air Force Maui Optical and Supercomputing Site*. Prepared for United States Air Force. RAND Project Air Force, RAND Corporation, Santa Monica.

Filimoehala, Christopher and Timothy Rieth
2013 *Final No Findings Letter Report for Archaeological Monitoring of Reber Circle Demolition at the Haleakalā High Altitude Observatory site, Papa‘anui Ahupua‘a, Makawao District, Maui, Hawai‘i (TMK: 2-2-007-008 [Portion]).* Prepared fro KC Environmental, Inc.. International Archaeological Research Institute, Inc., Honolulu.

Green, Constance M. and Milton Lomask
1969 *Vanguard, A History*. NASA SP-4202. The NASA Historical Series. NASA Historical Reference Collection, NASA History Office, NASA Headquarters, Washington, DC. http://history.nasa.gov/SP-4202/chapter9.html

Imada, Lee
2014 *Long-standing cooperation aids science program*. Maui News. http://www.mauinews.com/page/content.detail/id/589741/Long-standing. Accessed November 20, 2015.

Smithsonian Institution Archives
1980 Record Unit 371, Box 3, “The Torch,” November 1980 p. 4.

Steiger, Walter
n.d. *Origins of Astronomy in Hawai‘i*. Institute for Astronomy, University of Hawai‘i. https://www.ifa.hawaii.edu/users/steiger/introduction.html Accessed November 18, 2015.

University of Hawai’i Institute for Astronomy
2010 *Haleakalā High Altitude Observatory Site Haleakalā, Maui, Hawai‘i Management Plan*. Prepared by KC Environmental, Inc. Makawao. Prepared for University of Hawai’i Institute for Astronomy.

FOR SHPD USE ONLY:	Site #Click here to enter text.	TMK # Click here to enter text.

Photo 1. South façade with surrounding buildings. Tohoku University 60 cm telescope (T60) is the dome to the left (east) of the building. The Air Force Advanced Electro-Optical System (AEOS) telescope is in the background. View to the north.

FOR SHPD USE ONLY:	Site #Click here to enter text.	TMK # Click here to enter text.

Photo 2. South façade with Tohoku T60 telescope and the AEOS telescope enclosure in the background. View to the north.

FOR SHPD USE ONLY:	Site #Click here to enter text.	TMK # Click here to enter text.

Photo 3. South and west (portion) façade. View to the northeast.

FOR SHPD USE ONLY:	Site #Click here to enter text.	TMK # Click here to enter text.

Photo 4. Detail southwest corner. Note eaves and structural elements. View to the northeast.

FOR SHPD USE ONLY:	Site #Click here to enter text.	TMK # Click here to enter text.

Photo 5. East façade. FAA and Coast Guard towers in the background. View to the west.

FOR SHPD USE ONLY:	Site #Click here to enter text.	TMK # Click here to enter text.

Photo 6. East façade. Detail of south portion of building. View to the west.

FOR SHPD USE ONLY:	Site #Click here to enter text.	TMK # Click here to enter text.

Photo 7. Detail of east façade. View to the west.

FOR SHPD USE ONLY:	Site #Click here to enter text.	TMK # Click here to enter text.

Photo 8. Detail of east façade. Door. View to the west.

FOR SHPD USE ONLY:	Site #Click here to enter text.	TMK # Click here to enter text.

Photo 9. North façade. Faulkes telescope, Las Cumbres Observatory dome in the background. View to the south.

FOR SHPD USE ONLY:	Site #Click here to enter text.	TMK # Click here to enter text.

Photo 10. North façade. Faulkes telescope, Las Cumbres Observatory dome in the background right (southwest), Tohoku T60 telescope outbuilding on the left (east). View to the south.

FOR SHPD USE ONLY:	Site #Click here to enter text.	TMK # Click here to enter text.

Photo 11. Detail of north façade. Downspout, window frame, and eaves detail. Note loading door. View to the west.

FOR SHPD USE ONLY:	Site #Click here to enter text.	TMK # Click here to enter text.

Photo 12. Detail of north façade loading door. View to the south.

FOR SHPD USE ONLY:	Site #Click here to enter text.	TMK # Click here to enter text.

Photo 13. West façade. Note current construction materials for the Daniel K Inouye Solar Telescope (DKIST) are in front of the project building. Background right, next to the crane, is the DKIST, center right is the Zodiacal Observatory, center left is Tohoku T60 telescope, left is AEOS. View to the east.

FOR SHPD USE ONLY:	Site #Click here to enter text.	TMK # Click here to enter text.

Photo 14. West façade detail. View to the north, behind obstructing construction equipment.

FOR SHPD USE ONLY:	Site #Click here to enter text.	TMK # Click here to enter text.

Photo 15. Roof. View to the south. Faulkes telescope, Las Cumbres Observatory dome in the background.

Appendix C
Chapter 6E-8 Historic Preservation Review
Concurrence Letter
March 30, 2016

DAVID Y. IGE
GOVERNOR OF HAWAII

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

KEKOA KALUHIWA
FIRST DEPUTY

JEFFREY T. PEARSON
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

STATE HISTORIC PRESERVATION DIVISION
KAKUHIHEWA BUILDING
601 KAMOKILA BLVD, STE 555
KAPOLEI, HAWAII 96707

March 30, 2016

Adam J. Lauer, Ph.D.
International Archaeology, LLC
2081 Young Street
Honolulu, Hawaii 96826
Via email to: alauer@iarii.org

Log No: 2016.00186
Doc No: 1603MD15
Archaeology
Architecture

Aloha Dr. Lauer:

SUBJECT: Chapter 6E-8 Historic Preservation Review -
Draft Archaeological Inventory Survey of 0.0767 Acres with One New Site
Papa'anui Ahupua'a, Makawao District, Island of Maui
TMK (2) 2-2-007:008 (por.)

Thank you for the opportunity to review the draft report titled *Archaeological Inventory Survey for the Proposed Planets Optical Telescope at the Haleakalā High Altitude Observatory…*by Lauer January 2016, which we received on January 26, 2016. We apologize for the delay in our review. This report was developed for KC Environmental, Inc. on behalf of the University of Hawai'i. This parcel is part of the Haleakalā High Altitude Observatory Site. The subject location is being proposed for the construction of the Polarized Light from Atmospheres of Nearby Extra-Terrestrial Systems (PLANETS) optical telescope.

One historic property was identified, State Inventory of Historic Places (SIHP) site 50-50-15-8302. SIHP is a single-story wood frame building with corrugated metal sheeting on the exterior walls and roof, built on a concrete slab. It is currently in use as a storage facility. This structure is a component of the earliest permanent optical telescope operations on Haleakala and was part of the early phase of the United States' space launch and satellite programs (project Vanguard). It has been assessed as significant under criteria "a" and "d" for its association with events that have made a significant contribution to broad patterns of Hawaiian and American history, and has the potential to provide important information about history.

Additionally, SHPD received a Reconnaissance Level architectural survey (survey) for SIHP site 50-50-15-8302. SHPD concurs with the determination of eligibility made by International Archaeology within the survey, Baker-Nunn Satellite Tracking Facility is eligible for listing on the Hawaii and National Registers of Historic Places. SHPD accepts the survey as the final draft and requires further work. The survey is acceptable mitigation for the proposed project, which will have an effect on historic resources. The Architecture Branch requires no further mitigation commitments.

We are requesting revisions as detailed in the attachment to this letter. Please contact me at (808) 243-4641 or Morgan.E.Davis@hawaii.gov if you have any questions or concerns about this letter.

Mahalo,

Morgan E. Davis
Lead Archaeologist, Maui Section

cc: County of Maui
Department of Planning
Planning@co.maui.hi.us

County of Maui
Department of Public Works – DSA
Renee.Segundo@co.maui.hi.us

County of Maui
Cultural Resources Commission
Annalise.Kehler@co.maui.hi.us

Attachment
*Archaeological Inventory Survey for the Proposed Planets Optical Telescope at the Haleakalā High Altitude Observatory…*by Lauer January 2016

1. Executive Summary and throughout – as this location is State-owned and a government project, the citations are incorrect (should be HRS 6E-8/HAR 275 etc.).

    a. Provide contact information for the landowner/project proponent (not just the contractor).

2. Research Methods, page 17: needs to include date(s) of fieldwork; identification of archaeologist(s).
    a. Is the red box around the SIHP in Figure 6 the extent of the APE for this AIS? That needs to be clarified in the text either way, so this can be used as a reference once they move into renovation plans.

3. Recommendations: revise to address whether or not ground-altering will require archaeological monitoring/is planned or not/etc.

7.0 LIST OF PREPARERS

The preparers of this Environmental Assessment for the proposed Polarized Light from Atmospheres of Nearby Extra-Terrestrial Systems telescope facility are summarized on Table 7-1.

Table 7-1 List of Preparers

University of Hawai'i Institute for Astronomy	Jeff Kuhn, PhD	Professor/Astronomer
	Joe Ritter, PhD	Optics/Electrical Engineer
	Mike Maberry	Assistant Director for External Relations
KC Environmental, Inc.	Charlie Fein, PhD	Project Manager
	Laurie Allan	Technical Director
	Mike Reyes	Graphical Support
	Tom Kekona	Viewshed Analysis and Graphical Support
ERM-West, Inc.	Leslie Tice, CEP	HEPA Project Manager
	Natalie Bogan	Lead Technical Author
	Andrew Bielakowski	HEPA Technical Reviewer
		Principal Cultural Specialist
	Rick Shih	Principal Noise Specialist
	Leslie Parker	Biologist
	Amy Beernink	Senior Technical Editor
	Pamela Matthews	Editor