UNIVERSITY of HAWAIʻI® SYSTEM

Office of the Vice President for Research and Innovation

March 31, 2026

Mary Alice Evans, Director
Office of Planning and Sustainable Development
Environmental Review Program
235 S. Beretania Street, Suite 702
Honolulu, HI 96813

Dear Ms. Evans:

Subject: Draft Environmental Assessment for HI-SEAS Habitat Project, TMK 3rd. 3-8-001:001, North Hilo District, Island of Hawaiʻi.

The Draft EA (DEA) assesses the potential effects of constructing limited new facilities and resuming operations at the HI-SEAS Habitat project on the slopes of Mauna Loa. The University of Hawaiʻi at Mānoa, as the proposing and approving agency, anticipates that the proposed action is not likely to have a significant effect and therefore is issuing a notice of an Anticipated Finding of No Significant Impact, subject to the public review provisions of HAR Section 11-200.1-20. Please publish a notice of the DEA and AFONSI in the next edition of The Environmental Notice.

Please contact Dr. Kim Binsted at 808-398-1300 or at binsted@hawaii.edu if you have any questions. Our consultant, Ron Terry of Geometrician Associates, is also providing a pdf copy of the Draft EA, the action summary, significance criteria, and other required information via the Environmental Notice online submittal platform. Please contact our Dr. Terry at (808) 987-5239 or rterry@hawaii.rr.com, if you have any questions concerning the submittal.

Sincerely,

Chad Walton
Interim Vice President for Research and Innovation

Cc: Ron Terry, Ph.D., Project Environmental Consultant

2425 Campus Road, Sinclair 10
Honolulu, Hawaiʻi 96822
Telephone: (808) 956-5006 FAX: (808) 956-9150

From: dbedt.opsd.erp@hawaii.gov
To: DBEDT OPSD Environmental Review Program
Subject: New online submission for The Environmental Notice
Date: Monday, April 6, 2026 11:14:11 AM

Action Name

HI-SEAS Habitat Project

Type of Document/Determination

Draft environmental assessment and anticipated finding of no significant impact (DEA-AFNSI)

HRS §343-5(a) Trigger(s)

- (1) Propose the use of state or county lands or the use of state or county funds
- (2) Propose any use within any land classified as a conservation district

Judicial district

North Hilo, Hawai‘i

Tax Map Key(s) (TMK(s))

(3) 3-8-001:001

Action type

Agency

Other required permits and approvals

State Forest Reserve Special Use Permit

Proposing/determining agency

University of Hawai`i

Agency jurisdiction

State of Hawai‘i

Agency contact name

Kim Binsted

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Agency contact phone

(808) 398-1300

Agency address

Campus Road, Box 368
Honolulu, HI 96822
United States
Map It

Is there a consultant for this action?

Yes

Consultant

Geometrician Associates

Consultant contact name

Ron Terry

Consultant contact email

hiloronterry@gmail.com

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Consultant address

10 Hina Street
Hilo, HI 96720
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Map It

Action summary

The University of Hawai‘i with support from NASA seeks to resume research at an analog habitat site at the 8,090-ft elevation on Mauna Loa. The 0.5-acre site is on State Conservation District land at a previously graded and quarried area of a cinder cone that resembles the surface of Mars. Operations from 2013-2024 built a portable 900-sf structure similar to one that might be built on Mars. Research focused on operational and psychological issues that astronauts will experience as they explore the solar system. A crew of researchers lived in the habitat for months at a time, where mission length, distance from Earth, the size and functionality of the living space, communication delays and latency, and the characteristics of in-flight and surface extravehicular activities were simulated. New proposed features include a 1,000-gallon propane tank to supplement solar power as necessary, modular plant-growth chambers for food and oxygen production, and a low solar angle illumination set-up to simulate lunar conditions for 1- to 3-hour night missions up to 12 times a year.

Reasons supporting determination

Chapter 11-200.1-13, Hawai‘i Administrative Rules, outlines those factors agencies must consider when determining whether an Action has significant effects:

(a) In considering the significance of potential environmental effects, agencies shall consider and evaluate the sum of effects of the proposed action on the quality of the environment.

(b) In determining whether an action may have a significant effect on the environment, the agency shall consider every phase of a project, the expected impacts, and the proposed mitigation measures. In most instances, an action shall be determined to have a significant effect on the environment if it may:

1. Irrevocably commit a natural, cultural, or historic resource. No valuable natural or cultural resources would be committed or lost. The site is unvegetated, with no water bodies, and there are no cultural sites present. No valuable cultural resources and practices such as forest access, fishing, gathering, hunting, or access to ceremonial sites would be affected in any way.

2. Curtail the range of beneficial uses of the environment. The proposed temporary project in no way curtails beneficial uses of the environment in this area, which will be restored to its original condition after use is complete.

3. Conflict with the State's environmental policies or long-term environmental goals established by law. The State's long-term environmental policies are set forth in Chapter 344, HRS. The broad goals of this policy are to conserve natural resources and enhance the quality of life. The proposed action does not adversely affect the environment and is highly beneficial for education and research. It is thus consistent with all elements of the State's long-term environmental policies.

4. Have a substantial adverse effect on the economic welfare, social welfare, or cultural practices of the community and State. No adverse effects to the economic or social welfare will occur, and there will be a beneficial effect to education and scientific knowledge.

5. Have a substantial adverse effect on public health. No effects to public health are anticipated.

6. Involve adverse secondary impacts, such as population changes or effects on public facilities. No adverse secondary effects are expected to result from the project, which is not significant enough to directly or indirectly burden public infrastructure or facilities.

7. Involve a substantial degradation of environmental quality. The proposed action is minor and is being regulated by permits to avoid environmental degradation, and thus would not contribute to environmental degradation.

8. Be individually limited but cumulatively have substantial adverse effect upon the environment or involves a commitment for larger actions, The project does not interact with other activities in the region in such a way as to produce adverse cumulative effects or involve a commitment for larger actions.

9. Have a substantial adverse effect on a rare, threatened, or endangered species, or its habitat. No rare or listed threatened or endangered plant species are present on the graded site. Restrictions on lighting will ensure that there are no impacts to listed seabirds that may transit over the site at night. The project site has no vegetation, and surrounding patches of vegetation are protected from impact. Impacts to rare, threatened or endangered species of flora or fauna will be prevented by mitigation measures to avoid impacts (including those from lighting) to fledgling seabirds and prevent introduction of invasive species.

10. Have a substantial adverse effect on air or water quality or ambient noise levels. Due to the character and density of the proposed action, no adverse effects on these resources would occur.

11. Have a substantial adverse effect on or be likely to suffer damage by being located in an environmentally sensitive area such as a flood plain, tsunami zone, sea level rise exposure area, beach, erosion-prone area, geologically hazardous land, estuary, fresh water, or coastal waters. The project site, like much of the Big Island, is subject to lava inundation, but due to the temporary nature of the project and the mobility of the structures being emplaced, there is little risk.

12. Have a substantial adverse effect on scenic vistas and viewplanes, during day or night, identified in county or state plans or studies. No aspect of the proposed action would adversely impact scenic resources or viewplanes. Impacts related to dark skies have been mitigated by project design and the limitation of events involving lighting to less than 36 hours per year.

13. Require substantial energy consumption or emit substantial greenhouse gases. Although construction of new facilities and operation of the habitat will require the use of energy, no major adverse effects to energy consumption would be expected, and there is no feasible way to undertake the project without energy consumption.

Attached documents (signed agency letter & EA/EIS)

- AFONSI_Accessible-from-Word-HI-SEAS_UH-iVPRI_20signed1.pdf
- Draft-EA-HI-SEAS-Habitat-April-6-2026.pdf

Action location map

- HI-SEAS-Habitat-Facilities-Access-Road-and-Gate1.zip

Compliance certification (HRS §368-1.5):

The authorized individual listed below certifies that documents submitted are unlocked, searchable, and compliant with the Hawaii Electronic Information Technology Disability Access Standards (including, but not limited to transcripts, captions, and other descriptions accompanying audio/video files). The individual acknowledges that the submitter retains the responsibility for compliance after documents have been published and any compliance queries will be directed back to the agency and/or applicant.

Authorized individual

Ron Terry

Authorized individual email

hiloronterry@gmail.com

Authorized individual phone

(808) 987-5239

Authorization

- The above named authorized individual hereby certifies that he/she has the authority to make this submission.

HI-SEAS Habitat Project

Draft Environmental Assessment

Tax Map Key Number: (3rd) 3-8-001:001 (por.)

University of Hawai‘i
Campus Road, Box 368
Honolulu, HI 96822

April 2026

HI-SEAS Habitat Project

Draft Environmental Assessment

Humu‘ula, North Hilo District, Island of Hawai‘i
Tax Map Key Number: (3rd) 3-8-001:001 (por.)

PROPOSING/APPROVING
AGENCY:

University of Hawai‘i
2440 Campus Road, Box 368
Honolulu, HI 96822

CONSULTANT:

Geometrician Associates
10 Hina Street
Hilo, Hawai‘i 96720

CLASS OF ACTION:

Use of State Funds and Land
Use of Land in Conservation District

This document is prepared pursuant to:
Hawai‘i Environmental Policy Act,
Chapter 343, Hawai‘i Revised Statutes (HRS), and
Title 11, Chapter 200.1, Hawai‘i Department of Health Administrative Rules (HAR)

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SUMMARY OF THE PROPOSED ACTION, ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

The University of Hawai‘i at Manoa (UHM), with support from the National Aeronautics and Space Administration (NASA), seeks to resume investigating practicalities of long-term space exploration at an analog habitat site at the 8,090-ft elevation on Mauna Loa. The HI-SEAS (Hawaii Space Exploration Analog and Simulation) habitat is on State land within the Conservation District. The 0.5-acre site is on an old graded cinder cone surrounded by lava flows and closely resembles the surface of Mars. Operations from 2013-2024 built and utilized a portable structure similar to one that might be built on Mars. Research focused on the operational and psychological issues astronauts will experience as they explore the solar system. The missions involved a crew of researchers living in the habitat for months at a time, where mission length, distance from Earth, the size and functionality of the living space, communication delays and latency, and the characteristics of in-flight and surface extravehicular activities were simulated. The project involved a 2013 EA and a Conservation District Use Permit (CDUP) by the Department of Land and Natural Resources (DLNR).

The site is almost devoid of vegetation and contains no rare, threatened or endangered species. Consultation and archaeological survey found no cultural sites, resources or practices. The self-contained, 20-foot tall, 900 square-ft habitat has sleeping quarters, a kitchen, a computer and lab workspace, two composting toilets, and a shower. There are accessory water tanks, a wastewater tank and leachfield, a propane tank and communication facilities. All waste was contained for regular servicing and removal until composting toilets were built, and electricity was supplied primarily by solar power with an ultra-quiet and efficient propane generator as backup. Access is via a 1.3-mile long 4WD road off of Mauna Loa Observatory Road. In order to keep the site isolated, this access road was gated and locked at a point about 2,300 feet west of Mauna Loa Road during the duration of the experiment, with signage providing contact information for DLNR and the project. DLNR was supplied with a key to a separate lock, and any legitimate access request from any parties could be applied for and obtained after consultation with UHM.

The original plan in the EA and CDUP was that five years after approval (i.e., in 2018), the project would terminate, the habitat would be removed, the site would be cleared of any debris or traces of the experiment and renaturalized, and monitored to prevent establishment of invasives. UHM applied to DLNR for a 5-year time extension in 2019, which was granted. The focus of the project began to evolve to encompass similar projects such as the International MoonBase Alliance, led by long-term HI-SEAS partner Henk Rogers, which could conduct shorter-term studies designed to mimic missions to the Moon. It was determined by DLNR in 2023 that because of the change in the nature of activities, the original CDUP was no longer applicable. UHM then decided to prepare another CDUA and EA, which has taken until the present to complete. In the meantime, the site was secured.

The project would retain/modify all the features that are already onsite from the original habitat project and construct very limited new features including a 1,000-gallon propane tank to help supplement solar power when necessary, modular plant-growth chambers for food and oxygen production, and a low solar angle illumination set up to simulate lunar conditions for 1- to 3-hour EVA night missions up to 12 times a year. UHM has coordinated with DLNR and the UH Institute for Astronomy on measures to avoid impacts to seabirds and dark skies. The lights will be shielded from shining upwards and will utilize a low-blue spectrum that minimizes scattering. The project would also increase the fidelity of the mission analog by introducing greywater recycling for plant growth and other non-consumption purposes.

After five years, this second phase of the project is scheduled to terminate. Unless UHM determines that it would be useful to continue the project as described or in an altered form, and applies for an extension and any needed permits, the habitat would be removed. The site would be cleared of any debris or traces of the experiment.

PART 1 ACTION HISTORY, DESCRIPTION AND PURPOSE AND NEED

In the first decade of this century, the Department of Information and Computer Sciences at the University of Hawai‘i at Manoa (UHM) began investigating in collaboration with other institutions practical problems in long-term space exploration at an experimental habitat site at the 8,090-foot elevation on Mauna Loa on Hawai‘i Island. It was known that there are a number of serious risks, including radiation, microgravity, confinement in small spaces, and nutritional deficits, that could affect crew behavior, health and mission success (NASA 2009). To successfully return to the Moon, or venture onwards to Mars, asteroids or other deep-space destinations, scientists will need to assess these risks and develop reliable countermeasures.

Some of these risks that require study are also common to isolated, confined and/or extreme environments here on Earth. These are called analog environments, because they share a significant subset of the conditions astronauts will face in long-term space exploration. Hawai‘i has some very strong analog environments, which have the geological, operational and psychological characteristics of the environments astronauts will experience as they explore the solar system.

UHM now seeks to resume operations, with support from the National Aeronautics and Space Administration (NASA). The habitat site is on State of Hawai‘i land within the Conservation District and is part of the Mauna Loa Forest Reserve. UHM intends to build upon its successful project at Mauna Loa developing the HI-SEAS (Hawaii Space Exploration Analog and Simulation) facility. This research program constructed a realistic planetary-surface habitat and tested it under strong operational conditions to understand and address the risks of long-term human space exploration. NASA seeks to fund the upgrade of the existing facility and construction of new features at this facility to run analog missions to support research that will enable long-term human space exploration missions over a range of mission profiles. Although such analogs can support a wide variety of research, the emphasis at HI-SEAS is on addressing human behavioral health and performance (BHP) risks. In particular, the enhanced facility will be designed to simulate, as accurately as possible:

- Mission length
- Distance from Earth
- Size and functionality of the living space
- Communication delays and latency, and
- Characteristics of in-flight or surface extravehicular activities (EVAs, also known as spacewalks)

The site is on a previously graded cinder cone surrounded by lava flows and closely resembles the surface of Mars. Experiments conducted between 2013 and 2024 constructed and utilized a small, portable “habitat” similar to one that might be constructed for Mars to focus on the operational and psychological issues astronauts will experience as they explore the solar system. The project was the subject of an environmental assessment (EA) (UH 2013) and was granted a

Conservation District Use Permit (CDUP) in 2013 by the Department of Land and Natural Resources (DLNR).

The project installed the habitat within an area of about 0.5 acres on a previously graded and quarried portion of a cinder cone ridge. It is almost devoid of vegetation and contains no rare, threatened or endangered species. Previous and current consultation as well as 2012 archaeological studies have revealed no cultural sites, resources or practices. The habitat is a self-contained unit with sleeping quarters, a kitchen, a computer and lab workspace, two composting toilets, and a shower, along with an accessory water tank, a wastewater tank and a propane fuel tank. All waste was contained for regular servicing and removal. Electricity was supplied primarily by solar power with an ultra-quiet and efficient propane generator as backup. The habitat structure has about 900 square feet of usable floor space and was 20 feet in height. Access is via a 1.3-mile long 4WD road off of Mauna Loa Observatory Road. In order to keep the site isolated, this access road was gated and locked at a point about 2,300 feet west of Mauna Loa Observatory Road during the duration of the experiment, with signage providing contact information for DLNR and the project. DLNR was supplied with a key to a separate lock, and any access request from any parties could be applied for and obtained after consultation with UHM.

Starting in early 2013, the habitat was periodically inhabited by a crew of about six for missions lasting up to a year. The crews lived and worked under strict analog conditions, only venturing outside in simulated space suits, communicating with 'Earth' via channels disrupted by latencies and drop-outs. In addition to the NASA-funded BHP research, these long-term analog missions also offered opportunity for other researchers, who were invited to propose research studies to test their ideas in this environment. Topics included remote medicine, crew dynamics, communication technologies, and psychological support strategies. The project also partnered with schools for student participation through internships, classes and outreach with K-12 students.

The original plan disclosed by the EA and permitted by the Conservation District Use Permit (CDUP) was that five years after approval (i.e., in 2018), the project would terminate, the habitat would be removed, and the site would be cleared of any debris or traces of the experiment. Site restoration was to consist of removing all equipment and material; ensuring that no small pieces of trash remained behind; raking areas of loose cinder on which blocks had been placed to get a more natural-appearing surface; and monitoring the site after three months, six months and a year to determine if any invasive plants or animals have taken hold and deal with them appropriately in cooperation with DLNR-Division of Forestry and Wildlife (DOFAW).

The termination and removal process did not occur per plan, for several reasons. UH applied to DLNR for a 5-year time extension in 2019, which was granted. The focus of the project began to evolve. The intent was that in addition to simulating Mars missions, a project called the International MoonBase Alliance, led by long-term HI-SEAS partner Henk Rogers, would conduct shorter-term studies designed to mimic missions to the Moon, not directly involving the UHM research team. It was determined by DLNR in 2023 that because of the change in the

nature of activities, the original CDUP was no longer applicable. UHM then decided to prepare another CDUA and EA, which has taken until the present to complete. In the meantime, DLNR had inspected the site to inventory the equipment and supplies that remained on the site. DLNR requested removal of certain facilities, while permitting others to stay, provided that they were maintained, pending the granting or denial of the CDUP. DLNR informed UHM per letter of August 12, 2024 that UHM must secure these structures to withstand weather events, store any loose items, unutilized cords/ conduits/lines; and remove hazardous and waste. DLNR noted that a 50-gallon above ground propane storage tank was not authorized by DLNR or inspected by the County Fire Department (the EA discussed utilizing household-scale propane tanks). They accordingly requested its removal, with Fire Department authorization.

In response, UHM undertook a number of actions. A team went to the site to secure the structures to withstand weather events and store loose items/cords/conduits/lines. They removed all waste products, none of which were hazardous materials. They then invited DOFAW to inspect the site. Instead of removing the propane tank, UHM had the tank inspected in March 2025 by the Fire Department, which issued a permit for it. UHM asked DLNR for permission to retain the tank onsite, as it was fully inspected and would be of great value to the proposed missions, but permission was not granted. UHM then removed the tank.

The HI-SEAS facility is well-suited to the proposed research, as demonstrated by the series of NASA-funded simulated long-duration (4-12 month) missions carried out there in the past, and by the NASA funding to support the proposed upgrades. The proposed resumption of activities and improvements would make HI-SEAS a unique facility for BHP research to support lunar, Mars, and deep space missions. In order to legally conduct the activity, the project proponent is being required to prepare an EA and obtain a new CDUP as well as a Special Use Permit (SUP) pursuant to the State of Hawai‘i’s Forestry Rules at §13-104-18, Hawai‘i Administrative Rules, from the State Board of Land and Natural Resources (BLNR).

The project would retain/modify all the features that are already onsite from the previous HI-SEAS Habitat project and construct very limited new features. Retained/modified features include:

- An existing manufactured habitat consisting of self-contained units with sleeping quarters, a kitchen, a computer and lab workspace, and two bathrooms, one with a shower. The project would design and implement a set of modular barriers/ceilings within the habitat that will be used to vary the habitable volume to suit a wide range of crew sizes and mission profiles appropriate to the particular mission type.
- HI-SEAS currently has composting toilets and urinals, so the only wastewater produced by the habitat is greywater. The project would increase the fidelity of the mission analog by introducing greywater recycling for plant growth and other non-consumption purposes.
- As before, power will be obtained primarily from solar panels with batteries, with a backup portable Generac 10 kW Standby Generator run on propane stored in a new

1,000-gallon fuel tank that will be placed onsite. The fuel tank used for the previous project has been removed.
- Other features already present on the site that will be retained include two water tanks, a solar panel w/microwave transmitter for communications, instruments, a post-on-pier storage container w/panel, a buried greywater container with pipes to the habitat, and various cords, conduits and lines.

New proposed features that merit attention in the EA and permit applications include the following:

- Modular plant-growth chambers for food and oxygen production that can be put in or out of use and resized according to the desired mission profile. Both a free-standing growth chamber utilizing a shipping container design and smaller in-habitat chambers are proposed. Proposed research would focus on controlled-environment crop production and analog operations such as oxygen production, energy-efficient lighting, and crew-time logistics. The focus would be on plants expected to be useful in a lunar or Mars setting, particularly plants known to be strong oxygen producers.
- In order to simulate the low solar angle illumination of Artemis lunar missions that are expected to land at the Lunar South Pole and which will impact EVA feasibility, safety, and cognitive load, the project proponents will utilize horizontal lighting for 1 to 3 hour EVA missions up to 12 times a year. A set of lights equivalent in lumens to a set of car headlights will be installed pointing at 90 degrees towards a ridge to the south of the habitat. UHM has coordinated with DOFAW and the University of Hawai‘i’s Institute for Astronomy on measures to avoid impacts to seabirds and dark skies. The lights will be shielded from shining upwards and will utilize a low-blue spectrum that minimizes scattering.

After five years, the project would terminate, the habitat would be removed, and the site would be cleared of any debris or traces of the experiment. If at any time during or after the experiment UHM determines that the site is suitable for additional experimental uses, it would begin a new Conservation District Use Application and comply with all applicable Hawai‘i environmental laws and regulations.

Figure 1 Location Map

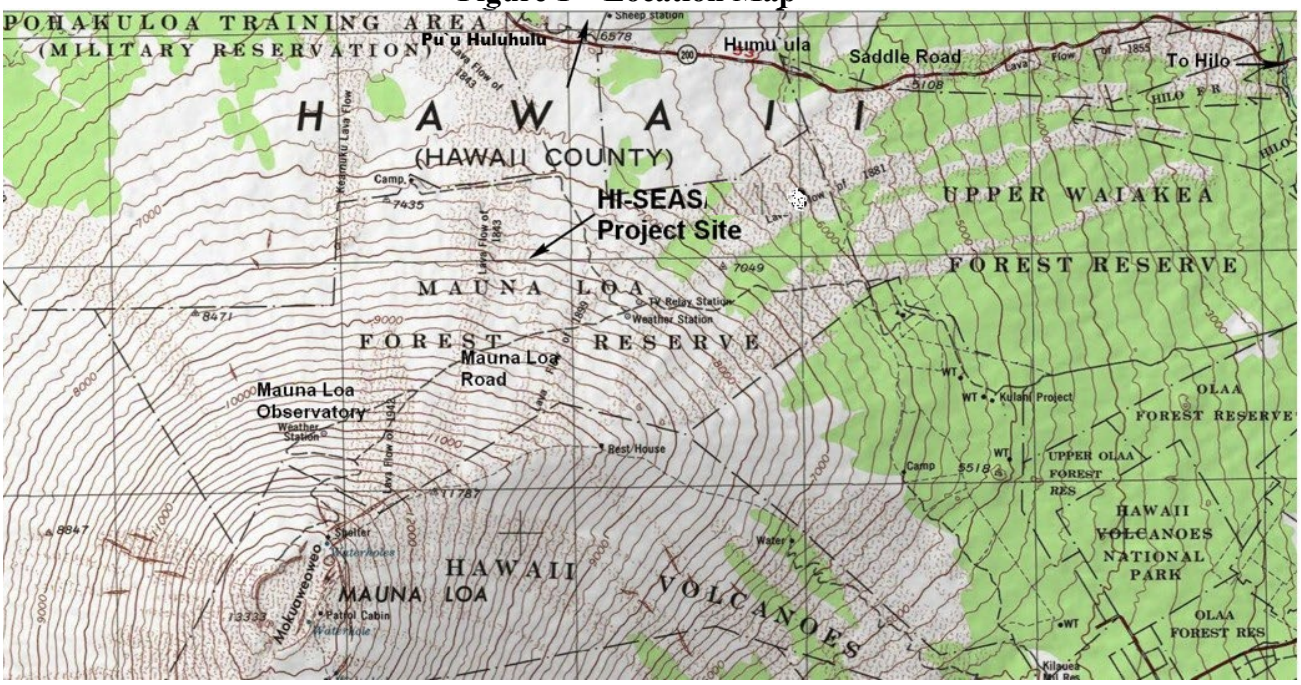
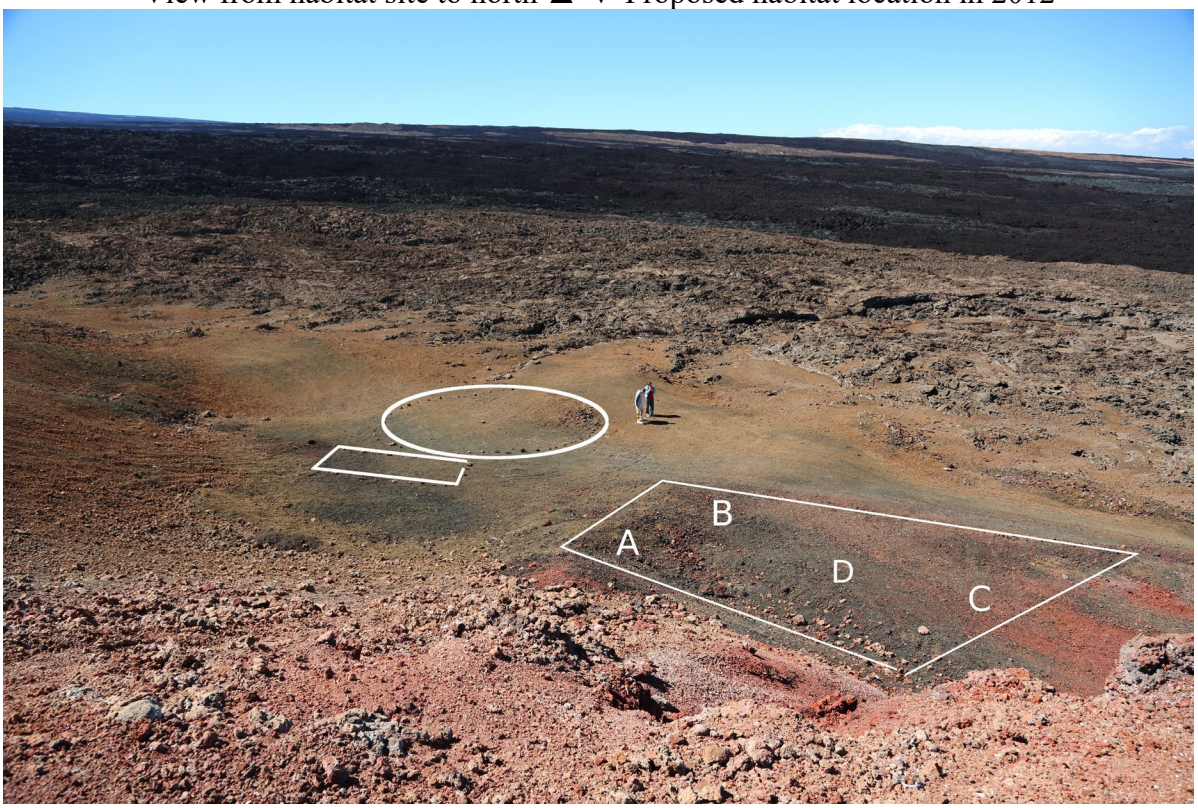


Figure 2 Aerial Image

Figure 3 Project Site Photos

View from habitat site to north ▲ ▼ Proposed habitat location in 2012

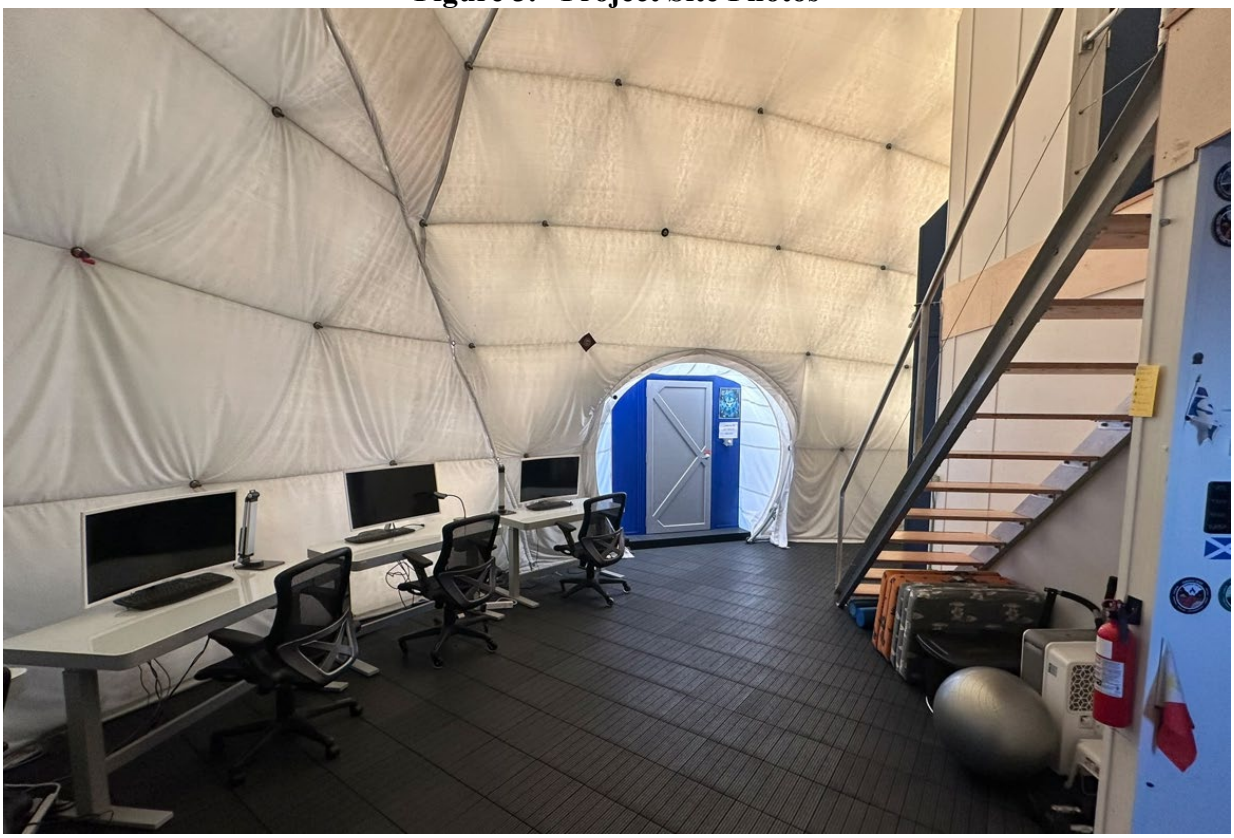


KEY: (Locations conceptual) Circle and rectangle mark habitat site and storage
A: water tank; B: septic tank; C: power system; D: storage container

Figure 3. Project Site Photos

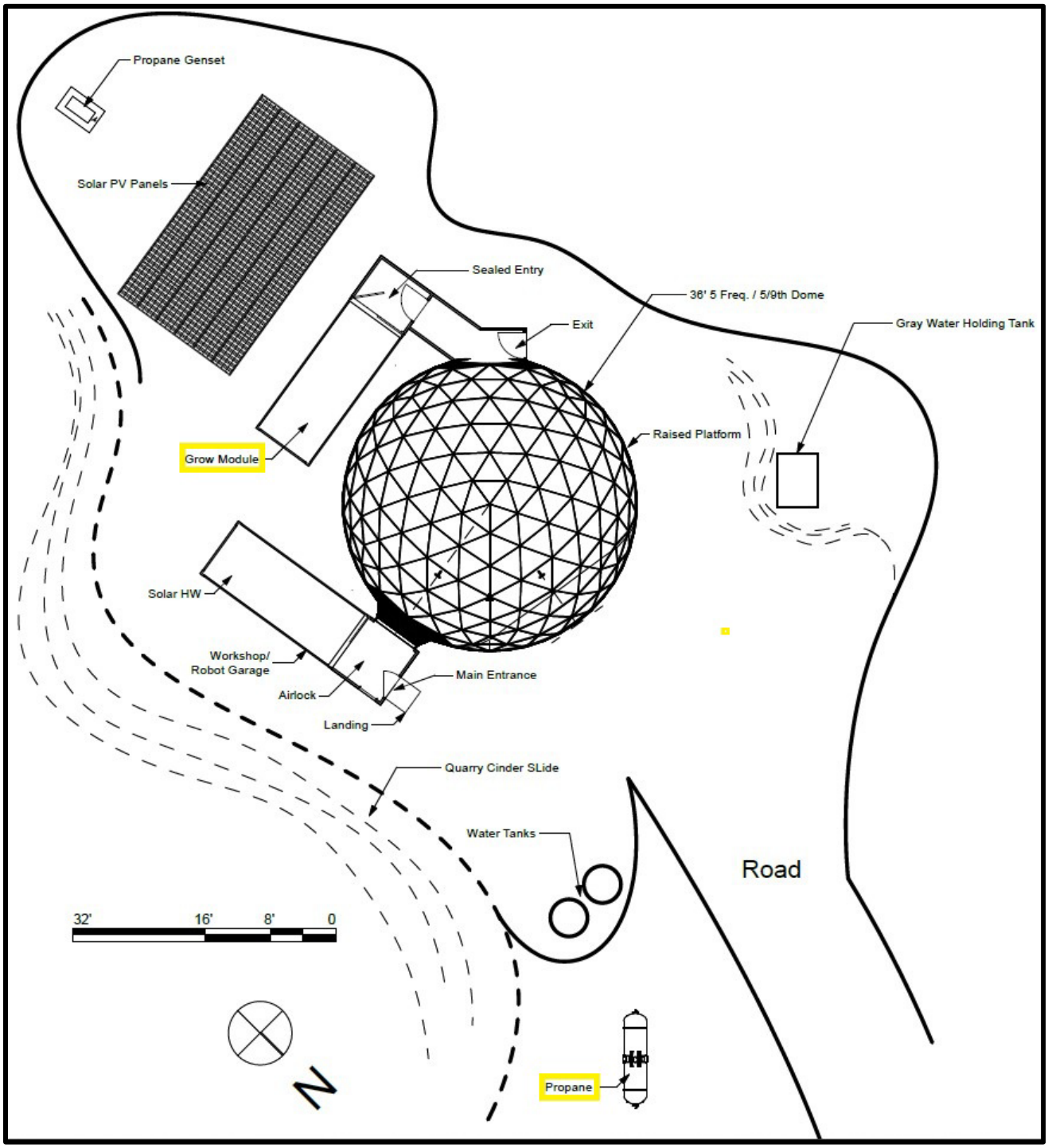
Habitat facility in 2026 ▲ ▼ View from south

Figure 3. Project Site Photos



▲ Interior of Habitat ▼

Figure 4. Site Plan with Existing Facilities and Proposed Growth Chamber and Fuel Tank



PART 2 ALTERNATIVES

As discussed above, the project involves experiments at a realistic planetary-surface habitat under strong operational conditions to understand and address the risks of long-term human space exploration. It is theoretically possible to conduct some of the research activities in an artificial environment – e.g., a stage inside a building – but sacrificing the near-reality of a high-elevation isolated site with geology similar to Mars would defeat the primary goal of assessing the psycho-social effects on future space explorers. The following criteria were considered highly desirable for potential sites for the original project in 2012:

- Located in Hawai‘i, on State land, to reduce costs to the University of Hawai‘i
- Mars-like physical geology
- Very little vegetation
- Very little macroscopic animal life such as mammals or birds
- Pre-graded to minimize disturbance of existing sites but maximize usability of site
- Physically isolated from used roads and trails, so that passersby are unlikely
- Visually isolated, so that minimal human activity can be seen from the site
- Low visibility from any roads or nearby public vantages, to discourage sightseers
- Accessible by 4WD vehicle and service trucks, but with a securable access so that a gate can be emplaced to discourage visitors
- Moderate temperature, so that sorties in mock-up suits are tolerable
- No significant environmental or cultural impact

Maunakea and Haleakalā, although offering a number of suitable sites, were considered more sensitive in terms of archaeological, cultural, biological and hunting resources, and therefore attention was focused on Mauna Loa. The requirement for feasible access limited the search to sites that connected to Mauna Loa Observatory Road. Map work in 2012 identified other sites that have some of these characteristics, but none that met all criteria.

In 2026, the fact that the facility has been built where it was even more strongly favors the chosen location, as the site was proven highly suitable and much infrastructure remains, minimizing construction costs.

PART 3 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

3.1 Geology

3.1.1 Definition of Resource

For the purposes of this analysis, geology includes surface geology, topography, geological hazards, and soils.

3.1.2 Region of Influence

The region of influence (ROI) for geology includes the approximately half-acre area directly affected by physical activities from the proposed project and immediately adjacent terrain.

3.1.3 Surface Geology

The project site is at 8,090 feet in elevation on the side of an elongated ridge of cinder/spatter cones from a Mauna Loa eruption dated from between 1,500 and 3,000 years before the present (see maps, aerial images and photographs in Figures 1-3). Just west of the cinder cone ridge is a pahoehoe lava flow associated with the eruption (Wolfe and Morris 1996).

3.1.4 Topography

As illustrated in Figure 3, the surface of the site has been modified by heavy equipment excavating and/or compacting the edge of an elongated cinder cone with multiple vents. The topography is irregular and slopes slightly upwards towards the axis of the cones. Minimal site alteration occurred to install the components of the project in 2013, involving mainly filling and leveling various patches on the existing road. These actions utilized operators who regularly maintain DLNR roads and equipment cleaned of soil and seeds to avoid introduction of invasive species, as well as very slight dressing and leveling of the already loose cinder on several hundred square feet of the habitat site with a small backhoe. Experience in this environment indicated that rearranging this cinder would not lead to any potential for erosion and sedimentation, and no special erosion prevention measures were required. No subsequent erosion or slope failures occurred on the site.

3.1.5 Soils

The lava landscape is too young to have developed soils and is not classified as a soil by the U.S. Natural Resources Conservation Services (U.S. Soil Conservation Service 1973). Plants are present in only very restricted locations on the minimally weathered substrate.

3.1.6 Seismicity/Lava Flow Hazards

The Island of Hawai‘i experiences high seismic activity and is at risk from earthquake damage (USGS 2000), especially to structures that are poorly designed or built, as the 6.7-magnitude quake of October 2006 and the 6.9-magnitude quake of May 2018 demonstrated.

The project site is rated Lava Flow Hazard Zone 2 on a scale of ascending risk from 9 to 1. The high hazard risk here is based on the fact Mauna Loa is an active volcano. Volcanic Hazard Zone 2 consists of areas on both sides of the northeast and southwest rift zones, which are downslope of potential eruption sites. About 20 percent of this area has been covered by lava in historical time, 5 percent since 1950. This high risk rating was reinforced by the Mauna Loa lava flow of November 2022, which approached within 0.8 miles of the site.

3.1.7 Impacts and Mitigation Measures

As stated in the 2013 EA, preparation of the project site involved only very minor leveling with hand tools or a small loader/excavator. The habitat was able to be set on leveled blocks, and no other load-bearing structures were used. The substrate was judged adequate for the modest weight of the habitat. No further topographic alteration is required other than very minor leveling for the grow chamber shipping container

UHM will continue to monitor volcanic activity in the area and will suspend the activity if eruption activity warrants it. In the November 2022 episode, the habitat was not occupied. The management team went to the site and removed valuable supplies and equipment.

3.2 Water Resources

3.2.1 Definition of Resource

Water resources are defined here to encompass the State’s and the nation’s lakes, streams, groundwater, wetlands, and coastal areas that are intended to be protected by the federal *Clean Water Act* (33 USC 26 parts 1251 et seq., 2000). Groundwater refers to subsurface hydrologic resources such as aquifers that are used for domestic, agricultural, and industrial purposes. Wetlands are defined by the U.S. Army Corps of Engineers (USACE) as areas that are characterized by a prevalence of vegetation adapted to saturated soil conditions, and are identified based on specific soil, hydrology, and vegetation criteria defined by USACE. For the purposes of this analysis, floodplains are also included in water resources, and they are defined as any low-lying area designated by the Federal Emergency Management Agency (FEMA) subject to inundation by a 100-year flood (i.e., a flood that has a one percent chance of being equaled or exceeded in any given year).

3.2.2 Region of Influence

The region of influence (ROI) for water resources includes the approximately half-acre area directly affected by physical activities from the proposed project, as well as areas immediately downslope, which could be affected by any runoff from the roof of the habitat or any other hardened structures. The site receives on average about 25 inches of rainfall per year (UHH-Geog 1998). Because the project would not extract or affect water in the underlying aquifer, which lies thousands of feet below the project surface, no specific aquifers are included in the ROI, although aquifers are discussed below.

3.2.3 Water Supply

There is no existing water supply at the site.

3.2.4 Water Quality

There are no streams, lakes, springs, wetlands or other water bodies in the project area, which contains lava flows too geologically young to have developed surface water features. Basal, perched and perhaps confined artesian aquifers associated with high elevation precipitation input from Mauna Loa and Maunakea are known to lie at variable depths below the surface of the Mauna Loa-Maunakea Saddle area. The nature of these aquifers was the subject of investigation in a research exploratory well project about 10 miles north at Pohakuloa Training Area (UH Hawai‘i Institute of Geophysics and Planetology 2012). Recent detailed logging of core samples supported by the U.S. Army and the National Science Foundation confirms that there are much shallower aquifers than expected, including a dike-impounded body and potential geothermal reservoirs (https://www.higp.hawaii.edu/hggrc/projects/humuula-groundwater-research-project/project-info/).

3.2.5 Floodplains and Drainage

The project site is not within an area mapped on Flood Insurance Rate Maps prepared by the Federal Emergency Management Agency (FEMA). The project site is thus classified within Zone X, outside a designated floodplain. There are no known areas of local, unmapped flood hazard, due to the highly permeable surface and low rainfall.

3.2.6 Impacts and Mitigation Measures

The proposed project would have no impact on water supply, water resources or floodplains. The habitat has a water tank holding 1,000 gallons that requires filling at least every 18 days via truck; current plans are to top off the tank weekly when in use. As discussed in Section 3.9, below, human waste has been and will continue to be dealt with in composting toilets. To enhance mission fidelity, grey water will be recycled for plant growth and other non-consumption purposes. Due to the low rainfall and very restricted nature of new impermeable surface associated with the project – essentially the 1,200 square feet of the footprint of the

habitat and accessory structures – there will be no measurable runoff. In addition, the surrounding substrate of volcanic cinder and pahoehoe lava flows is extremely permeable and absorbs all precipitation or other water input immediately, with no runoff.

3.3. Biological Resources

3.3.1 Definition of Resource

Biological resources are plant and animal species and the habitats in which they occur. This analysis divides these resources into flora and vegetation; fauna; and special status species, including threatened, endangered, and sensitive species and their defined critical habitat.

3.3.2 Region of Influence

The region of influence (ROI) for biological resources is concentrated on the approximately half-acre area directly affected by physical activities from the proposed project. Although the project has been successful in monitoring for invasive species and none appear to have been introduced, the ROI also includes high elevation areas of Mauna Loa and Maunakea that could be affected by invasive species that might gain a foothold in sub-alpine areas because of activities associated with any the project in this biologically sensitive area.

3.3.3 Flora and Vegetation

As evident in Figure 3, both in 2012 and still today, the actual project site has no plant growth because of its location on a previously graded substrate of volcanic ash in an arid, cold environment. Undisturbed areas nearby on the ash and lava substrates contain the typical very sparse vegetation commonly found in similar substrates throughout Maunakea and Mauna Loa. Near the project site are a few small clusters of the native shrubs kupaʻoa (*Dubautia scabra*), pukiawe (*Leptecophylla tameiameiae*) and ōhelo (*Vaccinium reticulatum*). Cracks and undersides of rocks have a few mosses, ferns (*Pellaea ternifolia*) and lichens of various forms.

3.3.4 Fauna

The site is poor habitat for feeding and nesting by most birds because of the paucity of vegetation. No birds were observed during a number of daytime observations. However, as with all of the island of Hawaiʻi, several listed seabirds may overfly the area and nest nearby between the months of April and December, including the endangered Hawaiian petrel (*Pterodroma sandwichensis*), the endangered band-rumped storm petrel (*Oceanodroma castro*), and the threatened Newell's shearwater (*Puffinus auricularis newelli*). These seabirds hunt over the ocean during the day and fly to higher elevations at night to nest. The Hawaiian petrel was formerly common on the Island of Hawaiʻi. This pelagic seabird reportedly nested in large numbers on the slopes of Mauna Loa and in the saddle area between Mauna Loa and Maunakea, as well as at the mid-to-high elevations of Hualālai. It has within recent historic times been reduced to relict breeding colonies located at high elevations on Mauna Loa, Kohala and,

possibly, Hualālai. The Hawaiian petrel (as well as the band-rumped storm petrel) generally nest on the Big Island well above 5,000 feet in elevation, although some Hawaiian petrel nests have recently been found at lower elevations on Kohala volcano. Both the Newell's shearwater and Hawaiian petrel are known to burrow under ferns on forested mountain slopes. These burrows are used year after year, usually by the same pair of birds. Although capable of climbing shrubs and trees before taking flight, they need an open downhill flight path through which they can become airborne. Once abundant on all the main Hawaiian islands, most Newell's shearwater colonies are today found in the steep terrain between 500 to 2,300 feet on Kaua'i. The band-rumped storm-petrel nests in burrows or natural cavities at high elevations, inland habitats, such as steep, heavily vegetated cliffs and high-elevation volcanic terrain. Hawaiian petrel colonies are typically located in either high elevation, xeric habitats or wet, dense forests. They nest in burrows, crevices, or cracks in lava tubes, providing protection from predators (https://www.mauinuiseabirds.org/wp-content/uploads/Band-rumped-Storm-petrel.pdf).

Band-rumped storm petrels were recently discovered nesting on the Mauna Loa side of the saddle between this mountain and Maunakea, only a few miles from the project site. In addition, the crowd-sourced website eBird (eBird.org) has maps documenting Hawaiian petrel observations by highly reliable observers on the upper slopes of Mauna Loa; band-rumped storm petrels were documented on eBird flying even closer, within only 1.5 miles of the site (Figure 5). DOFAW biologist Alex Wang (pers. comm. January 2025) indicates that several of the lava flows even closer to the habitat have nesting petrels. DOFAW continues to investigate the area and expects to find additional nests, possibly very close to the habitat. There is clear evidence that one and perhaps two species of seabird nest close enough to the habitat to be of concern and require special consideration.

The primary cause of mortality in these seabird species in Hawai'i is thought to be predation by alien mammals at the nesting colonies. Collision with man-made structures is another significant cause. Night-flying seabirds, especially fledglings on their way to sea in the summer and fall, can become disoriented by exterior lighting. Disoriented seabirds may collide with manmade structures and, if not killed outright, become easy targets of predatory mammals including cats and mongooses.

The project site in the strictest sense – the areas of disturbance upon which the habitat facilities were built and which are utilized for the experiment – has been previously disturbed and no seabird nests are known to exist or expected. Although each of these seabirds may overfly the area, direct disturbance of nests does not appear to likely. But given the likely presence of nests nearby, activities that could disturb the nests, including bringing in predators such as cats or dogs, or lighting that attracts and endangers seabirds as they fly around the nesting site, are of extreme concern.

There are no native mammals in Hawai'i except for Hawaiian hoary bats (*Lasiurus cinereus semotus*), which would not find the area highly suitable habitat because of the lack of vegetation that provides roosting and foraging habitat.

Close inspection of plant patches and cinder cone peaks in the general area revealed scat of feral non-native goats and/or sheep. These animals are deleterious to native flora but are valued as hunting resources. The habitat is extremely marginal for goats or sheep and they are likely present only very occasionally.

Because there are rare native arthropods present in certain high elevation areas, and there is relatively little known about arthropod distribution in high elevation areas of Hawai‘i, the 2012 project included a baseline survey for arthropods, the results of which are provided in Appendix 2. The survey included patches of native plants that were near but not in the habitat site. Six species of endemic but not rare arthropods were observed, as well as evidence of two moth larvae. The arthropods found during this survey are generally broadly distributed throughout the ‘a‘a and pahoehoe lava habitat types wherever their preferred microhabitat is present. There were no introduced invasive species except for some evidence of aphids on *Vaccinium reticulatum*, which are very commonly observed in this widespread plant. Importantly, no ants were observed. Follow up ant observations in 2026 found no ants.

3.3.5 Summary of Special Status Species

No rare, threatened or endangered species were observed on the project site or would find the project site suitable habitat, although, as noted above, at least two species of T&E seabirds are likely to overfly the general vicinity of the site at night. The lava flow near the cinder ridge is being surveyed by DOFAW to determine if nesting is occurring near the project site.

3.3.6 Impacts and Mitigation Measures

No impact to vegetation or flora would occur, as there are no plants on the actual site and only common alpine species nearby. As for fauna, there is a little or no known use by native birds and no expected use by native Hawaiian hoary bats. The only other mammals very occasionally present are feral goats or sheep, which are not of conservation concern in Hawai‘i. The project would not cause impacts to native arthropods. Free-ranging predators and scavengers found in the substrates are also not likely to have their populations affected by disturbance in the small physical footprint of rough a half-acre.

To avoid the potential downing of T&E Hawaiian seabirds that overfly the site, the 2013 project was designed to include a provision that all lighting was to be shielded in conformance with the Hawai‘i County Outdoor Lighting Ordinance (Hawai‘i County Code Chapter 9, Article 14), which requires shielding of exterior lights so as to lower the ambient glare caused by unshielded lighting.

As stated in Chapter 1, the project proponents now propose occasional EVA forays involving high intensity, low-angle lights that create illumination conditions similar to a near-polar base on the moon. A number of mitigation measures will be implemented in order to reduce the potential for impact to negligible levels. Several of these measures could by themselves be extremely

effective at reducing risks; the application of all of them will ensure absolute minimization of impact potential.

1. EVAs with artificial lighting will only be allowed from late December through February
2. No more than a dozen EVA sessions lasting three hours or less will be allowed to occur per year
3. Excursions will be timed to the degree practicable on nights within one week of a full moon at a time when the moon is up and visible
4. The horizontally-aimed lights will be shielded to prevent the light shining upwards
5. The lights will be aimed south towards Mauna Loa and a nearby ridge that will intercept much of the light
6. The intensity of the light will be roughly equivalent to a pair of automobile headlights
7. Low-blue spectrum lighting with a Correlated Color Temperature (CCT) of 3000 Kelvin or lower will be utilized.
8. DOFAW will be invited to inspect the site for compliance with these conditions and suggest other measures.
9. The site will be inspected the morning after all EVAs for downed birds
10. If downed birds are detected during or after EVAs, all lighting will be suspended and DOFAW will be contacted.

The Draft EA was shared with DLNR-DOFAW and others with expertise in seabirds to verify the accuracy of seabird data and the expected efficacy of proposed measures, which may be adjusted as necessary to most effectively reduce risk.

Note that the related subject of light pollution and its effects to astronomy are discussed below in Section 3.7.

Projects in relatively undisturbed alpine areas of Hawai‘i should endeavor to avoid introduction of invasive species. It should be noted that all of Mauna Loa Access Road as well as the specific project site have long been freely open to the public, without any special measures to prevent alien species introductions. Several weed species are, if not widespread, sparingly evident in the general area, particularly *Senecio madagascariensis*. As for the proposed project, there are very few proposed modifications to the site, with the only additional structures being the 1,000-gallon fuel tank and shipping container for the growth chamber, emplacement of which will involve only very minor leveling with hand tools or a small loader/excavator. In terms of operations, non-invasive vegetables may now be grown inside the growth chambers.

The project will proactively incorporate a number of measures to ensure that invasive plants and animals are not accidentally introduced to the environment. These measures are modified from invasive species protocol in the extremely sensitive summit ecosystem of Maunakea and will be incorporated in the project’s operating procedures. Many were implemented during the 2013-2024 project and will continue to be implemented:

- All vehicles, equipment and supplies destined for the project site will be inspected for invasive plants, insects or other animals prior to travel to the habitat project site, if there is any potential for invasive species. If any plants, insects, or other animals are observed in any vehicle, equipment, or delivery, the items will be cleaned and the species removed. If these are unfamiliar or known highly invasive species, the Hawai‘i Department of Agriculture (HDOA) will be contacted.
- If invasive species are found during an inspection process, one of three options will be undertaken, depending on the circumstances:
    1. Unpack and clean the delivery prior and repeat the inspection prior to leaving pier or other facility where found.
    2. Fumigate, using a State licensed and certified contractor appropriate to the threat identified, the container or delivery.
    3. Reject the delivery.
- If any off-island motor vehicles and equipment (new or used) are involved, they will be pressure washed before first use at the project site.
- Contractors, subcontractors, and suppliers will be informed of these guidelines.
- Immediate coordination with DLNR will occur if invasive species, particularly ants, are found on the site. Experts associated with or referred by DLNR can recommend a course of action, including any other authorities to contact.

The plant growth experiments conducted in the growth chamber would be carefully designed to avoid impacts. Best Management Practices would include the following:

- No use of invasive plants.
- Avoiding plants that produce airborne seeds/pollen, or stopping growth before that stage.
- No work involving genetically modified organisms or plant pathogens.
- Contained operations, using a sealed, shipping-container-based growth module with gasketed doors.
- Operational biosecurity practices to prevent escape of plant material, insects, and microorganisms, including regular inspections, use of only certified pest-free plant starts/media, no open-field soil import, and a "clean/dirty" workflow (e.g. boot covers or dedicated footwear; tool segregation).
- All liquid effluent (e.g. spent nutrient solutions, rinsates, condensate) will be collected and managed with no discharge to ground. Solid by-products (plant biomass, used media, filters) will be bagged, sealed, and stored in closed containers pending off-site treatment or disposal.

With these measures in place, the history of success in avoiding invasive species introductions is expected to continue.

3.4. Cultural Resources

3.4.1 Definition of Resource

Cultural resources are defined as those sites, structures, landscapes, districts, objects, records, and lifeway skills that are of importance to a culture or community for historic, scientific, traditional, or religious reasons. Cultural resources are tied to places, persons, events, or practices of social custom and traditional skills and are recognized for their heritage, social, educational, and scientific value through the passage of state and federal laws for their protection. Archeological resources are locations and objects from past human activities. Architectural resources are standing structures that are usually over 50 years of age and of significant historic or aesthetic value. Traditional cultural properties (TCPs) hold importance to Native Hawaiians or other ethnic groups for the continuing practice of traditional culture. Any of these properties may meet the criteria for inclusion in the State Register of Historic Places. A determination of eligibility (Chapter 6e, Hawai‘i Revised Statutes) is a requirement of the Hawai‘i State environmental assessment process before State-funded initiation of ground disturbance or alteration of a landscape or structure.

3.4.2 Region of Influence

The region of influence (ROI) for historic properties is concentrated on the approximately half-acre area directly affected by physical activities from the proposed project. Historic resources in areas outside this are not likely to experience any adverse effects from the proposed HI-SEAS uses. The ROI for cultural resources is more difficult to define, because any impact to cultural practices related to the project may have impact to communities outside the immediate area, but for the present discussion it will be defined as the Hawaiian Islands.

3.4.3 Historic Properties

As discussed previously, the project site is the end of a rough, unpaved road in a spot where vehicles and equipment have compacted the ground, making it more suitable for the proposed use. Inspection in 2012 indicated no evidence of any archaeological features at or near the project site. What appeared to be a modern cairn was located at the top of the ridge, well away from the area occupied by the project. Because of the extensive physical disturbance of the surface and the lack of manmade structures, it appeared that there was no potential to affect historic properties.

On November 15, 2012, the State Historic Preservation Division (SHPD) was requested by letter to concur that given the evident absence of historic properties, the project would not affect historic properties, or, if the agency was are unable to make that determination based on the information provided, to recommend additional information or reports needed to assess the effect on historic properties. SHPD was also provided a copy of the Draft EA for comment, and in a comment letter of January 11, SHPD (see Appendix 3), requested an archaeological survey.

Accordingly, a professional archaeologist prepared an archaeological assessment survey (AAS) (see Appendix 3). Close inspection determined that the area of proposed construction has been completely impacted by quarrying activities and no surface archaeological features or other historic properties were present or would be affected. Within the area surveyed for the proposed habitat, the single rock cairn was determined to be of modem construction and a culturally sterile lava tube with no historic features was also observed. The AAS underwent several rounds of review by SHPD to ensure that all historic property concerns were addressed. In the end, not only the half-acre area but also a 100-m wide perimeter surrounding the project area was surveyed. The wider survey identified several rock features along the roadway that were determined to be modern in construction. These included a fire ring, rock piles marking a road cut, a square rock feature, and a modified lava blister that was determined to be a modem hunting blind. On March 4, 2013, SHPD issued a review letter stating that based on the information submitted, SHPD concluded that no historic properties would be directly affected by this project (see letter in Appendix 3). The AAS was determined to have fulfilled the requirements of as Hawai‘i Administrative Rule (HAR) 13-275-5(b)(5)(A) and was accepted by SHPD. As a precaution, in the unlikely event that historic properties are inadvertently discovered during any of the activities associated with either the development or maintenance of the project, activity in the area of the discovery will be halted and DLNR-SHPD contacted immediately.

3.4.4 Cultural Impact Assessment

The Constitution of the State of Hawai‘i clearly states the duty of the State and its agencies to preserve, protect, and prevent interference with the traditional and customary rights of native Hawaiians. Article XII, Section 7 requires the State to “protect all rights, customarily and traditionally exercised for subsistence, cultural and religious purposes and possessed by ahupua‘a tenants who are descendants of native Hawaiians who inhabited the Hawaiian Islands prior to 1778” (2000). In spite of the establishment of the foreign concept of private ownership and western-style government, Kamehameha III (Kauikeaouli) preserved the people’s traditional right to subsistence. As a result in 1850, the Hawaiian Government confirmed the traditional access rights to native Hawaiian ahupua‘a tenants to gather specific natural resources for customary uses from undeveloped private property and waterways under the Hawai‘i Revised Statutes (HRS) 7-1. In 1992, the State of Hawai‘i Supreme Court reaffirmed HRS 7-1 and expanded it to include,

> “native Hawaiian rights…may extend beyond the ahupua‘a in which a native Hawaiian resides where such rights have been customarily and traditionally exercised in this manner” (Pele Defense Fund v. Paty, 73 Haw.578, 1992).

Act 50, enacted by the Legislature of the State of Hawai‘i in 2000, relating to Environmental Impact Statements, stated that:

> “…there is a need to clarify that the preparation of environmental assessments or environmental impact statements should identify and address effects on Hawaii’s culture, and traditional and customary rights… “[H.B. NO. 2895].

Material prepared for the Saddle Road Improvements Environmental Impact Statement (EIS) (FHWA-CFLHD 1999, Vols. IV and V) included a Cultural Impact Assessment (CIA) by Pualani Kanahele Kanakaʻole and Edward Kanahele of the Edith Kanakaole Foundation, along with a study of Traditional Cultural Properties (TCPs) by Dr. Charles Langlas. Also considered was work by Kepā and Onaona Maly related to Maunakea (Kumu Pono Associates 2003). This research included literature in local and national archives, and oral history interviews with kūpuna and elder kamaʻāina to gather traditional-historical accounts of Maunakea, but also included many accounts of the Saddle Region and the ahupuaʻa of Humuʻula, which stretches from the Hamakua Coast to Mauna Loa. Together, these studies provide a thorough assessment of the cultural background and values in the Saddle between Maunakea and Mauna Loa. The studies included extensive archival research, interpretation of chants and *mele*, and interviews with Hawaiian Home Lands (HHL) homesteaders and others. Most of the cultural background information in this EA is derived directly from this study and the summary of it prepared for the Saddle Road EIS (Ibid., vol. 1), which is paraphrased or quoted directly below.

Native Hawaiian culture began at least 1,000 years ago when people from other Polynesian lands are thought to have arrived in the Hawaiian Islands, Hawaiʻi nei. Hawaiian culture developed independently from the rest of Polynesia, although there was intermittent input by later Polynesian visitors until at least the 1200s, when transoceanic voyages appears to have ceased. Stages of development of Hawaiian culture include the settlement era and the era of high culture.

- Settlement Era. The beginning date of the settlement era is not known with certainty, but it is likely to have occurred over a thousand years ago. The era encompasses settlement, development of stable water and food sources, and acclimatization of these settlers and their culture to the new environment. These settlers adapted beliefs and practices of their southern islands culture to the Hawaiian Islands. Their religious establishment, food culture, societal structure, and clan system were all altered to form a new Hawaiian culture.
- Era of High Culture. The era of high culture includes the refinement of the Hawaiian society in all aspects from 1200 to the time period of around 1800. This era of high culture saw the coalescing of political power through powerful military chiefdoms that at times took over an entire island or multiple islands. The state religion was an integral part of the political structure. This system was the kapu system, which became the backbone of the Hawaiian ruling caste and legal system. The kapu system regulated behavior and dealt out punishment for infractions. Another parallel system, as powerful as the kapu, was the ʻaumakua worship, a worship system that serviced clans and extended families. This family worship utilized deified ancestors as their gods and guardians who were seen as empathetic yet powerful clan and family spiritual agents. These ʻaumakua provided security and support of the family system's cultural beliefs and practices.

In 1819, the kapu system was abolished by the ruling caste and the Hawaiian Kingdom evolved into a westernized constitutional monarchy. In 1893, the legal government of Queen Liliʻuokalani was overthrown from power. A two-generation decline in Hawaiian socioeconomic

status took place during the 1900s and was not arrested until the “Hawaiian Renaissance” began in 1970.

The proposed project site is within the island of Hawai‘i, the ‘apana (political land section or district) of Hilo and the ahupua‘a of Humu‘ula. The high elevation areas of the island are considered to have religious importance to Native Hawaiians. Place names reflect the relationship of this area of concern with the indigenous people, their philosophy of life, and their gods.

According to work by the Edith Kanaka‘ole Foundation, Lono-nui-akea was the original name for the Island of Hawai‘i. It is the sacred name of Lono, the god of stormy weather, dark clouds, and rain. Throughout Polynesia, two islands were honored as Ka inoa akua (the god name, or namesake), and the Island of Hawai‘i was one of these.

The popular interpretation of Maunakea is “white mountain.” Maunakea is known around the world, and is regarded by many as the highest island mountain, the highest mountain in the world from below sea level, and the best mountain from which to make astronomical observations. To the Native Hawaiian, Maunakea is a Kupuna, a grandparent or ancestor, and an One hanau, birthplace or home, and its name may more properly relate to Wakea, the Sky Father.

Another significant landmark within the project vicinity, located about 15 miles to the northwest, is Ka Pu‘u-a-Pele. The top of this cinder cone marks the joining of the ‘apana of Kona, Kohala, and Hamakua.

In the words of Pualani Kanaka‘ole Kanahele and Edward Kanahele:

> Wakea and Papa are the original parents of native Hawaiians. Mythologically they are the marriage of sky and earth: Wakea, Sky Father and Papa, Earth Mother. Between the two all things were born. Mauna Kea is the piko (center of a beginning or ending) of the island. This piko is the initial provider of the land mass of Hawai‘i mokupuni. Hawai‘i was also the hiapo, or first island child, of Papa and Wakea. The responsibilities and resources of Hawai‘i and Wakea are needed for the growth and well-being of the island and all living forms of this mokupuni.
>
> The kalo (taro, a staple food) was Wakea and Papa’s first food child and regarded as an elder brother who fed all indigenous natives, or kanaka maoli from the beginning of time today. During the time of ali‘i (chiefs, elite of the society) it was important for them to trace genealogy to the kalo and eventually to Wakea and Papa. When the genealogy could prove the connection they received the status of the senior line or hiapo line. Mauna Kea falls in the senior line genealogy.
>
> The Wakea and Papa beliefs and practices, including the tribute and respect for hiapo and kupuna, extend to contemporary times. Ancestral memory reminds the native Hawaiian

that the mountain, like their parents, is the well-spring and provider of physical and spiritual nourishment.

Strands of information from the past are found today in songs and people's actions. Besides land, water is a vital element of life and living. The high mountains attract clouds, then the clouds shed their water and the water soaks into the earth.

The Pohakuloa area has Lilinoe as the female deity of misty rain and heavy fog, while Poliahu is the snow deity which adorns the top of Mauna Kea during the winter. These male and female water forms both belong to the Mauna Kea area.

The ancestors of Native Hawaiians were island people and used the ocean to travel from island to island. Due to the vastness of the ocean and the limited land base, the measurement for survival was the ability to acquire food. Resources for the acquisition of food included the reef, fresh water, and fertile soil. The Hawaiian moon calendar was devised to assist Hawaiians in gathering and planting on fortuitous days. Using the moon calendar, the forefathers calculated the established cycles of all life forms. It was based on many generations of observation and practice, and it proved successful.

Other forms of traditional literature condone the fact that the ancestors made an effort to understand the intricacy of relationships of diverse life forms. One of the reasons for this was to protect and help sustain the food sources. They recognized a hierarchical order as well as a system of harmony and interaction of all existing life forms known to them.

They observed and made critical analyses of their sky, land, and ocean spaces. Rain, ocean, clouds, wind movement, coral species of the ocean, and seeded plants of the uplands are referred to within a common bond for generating regrowth or as a food source. Kane was responsible for regeneration, and the ocean currents, rain, wind, and clouds move together to make this possible. For food systems to regenerate themselves, the sky, land, and ocean spaces unite in a harmonic and natural rhythm to maintain the currents of water particles and clean air. This movement is known as lokahi. Lokahi is a system of working in unity and harmony. This knowledge was passed on through protocol, cultural practices, songs, and stories.

Lokahi is the antithesis of hierarchy. Lokahi is the system which bypasses the hiapo system and does not give precedence to first born or senior line. It is the system which states that everything is equal because everything, no matter how small or large, has a function which is necessary to maintain the overall well being of the whole entity. Native Hawaiian ancestors lived within these two systems and measured everything by this frame of reference.

One example is the division of ocean, sky, and land. These spaces were divided horizontally and vertically. The land division would be of primary concern for the proposed project. The most familiar is the vertical divisions, or moku and ahupua‘a

sections common to maps of today. The boundary lines run from mountains to the ocean. The vertical boundaries followed mountains, rivers, streams, and cinder cones.

The natural vegetation growth was the measuring device for the horizontal pattern of the second land division. For this division, vegetation growth dictated land division name changes. The forest, like the coral bed, is the food source and therefore a vital system for the continuum of life and life cycles. The trees house food for birds, insects, animals, and man, and produce seeds for regeneration. The forest provides vegetation used for medicinal purposes, spiritual adornment, housing construction, and many other items. The following information identifies the horizontal space and the kinds of flora typical to each of these horizontal land areas.

Kuahiwi. Kuahiwi means the mountain top, the backbone of the island, which is too high in elevation for heavy vegetation to grow. It is a very important area because of its height.

Kualono. Kualono is the region near the mountain top. Little vegetation grows in this area. The mamane and naio are the only hardy trees to grow at this height. Both of these are hardwood trees. The flower of the mamane was a specialty for the aliʻi because of its shape and yellow color. When he wanted a special lei he would send his runners to fetch mamane flowers. ʻAʻaliʻi can also be found at this height. The PISCES project site is within the Kualono.

Waomaʻukele. Waomaʻukele is the region named for the wet, soggy ground. This area was located in the rain belt of the island, especially on the koʻolau side of each island. The typical trees of this area are the very large koa, ʻohiʻa, varieties of lobelia, and mamane.

Waoakua. Waoakua is the forested region below the waomaʻukele. This area is said to be occupied by spirits of the forest. Man seldom ventured into this area during ancestral times except when a particular kind of tree was needed and could not be found elsewhere. The large trees acquired from the waoakua and the waomaʻukele deserved substantial offerings. This is the region where the forest had a greater variety of trees. Some of the trees found are kolea, hoʼawa, kopiko, maile, maua, alani, koa, and ʻohiʻa.

Waokanaka. Waokanaka is the forested region makai (toward the sea) of the waoakua. This area was frequented by native Hawaiians. They found wood and other materials for weapons, house construction, tools, surfboards, and canoe accessories. They harvested dye, collected medicine, collected bird feathers, gathered vegetation for leis, gathered vegetation for the kuahu, gathered material for making rope, and many other useful things for everyday living. The trees in the waoakua are also found in this area, but the trees of this area may be smaller.

> Other flora found in this area include pilo, hapu‘u, holei, papala, hau kuahiwi, palapalai ‘olapa, and mamaki.
>
> Kula. Kula referred to the upland grassy plains. The plants of the kula included ’ilima, ma‘o, ‘ama‘u, ‘a‘ali‘i, ‘uluhe, and pili.
>
> Kahakai. Kahakai referred to the edge of the ocean. At the kahakai was found the niu, hala, kaunaoa, kamani, hau, milo, naupaka, lama, and alahe‘e. All plants were recognized as useful to the Hawaiian (FHWA-CFLHD 1998, Vols. IV and V).

In evaluating the effects of the Saddle Road Improvements project, which occupied many of the zones listed above, the Edith Kanakaole Foundation identified these resources and concepts as of sufficient importance to potentially affect the quality of life for native Hawaiians and their relationship to the environment and land.

- Importance of vegetation and the identity of the land sections.
- High cultural value of older or larger trees and kipuka which normally housed older trees.
- Priority to promote new growth through the non-disturbance of seed producing forest areas within the waoma‘ukele and waoakua. Hawaiians did not penetrate these areas if the trees they needed were available elsewhere.
- Importance of food source and regenerative energy of the forest.
- Philosophy of “a life for a life.” When it was necessary to cut a large tree from the high forest, an offering of a human sacrifice was made.
- Importance of Waoma‘ukele as a good source of water, and for maintaining the richness of the rainforest.

Again, quoting Pualani Kanaka‘ole Kanahele and Edward Kanahele:

> Native Hawaiians are people whose daily lives and culture are rooted in and integrated with the surrounding natural and biological world. They recognized and practiced respect for hierarchy or hiapo for man and land alike. The mountain is the sacred child of Wakea, and it is the source for the land. The mountains and land were genealogically connected to native Hawaiians through the original ancestor, Wakea and Papa. The mountains or land, water, and sky were a necessary part of the life cycle. The taro was regarded as an older brother of the land and provided sustenance. The coral was also an older brother (of the sea) and was the means through which other food could be acquired. The hierarchical system assigns rank to man, god, and the elements of the environment. Within the hierarchical food system another set of rules apply. The older or larger trees are primary and most important. The other animals that use these trees as their residence or food source are secondary.
>
> The lokahi system complements and maintains the well being of the whole entity. Everything is important because each has a function.

> Water was and is necessary for all life forms. Laws for water and the use of water were formulated so all had exposure to water. Water that did not touch ground was highly prized. Such as the water in the lake on Mauna Kea and the water in the piko of the taro leaf. Water that moved underground or over land from the mountain to the sea was sometimes funneled into irrigation channels and fed the older brother kalo and was also treasured. The mountain and the waomaʻukele attracted the atmospheric water" (FHWA-CFLHD 1998, Vols. IV and V).

The resources of high importance in the Saddle area that were determined to be important as part of the above analysis were the mamane forest, kipuka, prehistoric trails, and historic trails. The cultural value of mamane/naio forest and kipuka is associated with the age and size of the trees. Although it would not be asserted that the setting of the PISCES project site renders it without cultural value, as all places and all elements of the landscape are bound together into a whole, each part of which has a function, it is important to note that no māmane trees, kipuka or trails are present on or near the project site.

An interview with Henry Auwae conducted by Dr. Charles Langlas as part of the Saddle Road project's Traditional Cultural Properties report is relevant to any study of traditional resources and practices in the Saddle region. Mr. Auwae's knowledge of these sites may have been unique. He was the only one of informants recommended through contact and coordination with native Hawaiian organizations, which included former cowboys from Parker Ranch and Puʻu Oʻo Ranch, who professed knowledge of cultural sites in the area. Mr. Auwae attained his knowledge about ritual sites and burials from his great grandparents, who adopted him, and imparted their knowledge to him. When he was a boy, his great grandparents journeyed with him several times through the Saddle. His great grandmother was an expert healer (kahuna laʻau lapaʻau) who traveled to see people who were sick and to collect medicinal plants, and his great grandfather the last of a line of prophets (kula). His great grandparents had specialist knowledge of ritual sites that they shared with Mr. Auwae when they traveled together. Although elderly at the time, he was gracious enough to be interviewed on five occasions as part of the Saddle Road project, and two helicopter trips were made to attempt to locate sites that he recalled from childhood visits or from other knowledge.

Mr. Auwae knew of two areas where people used to live and where there were Hawaiian burials, one on the west side and one in the Saddle. Mr. Auwae said there were Hawaiian graves in the Keamuku area, near Waikiʻi Ranch, on the far western side of the Saddle. Mr. Auwae also knew of settlements north of the present Saddle Road on the lower slopes of Maunakea, at an elevation where several springs existed, and he knew of graves in that area. He said there were formerly Hawaiian burials in the area of Bradshaw Army Airfield in the PTA, and to the southeast of Mauna Kea State Park in the PTA. Both areas were heavily bulldozed by the Army after World War II and he thought that nothing remained of the graves. With Mr. Auwae's assistance, followed up by on the ground survey of each of the many original alternative corridors considered in the Saddle Road EIS, the Saddle Road Improvements project avoided impacting or approaching any burials. None of the five ritual sites that Mr. Auwae knew of could

be definitely located because no stone remains of the sites were found. Mr. Auwae designated approximate locations for the sites, which were all far away from the HI-SEAS Habitat.

The Maunakea research by Kumu Pono Associates looked at the critical period in the 19th century when dramatic changes were occurring in the population, economy and land use.

> Because hunting, and subsequently ranching of bullocks, cattle and sheep was the primary activity on the mountain lands of Humu‘ula, areas once forested, soon became open pasture land. While the first formal lease of Humu‘ula was issued in 1857 (Keoni Ana to F. Spencer), it was interests of the Parker Ranch that held the longest lease on the Humu‘ula mountain lands. The lease, from 1900 to 2002, covered the area extending around Maunakea to the ‘Aina Hou-Pu‘u Huluhulu vicinity. The Parker Ranch interests initially focused on sheep ranching in the Humu‘ula-Kalai‘eha section, but in 1964, the ranch terminated its sheep program. Cattle operations were maintained until the end of the Parker lease in August, 2002 (Kumu Pono Assoc. 2003: 15).

The research also documented trails:

> Travel across the ‘aina mauna is documented in native traditions, which describe ala hele (trails) passing from the coastal lowlands through the forest lands; along the edge of the forests; across the plateau lands of the Pohakuloa-Ka‘ohe region, and to the summit of Mauna Kea. These ala hele approached Mauna Kea from Hilo, Hamakua, Kohala, Kona, and Ka’ū, five of the major districts on the island. Only Puna, which is cut off from direct access to the mountain lands, apparently did not have a direct trail to the ‘aina mauna. Thus, people traveling to Mauna Kea from Puna traveled through the lands of Waiakea, Hilo or Keauhou, Ka’ū to reach Humu'ula and the slopes of Mauna Kea.
>
> By the early 1820s, foreign visitors, in the company of native guides, began making trips across the ‘aina mauna and to the summit of Mauna Kea. Based on their accounts, travel in the region through the middle 1800s basically followed the old trails, or cut across new areas – a result of dense forest growth, and new lava flows covering older routes. By the 1850s, the Kingdom of Hawai‘i entered into a program of improving ancient trails and identifying new routes, by which to improve travel between various locations and facilitate commerce. The earliest recorded improvements, describing work government on a trail around Mauna Kea, document work on the Waimea-Kula‘imano trail (cutting across the lands of Ka‘ohe, Hamakua and Hilo), running above the forest line and to the coast of Hilo, date from 1854, when the Waimea-Kula‘imano route was improved to accommodate wagon travel.
>
> In the later 1850s, as leases were given out for the lands of Humu‘ula and Ka‘ohe, and the sheep and bullock hunting interests grew, the 1854 route was maintained, and the upper trail between Kula‘imano-Makahanaloa, was improved to the Kalai‘eha vicinity. In 1862, the Kingdom again initiated a program to improve the government roads across the ‘aina mauna. Two routes were proposed, one between Hilo and Waimea via

> Kalaiʻeha, and the second to improve on the trail from Kalaiʻeha towards Kulaʻimano-Makahanaloa, and around through Hanaipoe-Mana and Waimea. These trails, termed Alanui Aupuni, were appropriated and work completed by the late 1860s. The routes appear on island maps through 1901, with subsequent designations as trails on later maps (Kumu Pono Assoc. 2003:16-17).

The Kingdom of Hawaiʻi undertook surveys to determine the boundaries of lands awarded in the Māhele. In a survey map in Kumu Pono Assoc. (2003) (*Figure 31. Reduction of Register Map No. 668, the Land of Humuʻula (S.C. Wiltse, April 1862*), there are no features mapped near the site, but it the general area is called "Middle Ground", presumably the lava covered area between the summit of Mauna Loa and the plains in the Saddle. No trails were mapped in this area.

On November 3, 1873, the Commission of Boundaries for the Island of Hawaii, 3d Judicial Circuit met at the Court House in Hilo, on the application of J.O. Dominis, Agent of Crown Lands for the settlement of the boundaries of Humu'ula, Present were E.G. Hitchcock for applicant and for Mrs. L.K. Dominis; Her Excellency, R. Keelikolani, the Estate of Kamehameha V; C.R. Bishop and self; D. Kamai for Hawaiian Government Lands in Hilo; and D. Alapai.

The Commission heard testimony from, among others, J.A. Simmons, a 40-year resident and wild cattle hunter in Humuʻula; Nainoa, a kama'āina of Hamakua; John Parker, former wild cattle hunter and founder of Parker Ranch; Kahue and Kimo Waiki, kama'āina of Humuʻula; and Hanioa, a kama'āina of Hakalau and bird-catcher (Kumu Pono Assoc. 2003: 283-306). Testimony on boundaries was highly detailed for the area from approximately Omaokoili hill in the Saddle all the way to north across Mauna Kea to the shoreline in North Hilo. None of the testimony included detail such as place names from Omaokoili south, possibly because of the rough nature and relative lack of uses on this ʻaʻa-strewn slope of Mauna Loa. In the end, the Commission created a straight-line boundary between Omaokoili and Pohaku Hanalei on the summit rim of Mauna Loa.

The archaeological survey for the Saddle Road Improvements project researched trails and roads of the entire Saddle Region, including those that went up the slopes of Mauna Kea and Mauna Loa or headed towards Hualālai or Kīlauea (FHWA 1999, Appendix H:24-29). Major trails included the Waimea to Kalaʻiʻela/Puʻu ʻŌʻō Trail, which is often coincident with the later Saddle Road and connected to the Puʻu ʻŌʻō to Volcano Trail. Trails that extended across the slopes of Mauna Loa were present only as a series of fragments, mainly because of the dozens of branches of 19th and 20th century lava flows that covered much of the surface. Two of these trails, fragments of which are visible in the two 1930 USGS maps of Kaohe and Humuula, are present on the slopes of Mauna Loa between 6,000 and 8,000 feet but do not approach within several miles of the project site. The only roads or trails that come within a few miles of the project site all date to the mid-20th century. The Old Hilo Kona Road (now partly a component of the Mauna Loa Observatory Road) was the first, built in 1949 as a side project by Tom Vance, who had just completed directing the construction of the original Mauna Loa Summit Road from Hilo through Kulani to the Mauna Loa Observatory, which was then built in 1950 after the summit road was finished (Schnell and Pajo n.d.). The Mauna Loa Observatory Road (see Figure

1), which intersected the Old Hilo Kona Road and from there, the Mauna Loa Summit Road, provided a shorter and better route from Hilo to the Mauna Loa Observatory. It was built at some point between 1956 and 1966, based on airphotos. Finally, the unpaved access road to the quarry (see Figure 1) that was on the project site itself was built sometime in the same period, probably to help with the construction of the new section of the Mauna Loa Observatory Road.

Inspection of the half-acre HI-SEAS site with the project team, which includes Native Hawaiians familiar with both the site and the type of resources and settings that are important in Hawaiian cultural practices, did not reveal the type of resources on the site that would be important. Although all of the landscapes in the Hawaiian Islands can be said to be linked together and thus have cultural significance, no gathering resources such as plant material or wood are present on this small site, and there are no *pu'u*, springs, trails or other physical features that might have a role in cultural practice any association with legendary or divine beings.

Consultation

As part of early consultation for the EA in 2012 – when the site was still undeveloped – a letter describing the project and requesting input onsite conditions and potential impacts was provided to the Office of Hawaiian Affairs, the State Historic Preservation Division, and all members of the PISCES Cultural Advisory Committee [PCAC], which was set up by PISCES to ensure that their actions minimized impacts to cultural resources. Members included:

- Robert Lindsey
- Ahia Dye
- Lehua Veincent
- Frank Trusdell
- Kamaka Gunderson
- Koa Omphroy
- Kimo Pihana
- Nate Chang
- Ka'iu Kimura
- Kalepa Baybayan

No response was received from OHA. The coordination with SHPD, which did not raise any issues concerning cultural practices, is discussed above in Section 3.4.3. Although the PCAC members did not provide any specific information relative to cultural sites or practices potentially present or impacted, and several voiced support for the project and its potential to improve educational opportunities. General concerns expressed include the following:

- Cumulative impacts related to other projects planned within the next five years
- Relation to other projects on Maunakea
- Assurances regarding cleanup after the project is completed

Consultation in 2025-6 again included OHA, with no response received. PISCES was contacted again to determine if there were any additional considerations after the facility had been constructed and utilized over the last 13 years. A representative of PISCES called the EA author and inquired about the moku and ahupua‘a identities but did not have specific comments. She offered to contact various kupuna who might be familiar with the site or the area in general, saying that she would forward the EA author’s contact information. To date, there has been no additional information provided through PISCES. A longtime supporter of the project, Henk Rogers of Pu‘uwa‘awa‘a, contacted Danny and Anna Akaka, cultural practitioners with broad experience and knowledge of East and West Hawai‘i as well as the Saddle region. Anna responded that she was not really familiar with the particular area on Mauna Loa either although she had been to Mauna Loa Observatory with her father in the past. She suggested consulting cultural historians Kepā and Onaona Maly, who might be able to shed some light on any cultural sites that may have been there at that site. Their work on Maunakea was thus utilized as part of the historical background for this analysis.

No consultations or outreach in 2025-26 has been able to find any individuals with knowledge of cultural sites or practices on or near the project site. Based on the the fact that the habitat has existed for over a decade with no record of effects to cultural sites or practices, the educational benefit to a number of Hawaii students who participated in the missions or UHM outreach about the habitat, and the lack of change on or near the site, the original conclusions based on wide consultation appear to still be valid.

3.3.5 Impacts and Mitigation Measures

The project in its original iteration did not have any reported adverse impacts on any cultural resources or practices. The small, previously disturbed project site did not appear to have a unique cultural significance, and no gathering practices or resources are known from the site or nearby area, and none have been since identified. As discussed in Section 3.11, there are no other projects nearby with which cultural impacts would tend to accumulate.

The project site was blessed in a traditional Hawaiian ceremony to honor the land and ask permission for its use. The project proponents have pledged to respectfully restore the site to its pre-project condition at the end of the experiment. It should be noted that the original termination of the project was slated for 2018 and that it was extended an original five years. After this, the proponents hoped to set up a new experiment and resume operations, during which time they left all facilities and equipment on the site. In response to requests from OCCL, the project proponents respectfully removed some features, as requested, and secured the remainder. If the request to resume the experiment is granted by the BLNR, the proponents will continue to use these facilities and equipment. If the request is denied, the proponents will remove all facilities and equipment and leave the former quarry site as it was found.

The Hawai‘i State Supreme Court’s *Ka Pa‘akai O Ka ‘Aina* decision specifies that land use permits granted by County and State agencies must evaluate formally whether an action they approve will not have a significant adverse impact to traditional and customary Hawaiian rights.

The evaluation must consider three criteria, as listed below. This analysis and decision must be made independently by agencies, but applicants may be asked to supply draft findings. Based on biological and archaeological survey, documentary research and cultural consultation, the following findings are proposed consideration by the Board of Land and Natural Resources:

> (1) *The identity and scope of valued cultural, historical, or natural resources in the proposed project site*. There is no evidence that the geological features or sparse flora and fauna in the area are particularly desired or used for cultural practices. The site is very isolated from roads and is not adjacent and/or proximate to the shoreline, alpine scrubland or forest. As such, gathering of resources does not occur here. No unique landform or water features are present. No valued cultural, historic, or natural resources related to traditional and customary practices were identified on the project site, and no traditional and customary native Hawaiian rights are exercised therein.
> (2) *The extent to which those resources, including traditional and customary native Hawaiian rights, will be affected or impaired by the proposed action*. No resources or rights are present and none will be affected.
> (3) *The feasible action, if any, to be taken by the BLNR to reasonably protect native Hawaiian rights if they are found to exist*. The proposed action will not affect traditional Hawaiian rights and no action is necessary to protect these rights.

3.5. Air Quality

3.5.1 Definition of Resource

Although the *Clean Air Act* (42 USC 85 parts 7401 et seq., 1999) is a federal law, States are generally responsible for implementing the Act. Each State is required by the EPA to develop a State Implementation Plan that contains strategies to achieve and maintain the National Ambient Air Quality Standards (NAAQS). NAAQS establish limits for six criteria pollutants including ozone, nitrogen dioxide, carbon monoxide, sulfur dioxide, lead, and breathable particulates (PM10, or particulate matter less than 10 microns in diameter). EPA has set national ambient air quality standards (NAAQS) for six of the following criteria pollutants; ozone (O3), particulate matter (PM 2.5 and 10), nitrogen dioxide (NO2), carbon monoxide (CO), sulfur dioxide (SO2), and lead (Pb). The entire state of Hawai‘i is classified as in attainment, meaning criteria air pollutants do not exceed the NAAQS. Areas that violate air quality standards are designated as nonattainment areas for the relevant pollutants. Areas that comply with air quality standards are designated as attainment areas for relevant pollutants.

3.5.2 Region of Influence

The region of influence (ROI) for air quality is defined as the Saddle region, because prevailing winds could carry pollutants that might be generated from any project at this particular site throughout the entire Saddle region. A semi-persistent inversion layer at about 7,000-8,000 feet in altitude tends to limit effects to areas below this elevation. A sensitive receptor as far as air quality is concerned is present about seven miles to the southwest at the Mauna Loa Observatory

(MLO), which is a premier atmospheric research facility that has been continuously monitoring and collecting data related to atmospheric change since the 1950s. The undisturbed air, remote location, and minimal influences of vegetation and human activity at MLO are ideal for monitoring constituents in the atmosphere that can cause climate change. The observatory is part of the National Oceanic and Atmospheric Administration (NOAA) - Earth System Research Laboratory - Global Monitoring Division.

3.5.3 Existing Conditions

The entire state of Hawai‘i is classified as in attainment, meaning criteria air pollutants do not exceed the NAAQS. Local air quality is excellent and uninfluenced by human activities. Air pollution is mainly derived from volcanic emissions of sulfur dioxide, which convert into particulate sulfate and produce a volcanic haze (vog) that persistently blankets the Ka‘ū and Kona areas of the islands at lower elevations. The trade wind inversion generally keeps this area free of vog.

3.5.4 Impacts and Mitigation Measures

Preparation of the project site to emplace the 1,000-gallon propane tank and the free-standing growth chamber shipping container will involve only very minor leveling with hand tools or a small loader/excavator, and therefore dust generation will be negligible. The generator and visiting service vehicles will produce very small quantities of engine pollutants, but these are negligible compared to the thousands of vehicles and other equipment with engines operating in the Saddle region. No mitigation measures are necessary, other than keeping all equipment in good working order.

3.6 Noise and Visual Resources

3.6.1 Definition of Resource

The acoustic environment is defined as sound levels related to wildlife habitat and human health and enjoyment, which can be affected by noise, defined as unwanted sound.

The visual environment includes scenic areas, vistas and viewplanes, whether at the project site or with which the project can potentially interact.

3.6.2 Region of Influence

Sound from the type of activities proposed for the site would carry no more than a few hundred meters, and would generally be blocked from traveling east because of the ridge of cinder cones and prevailing easterly winds. The region of influence (ROI) for noise is thus defined as the area within 400 meters of the site.

The region of influence (ROI) for visual resources is defined as all parts of the Saddle region from which the project site is visible.

3.6.3 Existing Conditions

No sensitive human or wildlife noise receptors are present within the noise ROI, which is completely occupied by lava with little or no vegetation.

The habitat has been in place for 13 years, and it has views of/is visible from the south slope of Maunakea, portions of the north slope of Mauna Loa, Mauna Loa Observatory, portions of Pohakuloa Training Area and Pu‘u Huluhulu, a commonly visited cinder cone on Saddle Road that offers sweeping view of the Saddle. Because of the project site’s position on the west side of the cinder cone rise, it is not visible from points east, including the closest section of Mauna Loa Observatory Road. For most of its operational lifetime, it has had only minimal lighting and was not a source of light pollution or seabird attraction.

No scenic resources, including important viewplanes or scenic sites recognized in the Natural Beauty chapter of the Hawai‘i County General Plan, are present at or near the project site.

3.6.4 Impacts and Mitigation Measures

The project may involve very occasional light generator noise, but because of the lack of sensitive receptors, but there will be no noise impacts to any sensitive receptors.

Originally, the habitat dome coloring was planned to be reddish brown to blend into the cinder; it would likely not have been noticed from any public vantage point and would have had virtually no scenic impacts. During design, it was noted that a lighter color would improve the thermal comfort for the inhabitants, and a white dome was constructed. A red-brown camouflage cover was installed and used for a portion of the experiments, but it was eventually removed. Currently, with the white shade presenting a high contrast with the immediate red cinder background and especially the surrounding dark lava flow, the facility is visible as a white dot for many miles from any direction for which topography offers a clear line of site. Figure 5 shows a no-magnification view from roughly two miles away on Mauna Loa Observatory Road and a 4x magnification view from eight miles away on the lower slopes of Maunakea. However, even though it is clearly visible, the small size keeps the view from being intrusive and the direct scenic impact is negligible. It should also be noted that after the end of the experiment, the habitat and accessory structures will be removed and the site will be restored, permanently erasing any visual impact.

Figure 5. Views of the Habitat from Two Locations North of the Site

No-magnification view from roughly two miles south on Mauna Loa Observatory Road ▲

▼ 4x magnification view from eight miles away on the lower slopes of Maunakea.

A potential impact related to the planned lighting during extra-vehicular exercises is light pollution. Maunakea has some of the darkest skies in the world and it is essential to maintain them in this condition for both astronomy and protection of the natural environment. The vast majority of light pollution derives from the millions of lights associated with urban development in Hilo, Waikoloa and Waimea. However, even small activities closer to Maunakea can have effects. These impacts were considered in the design of the EVA activities. As noted in Section 1.1., the project would utilize horizontal lighting for 1- to 3-hour EVA missions up to 12 times a year. A set of lights equivalent in lumens to a pair of car headlights will be installed on or near the driveway pointing at 90 degrees towards a ridge to the south of the habitat (Figure 6). UHM has coordinated with DOFAW and the University of Hawai‘i’s Institute for Astronomy on measures to avoid impacts to seabirds (see Section 3.3) and dark skies. As a result, in addition to the design specifications listed above and restrictions related to seabirds, the following mitigation measures are being incorporated into the project specifically to reduce light pollution and render any potential impact non-significant:

1. No more than a dozen EVA sessions lasting three hours or less will be allowed to occur per year.
2. The horizonal-aimed lights will be shielded to prevent the light shining upwards.
3. The lights will be aimed south towards Mauna Loa and a nearby ridge that will intercept much of the light.
4. The intensity of the light will be roughly equivalent to a pair of automobile headlights.
5. Low-blue spectrum lighting with a Correlated Color Temperature (CCT) of 3000 Kelvin or lower will be utilized.

3.7 Socioeconomics and Land Use

3.7.1 Definition of Resource

Socioeconomic analyses can encompass investigations of population, income, employment, and housing conditions of a specific area. Because of the very minor nature of the project and the lack of nearby affected communities, the socioeconomic issues considered in this analysis are conformance with land use designations, education and recreation.

3.7.2 Region of Influence

The region of influence (ROI) for socioeconomics and land use is defined as the Island of Hawai‘i, that will most directly experience the project’s presence and benefits.

3.7.3 Existing Conditions

Population on the Big Island doubled from about 92,000 in 1980 to over 185,000 in 2010 (Hawai‘i DBEDT 2010). Since then, population increase has slowed, and in 2024 it was estimated at over 209,000 (U.S. Census Bureau Quick Facts). Although East Hawai‘i still has most of the island’s residents, much growth over the last 15 years has been concentrated in West

Figure 6. Area Planned for Illumination During Limited Nighttime EVA Missions

Hawai‘i, where most tourist resorts and hotels are located. On any given day, visitors account for over 5 percent of the de facto population – and most are lodging in West Hawai‘i.

The Saddle between Mauna Loa and Maunakea is nearly unoccupied, although there is a scattering of residences on Department of Hawaiian Home Lands pastoral lots in Humu‘ula, about 7 miles north of the project site (see Figure 1). The general area is used for recreation, primarily hunting in vegetated portions of the Mauna Loa and Upper Waiakea Forest Reserves and the roadside Gilbert Kahele Recreational Area. There is also hiking at Pu‘uhuluhulu near the intersection of the Maunakea Access Road with the Daniel K. Inouye Highway (see Figure 1). A section of Hawai‘i Volcanoes National Park about five miles south of the project site also sees some limited recreational use, but the Mauna Loa eruption of 2022 has temporarily disrupted access. Military uses predominate in the area northwest, which is part of the U.S. Army's Pohakuloa Training Area (see Figure 1).

3.7.4 Land Use Designations and Permits

Forest Reserve Designation and Special Use Permit

The project site itself is within the Mauna Loa Forest Reserve. This portion of the Forest Reserve is in DLNR Hunting Unit E, where wild pig, sheep and goats may be taken by archery only, with no dogs permitted. It is open year-round on weekends and holidays, and bag limits apply. Bird hunting in season according to regulations is also allowed. Research activities such as the one proposed are allowed with a Special Use Permit from the Hawai‘i State Board of Land and Natural Resources (BLNR) pursuant to the State of Hawai‘i's Forestry Rules at §13-104-18, Hawai‘i Administrative Rules. Special uses include activities such as meetings, weddings, concerts, shows, and other community events or activities and scientific collection of plants and animals. Permits are granted for activities considered compatible with the functions and purposes of a unit within a forest reserve. An application for a Special Use Permit is considered on its own merits, including its effect on the premises, facilities, and the public's use and enjoyment of the forest reserve. The project was granted Special Use Permits in the past. Attached as Appendix 4 is the previous permit from 2019 to "Construct and manage an experimental science facility to simulate Mars habitat." As the project would not adversely affect the Forest Reserve, and was previously granted a permit indicating that it was consistent with purposes of the Forest Reserve (in this case, research), it would appear to meet the standards for granting of a Special Use Permit, which UHM will apply for at the conclusion of the EA process.

Conservation District Use Permit

All land in the State of Hawai‘i is classified into one of four land use categories – Urban, Rural, Agricultural, or Conservation – by the State Land Use Commission, pursuant to Chapter 205, HRS. The project site is classified within the State Land Use Conservation District, Resource Subzone. Any proposed use must undergo an examination for its consistency with the goals and rules of this district and subzone. The applicant will prepare a Conservation District Use Application (CDUA), to which this EA will be an appendix. The project consists of a temporary

research project conducted by the University of Hawai‘i to collect data on human adaptation to a space analog environment. The action is therefore a *Data Collection Use* as defined in Section 13-5-22 (P-1, D-1), which is defined as “Data collection, research, education, and resource evaluation that involves permanent facilities or structures larger than 500 square feet or a land use causing significant ground disturbance or impact to a natural resource.”

The CDUA will be the formal application for a permit and evaluation of the consistency of the project with the criteria of the Conservation District permit process. Briefly, the following individual consistency criteria should be noted.

1. The proposed land use is consistent with the purpose of the Conservation District;

The purpose of the Conservation District is to conserve, protect and preserve the important natural resources of the State through appropriate management and use to promote their long-term sustainability and the public health, safety and welfare. The action is consistent with this purpose, in that it will contribute to public welfare through education and research, without jeopardizing any natural resource.

2. The proposed land use is consistent with the objectives of the subzone of the land on which the use will occur;

The proposed action is consistent with the objectives of the Resource Subzone, which is to ensure, with proper management, the sustainable use of the natural resources of these areas. The action involves a properly managed use that ensures sustained use of the natural resources of the area by being located away from important natural resources and taking measures to avoid any impacts.

3. The proposed land use complies with provisions and guidelines contained in Chapter 205A, Hawaii Revised Statutes (HRS), entitled "Coastal Zone Management," where applicable;

The property is not within the Special Management Area (SMA) and is not otherwise subject to the provision of the CZM regulatory process. The project is not inconsistent with the goals or objectives of the CZM program.

4. The proposed land use will not cause substantial adverse impact to existing natural resources within the surrounding area, community or region;

The proposed action will include mitigation measures to prevent soil erosion. The proposed project will have no adverse impacts to historic sites or to the scenic character of the area. No substantial adverse impact will occur to existing natural resources, including seabirds or dark skies, given extensive mitigation conditions on activities that involve lighting.

5. The proposed land use, including buildings, structures and facilities, shall be compatible with the locality and surrounding areas, appropriate to the physical conditions and capabilities of the specific parcel or parcels;

The proposed action is compatible with the former use as a cinder quarry and due to its very minor character is not incompatible with adjacent open space uses.

6. The existing physical and environmental aspects of the land, such as natural beauty and open space characteristics, will be preserved or improved upon, whichever is applicable;

The current site has already been modified for cinder quarrying and the previous project that constructed and operated the habitat and associated facilities, and resumption of the temporary project will not adversely alter any existing physical, environmental or open space characteristics. Effects from temporary lighting that will occur 12 times a year or less for period of 3 hours or less will be mitigated by extensive conditions, and the natural beauty characteristics including dark skies will not be adversely affected.

7. Subdivision of land will not be utilized to increase the intensity of land uses in the Conservation District;

The proposed action does not involve or depend upon subdivision.

8. The proposed land use will not be materially detrimental to the public health, safety and welfare.

The proposed action will enhance the quality of higher education and research in Hawai‘i and will have a beneficial effect upon public welfare.

County Land Use Designations and Policies

The County designates the site Conservation in the General Plan Land Use Pattern Allocation Guide Map (LUPAG), and the use is considered consistent with the LUPAG (see letters from Planning Department in Appendix 1a). It is not within the Special Management Area, which is meant to protect coastal resources.

According to the Planning Department (see letter in Appendix 1a), the project is consistent with County land use designations, and fulfills policies in the General Plan related to the economy, which includes the following:

2.3 (b) Encourage the expansion of the research and development industry by working with and supporting the University of Hawaii at Hilo and West Hawaii, the Natural Energy Laboratory at Hawaii Authority and other agencies' programs that support sustainable economic development in the County of Hawaii.

2.3 (f) Support all levels of educational, employment and training opportunities and institutions.
2.3 (i) Continue to encourage the research, development and implementation of advanced technologies and processes.

The Hāmākua Community Development Plan (CDP) planning area encompasses the judicial districts of Hāmākua and North Hilo (the district in which the project site is located) as well as a portion of the South Hilo district commonly referred to as Rural South Hilo (Wainaku to Hakalau). It was developed under the framework of the February 2005 County of Hawai‘i General Plan and was adopted in 2018 per Ordinance 2018-078. (https://www.hawaiicounty.gov/our-county/legislative/office-of-the-county-clerk/records).

Community Development Plans are intended to translate broad General Plan Goals, Policies, and Standards into implementation actions as they apply to specific geographical regions around the County. CDPs are also intended to serve as a forum for community input into land-use, delivery of government services and any other matters relating to the planning area.

The Hāmākua CDP does not specify land use per se at the project site, but it does contain policies relevant to the action:

- Protects coastal areas, agricultural land, and mauka forests from development
- Protects open space, areas with natural beauty, and scenic view planes
- Guides the development of programs to strengthen protections for coastal and agricultural lands as well as open space and view planes
- Preserves historic resources
- Ensures appropriate public access to the shoreline and mauka forests
- Guides the development of a regional network of trails
- Guides collaborative stewardship and enhancement of coastal and forest ecosystems, cultural resources, agricultural lands, public access, and trails
- Concentrates future development in the existing towns, villages, and subdivisions
- Supports the preservation of village and town character and guides the enhancement of communities’ unique sense of place

Utilizing areas for space science and technological projects is not mentioned in the CDP, but Policy 121 is to “Promote and develop the island of Hawaii into a unique scientific, environmental, and cultural model, where economic gains are in balance with social and physical amenities. Development should be reviewed on the basis of total impact on the residents of the County, not only in terms of immediate short run economic benefits.”

3.7.5 Impacts and Mitigation Measures

The project would have no adverse effect on socioeconomics or land use. No displacement or effects to existing populations or land uses would occur. The project would benefit society by

providing unique educational opportunities in the STEM (Science, Technology, Engineering and Mathematics) fields.

Maintaining the gate on the cinder road approximately 2,300 feet west of Mauna Loa Observatory Road will continue to restrict vehicular access to the site except for DOFAW, the project managers and those who might require such access and receive permission from the Division of Forestry and Wildlife, as discussed in Part 1. Because there are no known cultural or recreational uses of the cinder area, including hunting, this should not seriously inconvenience any parties, including hunters, who could access the surrounding area on foot, although game resource are extremely scarce in this unvegetated area. Once the experiment is complete, the gate will be removed and the access to this former cinder quarry could be restored.

The project appears to be is consistent with all land use designations, a finding which will be conclusively determined as part of the application for a DLNR-DOFAW Special Use Permit and a Conservation District Use Permit. Consultation with the County Department of Public Works and Planning Department does not indicate any need for grading or building permits.

The proposed action does not adversely affect any policies in either the General Plan or the Hāmākua CDP related to the protection of land or resources or the use of land for any purposes. The project takes advantage of the unique scientific opportunities offered by the landscape of Mauna Loa. No aspect of the action is contrary to the Hāmākua CDP.

3.8 Safety and Environmental Health

3.8.1 Definition of Resource

For the purposes of this EA, safety and environmental health refer to existing recognized environmental conditions (RECs) such as hazardous materials, toxic substances or hazardous conditions that have the potential to affect public health or safety.

3.8.2 Region of Influence

The region of influence (ROI) for safety and environmental health is the approximately half-acre area directly affected by physical activities from the proposed project. The issue of water quality is discussed in Section 3.2, above.

3.8.3. Existing Conditions

No Phase I Environmental Site Assessment was performed for the project site in the original 2013 EA. Visual inspection of the site, which contains only compacted volcanic ash, indicated no obvious evidence of contamination or hazardous conditions. The quarrying activity that occurred previously involved simple excavation and is unlikely to have left any significant contamination issues. Since that time, the facilities illustrated in Figure 4 were developed on the

site, in addition to a fuel tank that has since been removed and had no spill occurrences. There is no current indication that RECs exist on the site.

3.8.4 Impacts and Mitigation Measures

The resumption of the project, with the addition of a shipping container and 1,000-gallon propane tank, will involve minimal use of hazardous materials and toxic substances. The fueling area for the original diesel generator was designed so that a small spill could be confined and cleaned up. Once the fueling system was changed to propane, risks during refueling became minimal. All refueling will continue to be undertaken by trained professionals in conformance with all regulations and best practices.

3.9 Utilities

No electricity, telephone, water supply or wastewater utilities are present in the area or needed for the project. There will be no impact on utilities.

Power will continue to be supplied via solar panels with batteries, with a backup portable Generac 10 kW Standby Generator run on propane stored in a 1,000-gallon fuel tank that will be placed onsite.

Human waste will continue to be processed in composting toilets, with residual waste transported offsite periodically. In keeping with realistic extraterrestrial living conditions, the crew utilize low amounts of water, only about 600 gallons per month. Much of this becomes exhaled moisture or compost, and thus greywater production is low. Greywater flows into a holding tank slightly downhill from the habitat, where any solids settle out. It then flows into a tarp-lined evaporation field. The project will now recycle greywater to be utilized in the growth chambers. The tank and evaporation field will become almost unnecessary, although they will be left in place in case greywater production exceeds the recycling capacity.

3.10 Traffic and Transportation

Project managers access the site from Hilo and Kona by the Daniel K. Inouye Highway (DKI Highway, aka Saddle Road, State Route 200), and then Mauna Loa Observatory Road, a one-lane road used primarily by workers and suppliers at Mauna Loa Observatory (see Figure 1). Servicing the inhabitants of the habitat, including supplying food and water and removing compost, requires on average less than one trip a month, This level of additional vehicular activity will have no effect on traffic on the DKI Highway Road, with its approximately 6-7,000 vehicles per day (vpd) in 2025 (pers. comm. R. Terry with Hawai‘i Department of Transportation January 2026). Traffic on Mauna Loa Observatory Road is not metered but probably amounted to a few hundred vpd, at most, prior to its closure due to the 2022 Mauna Loa lava flow (which is expected to fully open at some point in 2026). Vehicles traveling downhill on Mauna Loa Observatory Road are usually obliged to pull over when an uphill-traveling vehicle

approaches. Every additional trip adds to the potential for such an encounter, but given the very low number of trips, this will not significantly impact traffic on this road.

3.11 Cumulative Impacts

3.11.1 Planned and Reasonably Foreseeable Projects

No construction or other projects involving an active land use are known to be occurring within a two-mile radius. Three to ten miles distant within Pohakuloa Training Area (PTA), there have been periodic planned expansions of training facilities. In 2011, the U.S. Army published a Draft Programmatic Environmental Impact Statement (PEIS) for the modernization of training infrastructure at a new battle training facility (U.S. Army 2011). The PEIS evaluated the impact of modernizing training ranges, infrastructure, and support facilities at PTA, including constructing and operating an Infantry Platoon Battle Area with an Infantry Platoon Battle Course, Live-fire Shoothouse, and a Military Operations on Urban Terrain facility. A Final EIS does not appear to have been prepared, consistent with shifting plans at the base. The U.S. Army is currently attempting to negotiate renewal of a lease for approximately 20,000 acres of State land at PTA. The request is undergoing environmental reviews and facing significant public opposition. The Hawai‘i Legislature is currently entertaining bills to prohibit live fire training at this and other Hawai‘i bases. Whatever the outcome of all these proceedings, because of both distance and future and proposed access, no activities at the base would interact in any way with the proposed HI-SEAS project.

A consortium of governments and institutions has long been planning the Thirty Meter Telescope (TMT), a large segmented mirror reflecting telescope to be built on the North Plateau of Maunakea (UHH 2010). This billion dollar project was originally expected to be built starting in the late 2010s, but has been delayed due to public opposition. It is unlikely to be constructed within the next five years, if at all. In any case, none of the TMT activities would interact in any significant adverse way with the proposed HI-SEASPISCES project.

3.11.2 Cumulative Impacts and Mitigation Measures

Cumulative impacts result when implementation of several projects that individually have limited impacts combine to produce more severe impacts or conflicts in mitigation measures. The adverse effects of the project – minor and temporary disturbance to air quality, noise or visual quality, plus a few vehicles per week at the site – are very limited in severity, nature and geographic scale. As discussed above, the projects known to be occurring nearby will not generate impacts with which the very minor and temporary effects from the HI-SEAS project would accumulate, and no cumulative impacts are foreseen.

PART 4: STATE OF HAWAI‘I FINDINGS

Chapter 11-200.1-13, Hawai‘i Administrative Rules, outlines those factors agencies must consider when determining whether an Action has significant effects:

> (a) In considering the significance of potential environmental effects, agencies shall consider and evaluate the sum of effects of the proposed action on the quality of the environment.
>
> (b) In determining whether an action may have a significant effect on the environment, the agency shall consider every phase of a project, the expected impacts, and the proposed mitigation measures. In most instances, an action shall be determined to have a significant effect on the environment if it may:

1. *Irrevocably commit a natural, cultural, or historic resource.* No valuable natural or cultural resources would be committed or lost. The site is unvegetated, with no water bodies, and there are no cultural sites present. No valuable cultural resources and practices such as forest access, fishing, gathering, hunting, or access to ceremonial sites would be affected in any way.

2. *Curtail the range of beneficial uses of the environment.* The proposed temporary project in no way curtails beneficial uses of the environment in this area, which will be restored to its original condition after use is complete.

3. *Conflict with the State's environmental policies or long-term environmental goals established by law*. The State's long-term environmental policies are set forth in Chapter 344, HRS. The broad goals of this policy are to conserve natural resources and enhance the quality of life. The proposed action does not adversely affect the environment and is highly beneficial for education and research. It is thus consistent with all elements of the State's long-term environmental policies.

4. *Have a substantial adverse effect on the economic welfare, social welfare, or cultural practices of the community and State.* No adverse effects to the economic or social welfare will occur, and there will be a beneficial effect to education and scientific knowledge.

5. *Have a substantial adverse effect on public health.* No effects to public health are anticipated.

6. *Involve adverse secondary impacts, such as population changes or effects on public facilities*. No adverse secondary effects are expected to result from the project, which is not significant enough to directly or indirectly burden public infrastructure or facilities.

7. *Involve a substantial degradation of environmental quality*. The proposed action is minor and is being regulated by permits to avoid environmental degradation, and thus would not contribute to environmental degradation.

8. *Be individually limited but cumulatively have substantial adverse effect upon the environment or involves a commitment for larger actions,* The project does not interact with other activities in the region in such a way as to produce adverse cumulative effects or involve a commitment for larger actions.

9. *Have a substantial adverse effect on a rare, threatened, or endangered species, or its habitat.* No rare or listed threatened or endangered plant species are present on the graded site. Restrictions on lighting will ensure that there are no impacts to listed seabirds that may transit over the site at night. The project site has no vegetation, and surrounding patches of vegetation are protected from impact. Impacts to rare, threatened or endangered species of flora or fauna will be prevented by mitigation measures to avoid impacts (including those from lighting) to fledgling seabirds and prevent introduction of invasive species.

10. *Have a substantial adverse effect on air or water quality or ambient noise levels.* Due to the character and density of the proposed action, no adverse effects on these resources would occur.

11. *Have a substantial adverse effect on or be likely to suffer damage by being located in an environmentally sensitive area such as a flood plain, tsunami zone, sea level rise exposure area, beach, erosion-prone area, geologically hazardous land, estuary, fresh water, or coastal waters.* The project site, like much of the Big Island, is subject to lava inundation, but due to the temporary nature of the project and the mobility of the structures being emplaced, there is little risk.

12. *Have a substantial adverse effect on scenic vistas and viewplanes, during day or night, identified in county or state plans or studies.* No aspect of the proposed action would adversely impact scenic resources or viewplanes. Impacts related to dark skies have been mitigated by project design and the limitation of events involving lighting to less than 36 hours per year.

13. *Require substantial energy consumption or emit substantial greenhouse gases*. Although construction of new facilities and operation of the habitat will require the use of energy, no major adverse effects to energy consumption would be expected, and there is no feasible way to undertake the project without energy consumption.

Based on evaluation of the environmental setting and impacts, the University of Hawai‘i at Manoa expects to determine that the proposed action will not have a significant effect upon the environment and is thus expected to issue a Finding of No Significant Impact (FONSI). This finding will be made in consideration of comments on the Draft EA.

PART 5 REFERENCES

Federal Highway Administration, Central Federal Lands Highway Division (FHWA-CFLHD). 1999. *Final Environmental Impact Statement, Saddle Road (State Route 200) Mamalahoa Highway (State Route 190) to Milepost 42*.

Gagne, W., and L. Cuddihy. 1990. "Vegetation," pp. 45-114 in W.L. Wagner, D.R. Herbst, and S.H. Sohmer, eds., *Manual of the Flowering Plants of Hawai'i.* 2 vols. Honolulu: University of Hawai'i Press.

Giambelluca TW, Chen Q, Frazier AG, Price JP, Chen Y-L, Chu P-S, Eischeid J., and Delparte, D. 2011. *The Rainfall Atlas of Hawai'i.* http://rainfall.geography.hawaii.edu

Handy, E.S.C., and E. Handy (with M.K. Pukui). 1972. *Native Planters in Old Hawai'i*. B.P. Bishop Museum Bulletin 233. Honolulu: Bishop Museum Press.

Hawai'i County Planning Department. 2005. *The General Plan, County of Hawai'i*. Hilo. http://www.hawaii-county.com/la/gp/toc.html

Heliker, C. 1990. *Volcanic and Seismic Hazards on the Island of Hawaii*. Washington: U.S. GPO.

Kumu Pono Associates. 2003. *Mauna Kea – Ka Piko Kaulana o ka 'Āina*. Prep. by Kepā and Onaona Maly. Hilo, Hawai'i.

University of Hawai'i at Hilo, Dept. of Geography. 1998. *Atlas of Hawai'i*. 3rd ed. Honolulu: University of Hawai'i Press.

U.S. Army. 2011. *Draft Programmatic Environmental Impact Statement for the Modernization Of Training Infrastructure And Construction and Operation Of An Infantry Platoon Battle Area at Pohakuloa Training Area, Hawaii*. Prep. by Booz Allen Hamilton for U.S. Army. Honolulu

NASA (National Aeronautics and Space Administration). 2009. H*uman health and performance risks of space exploration missions: evidence reviewed by the NASA Human Research Program*. Prep. by J.C. McPhee and J.B. Charles. Washington DC.

Schnell, R and L. Pajo, eds. N.d. *The Observatory, on Their Own*. Hilo, Hawai'i.

U.S. Fish and Wildlife Service (USFWS). 2026. ECOS Environmental Conservation Online System. https://ecos.fws.gov/ecp/species-reports.

U.S. Geological Survey (USGS). 2000. *Seismic Hazard Maps for Hawaii*. By F.W. Klein, A.D. Frankel, C.S. Mueller, R.L. Wesson and P.G. Okubo.

U.S. Soil Conservation Service. 1973. *Soil Survey of Island of Hawai'i, State of Hawai'i.* Washington: U.S.D.A. Soil Conservation Service.

University of Hawai'i at Hilo (UHH). 2010. *Final Environmental Impact Statement, Thirty Meter Telescope*. Hilo.

University of Hawai'i at Hilo, Dept. of Geography (UHH-Geog). 1998. *Atlas of Hawai'i*. 3rd ed. Honolulu: University of Hawai'i Press

University of Hawai'i, Hawai'i Institute of Geophysics and Planetology. 2012. *Final Environmental Assessment, Humu'ula Saddle Region of Hawai'i Island: A Detailed Hydrologic Evaluation and Exploratory Drilling Program*. Honolulu.

Vanderwoude, C., Klasner, F., Kirkpatrick, J. and S. Kaye. 2015. *Maunakea Invasive Species Management Plan*. Technical Report 191, Pacific Cooperative Studies Unit, University of Hawai'i.

Wolfe, E.W., and J. Morris. 1996. *Geologic Map of the Island of Hawai'i.* USGS Misc. Investigations Series Map i-2524-A. Washington, D.C.: U.S. Geological Survey.

PART 6 PERSONS AND AGENCIES CONTACTED

- Daniel and Anna Akaka
- Hawai‘i State Department of Health
- Hawai‘i State Department of Land and Natural Resources (DLNR), Land Division
- Hawai‘i State DLNR, Office of Conservation and Coastal Lands
- Hawai‘i State Department of Land and Natural Resources (DLNR), Land Division
- Hawai‘i County Dept. Public Works
- Hawai‘i County Police Department
- Hawai‘i County Planning Dept.
- Hawai‘i County Council
- Hawai‘i County Civil Defense Agency
- Hawai‘i County Fire Department
- Hawai‘i State Office of Hawaiian Affairs
- Pacific International Space Center for Exploration Systems (PISCES)
- Sierra Club, Moku Loa Group
- Hawaii Island Chamber of Commerce

PART 7 LIST OF PREPARERS

Ron Terry, Ph.D., Geography
34 years preparing EAs and EISs
Geometrician Associates LLC

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HI-SEAS Habitat Project

Environmental Assessment

APPENDIX 1a
Comments in Response to Early Consultation

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geometrician
ASSOCIATES, LLC
integrating geographic science and planning

phone: (808) 987-5239 10 Hina Street Hilo Hawaii 96720 hiloronterry@gmail.com

December 12, 2025

Dear Agency/Organization Official:

Subject: Early Consultation for Environmental Assessment for HI-SEAS Mars Habitat Project in State Land Use Conservation District on Mauna Loa, TMK (3rd.) 3-8-001:001, Humu‘ula, Hamakua District, Island of Hawai‘i

Our firm is in the process of preparing a Draft Environmental Assessment (EA) for a proposed State of Hawai‘i activity, in compliance with Chapter 343, HRS, and Title 11, Chapter 200.1, HAR. The Department of Information and Computer Sciences at the University of Hawai‘i at Manoa is building upon its successful project at Mauna Loa developing the HI-SEAS (Hawaii Space Exploration Analog and Simulation) facility. This research program built a realistic planetary-surface habitat and tested it under strong operational conditions to understand and address the risks of long-term human space exploration. The National Aeronautics and Space Administration (NASA) seeks to fund the upgrade of existing and construction of new features at this facility to run analog missions to support research that will enable long-duration human space exploration missions over a range of mission profiles. Although such analogs can support a wide variety of research, the emphasis is on addressing human behavioral health and performance (BHP) risks. In particular, the enhanced facility will be designed to simulate, as accurately as possible:

- mission length
- distance from Earth
- size and functionality of the living space
- communication delays and latency, and
- nature of in-flight or surface extravehicular activities

The HI-SEAS facility is already well-suited to this kind of research, as demonstrated by the series of NASA-funded simulated long-duration (4-12 month) missions carried out there in the past. The proposed improvements would make HI-SEAS a unique facility for BHP research to support lunar and Mars missions. In order to legally conduct the activity, the project proponent will be required to obtain a Conservation District Use Permit (CDUP), as well as a Special Use Permit (SUP) pursuant to the State of Hawai‘i’s Forestry Rules at §13-104-18, Hawai‘i Administrative Rules, from the Hawai‘i State Board of Land and Natural Resources (BLNR).

The project proposes restarting analog missions. It would retain/modify a number of features that are already on-site from the previous HI-SEAS Mars Habitat project and would also construct very limited new features. Retained/modified features include:

- An existing manufactured habitat consisting of self-contained units with sleeping quarters, a kitchen, a computer and lab workspace, and two bathrooms, one with a shower. The project would design and implement a set of modular barriers/ceilings within the habitat that will be used to vary the habitable volume to suit a wide range of crew sizes and mission profiles appropriate to the particular mission type.
- HI-SEAS currently has composting toilets and urinals, so all the habitat's wastewater is greywater. The project would increase the fidelity of the mission analog by introducing greywater recycling for plant growth and other non-consumption purposes.
- As before, power will be obtained primarily from solar panels with batteries, with a backup portable Generac 10 kW Standby Generator run on propane stored in a 1,000-gallon fuel tank that will be placed onsite. The fuel tank used for the previous project has been removed.
- Other features already present on the site that will be retained include two water tanks, a solar panel w/microwave transmitter for communications, instruments, a post-on-pier storage container w/panel, a buried greywater container w/ABS pipes, and various cords, conduits and lines.

New proposed features that merit attention in the EA and permit applications include the following:

- Modular plant-growth chambers for food and oxygen production that can be put in or out of use and resized according to the desired mission profile. Both a free-standing growth chamber utilizing a shipping container design and smaller in-habitat chambers are proposed.
- In order to simulate the low solar angle illumination of Artemis lunar missions that are expected to land at the Lunar South Pole and which will impact EVA feasibility, safety, and cognitive load, the project proponents are exploring whether they might be able to install a set of bright lights set low around the habitat. These will be used for durations of an hour or two on dark nights for lunar EVAs. Although this approach would not replicate the lunar surface albedo, it would produce long dark shadows similar to those on the moon. It is recognized that depending on time of the night and year, there is a potential for adverse interactions with seabirds and contribution to light pollution. Because of the high concern about lighting and its effects on dark skies and seabird passage in this highly sensitive area, the proponents are seeking extra scrutiny from organizations such as the U.S. Fish and Wildlife Service and the University of Hawaii's Institute for Astronomy to determine whether there are mitigation measures that could alleviate concerns.

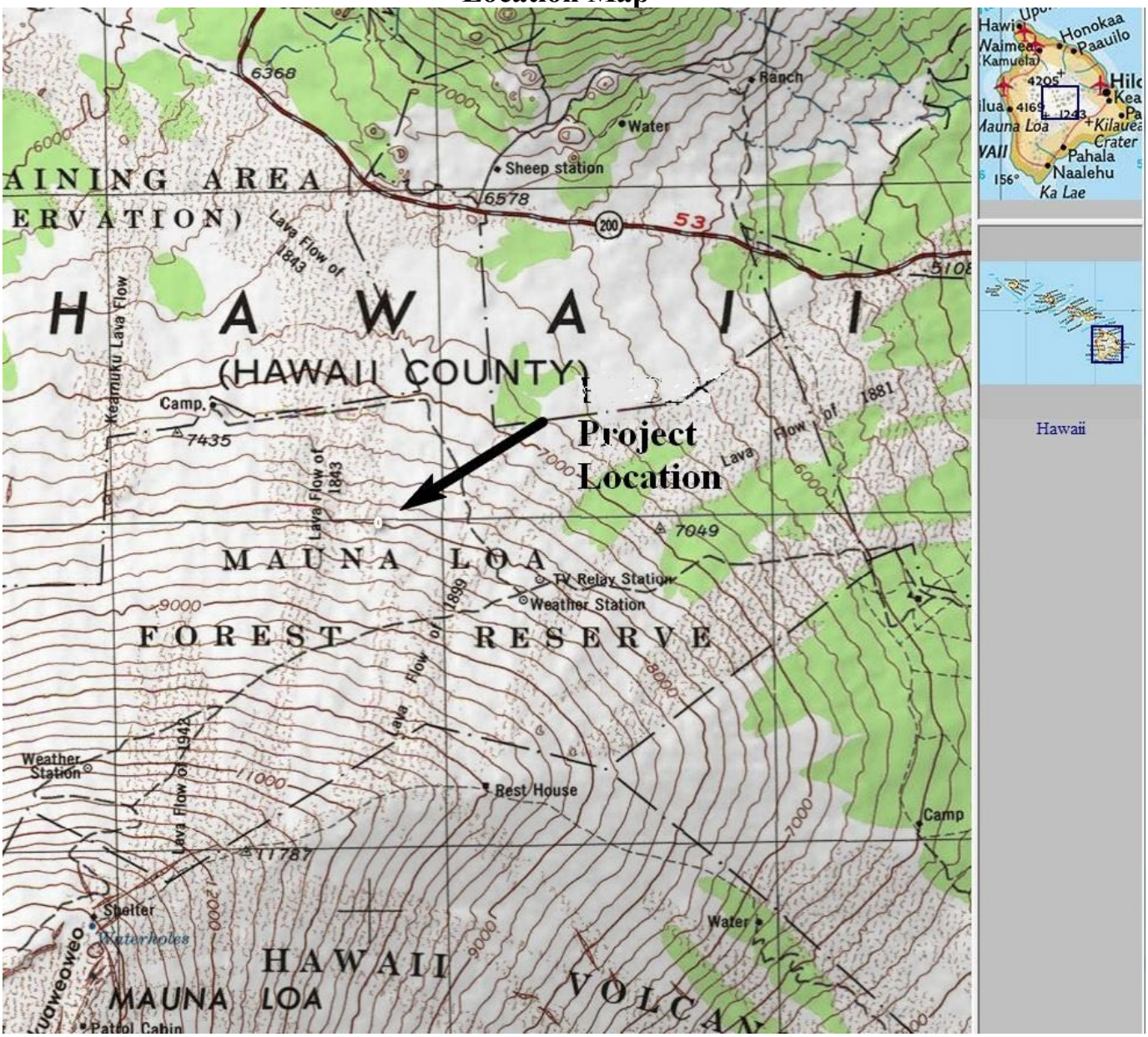
The areas of investigation in the Environmental Assessment will also include but not be limited to water quality assurance; wastewater treatment; flora, fauna, and ecosystems; traffic impacts; geology, soils, and hazards; flooding and drainage impacts; social and community impacts; cultural impacts; historic sites; and economic impacts.

I would appreciate your comments on any special environmental conditions or impacts. Please contact me at 808-987-5239 or by email to hiloronterry@gmail.com if you have any questions or require clarification. Kindly indicate whether you wish to receive a copy of the EA or notification of its availability when completed.

Sincerely,

Ron Terry, Principal
Geometrician Associates

Location Map



STATE OF HAWAI'I | KA MOKU'ĀINA 'O HAWAI'I
DEPARTMENT OF LAND AND NATURAL RESOURCES
KA 'OIHANA KUMUWAIWAI 'ĀINA

DIVISION OF FORESTRY AND WILDLIFE
19 EAST KAWILI STREET
HILO, HAWAII 96720

February 18, 2026

Geometrician Associates, LLC
Mr. Ron Terry
10 Hina St
Hilo, HI 96720

RE: Comments on Early Consultation for the Draft Environmental Assessment of the Proposed HI-SEAS Mars Habitat Project Located within Mauna Loa Forest Reserve

The request for comments on the early consultation draft EA was sent to the Division by the Office of Conservation and Coastal Lands. The Division of Forestry and Wildlife (DOFAW) has concerns about this project moving forward in forest reserve lands.

1. The project has changed hands multiple times during its lifecycle. UH Manoa was the original applicant; it was then taken over by HI-SEAS and is now back with UH Manoa. The HI-SEAS website advertised the opportunity to use the facility to conduct research for a fee of $1,000 per week. This commercial use violated the terms of the special use permit. Commercial use is not allowed in Mauna Loa Forest Reserve.
2. A photo on the HI-SEAS website shows researchers inside a cave near the facility without permission from DOFAW, which violates HRS §6D-7-Access - *No person may enter or traverse a cave, or any segment thereof, without the property owner's prior written consent.* The applicant did not obtain permission to access caves within the Mauna Loa Forest Reserve.
3. DOFAW does not support building additional structures within the forest reserve. This project appears to be evolving into a long-term program that exceeds the scope of the 2013 research permit, and as such, is entering a new phase of land disposition and compliance. DOFAW is legally restricted from leasing forest reserve lands. If the applicant seeks a long-term disposition on DLNR lands, the area must be removed from forest reserve designation and transferred to Land Division jurisdiction.
4. Recent surveys of the older lava flows in the HI-SEAS project vicinity detected U'au and Ake'ake, both of which are endangered species. Eleven nests were found in the surrounding areas. These birds are attracted to lighting. Installing exterior lighting poses a high risk of disturbing these species on site, and further development of the facility is inappropriate, given their presence.

Please reach out to Jay Hatayama at 808-974-4387 or jay.m.hatayama@hawaii.gov if you have any questions about our comments or need further information.

Mahalo,

David G. Smith
Administrator

Doug Simons

dsimons@hawaii.edu Wed, Dec 31, 2025, 2:45 PM (4 days ago)

Aloha Ron –

Good to hear from you and thanks for the opportunity to provide some comments informally about this project. Regarding low-elevation bright lights at the HI-SEAS facility on dark nights, minimizing the use of bright exterior lights in general is requested to minimize impacts on astronomical research being conducted by the Maunakea Observatories. Other mitigation steps to consider include –

Point the lights away from Maunakea and shield the light sources to avoid illuminating a broad area.

Use lights that emit little-to-no radiation at blue wavelengths, which scatter much more efficiently than longer wavelength lights

Consider best practices in outdoor lighting consistent with the recently published recommendations by the UH Dark Skies Protection Advisory Report.

I'm happy to discuss these suggestions or others you may have in mind. In any case, I appreciate the opportunity to offer comments on your proposal.

Mahalo,

Doug

JOSH GREEN, M.D.
GOVERNOR | KE KIA'ĀINA

SYLVIA LUKE
LIEUTENANT GOVERNOR | KA HOPE KIA'ĀINA

STATE OF HAWAI'I
KA MOKU'ĀINA 'O HAWAI'I
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CIARA W.K. KAHAHANE
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

REF:OCCL:TM

Correspondence: HA 26-94

February 4, 2026

Ron Terry
Geometrician Associates
hiloronterry@gmail.com

SUBJECT: Early Consultation Comments for the Environmental Assessment for the Hawai'i Space Exploration Analog and Simulation (Hi-SEAS) Project Located Within the Mauna Loa Forest and Game Reserve at Humu'ula, North Hilo, Hawai'i, TMK: (3) 3-8-001:001

Dear Ron Terry:

The Office of Conservation and Coastal Lands (OCCL) has reviewed your information regarding the subject matter. According to your information, you are in the process of preparing a draft Environmental Assessment and are seeking comments for the assessment. The University of Hawai'i's Department of Information and Computer Sciences with NASA is proposing to run analog missions to support research for human space exploration missions with an emphasis on addressing human behavioral health and performance risks by developing a Hawai'i Space Exploration Analog and Simulation (Hi-SEAS) facility. The site lies in the Conservation District Resource subzone.

On April 2, 2013, the Chairperson of the Board of Land and Natural Resources approved Conservation District Use Permit HA-3665 for the Hi-Seas/Pisces Mars Habitat Project subject to 23 conditions. A time extension was requested in 2019 so that the Mars facility could be maintained while a proposed "Moon Mission" Conservation District Use Application (CDUA) was developed for processing. CDUP HA-3665 was extended to April 2024, however no Moon Mission CDUA was submitted.

A second time extension was requested in December 2023. The Department declined to extend the CDUP as what was currently occurring on the site was not consistent with the permit. The Department allowed permitted land uses to remain on site while a CDUA and compliance with HRS Chapters 343 and 6E are developed. In addition, for the Ka Pa'akai analysis, consultation with individuals knowledgeable of traditional cultural uses of the area should take place. A CDUP for the site must be gained by August 12, 2026.

Proposed land uses in the Conservation District must be consistent with the encumbered agency's statutes, rules, and regulations. Further, the Public Land Trust Information System (PLTIS) identifies the subject parcel Trust Land Status as 5(b).

The Environmental Assessment (EA) should discuss the existing features of the site, its purpose and need. Regarding the modular plant-growth chamber, types of potential research proposals, containment and best management practices for plant-growth and by-products should be discussed.

Regarding the installation of bright lights set low around the site, this may have an effect on avifauna. The area may be an important fly way and may be near breeding areas for protected state and federally listed seabirds such as the ʻuaʻu or Hawaiian petrel, the ʻaʻo or Newell's shearwater and the akēʻakē or band-rumped storm petrel.

Please consult with DOFAW regarding appropriate survey methods for flora, fauna and avifauna that may be found in the vicinity. Results of the surveys should be included with the EA. If the project may have significant effects such as having a substantial adverse effect on a rare, threatened, or endangered species, or its habitat; this may require the preparation of an Environmental Impact Statement.

Please note, all documents such as an EA, that must be submitted to the Office of Planning and Sustainability's Environmental Review Program must be unlocked, searchable, and Americans with Disabilities Act (ADA) compliant. Should you have any questions regarding this correspondence, contact Tiger Mills of our Office at (808) 587-0382 or at Kimberly.mills@hawaii.gov.

Sincerely,

S Michael Cain

S. Michael Cain, Administrator
Office of Conservation and Coastal Lands

C: Chairperson
DOFAW/HDLO
County of Hawaiʻi
-Planning

Hawai‘i Island Chamber of Commerce

1321 Kino‘ole Street - Hilo, Hawai‘i 96720

Phone (808) 935-7178 - Fax (808) 961-4435 - Email exec@hicc.biz - www.hicc.biz

January 12, 2026

Dear Members of the Hawai‘i State Board of Land and Natural Resources and Reviewing Agencies,

On behalf of the Hawai‘i Island Chamber of Commerce (HICC), a member organization representing over 300 businesses, organizations, and individual members primarily based on the eastern portion of Hawai‘i Island, we offer our **support for the proposed enhancements to the Hawai‘i Space Exploration Analog and Simulation (HI-SEAS) facility and the restart of analog missions led by the University of Hawai‘i**, with funding support from the National Aeronautics and Space Administration (NASA).

The Chamber believes this project represents a valuable investment in Hawai‘i Island’s future workforce. It is our understanding that University of Hawai‘i students will be involved in all aspects of the project, from design and operations to mission execution and support, providing them with invaluable experience running realistic space exploration missions. These opportunities prepare students for high-skill careers in science, engineering, technology, and research, while helping build a strong local talent pipeline for Hawai‘i.

While the initial NASA funding of approximately $750,000 is modest, most project expenditures will remain in-state and on Hawai‘i Island, supporting local contractors and businesses. More importantly, the project’s long-term benefits extend beyond immediate economic impact by developing knowledge, skills, and experience that will benefit our community well into the future.

We also appreciate the project’s thoughtful approach to environmental stewardship, including limited new construction, careful consideration of visual impacts, and proactive efforts to address potential environmental concerns through the Environmental Assessment and permitting process.
In summary, the Hawai‘i Island Chamber of Commerce supports the HI-SEAS project for its meaningful contributions to workforce development, education, and Hawai‘i’s role in globally significant research. We respectfully encourage the reviewing agencies to consider these community benefits as the project moves forward.

Mahalo for your consideration.

Sincerely,

Carla Kuo
Executive Officer
Hawai‘i Island Chamber of Commerce

BELOW IS THE TEXT OF A LETTER SENT BY THE HAWAII COUNTY PLANNING DEPARTMENT TO RON TERRY ON JANUARY 29, 2026. DUE TO CERTAIN CHARACTERISTICS OF THE LETTER, IT COULD NOT BE MADE ADA ACCESSIBLE. THE SIGNED LETTER IN ITS ORIGINAL FORM IS AVAILABLE AT THE HAWAII COUNTY PLANNING DEPARTMENT.

C. Kimo Alameda, Ph.D., Mayor

William V. Brilhante, Jr., Managing Director

West Hawai'i Office
74-5044 Ane Keohokalole Hwy Kailua-Kona, Hawai'i 96740 Phone(808)323-4770
Fax (808) 327-3563

County of Hawai'i PLANNING DEPARTMENT

Jeffrey W. Darrow, Director

Michelle S. Ahn, Deputy Director

East Hawai'i Office 10 I Pauahi Street, Suite 3
Hilo, Hawai'i 96720
Phone (808) 961-8288
Fax (808) 961-8742

January 9, 2026

Geometrician Associates, LLC Attn: Ron Terry
10 Hina Street
Hilo, HI 96720
Email: hiloronterry@gmail.com Dear Ron Terry:
SUBJECT: Early Consultation for Environmental Assesment (PL-ENV-2025-000055)
Project: HI-SEAS Mars Habitat
TMK: (3) 3-8-001:001, Hamakua District, Island of Hawai'i

Thank you for your letter dated December 12, 2025, requesting comments from this office regarding any special environmental conditions or impacts for the HI-SEAS (Hawai'i Space Exploration Analog and Simulation) Mars Habitat Project.

The applicant is proposing to restart and upgrade the HI-SEAS Mars Habitat, a research facility located on Mauna Loa in the Hamakua District. The HI-SEAS facility is a simulated planetary-surface habitat used to conduct research on long-duration human space exploration missions. The project is administered by the University ofHawai'i at Manoa and supported by funding from the National Aeronautics and Space Administration (NASA). The purpose of the project is to conduct analog missions that evaluate human behavioral health and performance under conditions representative of extended missions to the Moon

and Mars. The facility is designed to simulate key mission characteristics, including mission duration, isolation from Earth, living space size and functionality, communication delays, and extravehicular activities. The HI-SEAS facility has previously supported simulated missions ranging from approximately four to twelve months in duration. The proposed upgrades would enhance the facility's ability to support future analog missions and related research activities.

The subject parcel, Tax Map Key (TMK) (3) 3-8-001:001, is designated Conservation by the State Land Use Commission. The County of Hawai'i General Plan (2005), as amended in December 2006, similarly designates the subject area as Conservation under the Land Use Pattern Allocation

Guide (LUPAG) Map. While the entire Island of Hawai'i is located within the Coastal Zone Management Area, the subject parcel is not within the Special Management Area.
The project site lies within the Hamakua Community Development Plan (CDP) planning area. The Hamakua CDP was adopted by Ordinance No. 2018-78 in August 2018. Policy 16 of the Hamakua CDP states:

"To reinforce existing protections, the CDP Land Use Guide Map designates mauka regions and forests in Hamakua to be Conservation, and directs mauka areas to remain primarily as open space to be preserved, protected, and connected to the region's rich network of natural and cultural resources. Development and construction in mauka "Conservation" areas shall be minimized and, when necessary, limited to recreation, research, and education facilities unless otherwise permitted by law. (GP 14.1.1; HRS 205-2(e)."

The proposed project is consistent with the conservation priorities in the Hamakua CDP.

Within the Conservation District, there is no county zoning, per se. The Department of Land and Natural Resources (DLNR) has jurisdiction over uses and activities within the Conservation District encompassing the subject area.

Based on the information provided, we recommend that the Environmental Assessment include the following information:

A description of how the proposed use is consistent with the policies, standards, and courses of action of the County of Hawai 'i General Plan, available at: https://www.planning.hawaiicounty.gov/general-plan-community-planning/gp/plan.

A description of how the proposed use is consistent with the policies and actions of the Hamakua Community Development Plan, available at: https://www.hawaiicounty.gov/home/showdocument?id=305702&t=638088491805867283

We have no further comments to offer at this time. However, please provide our department with a copy of the Draft Enviromental Assement for our review and comment. If you have any questions or if you need further assistance, please feel free to contact Jessica Lahip at (808) 961-8378 or email at Jessica.Lahip@hawaiicounty.gov.

Sincerely,

JEFFREY W. DARROW
Planning Director

JL:ad
\\hawaiicounty.gov\Depts\PL\PL\planning\public\wpwin60\JessicaL\Comment Letters.EA Reviews\Preconsult EA HI-SEAS

HI-SEAS Habitat Project

Environmental Assessment

APPENDIX 2
Arthropod Survey

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SUMMARY OF ARTHROPOD SURVEY WITHIN A PROPOSED OUTER PLANET HUMAN HABITAT SIMULATION (PISCES) ON MAUNA LOA, HAWAII, OCTOBER 15, 2012

Technical Report Prepared for Ron Terry in Association with a PISCES Human Habitat Simulation EA for University of Hawaii, Hilo

Prepared by Jesse Eiben
University of Hawaii at Manoa Entomology Program
October 29, 2012

SUMMARY OF FINDINGS

I conducted a short duration arthropod assessment at the proposed site of an experimental human habitat space dwelling simulation being developed by the PISCES program at UH Hilo. Ron Terry is preparing an environmental assessment of the site, and he accompanied me during the arthropod survey. I have extensive experience in studying the alpine environments of Hawaii, informed by my studies detailing the life history and habitat characteristics of the wekiu bug, *Nysius wekiuicola*, and developing arthropod diversity monitoring protocols on Mauna Kea, HI.

The site of the proposed PISCES human dwelling is comprised of mostly fine rock tephra and scoria apparently ejected from the adjacent cinder cone during relatively recent volcanic activity. We surveyed a small area (at most 0.5 acre) of vehicle impacted cinder and the surrounding intact pahoehoe lava flow for arthropods. Our methods were general, and included placing 10 vials (7 dram open plastic vials) baited with attractants for ants and other scavengers (baits were peanut butter, jelly, and sliced turkey deli meat), visual surface scanning for arthropod movement and subsequent capture or identification, focused visual searches for arthropods in different substrates (under rocks, in small lava-caves, in cinder tephra), and inspection of any observed plants for associated arthropods.

We observed six species of arthropods during the two hour morning survey, and evidence of two moth larvae. None of the insects or arthropods observed appeared to be introduced invasive species (except for some evidence of aphids on *Vaccinium reticulatum*). No ants were observed. There was very little vegetation within the proposed physical footprint of any buildings. The vegetation observed were generally species commonly found in similar substrates throughout Mauna Kea and Mauna Loa and included some mosses, ferns (*Pellaea ternifolia*), lichens of various forms under and on the sides of rocks, *Dubautia scabra*, *Leptecophylla tameiamiae* and *V. reticulatum*. Therefore, impacts to arthropods strictly associated with a plant type will not be a major concern if the proposed construction project occurs. Free ranging predators and scavengers found in the substrates are also not likely to have their populations affected by disturbance in a small physical footprint (0.25-0.5 acre). The arthropods found during this survey are generally broadly distributed throughout the aa and pahoehoe lava habitat types wherever their preferred microhabitat is present.

CONCLUSION AND RECOMMENDATIONS

The substrate type and plant community found at the PISCES study site are not unique to the site, and are broadly distributed at the same elevation band throughout Mauna Loa. The small amount of plant and arthropod diversity found at the site appears to be unimpacted by introduced species. Because the site is quite small, and human induced impacts will remain contained in a relatively small area, the direct impacts will be insubstantial. However, great care should be taken to limit the introduction of new species into this relatively pristine and intact high elevation ecosystem. The lack of the presence of ants (all of which are introduced in the Hawaiian Islands) at this elevation is a condition that should be preserved by limiting introduction potential, and eliminating any ant colonies found. The impacts of ants, if introduced by construction or human use, will have vast effects on the ecosystem not limited to the proposed PISCES study site. Additionally, any introduction of new invasive weeds will hasten the alteration of the arthropod community by potentially allowing new insects that may compete or predate upon the naturally occurring fauna. Finally, because the area of the proposed site is very small, environmentally harsh (little soil, extreme daily temperature and moisture fluctuations) and currently hosts limited biodiversity, identification and control of newly introduced species by human means can be efficient and inexpensive. The relative ease of keeping the surrounding ecosystem free of newly introduced species and thus intact as it presently exists should be a priority that can be met with basic preventive and control methods for introduced species.

Table 1. Arthropod Species List

Habitat Type/Photo	Arthropod Order/ Family	Species and notes
Pahoeohoe rocks Photo 1	Lepidoptera/ Cosmopteridgidae	*Hyposmocoma* sp.('burrito type'). Notes: Endemic. Distribution unknown, likely common in substrate type
Pahoeohoe rocks Photo 2	Araneae/Lycosidae (Wolf spiders)	*Lycosa* nr. *hawaiiensis.* Notes: Endemic. Distribution unknown, likely common in substrate type
Pahoehoe rocks in small lava tunnel Photo 3	Lepidoptera/Likely Noctuidae	N Likely *Agrotis* or *Peridroma* sp . Notes: Unknown origin, likely endemic; Evidence (frass) found in rock depression indicative of caterpillar feeding
Vaccinium reticulatum Ohelo plant	Psocoptera/Psocidae (Bark lice)	*Ptycta* sp. Notes: Endemic, Diverse genus (50+species) is found widely in many habits associated with variety of plants
Vaccinium reticulatum Ohelo plant, and in ant survey vials	Hemiptera/Lygaeidae (Seed bugs)	*Nysius lichenicola.* Notes: Endemic. Found commonly at high elevations on Ohelo and other host plants
Vaccinium reticulatum Ohelo plant	Lepidoptera/Unknown	Unknown. Notes: Found evidence (frass and webbing) of caterpillar feeding on fallen Ohelo leaves
Vaccinium reticulatum Ohelo plant	Hymenoptera/Bethylidae	*Sierola* sp. Endemic. Very speciose genus (likely many hundreds of species, ~180 described), arthropod parasitoids
Dubautia scabra	Hymenoptera/Vespidae	*Nesodynerus* sp. Endemic. Ground nesting mud-wasps that feed on microlepidoptera

Photo 1. *Hyposmocoma* sp. web/dirt case

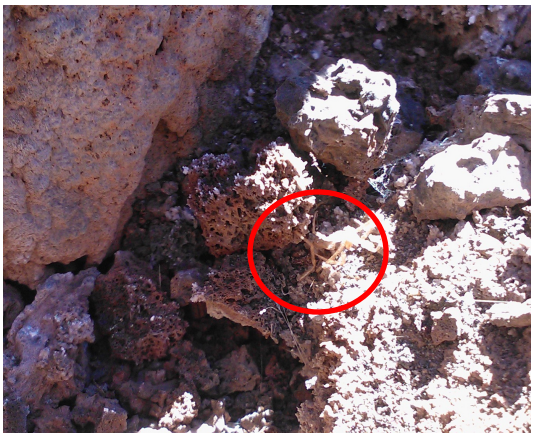

Photo 2. *Lycosa* sp. spider skin-molt

Photo 3. Lepidoptera frass. Likely Noctuid caterpillar feeding on lichens

HI-SEAS Habitat Project

Environmental Assessment

APPENDIX 3
Archaeological Survey and SHPD Correspondence

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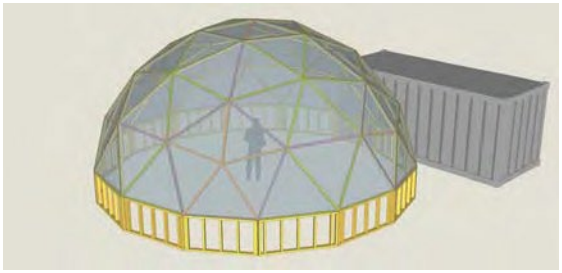
RC-0817

Archaeological Assessment Survey
HI-SEAS/PISCES Mars Habitat Project

(TMK: 3-3-8-01:001 por.)



Humu‘ula Ahupua‘a
North Hilo District
Island of Hawai‘i

DRAFT VERSION

PREPARED BY:

Robert B. Rechtman, Ph.D.

PREPARED FOR:

Kim Binsted
Department of Information and Computer Sciences
University of Hawai‘i at Mānoa
1680 East-West Rd.
Honolulu, HI 96822

January 2013

RECHTMAN CONSULTING, LLC
507-A E. Lanikaula St. Hilo, Hawaii 96720
phone: (808) 969-6066 fax: (808) 443-0065
e-mail: bob@rechtmanconsulting.com
ARCHAEOLOGICAL, CULTURAL, AND HISTORICAL STUDIES

RC-0817

Archaeological Assessment Survey
HI-SEAS/PISCES Mars Habitat Project

(TMK:3-3-8-01:001 por.)

Humu‘ula Ahupua‘a
North Hilo District
Island of Hawai‘i

RECHTMAN CONSULTING

CONTENTS

FIGURES

INTRODUCTION

At the request of Kim Binsted, Ph.D. with the Department of Information and Computer Sciences at the University of Hawai‘i at Mānoa, Rechtman Consulting, LLC conducted an archaeological survey of the area encompassing and surrounding a proposed temporary experimental site within an existing cinder quarry located at about 8,000 feet on the northeastern slope of Mauna Loa in Humu‘ula Ahupua‘a, North Hilo District, Island of Hawai‘i (Figure 1). The project site (about 0.5 acres) is located within a larger state-owned parcel (TMK:3-3-8-01:001) (Figure 2).

The University of Hawai‘i at Mānoa, in collaboration with Cornell University, and the Pacific International Space Center for Exploration Systems (PISCES), has proposed to construct and operate a temporary experimental research station on a volcanic landscape that closely resembles the surface of Mars. The research station will be a small, portable “habitat” structure similar to one that might be constructed for inhabiting Mars. The habitat facility will be a self-contained unit with sleeping quarters, a kitchen, a computer and lab workspace, and a bathroom, along with an accessory water tank and wastewater tank. All wastewater and biological waste will be contained for regular servicing and removal. Power will be supplied either by a solar power provider or an ultra-quiet and efficient LPG generator. The habitat structure would have about 900 square feet of floor space and be 20 feet in height or less and will be barely visible from any public vantage point, and not within the range of visual impact of any known historic property. Access to the location of the proposed research facility will be along a 1.3-mile existing graded and cindered road extending wet from Mauna Loa Road (Figure 3). In order to maintain the integrity of the experiments, the site will need to be isolated from access by the general public. To accomplish this, the existing access road would be gated and locked during the proposed five years of experimentation.

During the proposed five years of operation “astronauts” will conduct a variety of experiments focused on the operational and psychological issues space travelers might experience as they explore the solar system. The central experiment will focus on food needs during long-term planetary exploration missions. The University of Hawai‘i at Mānoa study, entitled Hawai‘i Space Exploration Analog and Simulation (HI-SEAS), will examine the tradeoffs (energy, effort, satisfaction, waste) between using pre-prepared meals versus meals that require some preparation. The habitat would be inhabited by a crew of six that will live and work under strict analog conditions, only venturing outside in simulated space suits and communicating with “Earth” via channels disrupted by latencies and drop-outs, etc. These long-term analog missions will also offer an opportunity for other researchers, who will be invited to propose research studies to test their ideas in this environment. Upon termination of the project the habitat facilities will be removed and the site will be cleared of any and all debris leaving no trace of its former presence.

As this project proposes to use State-owned Conservation District land, an Environmental Assessment (EA) was prepared in compliance with Hawai‘i Revised Statutes Chapter 343. The Department of Land and Natural Resources–State Historic Preservation Division (DLNR-SHPD) provided review comments (DOC NO: 13 10SN01) on the draft EA and among other things, recommended that “an archaeological inventory survey be conducted of the undisturbed lands surrounding the proposed habitat,” and that this “survey should include the location of the proposed gate and any corridors along the existing road that could be affected by road improvements in connection with the construction and use of the facility.”

The current study was conducted pursuant to the DLNR-SHPD recommendation and was undertaken in accordance with Hawai‘i Administrative Rules 13§13–275; and performed in compliance with the Rules Governing Minimal Standards for Archaeological Inventory Surveys and Reports as contained in Hawai‘i Administrative Rules 13§13–276. According to 13§13-275-5(b)(5)(A) when no archaeological resources are discovered during an archaeological survey the production of an Archaeological Assessment report is appropriate. Compliance with the above standards is sufficient for meeting the historic preservation review process requirements of both the DLNR–SHPD and the County of Hawai‘i Planning Department.

In the pages that follow, this report provides a project area description; a brief discussion of prior archaeological studies, derived settlement patterns, and project area expectations; and the results of the field investigation of the current project area.

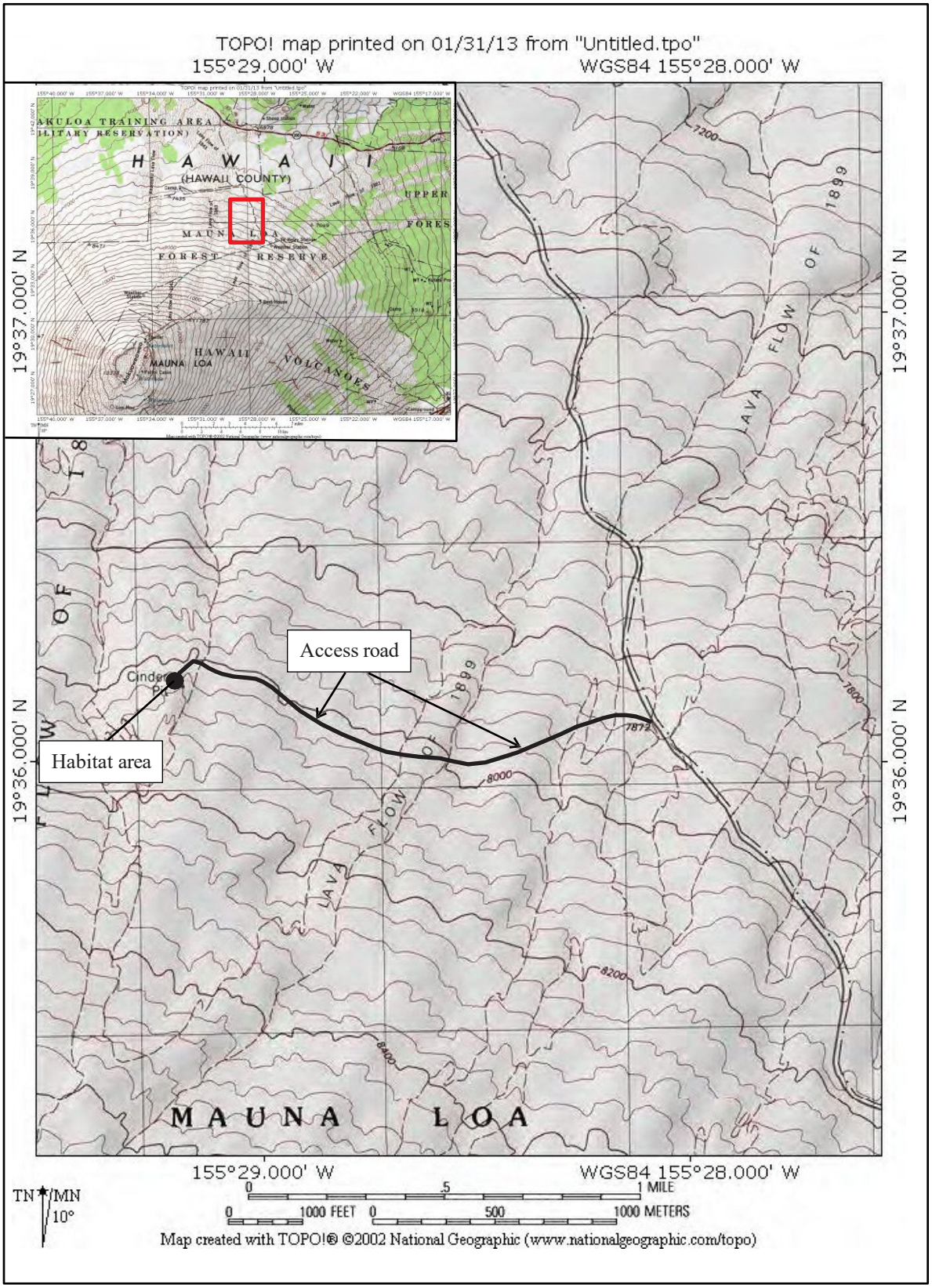


Figure 1. Study area location.

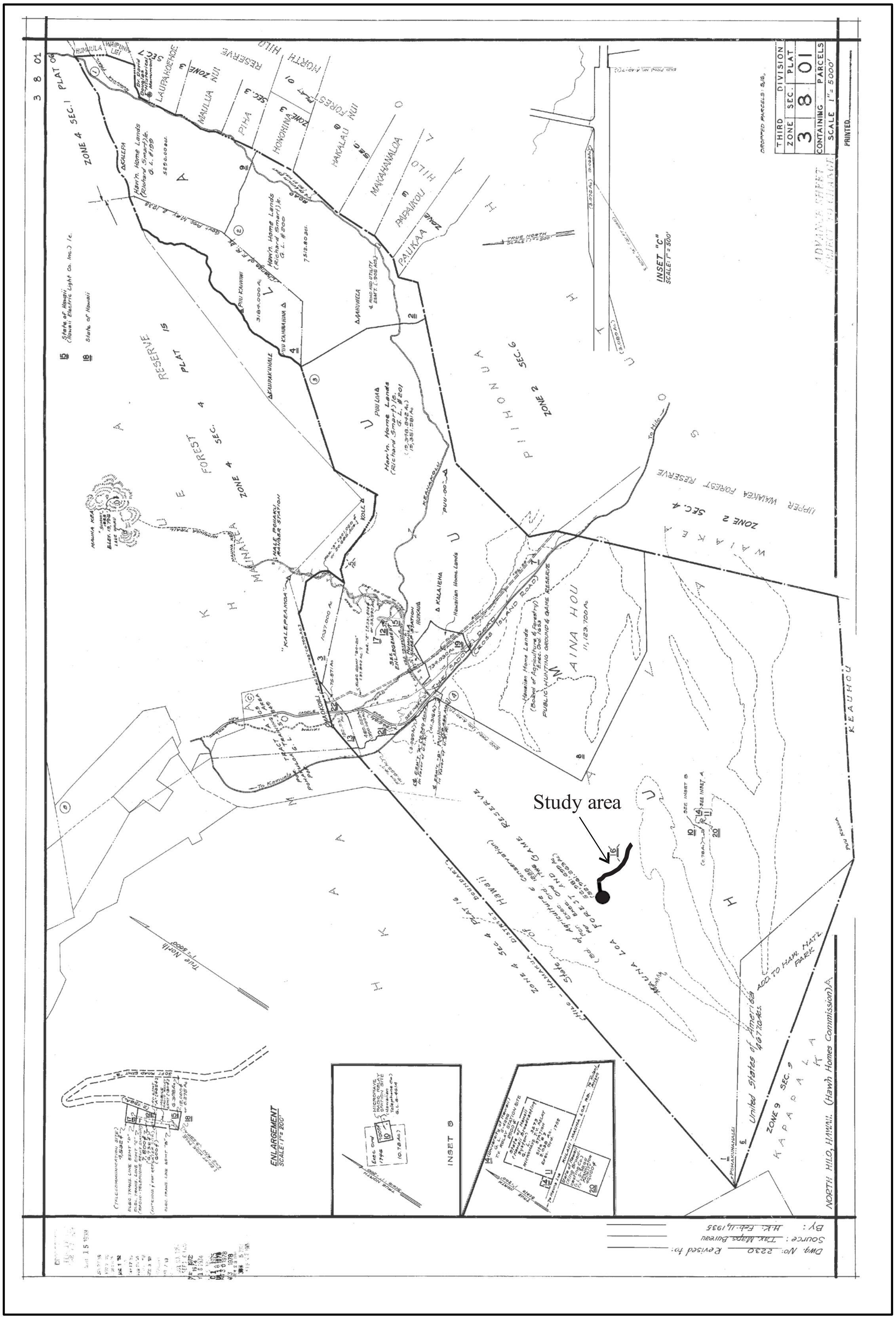


Figure 2. Tax Map Key: 3-3-8-01 showing location of study within Parcel 001.

Figure 3. Google Earth image of study area.

PROJECT AREA DESCRIPTION

The area proposed for the experimental habitat facility occupies less than 0.5 acres on an already leveled and mechanically disturbed volcanic cinder substrate (Figure 4) on the side of an elongated ridge of cinder/spatter cones (Figure 5) that were created during a Mauna Loa eruption dated from between 1,500 and 3,000 years before the present (Wolfe and Morris 1996). This area has been developed as a quarry for red cinder (Figure 6), and is accessed using a graded and cindered road (Figure 7) that in some areas is over 30 feet wide. There are several more recent lava flows dating between the 1840s and the 1930s that make-up the surrounding landscape that extends along the access road between the quarry and Mauna Loa Road (Figure 8). Vegetation within this area is considered spare at best with a few small clusters of the native shrubs *kupaoa* (*Dubautia scabra*), *pukiawe* (*Leptecophylla tameiameiae*) and *ōhelo* (*Vaccinium reticulatum*).

For the purposes of the current study, the area of investigation included a corridor encompassing the existing access road and mechanically altered roadway shoulders (the HI-SEAS/PISCES Mars Habitat Project does not anticipate having to make improvements to the access road beyond the current limits of the existing mechanically disturbed areas, including the placement of a security gate); the roughly 0.5 acre footprint of the proposed location of the temporary habitat and support facilities; and an area extending 100 meters in all directions surrounding the proposed location of the temporary habitat and support facilities.

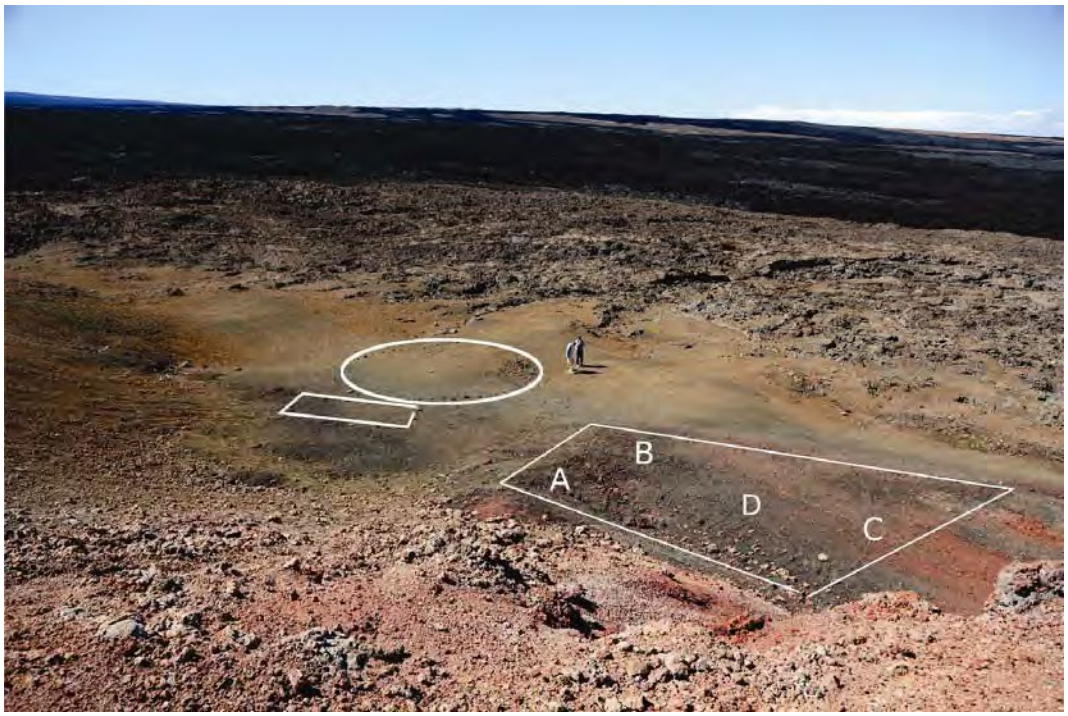


Figure 4. Proposed locations of "habitat" and support facilities; circle and rectangle are habitat structure and storage unit, A is water tank, B is septic tank, C is power system, D is storage unit.

Figure 5. Ridge of cinder cones that have been quarried.

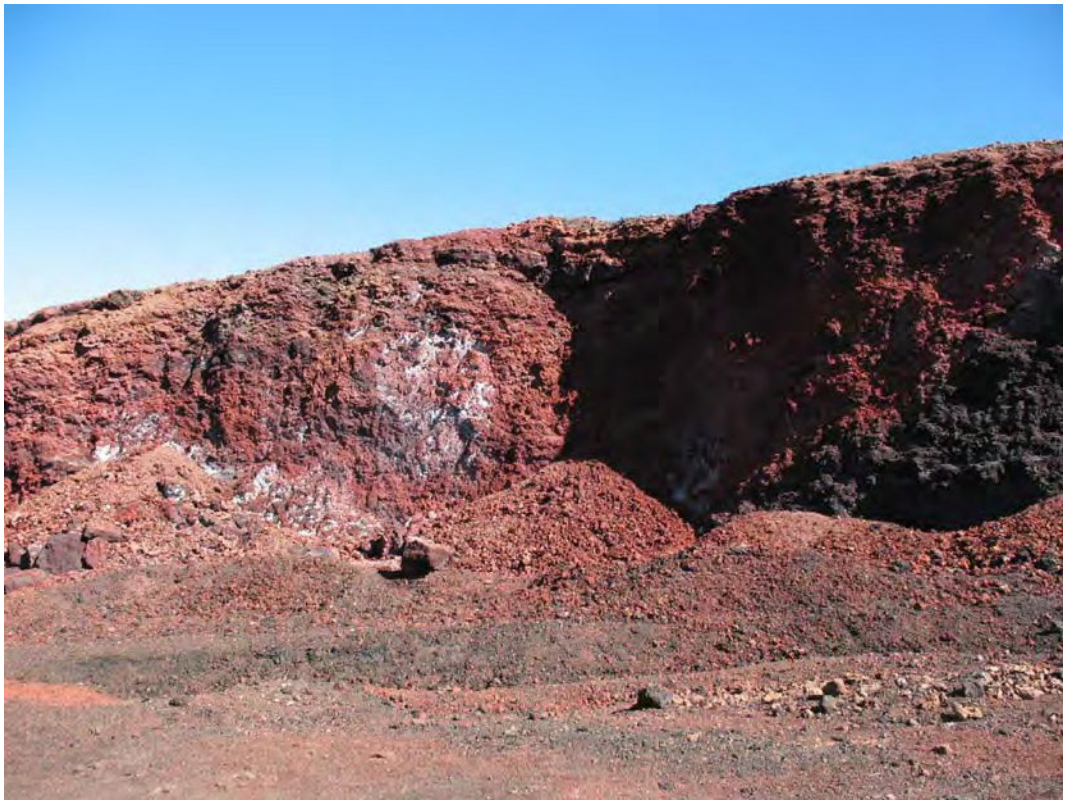


Figure 6. Red cinder quarry area.

Figure 7. Typical view of existing graded and cindered access road.

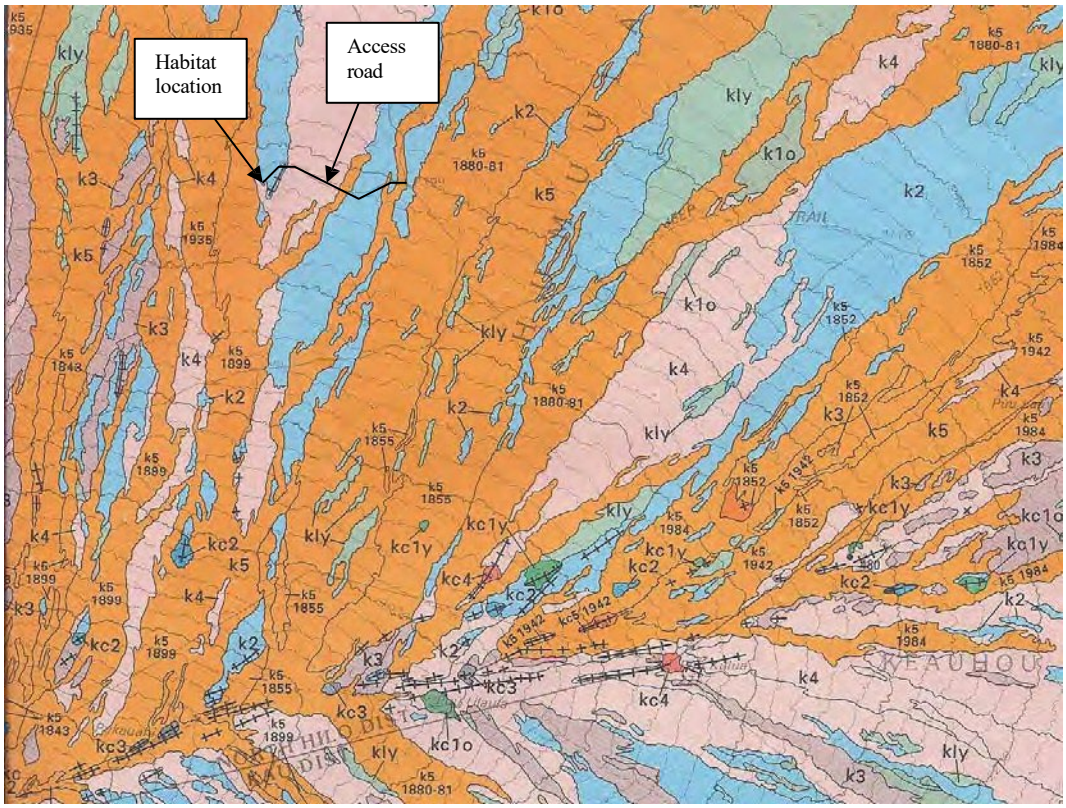


Figure 8. Portion of *Geological Map of the Island of Hawai'i* (Wolfe and Morris 1996).

PRIOR ARCHAEOLOGICAL STUDIES, SETTLEMENT PATTERNS, AND STUDY AREA EXPECTATIONS

In 2005, Rechtman Consulting, LLC completed an archaeological study (Rechtman 2005) in compliance with Section 106 of the National Historic Preservation Act for the then proposed improvement to Mauna Loa Road. That study area was a 125 feet (38 meters) wide corridor centered on the existing roadway extending from 6,500 feet to 11,200 feet elevation. Several lava tubes were encountered and explored; and four modern features, two cairns and two memorial markers, were identified. There were no archaeological features observed in the study corridor and none of the lava tubes contained cultural features or deposits.

In his regional synthesis of the Hāmākua District, Cordy (1994) summarizes and discusses Precontact and Historic land use patterns and the results of prior archaeological studies in what he terms the Interior Plateau Subregion; this summary and discussion is also applicable to the current study area in the upper portion of Humu‘ula Ahupua‘a in the North Hilo District. Citing legendary and historical sources, Cordy identifies two primary uses for this region, as a cross-island transportation corridor and as a resources area for obtaining birds. Major trail routes were ethnohistorically recorded and or made during the Historic Period that connected Ka‘ū, Kona, Waimea, and Hilo. While the locations of most of these are known outside of the current study area, it is possible that undocumented branches off of these trail/roads could be present in the current study area. Such trails were also used to access nesting areas of the *‘u‘au* (Petrel) and *nēnē* (Hawaiian Goose). Sources indicate that both of these bird species were seasonally plentiful in the upland region, and that exclusive rights to hunt/collect them from this area belong to certain *ahupua‘a* within each major island district (Athens and Kaschko 1988; Hommon and Ahlo 1983). Potential archaeological evidence of bird hunting/collecting on the slopes of Mauna Loa was documented during investigations at the United States Army Pōhakuloa Training Area to the northwest of the current study area (Athens and Kaschko 1988). Possible sites associated with this activity are *pāhoehoe* excavations and lava tube habitations, however, in the prior studies there were no such sites documented above the 6,500 elevation.

CURRENT FIELD INVESTIGATION

On January 29, 2013, Robert B. Rechtman, Ph.D. and Erik Hanson, B.A. conducted a surface survey of the entire area of investigation. The length of the existing roadway corridor from the proposed habitat location to Mauna Loa Road was walked and two alternative locations within the roadway corridor for the proposed security gate (see Figure 3, Figures 9 and 10) were examined. There were no archaeological resources observed anywhere within the existing roadway corridor. There were a few modern rock features observed adjacent to the roadway on its *mauka* side; these included: a fire ring (Figure 11), rock piles marking a road cut, a modified blister/hunting blind (Figure 12), and a square rock stacking (Figure 13). The area of the proposed habitat (see Figure 4) is within the quarry proper and has been completely mechanically leveled, thus no archaeological resources are present; and the 100 meter area surrounding the proposed habitat facility was likewise void of archaeological features. A single rock cairn (Figure 14) was observed in this latter area that was clearly modern, using quarried red cinder in its construction; and a small narrow lava tube (Figure 15), exposed by quarrying activity was also observed, explored, and found to be culturally sterile.

Given the negative findings of the current study, it is concluded that no historic properties will be affected by the HI-SEAS/PISCES Mars Habitat Project. If however, in the unlikely event that historic properties are inadvertently discovered during any of the activities associated with either the development or maintenance of the HI-SEAS/PISCES Mars Habitat Project, activity in the area of the discovery will be halted and DLNR-SHPD contacted immediately.

Figure 9. Location of Gate Alternative 1.

Figure 10. Location of Gate Alternative 2.

Figure 11. Modern fire ring on *mauka* side of access road near quarry.

Figure 12. Modern hunting blind area on *mauka* side of access road.

Figure 13. Modern square rock stacking on *mauka* side of access road.

Figure 14. Modern rock cairn using red cinder in along quarry ridge in greater habitat area.

Figure 15. Entrance to small non-cultural lava tube in greater habitat area.

REFERENCES CITED

Athens, S., and M. Kaschko
1988 Prehistoric Upland Bird Hunters: Archaeological Inventory Survey and Testing for the MPRC Project Area and the Bobcat Trail Road, Pohakuloa Training Area, Island of Hawaii. Draft IARII manuscript on file with the Department of Land and Natural Resources-State Historic Preservation Division, Kapolei, HI.

Cordy, R.
1994 *A Regional Synthesis of Hāmākua District, Island of Hawai'i*. Historic Preservation Division, Department of Land and Natural Resources, State of Hawai'i.

Hommon, R., and H. Ahlo, Jr.
l983 A Research Design for Archaeological Studies at the Pohakuloa Training Area, Island of Hawaii. Science Management, Inc. (Honolulu). Prepared for United States Army Corps of Engineers.

Rechtman. R.
2005 Request fro SHPO Concurrence with a Determination of No Historic Properties Affected Pursuant to the National Environmental Policy Act and in Compliance with Section 106 of the National Historic Preservation Act—Mauna Loa Road Improvement Project. Ka'ohe and Humu'ula *ahupua'a*, Hāmākua and North Hilo Districts, Island of Hawai'i. Rechtman Consulting Report RC-0268. Prepared for the United States Department of Commerce – National Oceanic and Atmospheric Administration, Mountain Administrative Support Center, Boulder, CO.

Wolfe, E.W., and J. Morris
1996 *Geological Map of the Island of Hawaii*. U.S. Department of the Interior, U.S. Geological Survey.

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

WILLIAM J. AILA, JR.
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

ESTHER KIA'AINA
FIRST DEPUTY

WILLIAM M. TAM
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

HISTORIC PRESERVATION DIVISION
DEPARTMENT OF LAND AND NATURAL RESOURCES

601 Kamokila Boulevard, Suite 555
Kapolei, HI 96806

March 4, 2013

Robert Rechtman, Ph.D.
Rechtman Consulting, LLC
507-A E. Lanikaula St.
Hilo, Hawai'i 96720

LOG NO: 2013.1749
LOG NO: 2013.0088
DOC.NO:1302SN04
Archaeology

Dear Dr. Rechtman:

SUBJECT: **Chapter 6E-8 Historic Preservation Review –**
Archaeological Assessment Report for the HI-SEAS/PISCES Mars Habitat Project
Humu'ula Ahupua'a, North Hilo District, Island of Hawai'i
TMK: (3) 3-8-001:001 (por.)

Thank you for the opportunity to review your document titled *Archaeological Assessment Survey HI-SEAS/PISCES Mars Habitat Project, Humu'ula Ahupua'a, North Hilo District, Island of Hawai'i, TMK: (3) 3-8-001:001 (por.)* (Rechtman January 2013). This document was received in our Hilo office on February 5, 2013. It was prepared for the University of Hawai'i as lead State Agency pursuant to Hawaii Revised Statues, Chapter 343. Based on the submitted documents, the project seeks to build a temporary experimental site called a "habitat" on 0.5 acres of a previously disturbed and quarried cinder cone. The site is located on State of Hawai'i land and is within a Conservation District within the Mauna Loa Forest Reserve. The project is a collaboration between the Department of Information and Computer Sciences at the University of Hawai'i at Mānoa, Cornell University, and the Pacific International Space Center for Exploration Systems (PISCES). The assessment was conducted in response to a letter dated January 11, 2013 on the draft EA for the project that recommended an archaeological inventory survey of the undisturbed areas surrounding the project area, including access road improvements and the gate installation area (Log 2013.3704, 2012.3826, Doc. 1301SN01).

As recommended in our previous review, the perimeter surrounding the project area was included in this current survey and a 100 m area surrounding the proposed habitat was surveyed for the presence or absence of historic properties. The survey identified several rock features along the roadway that were determined to be modern in construction. These included a fire ring, rock piles marking a road cut, a square rock feature, and a modified lava blister that was determined to be a modern hunting blind. Within the area surveyed for the proposed habitat, a single rock cairn, again determined to be of modern construction and a lava tube was observed; upon inspection it was found to be culturally sterile. The area of proposed construction has been completely impacted by quarrying activities and no surface archaeological features were visible. The survey found Based on the information submitted, SHPD believes that **no historic properties will be directly affected** by this project.

This archaeological assessment report fulfills the requirements of as Hawaii Administrative Rule (HAR) 13§13-275-5(b)(5)(A) and it is accepted by SHPD. Please send one hard copy of this report, clearly marked FINAL, and an electronic version on CD to the Kapolei office, attention SHPD Library. Please contact Sean P. Naleimaile (808) 933-7651 or Sean.P.Naleimaile@hawaii.gov if you have any questions or concerns regarding this letter.
Aloha,

Theresa K. Donham, Archaeology Branch Chief

cc: Mr. Ron Terry rterry@hawaii.rr.com
Dr. Kim Binstead, binsted@hawaii.edu

HI-SEAS Habitat Project

Environmental Assessment

APPENDIX 4
Forest Reserve Special Use Permit (2019)

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GOVERNOR OF HAWAII

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STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF FORESTRY AND WILDLIFE
19 EAST KAWILI STREET
HILO, HAWAII 96720
PHONE: (808) 974-4221 FAX: (808) 974-4226

PERMIT FOR ACCESS, COLLECTING AND RESEARCH

****Permit and Attachment must be in investigators possession at all times while on the property.****

PERMISSION IS GRANTED TO:
Dr. Kim Binsted
HI-SEAS/PISCES Mars Habitat Project

FOR THE FOLLOWING PURPOSE: Construct and manage an experimental science facility to simulate Mars habitat.

LOCATIONS(S): Mauna Loa Forest Reserve; in the old quarry site off of Mauna Loa Access Rd.

FOR THE PERIOD: March 31, 2019- March 30, 2021 (renewal of 2017 permit)

SPECIAL CONDITIONS:

- **Hunting, open fires, and littering is prohibited**.
- **Motor vehicles shall be used only on established roadways**.
- Vehicles shall be parked so as not to block traffic on access roads and shall not park in vegetated areas. Only 4-wheel drive vehicles will be allowed. ATVs and OHVs are not allowed outside of the quarry area or off the established roads.
- All rubbish and solid waste produced by the facility will be removed from the site and disposed of in a proper waste disposal facility.
- The permittee shall comply with all applicable Department of Health administrative rules. Potable water and sanitation facilities shall have the approval of the Dept. of Health and the County Dept. of Water Supply.
- All fuel, generators and other motorized equipment, shall be stored in a manner that fuel
- leaks are contained, to prevent contamination of the soil on the site.
- The consumption of alcoholic beverages is prohibited in all forest reserves.
- Best management practices shall be employed to avoid excessive soil erosion on the site.

- A gate may be constructed 200 yards before the quarry site to keep the public from driving into the project area.
- At the conclusion of the project the permittee shall completely remove the Mars Habitat Structure and all associated buildings and containers from the project area and will return the site to its original natural condition as described in the Final Environmental Assessment report.
- Permit is not transferable.
- The removal, injury, killing, or any unnecessary disturbance of native flora and fauna is prohibited.
- The permittee shall notify DOFAW in writing when construction activity is initiated and when it is completed.
- All field personnel should be trained to recognize rare plant species and should avoid trampling native vegetation. Permittee must notify DOFAW (in writing) of the location of any threatened or endangered plants, birds, bats, or insects encountered in the project area.
- Provision of Chapters 183, 185, and 195, Hawaii Revised Statutes, 1985, as amended, and any other laws applicable thereto, and all rules and regulations of the Department of land and Natural Resources shall be strictly observed. Infractions or misconducts will constitute grounds for revocation of this permit and criminal prosecution. Any person whose permit has been revoked shall not be eligible to apply for another permit until the expiration of two years from the date of revocation.
- The Permittee waives any and all claims he may have against the State of Hawaii and its respective officers, agents and employees, and agrees to hold harmless and indemnify the State of Hawaii and its respective officers, agents and employees, from any suits, actions and claims arising out of or in any way connected with the activities allowed under this permit.
- This Access Permit is revocable and terminable at any time, for violations of the conditions of the special use permit, in the sole and absolute discretion of the Hawaii Branch Manager.

_____ _____

Dr. Kim Binsted
University of Hawaii, HI-SEAS/PISCES

Date

APPROVED BY: Steven T. Bergfeld 3/4/19

Steven T. Bergfeld
Hawaii Branch Manger

Date of Issue: 3/4/19

cc: DOCARE