University of Hawai‘i
Institute for Astronomy

Haleakalā High Altitude Observatory Site
Haleakalā, Maui, Hawai‘i

Management Plan

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EXECUTIVE SUMMARY

This Management Plan (MP) for the University of Hawai‘i (UH) Institute for Astronomy (IfA) Haleakalā High Altitude Observatory Site (HO) is in accordance with Hawai‘i Administrative Rules (HAR) Chapter 13: Department of Land and Natural Resources (DLNR), Subtitle 1: Administration, Chapter 5: Conservation District, where this document is implemented to regulate land use in the Conservation District for the purpose of conserving, protecting, and preserving 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. This MP was also prepared according to Exhibit 3 in HAR 13-5. “Management plan”, as defined in HAR 13-5-2, means a comprehensive plan for carrying out multiple land uses (HAR §13-5-2).

HO is not a multiple land use property. HO is a single land use parcel that is not open to the general public. This MP replaces the management planning policies and practices in the University of Hawai‘i Institute for Astronomy Haleakalā High Altitude Observatory Site Long Range Development Plan (LRDP). While the long range planning aspect of the LRDP is current, the management plans for HO that were included in the LRDP are superseded by the more comprehensive management plans in this MP.

The MP describes the proposed land use for HO and how it is consistent with the purpose of the Conservation District and General Subzone. The MP provides a tax map key, a map showing the HO site and adjacent properties, and an aerial photo annotated with the existing facilities within HO.

The ownership of the property is explained with respect to the Executive Order (EO) 1987 that established HO in 1961. EO 1987 has no expiration date. Details are provided on the natural resources at the site, including plants, wildlife, endangered species, cultural, historic, and archeological resources, and visual resources; as well as the constraints for access to the site. The existing land uses are described, including the history of the facilities at HO and a description of the currently active facilities. A list of existing Conservation District Use Permits (CDUPs) for HO is also provided.

The proposed land use is within the 18.166-acre HO site, where facilities observe the Sun, provide a world-class telescope for education and research outreach to students all over the world, use lasers to measure the distance to satellites, track and catalogue man-made objects, track asteroids and other natural potential space threats to Earth, and obtain detailed images of spacecraft. It is a principal site for optical and infrared surveillance, inventory and tracking of space debris, and active laser illumination of objects launched into Earth orbit, activities that are all crucial to the nation’s space program. Under this MP, this land use would continue with current operations, new scientific experiments and research, and new facilities would be developed as appropriate. The Site Plan would be unchanged from the 18.166 acres currently designated for “…Haleakalā High Altitude Observatory Site purposes only” under EO 1987. Further justification is presented for the above land use within the subzone and its relationship to the existing land use.

Monitoring strategies are presented to ensure the protection of cultural, historic, and archeological resources through policies, practices, and procedures developed in consultation with Native Hawaiian practitioners, agencies, interested individuals, and the Maui community, to ensure that historic preservation concerns are met. Monitoring strategies are also presented to prevent introduction of alien invasive species (AIS), to protect endangered species, and to educate all workers and contractors as to the potential impacts of construction and operations on the cultural and biological resources. Monitoring for construction practices to protect all resources at the site is described. Finally, the MP imposes certain design criteria on new facilities to minimize inappropriate design elements within the natural environment at the summit.

The effective time duration for this MP shall be for an initial term of one decade, beginning December 1, 2010, and ending on November 30, 2020, and may be extended if appropriate. An annual reporting schedule is established, along with annual reporting requirements.

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1.0 GENERAL DESCRIPTION

MANAGEMENT PLAN

This Management Plan (MP) for the University of Hawai‘i (UH) Institute for Astronomy (IfA) Haleakalā High Altitude Observatory Site (HO) is prepared in accordance with Hawai‘i Administrative Rules (HAR) Chapter 13: Department of Land and Natural Resources (DLNR), Subtitle 1: Administration, Chapter 5: Conservation District, where this document is implemented to regulate land use in the Conservation District for the purpose of conserving, protecting, and preserving 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. This MP was prepared according to Exhibit 3 in HAR 13-5.

“Management Plan” as defined in HAR 13-5-2 means a comprehensive plan for carrying out multiple land uses (HAR §13-5-2). HO is not a multiple land use property. HO is a single land use parcel and is not open to the general public.

The Chapters and Sections of this MP are outlined in accordance with HAR 13-5, Exhibit 3: Management Plan Requirements, September 6, 1994.

HALEAKALĀ HIGH ALTITUDE OBSERVATORY SITE

In 1961, Executive Order (EO) 1987 issued by Hawaii’s Governor Quinn to UH set aside 18.166 acres of land on the summit of Haleakalā to establish the HO site. EO 1987 has no expiration date. This area of the Conservation District was set aside for “…Haleakalā High Altitude Observatory Site purposes only” (EO 1987). Since then, consistent land uses for HO include the numerous facilities conducting astronomical research and advanced space surveillance that exist within the property boundaries. Other agencies established facilities adjacent to HO through EO during the same period.

The UH IfA is the steward of the 18.166 acres of land designated as HO and is responsible for managing and developing the property. HO is a preeminent state, national, and international resource for astronomical and related studies. In order to continue in the forefront of astronomy, UH must provide high-quality research and training facilities, and place special emphasis on programs that have distinctive attributes, while maximizing both the educational and scientific benefits for UH and the State of Hawai‘i. It is important that these goals be achieved while preserving, protecting, integrating, and balancing significant and unique cultural and natural resources and educational and research values on Haleakalā.

Presently, facilities located within HO observe the Sun, provide a world-class telescope for education and research outreach to students all over the world, use lasers to measure the distance to satellites, track and catalogue man-made objects, track asteroids and other natural potential space threats to Earth, and obtain detailed images of spacecraft. It is a principal site for optical and infrared surveillance, inventory and tracking of space debris, and active laser illumination of objects launched into Earth orbit, activities that are all crucial to the nation’s space program.

HO LONG RANGE DEVELOPMENT PLAN - http://www.ifa.hawaii.edu/haleakala/LRDP/

The IfA Long Range Development Plan (LRDP) for the HO site is a publicly vetted document. In broad terms, the LRDP describes the general environmental, cultural, and historic conditions, and the site characteristics that guide future development. It also describes the principles that define the scientific programs that the UH strives to maintain and develop at HO and the potential new facility developments that will keep the UH in the forefront of astronomy into the next decade. In order to describe and to protect this resource, while accommodating the growing need for public scrutiny and partnering in its astronomical planning, the IfA planning process for long-range development takes into consideration the environmental, cultural, and historic importance of Haleakalā. The LRDP also includes discussion of possible locations for future development within the HO property.

Following the review process used for environmental documents, the LRDP was distributed to State of Hawai‘i and County of Maui entities, the National Park Service (NPS), the U.S. Air Force, community associations, individuals, and Maui public libraries. Notice of release of the draft LRDP was also published in the local newspaper, the *Maui News*. The draft LRDP had an extended, nine-month, public comment period. Therefore, one intention for the LRDP had been to provide a vehicle for consulting with the greater Maui community, Upcountry organizations, and individuals concerned about development, as well as Native Hawaiian interests.

While the long range planning aspect of the LRDP is current, the management plans for HO that were included in the LRDP are superseded by the comprehensive management plans in this MP.

1.1 Proposed Land Use In General Terms

In 1961, the State Land Use Law (Act 187), codified as HRS, Chapter 205, established the State Land Use Commission (LUC) and granted the LUC the power to zone State lands into one of three districts: Agriculture, Conservation, and Urban. Act 187 vested the DLNR with jurisdiction over the Conservation District.

The objectives of the State 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. This area of the Conservation District has been set aside for astronomical research, and many facilities conducting astronomy and advanced space surveillance already exist within the HO area.

The DLNR formulated subzones within the Conservation District and regulates land uses and activities therein. Figure 1-1 is a subzone map from the Office of Conservation and Coastal Lands (OCCL) website. Conservation District Subzone designations regulated by the DLNR are Protective, Limited, Resource, General, and Special. Since 1964, the Board of Land and Natural Resources (BLNR) has adopted and administered land use regulations for the Conservation District.

“Subzone” means a zone established within the Conservation District, which is identified by boundaries and resource characteristics (HAR 13-5-2). The objectives of the General Subzone are to designate open space where specific conservation uses may not be defined, but where urban uses would be premature.

In 1961, an EO by Hawaii’s Governor Quinn set aside 18.166 acres of land on the summit of Haleakalā in a place known as Kolekole to be under the control and management of the Board of Regents of the University of Hawai‘i. The site is known as HO and UH is the owner of the parcel. The IfA is responsible for managing and developing the land. The EO has no expiration date.

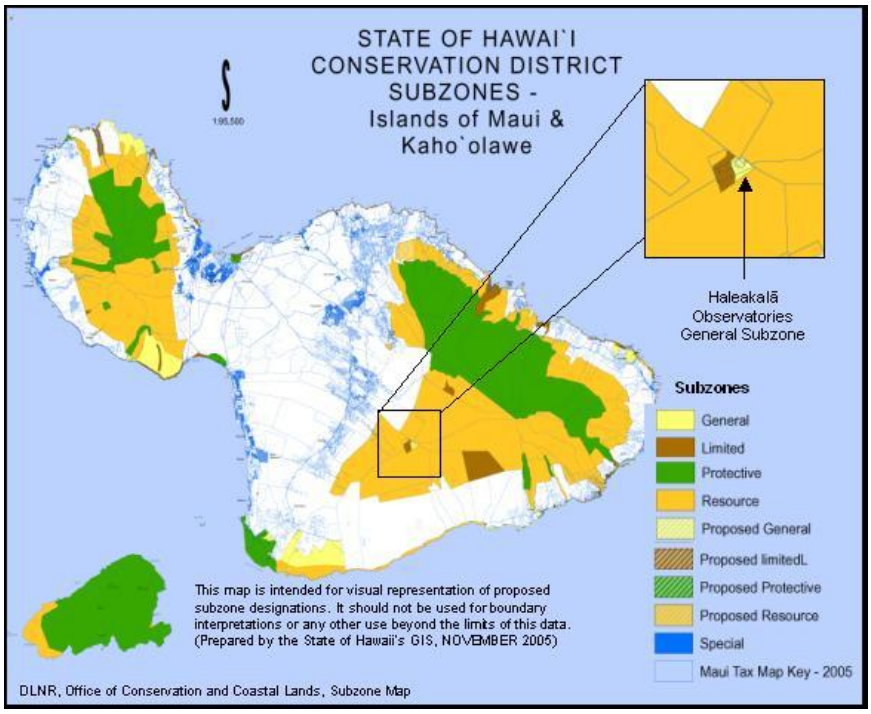


Figure 1-1. Island of Maui Conservation District Subzones Showing HO in General Subzone.

1.2 Land Use Consistent with the Purpose of the Conservation District and the Property's Subzone

HO is located within a General Subzone of the State of Hawai‘i Conservation District that has been set aside for astronomical research (Fig. 1-1). The objectives of the General Subzone (HAR Chapter 13-5-14) are to designate open space where specific conservation uses may not be defined, but where urban uses would be premature. Identified applicable land uses in the General Subzone include R-3 Astronomy Facilities, (D-1) Astronomy facilities under an approved management plan (HAR 13-5-25).

1.3 Location Map

The land designated and assigned to UH in 1961 for scientific purposes via EO 1987 is located on State of Hawai‘i land within the Conservation District and General Subzone, on Pu‘u Kolekole, near the summit of Haleakalā, about 0.3 miles from the highest point, Pu‘u Ula‘ula (Red Hill) Overlook, which is in Haleakalā National Park (HALE). Figure 1-2 shows the Tax Map Key (2) 2-2-07-008. At an elevation of 10,023 feet above sea level (ASL), Haleakalā is one of the prime sites in the world for astronomical and space surveillance activities. The Kolekole cinder cone lies near the apex of the Southwest rift zone of the mountain. The rift zone forms a spine separating the Kula Forest Reserve from the Kahikinui Forest Reserve, both of which are pristine lands along the rift zone.

Other agencies established adjacent facilities through EO during the same period. Figure 1-3 shows the HO site and the adjacent properties. Figure 1-4 shows an annotated aerial view of HO.

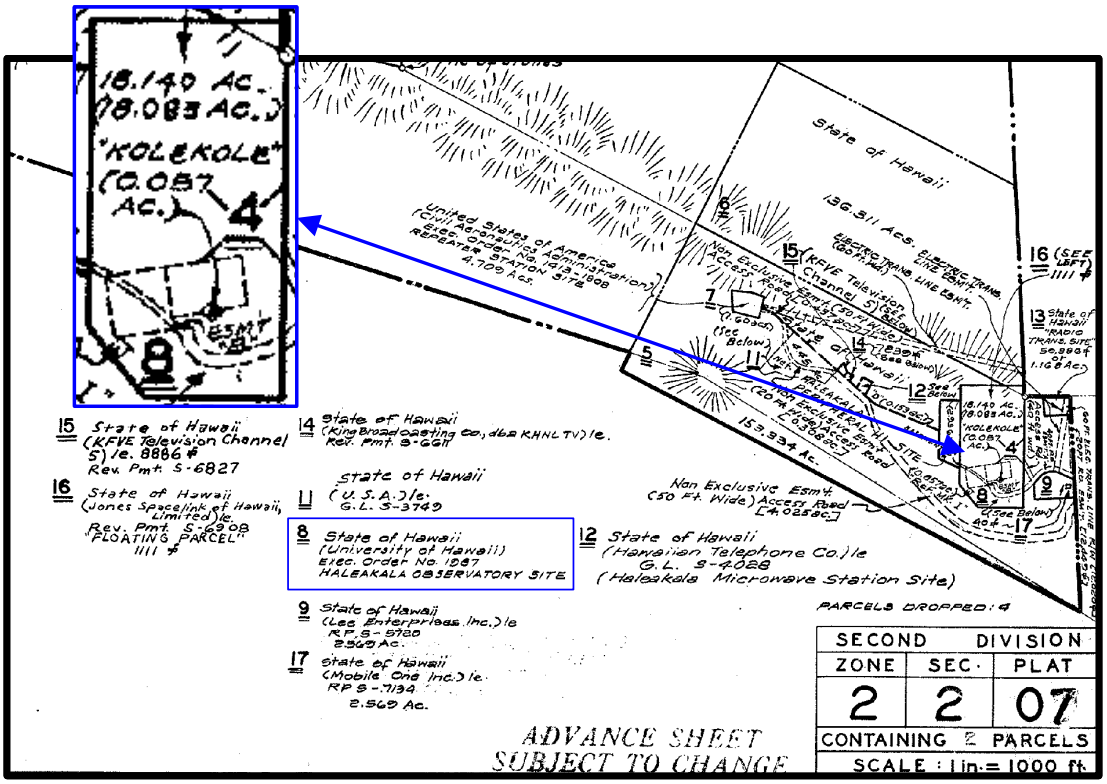
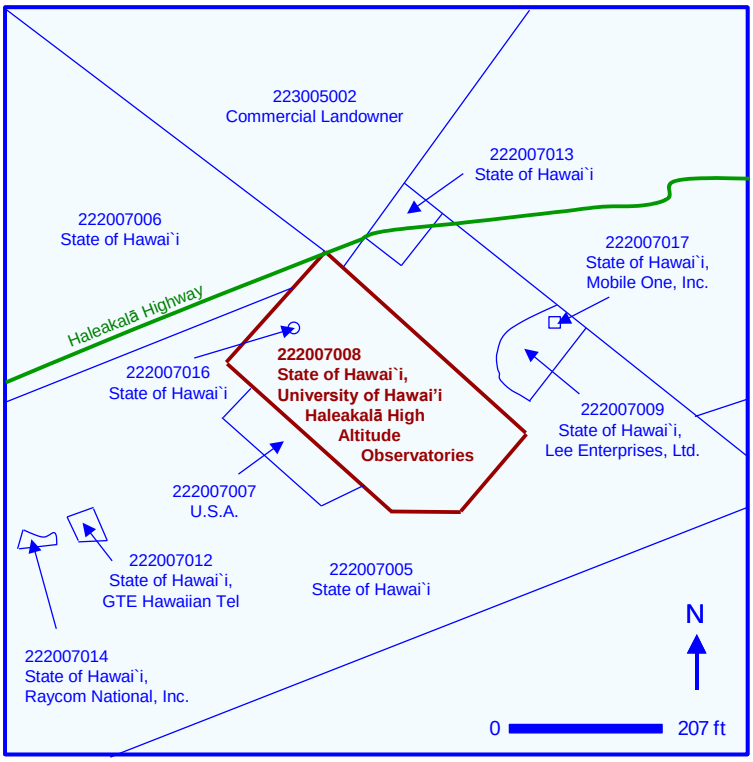


Figure 1-2. Tax Map Key Showing HO.



Internet website: http://kivanetext.co.maui.hi.us/kivanet/2/permit/index.cfm

Figure 1-3. HO Site and Adjacent Properties.

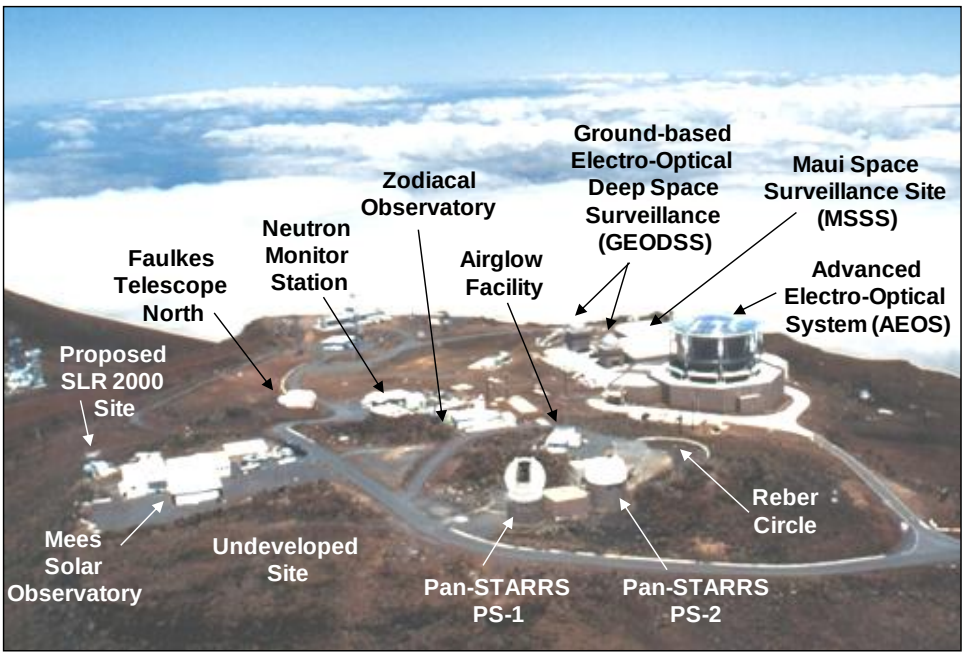


Figure 1-4. Aerial View of HO.

2.0 EXISTING CONDITIONS ON PARCEL

2.1 Ownership

In 1961, an EO by Governor Quinn set aside 18.166 acres of land on the summit of Haleakalā in a place known as Kolekole. The site is known as HO. UH is the owner of the parcel, under the control and management of the UH Board of Regents for observatory site purposes only. The EO has no expiration date.

HO is located in the area of the State of Hawai‘i Conservation District that has been set aside for astronomical research (HAR 13-5-25: Identified land uses in the General Subzone, R-3 Astronomy Facilities, (D-1) Astronomy facilities under an approved management plan); and many facilities conducting astronomy and advanced space surveillance already exist within HO.

2.2 Resources

The following sections describe the natural resources currently found at HO. “Natural resource” means resources such as plants, aquatic life and wildlife, cultural, historic and archeological sites and minerals (HAR 13-5-2, Definitions).

2.2.1 Cultural and Historic Resources

According to o‘mana‘o (remembrances, recollections) of many Native Hawaiians interviewed for the recent cultural impact assessments, for the ancient Native Hawaiians, Haleakalā — which includes the Kolekole area on which HO resides — is considered a piko (the navel, or center of Maui Nui a Kama (Greater Maui). It is a Pu‘u Honua (sacred refuge, or place of peace), which Hawaiian ancestors believed was a Wao Akua, or place where gods and spirits walk. The cultural resources of Kolekole date back more than a thousand years and are an integral part of the Hawaiian culture, both past and present. In

ancient times, commoners could not even walk on the summit because it belonged to the gods. The sacred class of na poāo kāhuna (priest) used the summit area as a learning center. It was a place where the kāhuna could absorb the tones of ancient prayer and balance within the vortex of energy, for spiritual manifestations, the art of healing, and the study the heavens for navigation purposes. Kolekole itself was a very special religious place used by the kāhuna poʻo (head priest) as a training site in the arts. There are numerous gods and goddesses said to reside on the summit, in the crater, and all around the mountain. (CKM 2006).

Planning and management for scientific development at HO must be conducted with an understanding of, and a respect for, the connection and delicate balance between the Native Hawaiians, the āina (land), and the ocean from which it was born.

A Cultural Resource Survey (CKM 2003), a Traditional Practices Assessment (CKM 2002), and an archeological inventory (Fredericksen 2003), were completed in 2003 to address historic and cultural issues for long-range development planning at HO. A subsequent cultural resources study, Cultural and Historical Compilation of Resources Evaluation and Traditional Practices Assessment was conducted in 2006 (CKM 2006) as part of the environmental compliance process for the proposed Advanced Technology Solar Telescope (ATST) Project.

In 2007, Cultural Surveys Hawaiʻi, Inc. (CSH) was commissioned to conduct a Supplemental Cultural Impact Assessment (SCIA). The SCIA was performed in accordance with the guidelines for assessing cultural impacts, as set forth by the Office of Environmental Quality Control (OEQC 1997) and was intended to supplement the initial Cultural Resource Evaluation (CKM 2006) for the proposed ATST Project. The primary purposes of the SCIA were to widen community outreach and to gather additional information on the Traditional Cultural Property (TCP) of Haleakalā as an additional means to assess the potential effects of that particular proposed undertaking on Native Hawaiian traditional cultural practices and beliefs. Although the SCIA was conducted for a specific project, the preparers of the SCIA made an additional effort to gather supplementary information, community input, and knowledge of the summit area, and therefore, the information is relevant to the management of HO. The SCIA contains considerable additional historical perspective on Haleakalā. It discusses in great detail the symbology of the mountain, its role in the history of Maui as a living entity, as well as the archeological record. The information provided is intended to educate the reader about the spiritual sacredness and cultural relationship of Native Hawaiians to Haleakalā as a whole and to the summit area in particular.

This section briefly describes the results of those surveys and the numerous previous studies with respect to resources of cultural value and their significance, ancient traditional practices, and archeological sites in and around what is now HO.

Cultural Resources

Pele (goddess of fire), Poliʻahu (goddess of snow), Māui (the demi-god), and others inhabited the area. In Hawaiian lore, it is said that Māui stood with one foot on Kolekole and the other on Hanakauhi Peak when he lassoed the Sun.

Haleakalā Crater was used as a trans-Maui thoroughfare and source for basalt stones. There are specific teachings related by the kupuna (elder) that guided commoners who were permitted access for gathering stones and to bury the dead. Numerous archeological sites have been recorded on the crest and in the crater, including, in order of frequency, temporary shelters, cairns, platforms with presumed religious purposes, adze quarries and workshops, caves, and trails (Rosendahl 1978). These are all remnants of the very elaborate spiritual and cultural life that the Native Hawaiians focused around the summit area.

Within Kolekole, cultural resources of importance are: temporary habitation or wind shelters, two petroglyph images, one site interpreted as a possible burial, and two ceremonial sites (CKM 2003). The

sites are important in that they have yielded information on prehistory. Native Hawaiians know that this area, as a remnant of a Native Hawaiian landscape, provides significant cultural value because of its ceremonial and traditional importance.

Traditional Cultural Practices

During preparation of the Traditional Practices Assessment (CMK 2002), it was understood that due to the construction of former and existing buildings over the past 70+ years, much of the physical evidence of ancient Hawaiian traditional and cultural practices in the area was destroyed. The SCIA also provides information about Haleakalā as an important place where traditional cultural practices take place and several types of traditional cultural practices continue to take place, as listed and described below:

1. Gathering of plants
2. Traditional hunting practices
3. Collecting for basalt and tools
4. Pōhaku Pālaha – The Piko of East Maui
5. Traditional Birth and Burial Practices
6. Haleakalā as a Sacred Mountain
7. Ceremonial Practices, e.g., honoring the solstice or equinox
8. Astronomy
9. Travel

Gathering of Plants

Several plants have had and continue to have particular cultural importance. The SCIA reported that traditional gathering of plant resources continues to take place today within the upper elevations surrounding the summit (SCIA p. 102).

In the past, ʻōhelo berries (*Vaccinum sp.*) were traditionally offered to Pele by those who frequented the upper elevations of the mountainous regions (SCIA, p. 102). Today, upland hikers and those in transit often pick ʻōhelo berries as a food resource when found ripe. Another example of plant gathering is the collection of pūkiawe (*Syphelia tameiameiae*) and *lehua* blossoms used for lei making (SCIA, p. 102). The SCIA also reported that pūkiawe, lehua, māmane and other plants and flowers are used for this same purpose (SCIA, p. 102). The trunks and branches of the ʻaʻaliʻi (*Dodonaea viscosa*) and māmane (*Sophora chrysophylla*) were traditionally harvested and used for hale, or house, posts. Present day efforts have revived the construction of traditional structures, however, it is unknown at this time whether these plants are actively harvested (SCIA, p. 102). Māmane timber has also been traditionally used for weaponry, particularly spears; however, it is unknown whether modern craftsmen of traditional weaponry harvest this timber today (SCIA, p. 102). Pōpolo (*Solanum americanum*) leaves, which are also found along the upper elevations and summit of Haleakalā were traditionally used (and appear to continue to be used) in laʻau lapaʻau, or Hawaiian medicinal practices. Specifically, they have been used for alleviating sore tendons, muscles, and joints (SCIA, p. 102).

Hunting Practices

Traditional hunting of birds for food and feathers was documented at least 100 years ago (SCIA, p. 103). The ʻuaʻu (Hawaiian petrel, *Pterodroma phaeopygia sandwichensis*) was particularly sought after; they were considered to be very tasty, especially the nestlings, which were reserved for the exclusive enjoyment of the chief (SCIA, p. 103 and NPS 2008 Ethnographic Study, p. 36). In addition to the ʻuʻau and nēnē (*Nesochen sandvicensis*), the extinct flightless birds *Platochen pau* and *Branta hylobadisies*

were hunted. Hunting practices today include the hunting and taking of "deer, goats, pigs, pheasant, chukar partridges, francolin and other game birds has become a culturally- supported subsistence practice" (SCIA, p. 104). Feathers from some of the game birds "are highly prized for their use in hatbands (SCIA, p. 104).

Basalt Collection

One of the reasons people came to the mountain was to collect basalt for use in tool-making. Physical evidence from several archeological sites on the mountain seems to indicate that there were areas used for collection, reduction, and transport of basalt to lower elevations (NPS 2008 Ethnographic Study, p. 36). Evidence exists of areas where basalt was quarried that were used for "lithic workshops", which "are surface scatters of basalt debitage, with very few finished tools. This suggests that the scatters are related to reduction activities rather than sites where tools were used" (NPS 2008 Ethnographic Study, p. 36). Many of the lithic workshops are associated with cave shelters, structures, or natural rock formations (such as cliff faces) that would have afforded protection from inclement weather (NPS 2008 Ethnographic Study, p. 36).

Pōhaku Pālaha – The Piko of East Maui

Traditionally, Maui Island was separated into 12 moku, or districts during the time of the Aliʻi Kakaalaneo and under the direction of the Kahuna Kalaihaʻohiʻa (SCIA ref. Beckwith 1940:383). The western portion Maui Island, dominated by Mauna Eke, the range commonly referred to as the West Maui Mountains, was subdivided into three moku: Lāhaina, Kaʻanapali, and Wailuku. The eastern portion of Maui Island, dominated by Mauna Haleakalā, was subdivided into the remaining nine moku: Hāmākua Poko, Hāmākua Loa, Koʻolau, Hāna, Kīpahulu, Kaupō, Kahikinui, Honuaʻula, and Kula. There is a naturally circular stone plateau, referred to as Pālaha (SCIA ref. Sterling 1998:3), along the summit of Haleakalā where one ahupuaʻa from each moku, with the exception of Hāmākua Poko, originate. Pōhaku Pālaha (SCIA Fig ref), as it is commonly known today, is located on the northeast edge of Haleakalā Crater, at Lauʻulu Paliku and is considered as the piko (navel or umbilical cord [Pukui and Elbert 1986]) of east Maui (Mr. Timothy Bailey, personal communication (References omitted).

The term, *Pōhaku Pāloha*, is used to describe a place in the northeast corner of the crater. The origin of the term is complex, perhaps interpreted as smooth and flat, or flat rock, but essentially referring to a convergence point where eight of the nine districts of Maui meet, which is a unique spatial organization of the islands (NPS 2008 Ethnographic Study, p. 24). There are more prominent points on the mountain, e.g., Haleakalā Peak, which is the high point on the south rim of the crater, but the cultural significance of this location originates with the concept of a piko, or mouth, which has been described as that of an octopus (SCIA, p. 106) from which eight tentacles spread out over a rock, making it difficult to pry loose, in essence, they are stuck flat to the rock. The symbolic significance of the piko to Native Hawaiians as the center, or source life, would apply to this locus of interlocking districts, or moku (SCIA, p. 107).

Birth and Burial Practices

Native Hawaiians frequently buried their dead in the crater. In addition, the umbilical cords of newborns, or piko, were left in the crater as well. Burial sites have been identified in the crater and one possible burial feature has been described at HO (Fredericksen 2003). Haleakalā is vital to the birth and death life cycle for Native Hawaiians who were and continue to be maʻa (familiar or accustomed) to this place (SCIA, p. 103).

Haleakalā as a Sacred Mountain

There is much historical research, testimonies, and other views that Haleakalā is a sacred place. As such, those who view Haleakalā as sacred consider development of the summit area to be desecration. Different individuals explain this viewpoint in various terms, or as expressed by one Maui kupuna (elder), "[w]hen

a culture depends on these natural wonders of their environment for survival and reverence communications to a higher power than themselves, all care must be given to this practice" (SCIA, p. 105).

The summit area is referred to as Wao Akua and is considered to be the realm of the gods, and, as such, is a place to be revered. It is an area that is described to have been kapu, or restricted to all but the highest ranking of Native Hawaiians, such as their kāhuna, or priests. Even today, visitors "…must go in a sense of humbleness and in a sense of asking and in a sense of not disturbing unduly…" (SCIA, p. 106)

There is a protective instinct among Hawaiian people to properly care for Haleakalā, not just for themselves but for future generations. That care is expressed as a strong feeling for responsibility to prevent development on Haleakalā, rather than propose or agree to mitigation for the adverse cultural effects that may result from construction at the summit (SCIA, p. 106).

Ceremonial Practices

Most of the cultural rituals and ceremonies that may be practiced on Haleakalā are not known to the general public because they are kept secret for personal reasons or to maintain the integrity of particular rituals from generation to generation (SCIA, p. 107). This is not uncommon in the Hawaiian culture, and during consultations with Native Hawaiians only a few specifics of these practices have been shared (SCIA, p. 107). The best-known ritual to non-Native Hawaiians is the calling of the Sun, or "e ala e", which is a chant used to greet ancestors, kupuna, and [also] greet the Sun as it rises (SCIA, p. 107). Some consulted parties have shared other rituals that include such practices as annual pilgrimages to honor certain trees, conducting solstice ceremonies, visiting special sites at certain times of the year for offerings, and going to the summit for chanting. Certain times of the day, month, or year are considered important because at these times the Sun is at zenith. The zenith has particular significance in that there would be the greatest amount of hā, or spiritual breath that comes from above. For example, ceremonies at Leleiwi, about two miles from HO, have been described that involve the time when one's shadow is completely absent. These are described as being a time of hālāwai, or meeting, where everything in the world meets (Leleiwi is famous for "Specter of the Brocken", an unusual effect in which one can see his/her own shadow in the clouds surrounded by a rainbow, if the clouds are low and the Sun is behind the viewer. The hālāwai can also provide an opportunity to simply sit, with a sense of being with one's ancestors, doing what they did for generations (SCIA, p. 109).

Another example of the importance of Haleakalā for ritual practices is the ability to honor the Sun during the solstices and equinoxes in ways that are not possible at sea level. With visibility to the horizon over long distances, it is possible to see, for example, the Sun track across the sky and touch particular points around the summit, e.g., Puʻukukui. These practices essentially use Haleakalā as a calendar (SCIA, pp. 107-108).

Astronomy

As described in oli (chants) and the moʻolelo (stories) about the summit of Haleakalā, the area around Kolekole was used for a training ground in the arts of reading the stars and being one with the celestial entities above and was considered sacred because of its height and closeness to the heavens.

Astronomy has a very large role in the cultural importance of Haleakalā:

> Astronomical matters, both practical and ceremonial, may have been the basis for the most important activities at Haleakalā. All of the possible traditional names for the mountain are associated with tales of the demi-god Māui and his efforts to catch and slow the Sun. These tales involve two aspects, one is the perception of Haleakalā reaching to the sky, and the other is

> Haleakalā as a place where the observation of solar movement (that is, the marking of seasons) took place.

The recognition of Haleakalā as a place to study the Sun, astronomy, astrology, and the constellations continues into modern times (NPS 2008 Ethnographic Study, p. 31).

Travel

Haleakalā has long been recognized as a traditional traveling route through East Maui. Travel from one side of Maui Island to the other side often resulted in experiencing Haleakalā. The Kaupō and Ko'olau Gaps provided an excellent route to connect these two districts, and it traversed through the crater (NPS 2008 Ethnographic Study, p. 33). A trail once led from Nu'u (in Kaupō) directly up the steep southern flank of the mountain to the south rim of the summit of Haleakalā (NPS 2008 Ethnographic Study, p. 33).

In 2005, in recognition of the cultural importance of Haleakalā and in the spirit of hoʻoponopono (to "make right"), UH contracted Native Hawaiian stonemasons to erect a west-facing ahu (altar or shrine) (Fig. 2-1) within the HO set aside "Area A" for the sole reverent use of Native Hawaiians for religious and cultural purposes with the understanding that such use will not interfere with other uses and activities within HO (Fig. 2-2). A hoʻomahanahana (dedication or "warming" offering) was held, at which time the ahu was named Hinalaʻanui.

In 2006, in the spirit of makana aloha (gift of friendship) for a proposed project, UH contracted the same Native Hawaiian stonemasons to erect an east-facing ahu near the UH Mees Solar Observatory (MSO) site (Fig. 2-1), not within the HO set aside "Area A". Upon its completion, a hoʻomahanahana was held and the ahu was named Pāʻele Kū Ai I Ka Moku. Native Hawaiians are welcome to utilize these sites for reverent, religious and cultural purposes, on a non-interference basis with site activities.

As shown in oli (chants) and the moʻolelo (stories) about the summit of Haleakalā, the area around Kolekole was used for a training ground in the arts of reading the stars and being one with the celestial entities above, by the Kahuna Poʻo (High Priest). This site was sacred to them because of its height and closeness to the heavens.

Evidence of sacred use found within HO includes koʻa (ceremonial rock formations) and temporary habitation shelters. These may have been used for ceremonies by the priesthood during Makahiki festivals. In ancient times, the moʻolelo tells of kāhuna and their haumāna (students) living at Haleakalā and conducting initiation rites and practices. Traditional accounts also exist of the use of Haleakalā in rites of passage such as birth and death. Haleakalā's connection to a symbolic rebirth is reflected in the traditional Hawaiian practice of piko storing. A pit at Haleakalā named Na Piko Haua was still being used by Kaupo residents in the 1920s to store their offspring's umbilical cords (Krauss 1988).

Haleakalā has long been recognized as a traditional traveling route thru East Maui. In the sixteenth century, Kihapiʻilani, Aliʻi nui (high chief) of a united Maui constructed a trail around the island and over Haleakalā, uniting the politically important districts of Hana and Kaupo with West Maui. Peoples of Honuaʻlua buried their dead in Haleakalā Crater (Handy and Handy 1972). Several references specify burials of both chiefs and commoners in Haleakalā Crater (SCIA ref. Kaʻaiʻe, Kamakau; in Sterling, 1998:264-265), and one possible burial is recorded on the northwest boundary of HO property (Fredericksen 2003).

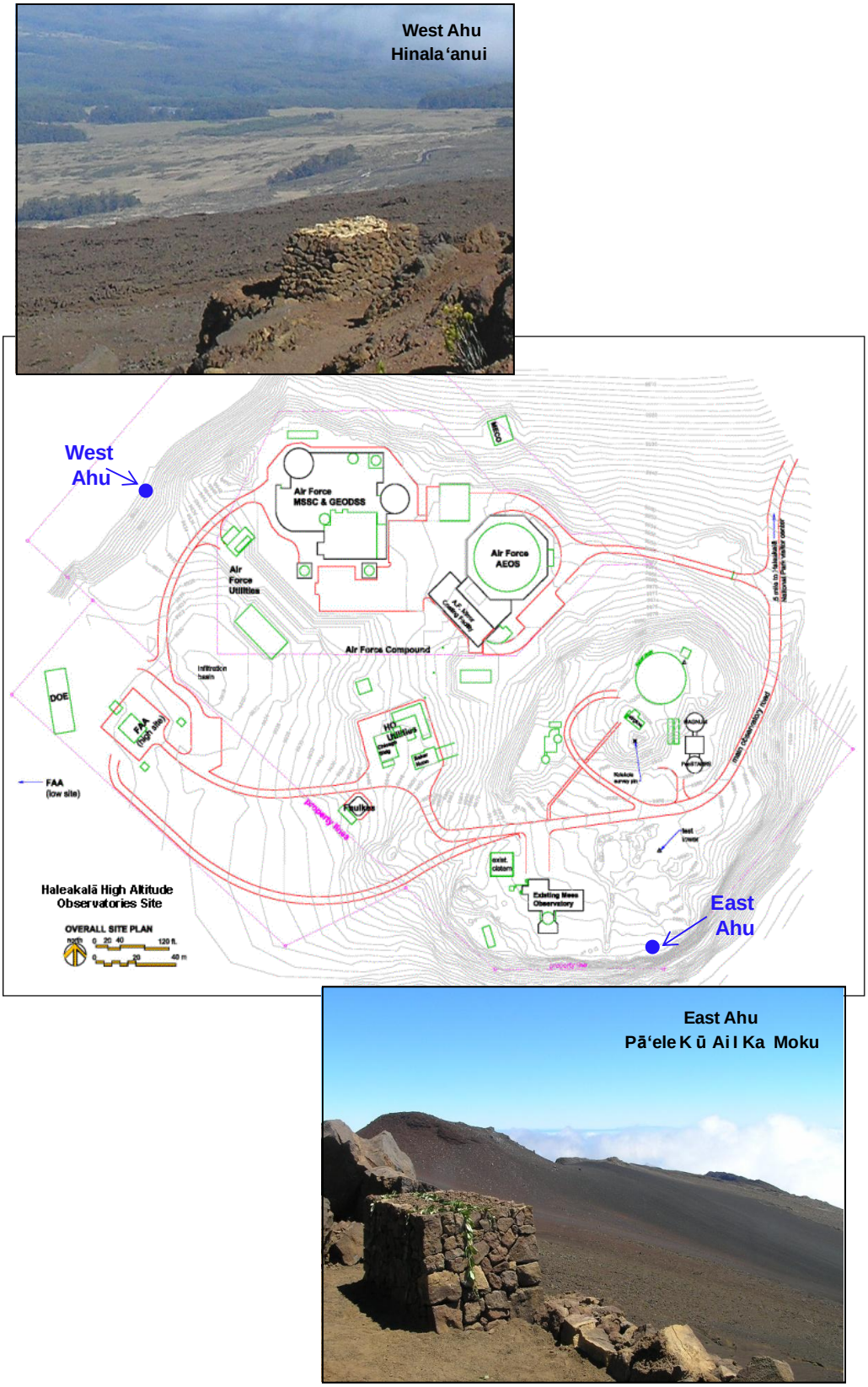


Figure 2-1. East- and West-facing Ahu Locations at HO.

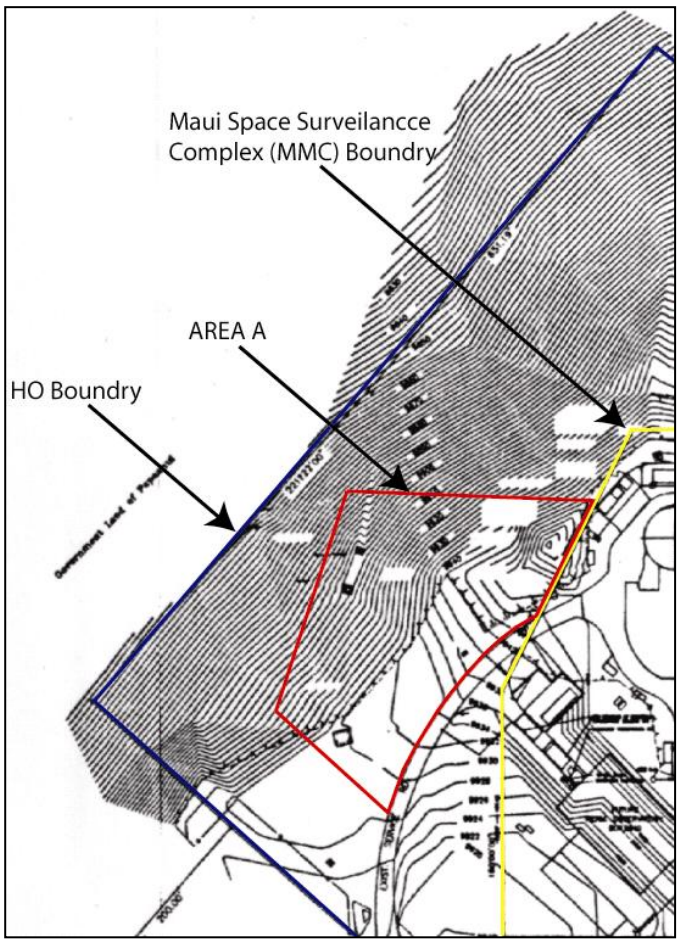


Figure 2-2. Set Aside "Area A" Location at HO.

Early post-contact travel to Haleakalā by haole (foreigner) was mostly limited to expeditions and sightseeing until the late 1800s. There is evidence that the Hawaiians continued to ascend Haleakalā throughout the 1800s not only for its popularity as a traveling route, but also for its ceremonial significance. Cattle ranching occurred on the slopes in the late 1800s, and in 1916 the U.S. Congress allotted 21,000 acres at the summit of Haleakalā as part of the Hawai'i National Park. The Park opened in 1921 and operated peacefully for 20 years until the U.S. Army began seeking sites for "unspecified defense installations" (Jackson 1972:130). By 1945, the Army had installations on both Red Hill and Kolekole Peak, just outside National Park boundaries. These installations were utilized until the end of World War II and intermittently thereafter, including during the Korean War. Grote Reber built a radio telescope on Kolekole in 1952, and between 1955 and 1958, the UH and the U.S. Air Force shared use of the Red Hill facilities. By 1960 to 1961, the UH was operating its observatory at the Kolekole location (Jackson 1972:131).

Today, spiritual practices continue in and around Kolekole. Flora and fauna are still collected for hula adornment by Kumu Hula, and native Hawaiians frequent the site for sunrise or sunset practices. The mana (spirit) of the area is wholly dependent on the vistas that can be viewed and the connection with earth and sky. For example, Native Hawaiians know that the spiritual essence is not something tangible at the summit area, but that one can feel the presence of the gods (CKM 2003, oral history).

Haleakalā Summit

The summit of Haleakalā is considered a significant cultural resource in and of itself. It is eligible for listing on the National Register of Historic Places (NRHP) as a TCP through consultation with the State Historic Preservation Division (SHPD) under Criterion "A" for its association with the cultural landscape of Maui and this is reflected in the number of known uses, oral history, mele (song) and legends surrounding Haleakalā. The term "Traditional Cultural Property" is used in the NRHP to identify a property "that is eligible for inclusion in the NRHP because of its association with cultural practices or beliefs of a living community that, (a) are rooted in that community's history, and (b) are important in maintaining the continuing cultural identity of the community" (DOI 1994). The summit is also eligible under NRHP Criterion "C" because it is an example of a resource type, a natural summit, and a source for both traditional materials and sacred uses. The value ascribed to Haleakalā as a TCP can be expressed in five distinct attributes, solidifying the role of the summit as a place of value.

1. Haleakalā summit is considered by Native Hawaiians, as well as more recent arrivals to Hawai‘i, as a place exhibiting spiritual power.
2. The summit of Haleakalā is significant as a traditional cultural place because of traditional cultural practices conducted there. For both Hawaiians and non-Hawaiians who live and visit here, the summit is a place of reflection and rejuvenation.
3. The mo‘olelo and oli surrounding the summit present a collection of stories suggesting the significance of Haleakalā as a TCP.
4. Some believe that the summit possesses therapeutic qualities.
5. The summit provides an "experience of place" that is remarkable.

Historic Resources

One historic site is present at HO. It is identified as the Reber Circle site, which is a remnant of early 1950s astronomy construction that lies at the peak of Pu‘u Kolekole. It is designated by the State Inventory of Historic Places (SIHP) as Site 5443 (UH IfA 2005) and is eligible for listing on the NRHP under Criterion "A" because of its association with mid-20th century scientific studies at Haleakalā, and under Criterion "D" for its information content. This site remnant consists of a concrete and rock foundation that was part of the former radio telescope facility that was constructed in 1952 by Grote Reber, an early pioneer of radio astronomy. The bulk of this structure was dismantled about 18 months after the facility was completed. This site is composed of a concrete and rock foundation that is approximately 25 meters (82 feet) in diameter, the outer rim of which is up to 1 meter (3.28 feet) in width and approximately 80 centimeters (2.62 feet) in height.

2.2.2 Archeological Resources

There were two archeological surveys conducted in portions of HO during the 1990s. The first of these was in 1990 and consisted of a reconnaissance survey by Pacific Northwest Laboratory on behalf of the US Air Force for the Advanced Electro-optical System (AEOS) Environmental Assessment (EA) (Chatters 1991). Cultural Surveys Hawai‘i, Inc., conducted the second study, an archeological inventory, in 1998. During the course of this study, a walkover, four archeological sites were identified, primarily along the western side of Kolekole. These sites included 23 temporary shelters and a short low wall. These wind shelters were typically constructed against the existing rock outcrop of the hill. The sites were designated Site 50-50-11-2805 through 50-50-11-2808. One sling stone was found on the floor of Feature J at Site 50-50-11-2807. In addition, one ‘opihi (limpet) (*Cellana* spp.) shell, was noted on the surface of the Feature B floor of Site 50-50-11-2808. There was no subsurface investigation carried out, and only Site 50-50-11-2805 was mapped (additional inventory work was done at these sites in 2005).

Cultural Surveys Hawai‘i, Inc. conducted another study in 2000 (FTF EA 2001), in conjunction with the planned construction of the FTF. They located two previously unidentified sites (50-50-11-4835 and 50-50-11-4836) to the west of the MSO facility. Both of these sites were constructed against an exposed rock outcrop. Site 50-50-11-4835 consists of two features—both historic rock enclosures filled with burned remnants of modern refuse—obviously historic trash burning pits. The researchers speculated that the U.S. Army might have initially used these during the war and later UH workers used them (FTF EA). Site 50-50-11-4836 consists of three terraces, a rock enclosure, two leveled areas and a rock wall, all constructed against an exposed rock outcrop. Five of the features are interpreted as temporary shelters, while the two leveled areas were of indeterminate usage. Although one test unit did not reveal any pre-Contact cultural materials, their construction is consistent with pre-Contact structures used for temporary shelters in other areas of Haleakalā Crater (Bushnell and Hammatt). The IfA has preserved both sites.

A comprehensive archeological inventory survey of HO was completed in fall 2002 (UH IfA 2005) and the inventory survey report was approved by SHPD. An archeological preservation plan for "Science City" (Xamanek Researches, 2006) was prepared in 2006 and approved by SHPD in a July 10, 2006, review letter (DLNR 2006). Whereas surveys had previously been conducted for specific construction projects within HO and a number of archeological features had been identified, the 2002 survey of the entire 18.166 acres for the LRDP (UH IfA 2005) was exhaustive and included location and description of six previously unidentified sites. These sites were assigned State of Hawai‘i designations, and further documentation was obtained for four previously identified sites that were listed with the SHPD. In total, 29 new features were identified and five excavation units were used to sample selected features that were located in some of the previously undocumented sites. These sites consist of wind shelters, two petroglyph images, a possible burial feature, and an historic foundation known as Reber Circle. Supplemental information was obtained from Sites 50-50-11-2805 to 50-50-11-2808 per discussions with Dr. Melissa Kirkendall of the SHPD Maui office. In addition, a trail segment was recorded at Site 50-50-11-4836 and designated as Feature F. Several isolated pieces of coral were noted in the southeastern portion of the 18.166-acre study area, but not assigned a formal site number because the coral pieces were not weathered. A possible site consisting of several pieces of coral in a boulder was plotted on the project map, but was determined to lie off the project area. The results of the inventory survey were submitted to SHPD for preservation review, although there was no triggering action requiring submittal of the survey, as described in HRS Section §6E-8. The significance assessments were accepted (DLNR 2003).

Most of the newly identified features are temporary habitation areas or wind shelters. Two features at one site are petroglyph images and, as indicated above, one new site is interpreted as a possible burial. Two small platforms thought to have ceremonial functions were also identified, as was a possible trail segment. All of the newly identified sites and previously designated ones retain their significance rating under at least Criterion "D" for their information content under NRHP and State historic preservation guidelines. All of the previously identified sites mentioned in this report qualify for significance because of their information content under Criterion "D" of State and NRHP historic preservation guidelines. In addition, the possible burial (Feature D) and the 2 petroglyph images (Features F and G) of Site 50-50-11-5440, as well as Site 50-50-11-5441 and the Site 50-50-11-4836 trail segment (Feature F) also qualify for their cultural significance under state Criterion "E". Finally, it is important to note that the various sites located in HO are a remnant of a Native Hawaiian cultural landscape. Because Haleakalā is noted for its ceremonial and traditional importance to the Native Hawaiians, the entire HO complex of sites may well qualify for importance under significance NRHP Criterion "A" and state criterion "E".

The general lack of material culture remains suggests that the HO area was used for short-term shelter purposes, rather than extended periods of temporary habitation. While there was no charcoal located during testing in the project area, the newly identified sites are nevertheless tentatively interpreted as indigenous cultural resources, some of which may have been modified or used in modern times. A map of the archeological features at HO, including Historic Site 5443 Reber Circle, is presented in Figure 2-3.

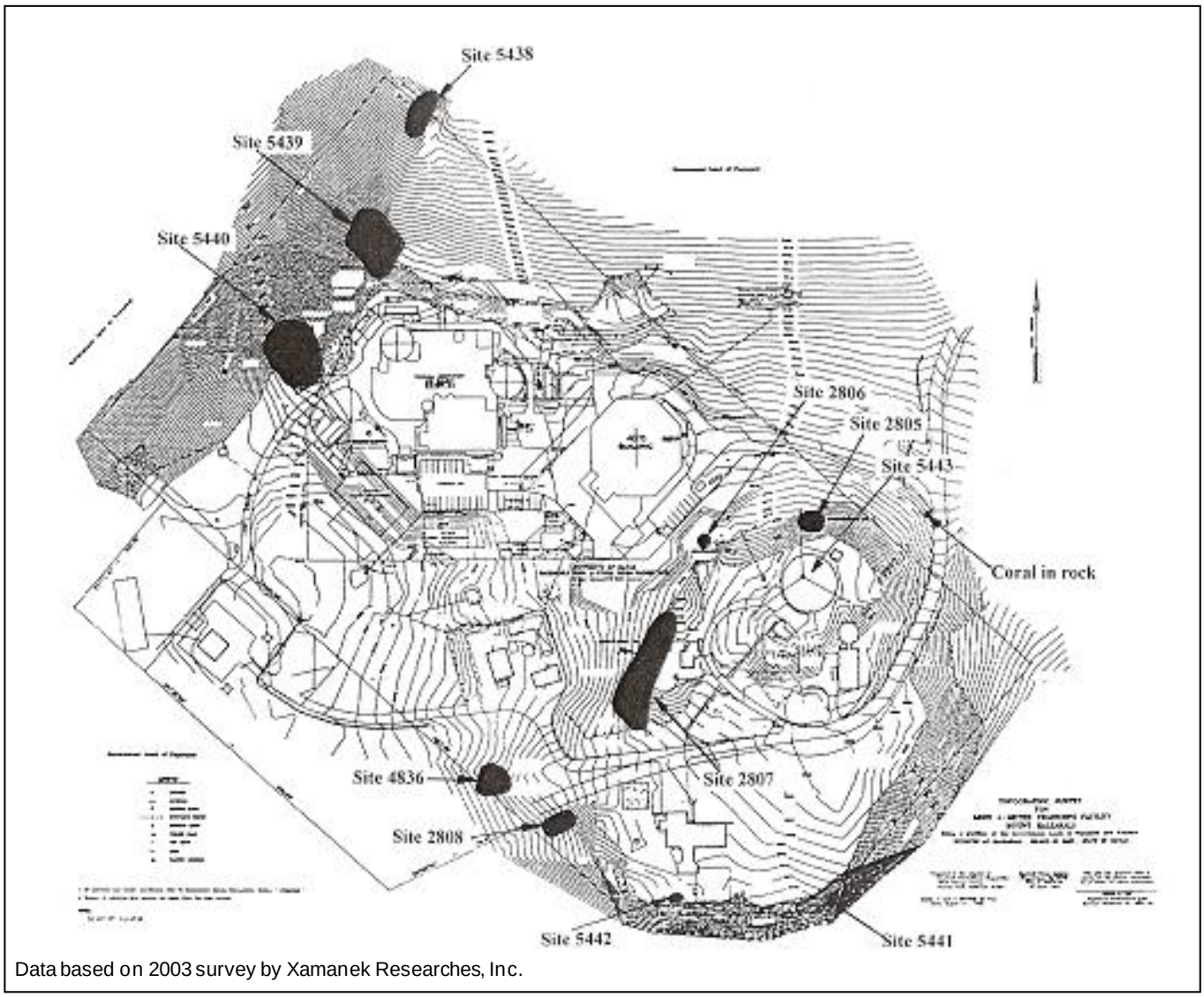


Figure 2-3. Archeological Sites at HO.

Table 2-1 Summary of HO Archeological Sites.

Site numbers are prefaced by 50-50-11: 50=State of Hawai‘i, 50=Maui, 11=Kilohana quadrangle.

SIHP Site #	Description (Number of Features)	Age	NRHP Significance Criterion
2805	Wind shelter (1)	Pre-contact - post-contact	D
2806	Wind shelter (1)	Pre-contact	D
2807	Wind shelter (13), Wind shelter, C-shape (2), Wind shelter/terrace (1)	Pre-contact - post-contact	D
2808	Wind Shelter (3)	Pre-contact - post-contact	D
4835	Trash pit (2)	Possible WWII era, modern trash observed	D
4836	Wind shelter (5), Trail (1)	Pre-contact-post-contact	D
5438	Wind shelter (1), Terrace/Wind shelter (1), Terrace-like Wind shelter (3), Rock pile (1)	Pre-contact - post-contact	D
5439	Rock Shelter (2), Wind shelter (4), Wind shelter, C-shape (6), Rock pile (1)	Pre-contact - post-contact	D
5440	Wind shelter, enclosure (1), Wind shelter, C-shape(2), Wind shelter natural terrace (1), Platform (1), Petroglyph (2)	Pre-contact - post-contact	D
5441	Terrace (2)	Pre-contact - post-contact	D
5442	Rock wall partial enclosure (1)	Pre-contact - post-contact	D

2.2.3 Topography Geology, and Soils

Haleakalā Observatories is wholly contained within Pu‘u Kolekole. The Kolekole volcanic center is located in East Maui on the southwest rift of Haleakalā, adjacent to the deeply eroded and spectacular summit depression. Alkalic lava flows in this area belong to both the post-shield stage Kula series as well as to the initial phase of the rejuvenated stage Hana series. The observatories are largely built on ankaramitic picro-basalts and some basanites (Bhattacharji 2002). Geological field studies describe the HO property as an asymmetric volcanic cone whose slopes are steeper at the western and northwestern sides, while the eastern and southern slopes are gentler. Much of the northern slope — most of which is occupied by the Air Force Maui Space Surveillance Complex (MSSC) — is flattened and had been disturbed. The central crater of Kolekole is described as a flattened bowl of ponded ankaramite lava, spatter and pyroclastic ejecta. More than one eruptive vent was present on Kolekole. The primary vent was likely in the approximate position of the present day Panoramic-Survey Telescope and Rapid Response System (Pan-STARRS) PS1 telescope (LURE Observatory South Dome), and one prominent likely secondary event is within the wide depression near the western border of the property (Bhattacharji 2002, Fig. 5).

The significance of Pu‘u Kolekole appears to be a result of its geographical position near the apex of the southwest rift zone of Haleakalā, which resulted in a somewhat unusual volcanic history. Kolekole exhibits both post-shield (Kula) volcanism and the initial stage of rejuvenated (Hana) alkaline volcanism in proximity to each other on or near the surface. Samples from different eruptive centers on the site that were collected and analyzed demonstrate that the transition between eruptive cycles was taking place at

Pu‘u Kolekole. Age dating of lavas from the site and micro-chemical barometry confirm this unusual confluence of what are two distinct volcanic regimes elsewhere on Maui.

Topography

The Island of Maui, nicknamed “The Valley Isle” and the second largest of the Hawaiian Islands, is a volcanic doublet: an island formed from two volcanic mountains that abuts one another to form the isthmus between them (Fig. 2-4). Mauna Kahalawai, also known as the West Maui Mountain, is the much older volcano and has been eroded considerably. Haleakalā, the larger volcano on the eastern side of Maui, rises above at 10,023 feet ASL. The last eruption occurred sometime between 1650 and 1790, and the lava flow can been seen between Āhihi Bay and La Perouse Bay on the southwest shore of East Maui. Both volcanoes are shield volcanoes and the low viscosity of the Hawaiian lava makes the likelihood of the large explosive eruptions negligible.

The summit area of Haleakalā is rugged and barren, consisting of lava and pyroclastic materials. Within a 4-mile radius of HO, the elevation drops to approximately 3,600 feet ASL, with an average slope greater than 30 percent.

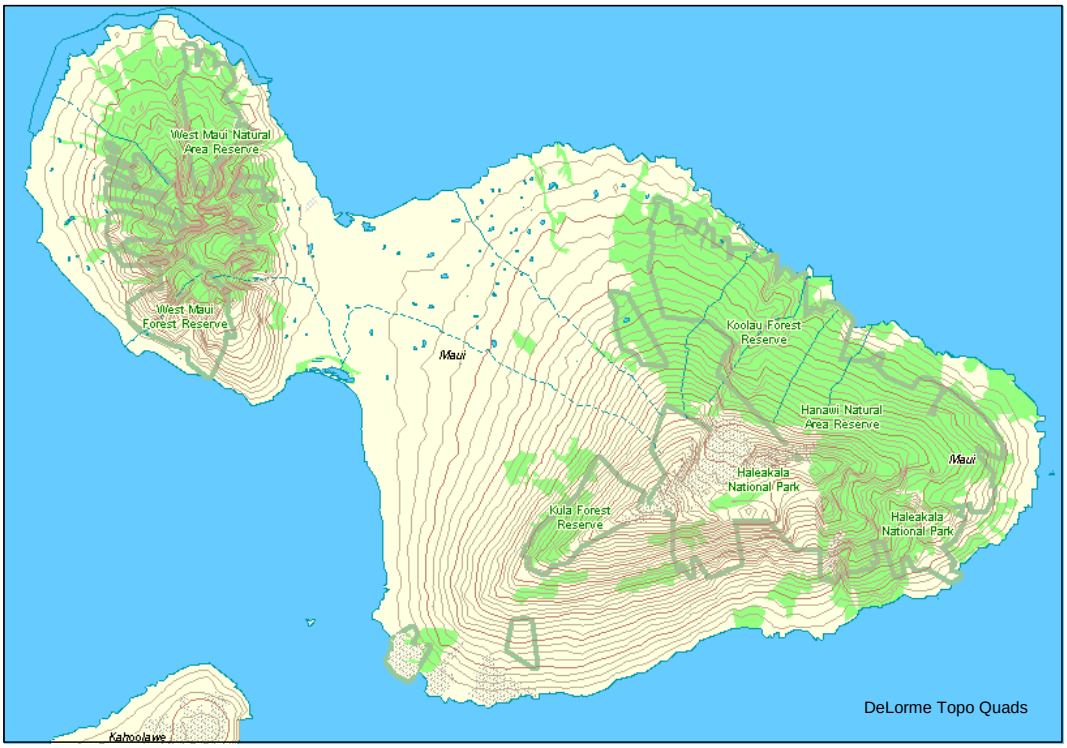


Figure 2-4. Topography for Island of Maui, Hawai‘i.

Geology

Over the course of Haleakalā’s formation, three distinct phases of eruption have taken place. The first, called the Honomanu Volcanic Series, is responsible for the formation of Haleakalā’s primitive shield and most likely its three prominent rift zones. Honomanu lavas are exposed over less than 1 percent of Haleakalā, but are believed to form the foundation of the entire mountain to an unknown depth below sea level. The second series, or Kula Volcanic Series, overlaid the previous Honomanu Series with its lava flows. Eruptions of this series were considerably more explosive than its predecessor, leading to the formation of most of the cinder cones along the three rift zones.

A period of inactivity followed the Kula Series, during which time erosion began to predominate the formation of Haleakalā Crater by forming great valleys leading to the coast. After this long period of erosion, the final volcanic eruptions, called the Hana Volcanic Series, partially filled the deep valleys. Several cinder cones and ash deposits lined the East and Southwest Rift Zones ranging from a few feet high to large cones more than a mile across at the base and 600 feet high. Lava flows within the Haleakalā Southwest Rift Zone range from 200 to 20,000 years old. Six flows have erupted in this area within the last 1,000 years. During the latest eruption, sometime between 1650 and 1790, lava emerged from two vents and flowed into La Perouse Bay, where a small peninsula was constructed. Recent studies have indicated that Haleakalā volcano may still be active, in light of the numerous eruptions during the last 8,000 years (Bergmanis, et al, 2000).

Soils

The summit area is covered with volcanic ejecta consisting of lava, cinder, and ash of the Kula and Hana Volcanic Series. There is no soil development in the immediate vicinity of HO. Soil development occurs with increased distance (greater than 1.5 miles) from the summit. Most of the area is situated on Cinder Land (rCl), which is thought to be of the Kula period of volcanism (U.S. Soil Conservation Service, 1972). A foundation investigation conducted in 1991, in the northern area of HO revealed that cinder in this area is underlain by 5 feet of volcanic clinker and 16 feet of volcanic cinder.

2.2.4 Biological Resources

2.2.4.1 Botanical Resources

The vegetation type at HO is an *Argyroxiphium*/*Dubautia* alpine dry shrubland. Dry alpine shrublands are typically open communities, occurring at 3,000 to 3,400 meters (9,842 to 11,155 feet) elevation, predominantly on barren cinders, with very sparse vegetation cover (Wagner et al. 1999). The substrate is a mixture of ash, cinders, pumice, and lava (MSSC 2002). The vegetation is sparse, from a near barren <1 percent cover to about 10 percent cover. The vegetation is low, no more than one meter (3 feet) tall anywhere on the site. During the most recent survey (Starr 2002), a total of 32 plant species were observed. Of these, 11 (34 percent) were native and 21 (66 percent) were non-native.

Within the site there are two general types of land area: undisturbed and those where construction has occurred. Undisturbed areas are comprised of predominantly native plants including shrubs, such as naʻenaʻe (*Dubautia menziesii*), pukiawe (*Styphelia tameiameiae*) and ʻohelo (*Vaccinium reticulatum*), herbs, such as tetramolopium (*Tetramolopium humile*), and grasses, including bentgrass (*Agrostis sandwicensis*), hairgrass (*Deschampsia nubigena*), and mountain pili (*Trisetum glomeratum*). Three species of native ferns, ʻiwa ʻiwa (*Asplenium adiantum-nigrum*), ʻoaliʻi (*Asplenium trichomanes* subsp. *densum*), and kalamoho (*Pellaea ternifolia*) are found tucked into rock crevices and overhangs around the Lunar Ranging Experiment (LURE) Observatory and on the steep slopes on the southeast part of the property near the MSO facility.

Areas of HO property where construction has occurred generally support fewer native species and contain more weeds. One notable exception is the endemic silversword or ʻahinahina (*Argyroxiphium sandwicense* subsp. *macrocephalum*) which is found exclusively on areas where construction has occurred. Weeds found in these disturbed areas include non-native herbs, such as thyme-leaved sandwort (*Arenaria serpyllifolia*), storksbill (*Erodium cicutarium*), hairy cat's ear (*Hypochoeris radicata*), sweet alyssum (*Lobularia maritima*), common mallow (*Malva neglecta*), black medick (*Medicago lupulina*), evening primrose (*Oenothera stricta* subsp. *stricta*), common plantain (*Plantago lanceolata*), polycarpon (*Polycarpon tetraphyllum*), sheep sorrel (*Rumex acetosella*), wood groundsel (*Senecio sylvaticus*), sow thistle (*Sonchus* sp.), and common dandelion (*Taraxicum officinale*). These areas also harbor a selection of non-native grasses, including sweet vernal grass (*Anthoxanthum odoratum*), rescue grass (*Bromus*

willdenowii), Bermuda grass (*Cynodon dactylon*), Yorkshire fog (*Holcus lanatus*), annual bluegrass (*Poa annua*), Kentucky bluegrass (*Poa pratensis*), and brome fescue (*Vulpia bromoides*).

ʻahinahina (Haleakalā silversword)
The ʻahinahina or Haleakalā silversword are Federally-listed as a "threatened" species, meaning they may become endangered throughout all or a significant portion of their range if no protective measures are taken. In 2002, nine live ʻahinahina and three dead ʻahinahina flower stalks were located within the HO property. All of the live plants are on the MSSC site. During the June 2009 botanical survey (Starr 2009), the same botanists who conducted the 2002 survey "...were pleasantly surprised to find silverswords were now locally common within the Air Force site at HO, with 159 silverswords counted. The silverswords were generally in the same places as in 2002, but in much greater abundance."

2.2.4.2 Avifaunal Resources

ʻUaʻu (Hawaiian Petrel)
The ʻuaʻu, or Hawaiian Petrel *(Pterodroma sandwichensis)*, a Federal- and State-listed endangered bird species, is present in the summit area (UH IfA 2005). Haleakalā National Park (HALE) biologists have been conducting regular monitoring and searches of ʻuaʻu nests since 1988. Approximately 85 percent of the world's known ʻuaʻu population nests on Haleakalā (Fig. 2-5), near the summit (HALE 2003). Most of the population is within HALE boundaries. About 55 burrows are within 1/4 mile (400 meters) of the Haleakalā Observatories, but outside HALE boundaries (HALE unpublished data). These are considered part of the "Haleakalā population." Approximately 30 known burrows are along the southeastern perimeter of HO and several burrows are northwest of HO, with a large number of burrows in and around HO (Fig. 2-6). This was derived from data obtained during the 2006 and 2007 surveys by the NPS and KC Environmental, Inc.

The ʻuaʻu can be found nesting at Haleakalā from February to November. The birds make their nests in burrows and return to the same burrow every year. The species distribution during their non-breeding season is poorly known, but they are suspected to disperse north and west of Hawaiʻi, with very little movement to the south or east. The ʻuaʻu typically leave their nests just before sunrise to feed on ocean fish near the surface of the water and just before sunset transit from the ocean back to Haleakalā. These birds have limited vision and their high speed and erratic nocturnal flight patterns may increase the possibility of collisions with fences, utility lines, and utility poles (Simons and Hodges 1998).

ʻUaʻu are believed to navigate by stars, so man-made lights may confuse in-flight ʻuaʻu. Evidence suggests these birds will fall to the ground in exhaustion after flying around lights, where they are susceptible to being hit by cars or attacked by predators (Simons and Hodges 1998); however, this has not been observed at HO. In addition to these hazards, confirmed causes of ʻuaʻu mortality include nest collapse by wild goats, predation by native owls and introduced predators, road-kills, collision with such objects as buildings, utility poles, fences, lights, and vehicles, and disturbance from road resurfacing activity (Natividad Hodges and Nagata 2001).

During fall 2004, ABR, Inc. conducted a study for the MSSC (ABR 2005). Using ornithological radar and visual sampling techniques, this study's objective was to determine movement patterns of ʻuaʻu near the summit of Haleakalā, including spatial movement patterns, temporal movement patterns, and flight altitudes. Many of the patterns observed in this study matched what is known about the biology of ʻuaʻu. Breeding adults, non-breeding sub-adults, and adults are active in the summer when the displaying non-breeders are active and fly erratically and circle the colonies at low altitudes. In contrast, only adults visit the colonies during the fall, when they simply fly in and land at burrows to feed young. It is suspected that fewer birds were seen on the radar in the vicinity of the MSSC than near the crater because the crater is much more active for breeding and displaying birds than is that part of the colony along the

southwestern ridge (i.e., the ridge on which the observatories and the Federal Aviation Administration (FAA) site are located).

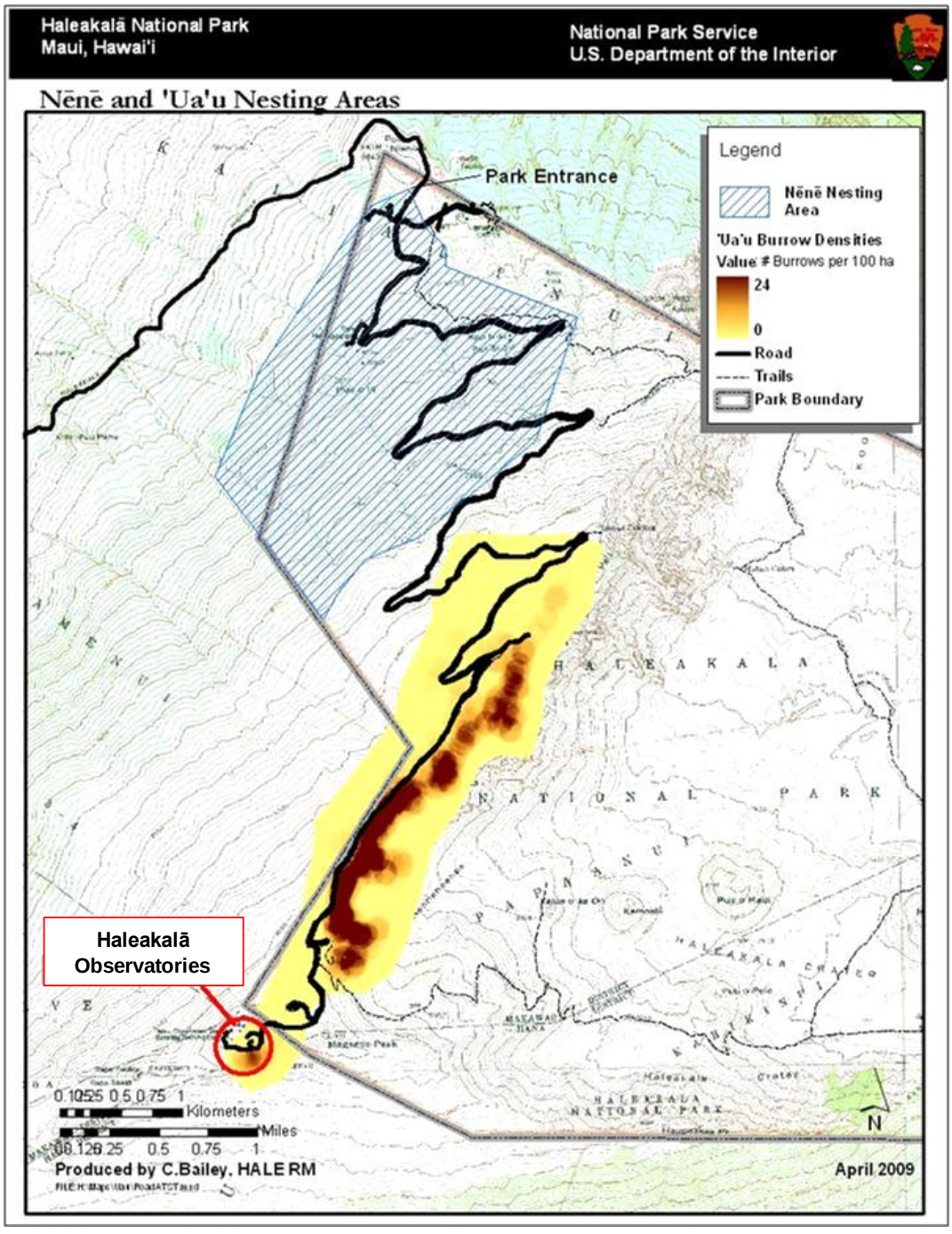


Figure 2-5. Petrel Burrows Near Summit of Haleakalā.

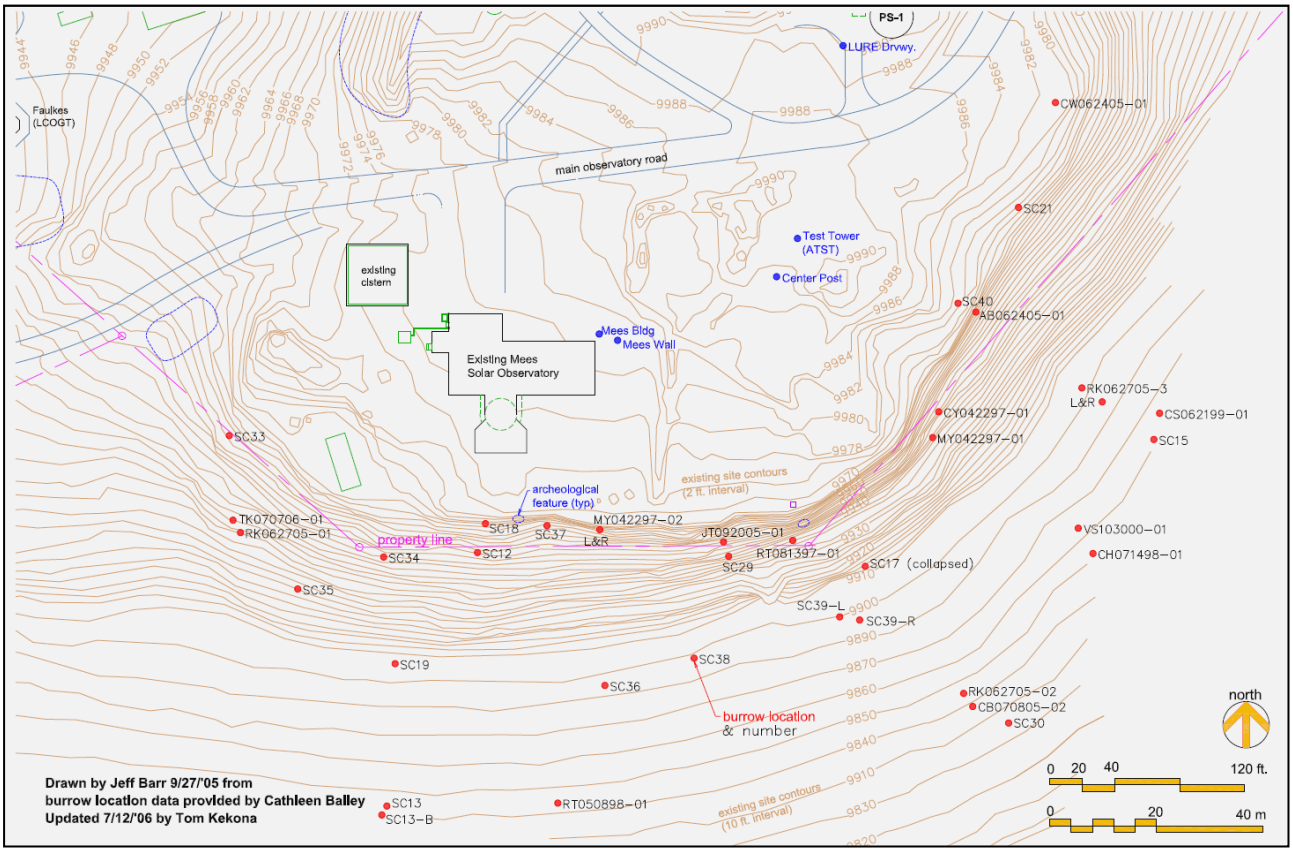
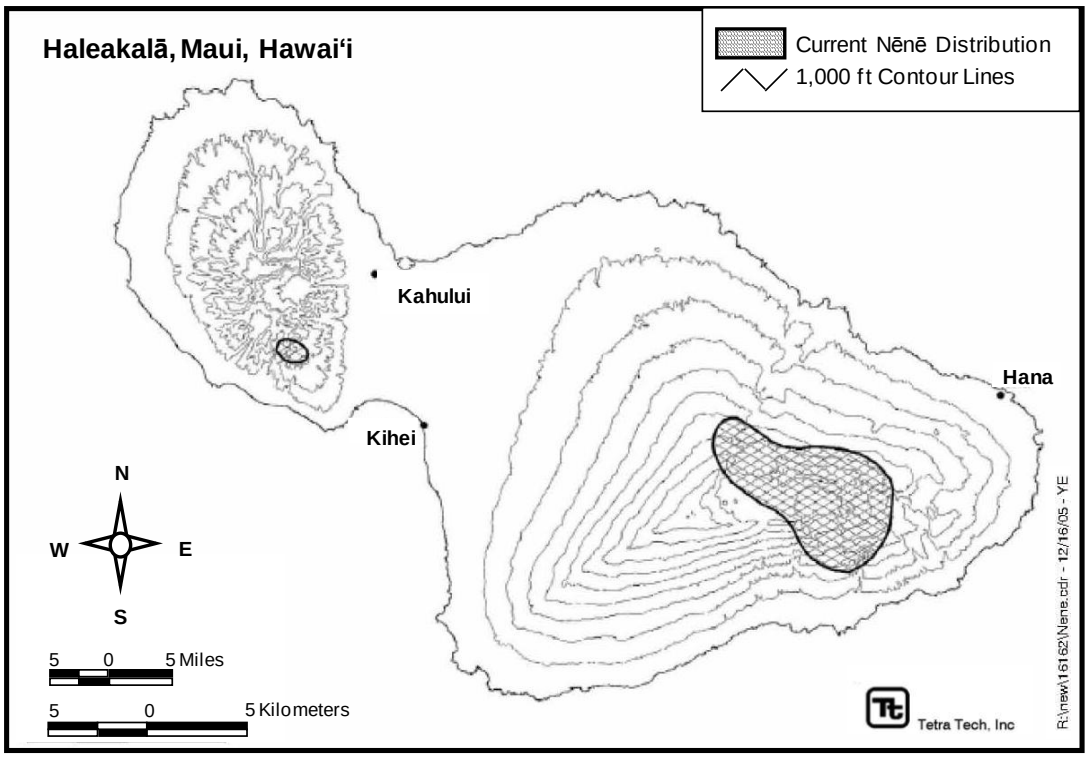


Figure 2-6. Petrel Burrows In and Around HO.

Nene (Hawaiian Goose)

The nēnē, or Hawaiian goose *(Branta sandvicensis* also known as *Nesochen sandvicensis),* is a Federal- and State-listed endangered species on Haleakalā and is the only extant species of goose not occurring naturally in continental areas. The nēnē formerly bred on most of the Hawaiian Islands, but currently is restricted to the islands of Hawai‘i, Kaua‘i and Maui. Nēnē seem to be adaptable and are found at elevations ranging from sea level to almost 8,200 feet (Fig. 2-7) in a variety of habitats, including non-native grasslands, sparsely vegetated, high elevation lava flows, cinder deserts, native alpine grasslands and shrublands, open native and non-native alpine shrubland-woodland community interfaces, mid-elevation (approximately 2,300 to 3,900 feet) native and non-native shrubland, and early successional cinder fall. Critical habitat has not been designated for the nēnē. The nēnē population on Maui is thought to consist of approximately 330 individuals. While the nēnē has been known to fly over HO, the summit area is outside the known feeding range of the bird.

These non-migrating, terrestrial goose nesting periods occur from October to March. Preferred nest sites include sparsely to densely vegetated beach strands, shrublands, grasslands and woodlands on well-drained soil, volcanic ash, cinder, and lava rock substrates. Nēnē are ground nesters and their nests are usually well hidden in the dense shade of a shrub or other native vegetation, but on Kaua‘i nēnē have built nests under alien species. Nēnē are browsing grazers, eating over 50 species of native and introduced plants.



Draft Revised Recovery Plan for the Nene or Hawaiian Goose, USFWS, 2004

Figure 2-7. Current Distribution of Nēnē on Maui.

Once abundant, the nēnē population has declined. The primary causes of this decline were habitat loss, hunting during the nēnē breeding season (fall and winter), and the impacts of alien mammals introduced during both Polynesian and western colonization.

Current threats to the nēnē population include predation, nutritional deficiency due to habitat degradation, a lack of lowland habitat, human-caused disturbance, road-kills, behavioral problems, and inbreeding depression. Dogs *(Canis familiaris),* cats *(Felis cattus),* mongoose *(Herpestes auropunctatus),* rats *(Rattus* spp.*),* and pigs *(Sus scrofa)* prey on nēnē, while feral cattle *(Bos taurus),* goats *(Capra hircus),* pigs, and sheep *(Ovis aries)* have been known to alter and degrade nēnē habitat through their foraging.

Potential threats to the nēnē are identified below and follow U. S. Fish & Wildlife Service (USFWS) classification of factors that may negatively affect a species, leading to its decline, as identified in Section 4(a) of the Endangered Species Act (ESA). These include:

1. The present or threatened destruction, modification, or curtailment of its habitat or range;
2. Over-utilization for commercial, recreational, scientific, or educational purposes;
3. Disease or predation;
4. The inadequacy of existing regulatory mechanisms; and,
5. Other natural or manmade factors affecting its continued existence.

The "Draft Revised Recovery Plan for Nēnē or Hawaiian Goose" (USFWS 2004) indicates there is a high degree of threat to this species. USFWS also believe that this species has a high recovery potential because it is a taxonomically, or genetically "pure" species and as such does not interbreed with domestic geese and is generally not in conflict with regular human activities.

ʻOpeʻapeʻa (Hawaiian Hoary Bat)

The ʻopeʻapeʻa, or Hawaiian hoary bat *(Lasiurus cinereus semotus),* is a Federal-listed endangered species that resides on the lower slopes of Haleakalā. A recovery plan was assigned to the ʻopeʻapeʻa, which indicates it is a subspecies with moderate degree of threat and a high potential for recovery. The ʻopeʻapeʻa is found on Hawaiʻi Island, Maui, Oʻahu, Kauaʻi and Molokaʻi. On the island of Hawaiʻi, most observations have been from between sea level and 7,500 feet ASL, although individuals have been recorded at elevations as high as 13,000 feet. On Maui, the bat resides in the lowlands of the Haleakalā slopes. Even though several sightings have been reported near HO, it is unlikely that the bat is a resident of the area, due to the relatively cold summit temperatures and the lack of flying insects in the area, which is the preferred food source (AFRL 2005).

The nocturnal ʻopeʻapeʻa is the only native terrestrial mammal known to occur in the Hawaiian archipelago, although other bat species have been found in sub-fossil remains. According to the USFWS, relatively little research has been conducted on this endemic Hawaiian bat and data regarding its habitat and population status are very limited. It is believed that bats typically depart the roost shortly before sunset and return before midnight, although this is based on a small number of observations (USFWS 1998). Bats are most often observed foraging in open areas, near the edges of native and non-native forests, or over both marine and fresh open water, and over lava flows. Roosting bats have been recorded from a variety of species including hala *(Pandanus tectorius),* kukui *(Aleurites moluccana),* pukiawe *(Styphelia tameiameaiae),* java plum *(Syzygium cumini),* ohia lehua *(Metrosideros polymorpha),* and *Eucalyptus* sp. Bats have been observed feeding from 3 to 492 feet above ground and water. Most of the available data suggests that this elusive bat roosts solitarily in the foliage among trees in forested areas.

Habitat requirements may vary seasonally and with reproductive condition, but this is not clear. Breeding probably occurs mostly between September and December, with young being born in May or June. Hawaiian hoary bats do not migrate off island, although seasonal elevation movements and island-wide migrations may occur. The availability of roosting sites is believed to be a major limitation in many bat species, but other threats to this subspecies include direct and indirect effects of pesticides, predation, alteration of prey availability (introduced insects), and roost disturbance (USFWS 1998). The recovery plan for the Hawaiian hoary bat (USFWS 1998) suggests the subspecies is experiencing a moderate degree of threat and has a high potential for recovery. Critical habitat has not been designated for this species.

2.2.4.3 Other Introduced Fauna

Introduced fauna that could be observed within the summit area include the chukar (*Alectoris chukar*), the feral goat (*Capra hircus*), the Polynesian rat (*Rattus exulans),* and the roof rat (*Rattus rattus*) (AFRL 2005). The Indian mongoose (*Herpestes auropunctatus*) is occasionally observed on the summit. These species are not included on Federal or State threatened or endangered lists.

2.2.4.4 Invertebrate Resources

The highest elevations of Haleakalā were once considered lifeless, but biologists have discovered a diverse fauna of resident insects and spiders. These arthropods inhabit unique natural habitats on the bare lava flows and cinder cones. Because they feed primarily on windblown organic materials, they form an aeolian ecosystem.

In Hawai‘i, aeolian ecosystems are used to describe those that exist on non-weathered lava substrates mostly, but not exclusively, found at high elevations (Medeiros and Loope 1994). On Haleakalā an aeolian ecosystem extends up the summit from about the 7,550 feet elevation. It is characterized by relatively low precipitation, porous lava substrates that retain relatively little moisture, little plant cover, and high solar radiation. The dark, heat-absorbing cinder provides only slight protection from the extreme temperatures, and thermal regulation and moisture conservation are critical adaptations of arthropods occurring in this unusual habitat.

Due to the harsh environment, fewer insects are present at upper elevations on Haleakalā than are found in the warm, moist lowlands. However, an exceptional assemblage of insects and spiders make their home on the mountain's upper slopes. A survey and inventory of arthropod fauna was conducted for the 18.166 acres of HO in 2003 for the LRDP (Pacific Analytics 2003). In the 2003 study, several species were added to the previous inventory site records.

An additional survey including arthropod collection and analysis was conducted in 2005 at the Mees and Reber Circle sites for the proposed ATST Project (Pacific Analytics 2005). The arthropod species that were collected in this study were typical of what had been found during previous studies. Although the study was conducted during the winter months, no species were found that are locally unique to the site, nor were there any species found whose habitat is threatened by normal observatory operations.

In March 2007, another arthropod inventory was conducted for arthropod sampling at the sites considered in the proposed ATST Project (Pacific Analytics 2007). The goal was to detect additional species that may have been missed during previous samplings. This additional survey, including night sampling, covers a seasonal component not included in the two previous studies. This survey was conducted during the winter months. The results of the 2007 arthropod survey indicate there are no species of concern or legal constraints related to invertebrate resources in that project area. No invertebrate species listed as endangered, threatened, or that are currently proposed for listing under either Federal or State of Hawai’i endangered species statutes were found.

A June 2009 arthropod survey was conducted and extended to larger portions of the HO property (Pacific Analytics 2009). There were a number of additional species collected, including one endemic carabid beetle (*Mecyclothorax*), and two species of long horn beetles of the genus *Plagithmysus*. Carabid beetle populations appear to be impacted when alien predators are introduced to their habitats and their conservation is considered important. The two species of long-horn beetles are considered rare and are infrequently collected.

The diversity of the arthropod fauna at HO is somewhat less than what has been reported in adjacent, undisturbed habitat. This is expected, in that buildings, roads, parking areas, and walkways occupy 40 percent of the site. However, the undisturbed habitat on the site that was sampled has an arthropod fauna generally similar to what could be expected from other sites on the volcano with similar undisturbed habitat. Most of the arthropods collected during the 2003 study were largely associated with vegetation at the site. Observatory construction and operations have increased the suitability of some habitats for plants and increased vegetation has probably caused an increase in the populations of some native arthropod species.

2.2.4.5 Presence of Threatened or Endangered Species

The following is a summary of species listed as either threatened or endangered under the ESA, which have been observed in or near the boundaries of HO and described in the sections above.

1. ‘ahinahina or Haleakalā silversword *(Argyroxiphium sandwicense* ssp. *macrocephalum),*

2. ʻuaʻu or Hawaiian Petrel *(Pterodoma phaeopygia sandwichnesis)*,
3. nēnē or Hawaiian goose *(Branta sandvicensis)*; and,
4. ʻopeʻapeʻa or Hawaiian hoary bat *(Lasiurus cinereus semotus)*.

2.2.5 Visual Resources

Approximately 1.7 million visitors annually (HALE 2006) are attracted to Haleakalā's various lookouts and vantage points for its spectacular vistas. Looking down the slopes to the northwest, a majestic view of Maui's isthmus and West Maui Mountains is afforded, while to the east are the richly colored scenes of the crater and, on minimal cloud-cover days, the slopes of Maunakea, Maunaloa and Hualālai.

On a cloudless night, Haleakalā also serves as an outstanding platform from which to view the heavens, facilitated by its position above the cloud inversion layer, the clean atmosphere, and the lack of degrading light sources. As indicated on the HALE signage on Puʻu Ulaʻula, "Observatories were built near the highest point on Maui because the air offers the fourth best viewing conditions on the planet. Here above the clouds, the atmosphere is clear and dry, with minimal air and light pollution." Because Haleakalā is blanketed with dark-hued cinders and ash and lacks vegetation, its appearance contrasts sharply with the lush tropical forests found at lower elevations.

Visibility of the HO facilities within HALE varies depending upon one's vantage point within HALE. Several HO facilities are highly visible from Puʻu Ulaʻula (Fig. 2-8). Some HO facilities are partially visible from the Park entrance station to about the first mile of the Park road, the Park Headquarters Visitor Center, portions of the Park road corridor (particularly the last one-third of the Park road closest to the summit), and near the summit from the Haleakalā Visitor Center (Pa Kaʻoao or White Hill).

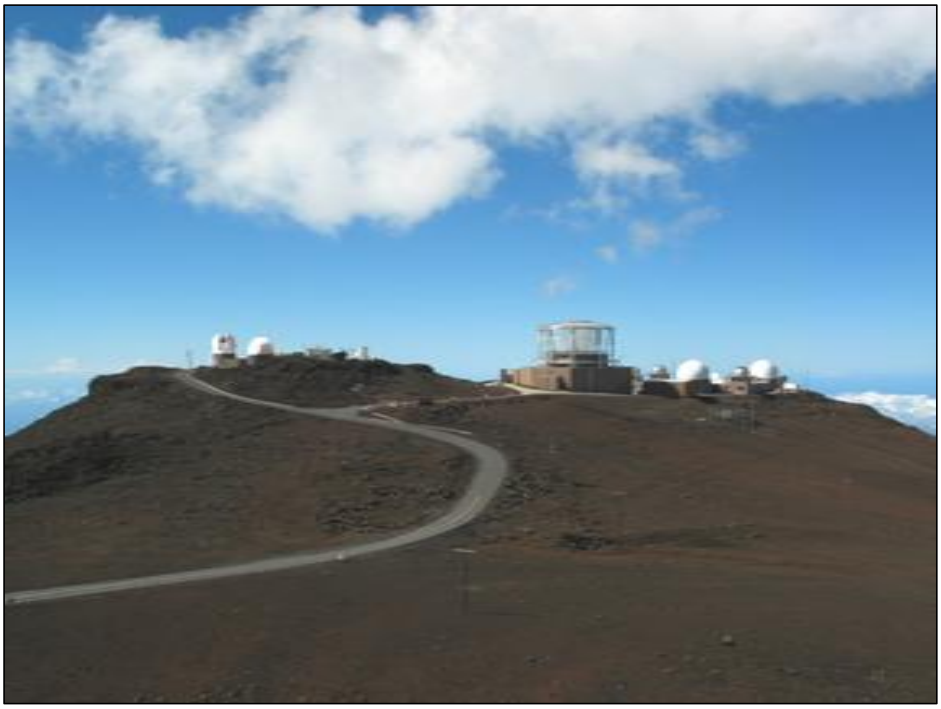


Figure 2-8. Current View of HO from Puʻu Ulaʻula.

Overall, visibility of the HO facilities is highly variable depending on a combination of factors. These include locations from where one views them on the island, atmospheric conditions (e.g., dust content, humidity), time of day, cloud cover, and human activity (e.g., cane burning). For example, on a clear, low-humidity day, some of the facilities would be distinguishable as very small man-made objects from as far away as Ma‘alaea Bay, which is a distance of approximately 17 linear miles. However, in humid and/or dusty conditions, they may not be visible at all from Ma‘alaea Bay or even from locations in Upcountry Maui at half that distance.

Visibility of the summit area would be more likely in the early morning before the daytime cloud inversion layer builds up, and in the late afternoon after the inversion layer dissipates. When mid- and upper-level cloud cover is absent, a few of the existing structures at HO are, depending on one’s vantage point, visible from miles away. Some of the facilities can also be seen from public viewpoints and highways that climb the slopes of the mountain (UH IfA 2005). The current facilities at HO that are closest to the northern boundary of the property are visible in various locations on Maui. The tallest of these, the metallic 117-foot tall U. S. Air Force Advanced Electro-optical System (AEOS) completed in 1994, is easily seen with the unaided eye from most areas within the Central Valley as well as from some windward and leeward communities, especially in morning and late afternoon hours. However, the two white 60-foot tall domes of the Maui Space Surveillance Site (MSSS), completed in 1965, are also visible in many of those same areas when the summit area is free of clouds. The colors of the domes of the HO facilities, which are either white or aluminized, make them more or less visible depending on Sun angle, cloud cover, and position of the viewer.

2.2.6 Water Resources

Haleakalā Observatories is within the Waiakoa and the Manawainui Gulch watersheds. As shown on Figure 2-9, the groundwater boundaries are the Kamaole and Makawao Aquifer Systems of the Central Aquifer Sector and the Lualailua and Nakula Aquifer Systems of the Kahikinui Aquifer Sector (AFRL 2005). The watersheds and aquifer systems make up the Region of Influence (ROI). A sector is a large region with hydro-geological similarities that primarily reflects broad hydrogeological features, and secondarily, geography. A system is an area within a sector showing hydro-geological continuity.

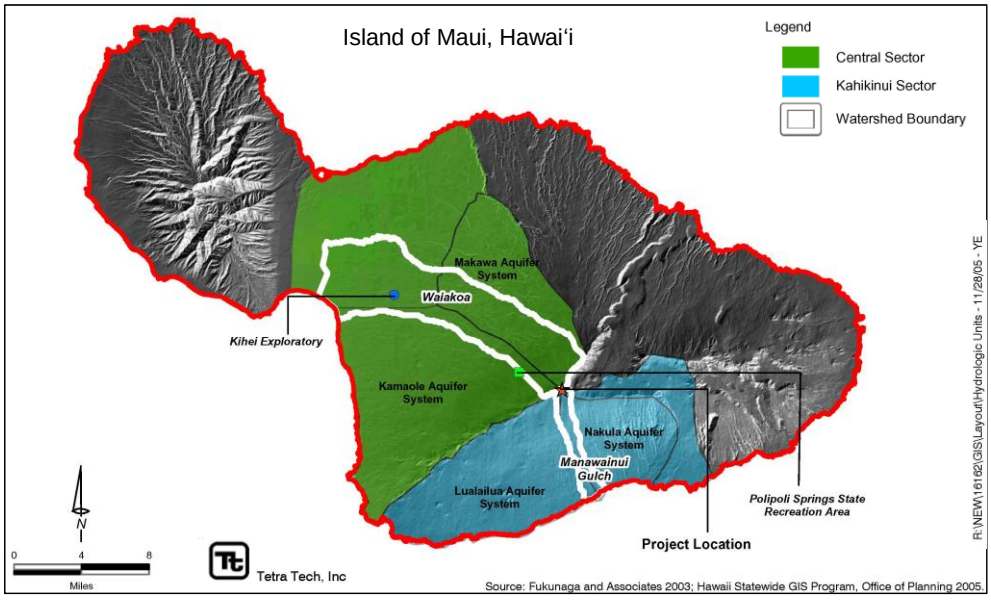


Figure 2-9. Hydrologic Features.

There is no source or supply of water at the summit area of Haleakalā. At various times during the year — particularly the winter months — rainwater is collected from building roofs, etc., and stored in water-catchment systems. To supplement this source, water is trucked to each user in certified tanks where it is stored on-site. Users maintain their own collection systems and storage tanks for potable and/or non-potable water, as well as their individual pumping and distribution systems.

Surface Water

The primary hydrologic unit for describing stream flow is the drainage basin, whereas the principal division for groundwater is the aquifer system. The boundaries of drainage basins and aquifer systems do not necessarily coincide because groundwater flow is governed by subsurface geological continuity rather than by topographic controls (Yuen and Associates 1990). Drainage basin boundaries for the Proposed Action are the Waiakoa and Manawainui Gulch watersheds, two of the 112 Maui Watershed Units totaling 466,437 acres.

Most streams on Haleakalā are intermittent because of the steep, permeable lava terrain. The nearest intermittent streams are approximately 1.9 miles down slope of the MSO facility. Perennial streams at low elevations originate from groundwater springs. An area of lower elevation within HO acts as a ponding and infiltration area for stormwater at Kolekole cinder cone (AFRL 2005).

There are no water bodies at the HO site. The Polipoli Springs water system is within the project aquifer system. The Polipoli Springs State Recreation Area water system is in the Kahikinui Forest Reserve, 9.7 miles upland from Kula on Waipoli Road. The water system is owned and operated by the State of Hawai‘i and managed by the Hawai‘i DLNR State Parks. The water system serves a park cabin and campground area. The non-potable source for the water system is an unnamed spring whose water flows through a 1.5-inch pipe to the campground area. The estimated water demand is 2,000 gallons daily (Fukunaga and Associates 2003).

Drainage Features

On the native slopes of Haleakalā, virtually all precipitation infiltrates the soil profile. Once in the soil, gravity continues to force the water down into the soil. When the water hits a less permeable layer, such as basalt, it flows in the path of least resistance. This means subsurface water flows, driven by gravity, down gradient along the surface of the basalt layer. The flow continues along the interface between the highly pervious cinder material and the basalt layer until it either resurfaces as a spring or stream or flows into a fissure in basalt, contributing to groundwater storage (UH IfA 2005a).

In March 2005, soil borings were taken at HO (Island Geotechnical). The results of the exploratory borings revealed that the soil profile generally consists of sands and gravels on top of a basalt layer. This means water can easily infiltrate the upper soils and then becoming significantly slowed when it reaches the basalt layer, which ranges from 5 to 21 feet (UH IfA 2005a).

All precipitation falling near the summit is infiltrated and flows subsurface toward the natural drainage courses, such as Manawainui Gulch. Loss of rainfall would be caused by evaporation in the soil column (UH IfA 2005a). Due to site topography, as well as a small collection of stormwater conveyance systems consisting of concrete channels and culverts, runoff generated within the HO site is controlled and conveyed via natural drainage paths to an infiltration basin at the western extremity of HO property. The runoff collection system was originally designed to maintain stormwater runoff on paved surfaces and consists of gutters and channels intended to prevent stormwater from discharging onto native soils adjacent to paved surfaces. Ten main stormwater flow paths have been identified at the HO site. Figure 2-10 illustrates the existing runoff patterns associated with HO.

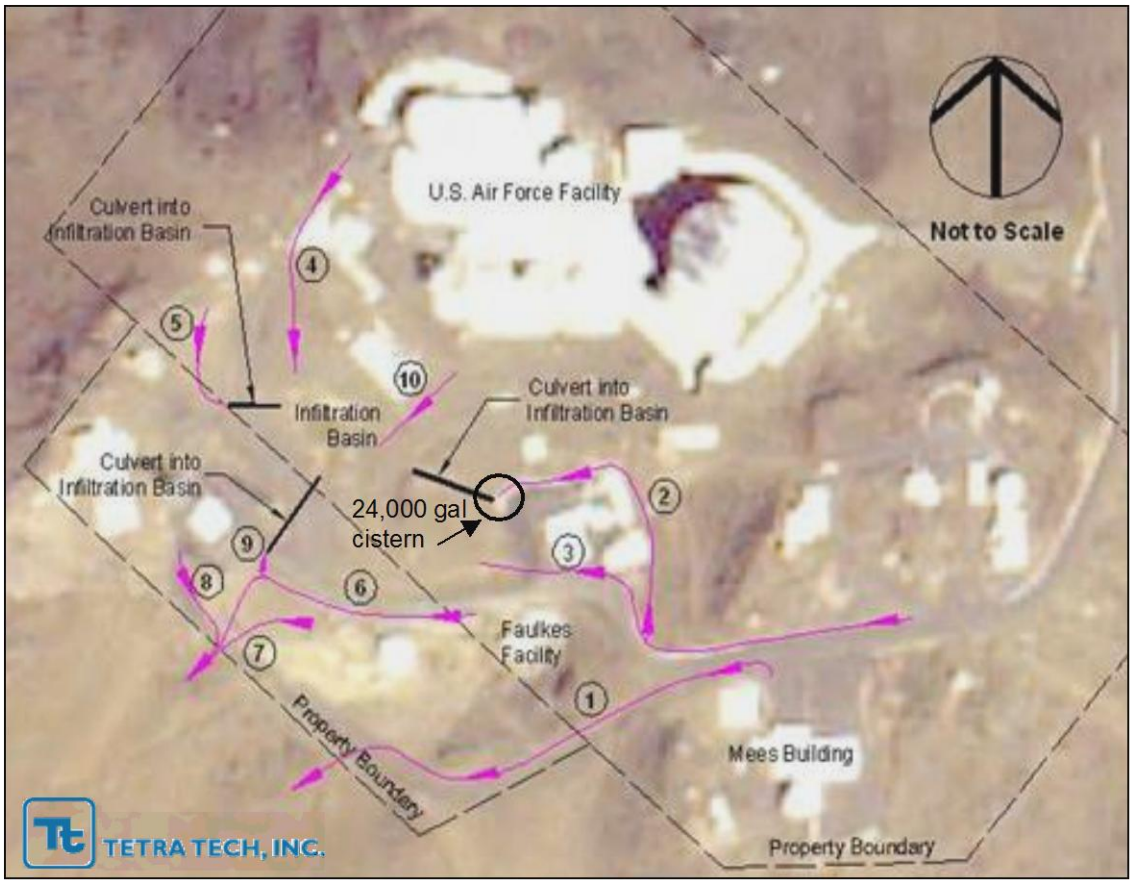


Figure 2-10. Existing Stormwater Runoff Patterns at HO.

The following is a brief description of each flow path in the HO drainage system:

Flow Path 1: Runoff from the parking lot associated with the MSO facility leaves the paved surface and flows down an abandoned road. The runoff then flows across a flat area before discharging along the southern slopes of the volcanic cone.

Flow Path 2: Runoff from the upper portion of the site drains onto the road and flows into a paved gutter. As designed, the runoff was to enter a concrete channel constructed behind the gathering of buildings and then be conveyed through a culvert into the infiltration basin.

Flow Path 3: Due to temporary blockage of Flow Path 2, concentrated runoff flow was redirected along the paved areas associated with the cluster of buildings. An asphalt berm was constructed to direct the runoff away from the buildings and toward the infiltration basin. Once the runoff discharges onto the native material, the flow dissipates into multiple undefined channels leading toward the infiltration basin.

Flow Path 4: Stormwater runoff from a small portion of the Air Force complex, along with runoff from the access road and concrete storage areas, flows along the edge of the road leading toward the infiltration basin.

Flow Path 5: The native soil in this Department of Energy (DOE)-controlled area appears to have been impacted from past activities such as parking and storage. Runoff from this area is conveyed to the infiltration basin through a culvert under the access road.

Flow Path 6: This concrete channel is designed to convey runoff from the road and from the Faulkes facility. The channel leads to two culverts under the access roads. The lower portion of the channel is a deposition location for sediment prior to where it enters the first culvert.

Flow Path 7: Runoff flows toward the south.

Flow Path 8: A portion of the runoff from the FAA facility flows toward the south and discharges over the slopes of the volcanic cone.

Flow Path 9: Runoff within the concrete channel was designed to flow into the infiltration basin through a series of two culverts that were placed under access roads

Flow Path 10: A large portion of the Air Force facility generates stormwater runoff that flows into the infiltration basin. The paved surfaces associated with the facility have curbs, which keep the runoff on paved surfaces until it enters the pipe network which discharges into the infiltration basin.

Runoff harvesting is also part of the drainage features at HO. Runoff from the MSO facility building is captured and stored in the adjacent 64,100 gallon cistern and is used for domestic water; and a 24,000 gallon cistern is associated with the Neutron Monitoring Station below the MSO facility. Some of the runoff from the UH facilities is captured by these cisterns before it reaches the infiltration basin.

Groundwater

As previously mentioned, the groundwater resources below HO are characterized as part of the Kamaole and Makawao systems of the Central sector and the Lualailua and Nakula systems of the Kahikinui sector. The characteristics of the groundwater of the Kamaole, Makawao, Lualailua, and Nakula systems are the same as those of the nearby systems and sectors. Two high-level, unconfined, perched aquifers exist, one on top of the other in dike compartments. Groundwater in both the upper and lower aquifers was identified as freshwater (containing less than 250 milligrams per liter of chloride) that has the potential for future use as drinking water, but it was not being used when the aquifer was classified. The upper aquifer is classified as being replaceable and highly vulnerable to contamination, while the lower dike aquifers are classified as being irreplaceable and moderately vulnerable to contamination. There are no drinking water wells within 11 miles of the summit (AFRL 2005).

The current MSO facility at HO uses a cesspool for handling wastewater and septic waste. This could affect subsurface water quality, but plans are in place to remove the cesspool, to remediate the site, and to construct a wastewater treatment facility in accordance with appropriate permits and procedures of Maui County and the State Department of Health. Generally speaking, cesspools do not treat wastewater, but rather remove solids and provide for anaerobic digestion of solids. The cesspool effluent is then filtered through the surrounding soil and groundwater providing for the general "treatment" of the (non-solids) wastewater. Pathogens and nutrients in potentially high concentrations (particularly nitrogen and phosphorous) are typically released from such systems, possibly degrading subsurface water quality and resulting in minor, adverse, and long-term impacts on groundwater within a discrete distance of the cesspool. Given the distance of approximately 11 miles to the nearest drinking water well, it is unlikely that continued operation of the cesspool would have an adverse affect on drinking water. If cesspool contaminants reach perched groundwater several thousand feet below HO, which then flows to surface water, then some adverse affects from cesspool operation could occur to human or ecological exposures to the surface water. Any dissolved recalcitrant contaminants (e.g. metals) discharged to the cesspool

would be expected to migrate further from the cesspool, and/or remain present longer than less recalcitrant contaminants. Organic and inorganic solids would continue to accumulate in the cesspool, requiring ongoing periodic removal and off-site disposal.

2.3 Constraints (e.g., Flood plain, tsunami, volcanic, topography)

The location of HO is at an elevation of 10,023 feet ASL. Constraints known to occur at higher elevations in Hawai‘i and other constraints in and around HO are addressed in the following sections.

2.3.1 Unauthorized Entry

Existing access to HO is via HALE (Fig. 2-11) and then through the entrance to the HO complex just past Pu‘u ‘Ula ‘Ula. There is no general public access to HO and authorized entry only is posted on the sign (Fig. 2-12) located at the entrance to the facilities. Native Hawaiians are welcome to enter for cultural and traditional practices as indicated on the sign.

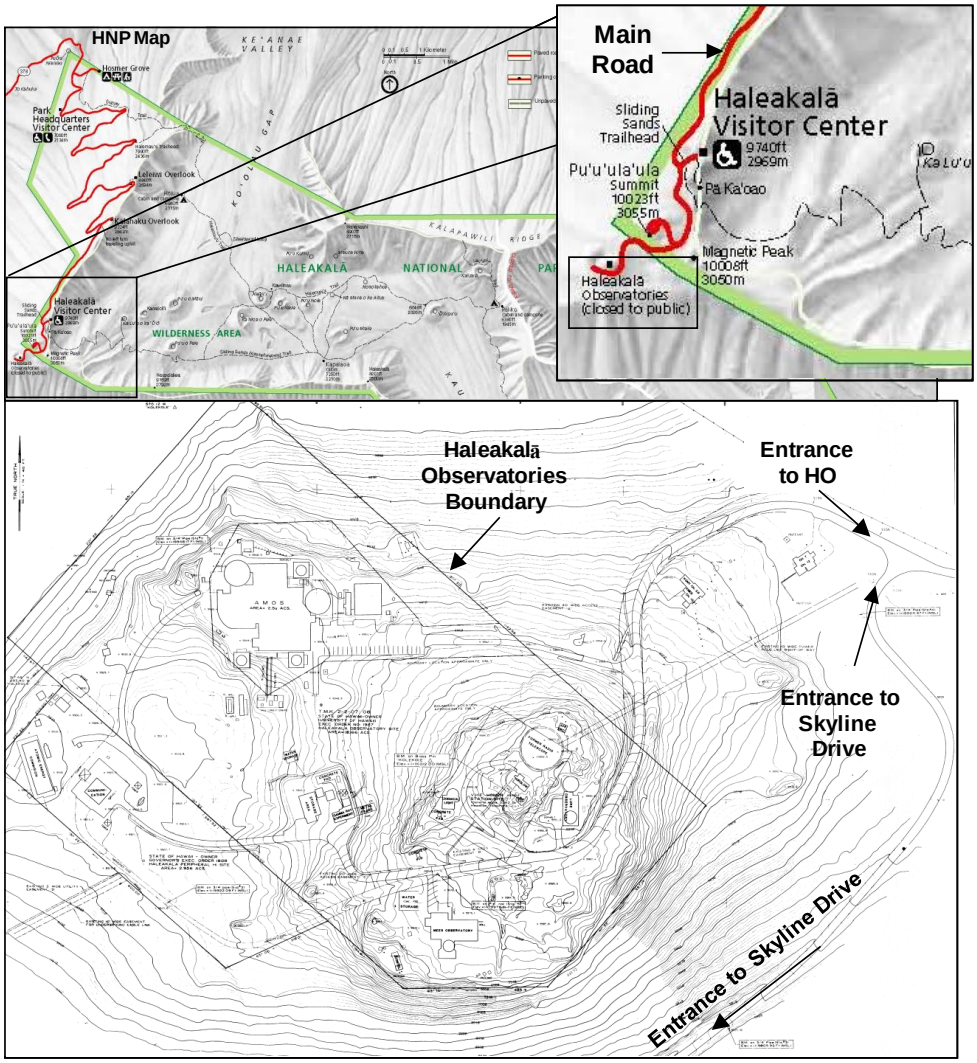


Figure 2-11. Existing Access to HO.

Figure 2-12. Sign at Entrance to HO.

2.3.2 Coastal Zone Management Area

To determine whether HO falls in the Coastal Zone Management area, reference was made to the County of Maui Planning Department map entitled *Island of Maui Showing Special Management Area* provided by the County of Maui GIS Program Office of the Managing Director, dated July 2002, and located in the Zoning and Administration Enforcement Division of the Planning Department, Wailuku, Maui. The map clearly indicates that the HO complex is not in the Coastal Zone Management area. The Kilohana Map M-11, State Land Use Designation Map (Conservation District topography map) located in the same County office verifies that the subject parcel is not within the Special Management Area (June 1995, State of Hawai‘i Land Use Commission). In addition, prior projects at HO requiring Conservation District Use Permits were submitted for zoning evaluation by the County Department of Planning. No special zoning was identified for HO.

2.3.3 Existing Covenants, Easements, and Restrictions

Other than the use restrictions described in the Governor’s EO 1987 “…Haleakala High Altitude Observatory Site purposes only”. EO 1987 has no expiration date and there are no other existing covenants, easements, and restrictions, which would constrain the use of HO.

2.4 Existing Land Use

In 1961, the State Land Use Law, Act 187, which has been codified as HRS, Chapter 205, established the State LUC and granted the LUC the power to zone all lands in the State into three districts: Agriculture, Conservation, and Urban (the Rural District was added in 1963). Act 187 vested the DLNR with jurisdiction over the Conservation District, who then divided the Conservation District to subzones in order to better regulate land uses and activities therein. Since 1964, the BLNR has adopted and administered land use regulations for the Conservation District and made major changes to the regulations in 1978 and 1994.

The objective of the Conservation District is to conserve, protect, and preserve the important natural resources of the State through appropriate management and use in order to promote their long-term sustainability and the public health, safety, and welfare. The use of the HO property has been and will

continue to be consistent with the purposes under which the HO area was set aside to UH by Governor's EO 1987. The HO area wholly within the Conservation District has been set aside for "…Haleakalā High Altitude Observatory Site "…Haleakalā High Altitude Observatory Site purposes only" (EO 1987). Many facilities conducting astronomical research and advanced space surveillance already exist within HO (see Fig. 1-4). In accordance with HAR 13-5, uses on HO property are consistent with Conservation District land use requirements, which require a Conservation District Use Application (CDUA) be filed with the DLNR and approved by the BLNR prior to the initiation of such uses.

The Conservation District has five subzones: Protective, Limited, Resource, General and Special. Omitting the Special Subzone, the four subzones are arranged in a hierarchy of environmental sensitivity, ranging from the most environmentally sensitive (Protective) to the least sensitive (General); the Special Subzone is applied in special cases specifically to allow a unique land use on a specific site.

These subzones define a set of "identified land uses" that may be allowed by discretionary permit. The OCCL can accept a permit application only for an identified land use listed under the particular subzone covering the subject property. Most of the identified land uses require a discretionary permit or some sort of approval from the DLNR or BLNR. Major permits are required for land uses that have the greatest potential impact. Major permits also require an EA or an Environmental Impact Statement (EIS), possibly a public hearing, and decision making by the BLNR. Minor permits are required for land uses that may have fewer impacts. Minor permits may be approved by the BLNR chairperson (and may not require a public hearing) or by the OCCL administrator (for certain minor uses within the Conservation District).

2.4.1 HO Facilities

This area of the Conservation District is set aside for "…Haleakalā High Altitude Observatory Site purposes only" (EO 1987). Presently, facilities located within HO (see Fig. 1-4) observe the Sun, provide a world-class telescope for education and research outreach to students all over the world, use lasers to measure the distance to satellites, track and catalogue man-made objects, track asteroids and other natural potential space threats to Earth, and obtain detailed images of spacecraft. It is a principal site for optical and infrared surveillance, inventory and tracking of space debris, and active laser illumination of objects launched into earth orbit, activities that are all crucial to the nation's space program.

Historical Uses

Over the past 45 years, HO has experienced managed growth of scientific research within its boundaries (UH IfA 2005). Table 2-2 lists a facility history for scientific events that occurred beginning in the spring of 1951 when Grote Reber conducted radio astronomy experiments at Haleakalā.

Table 2-2. Facility History at Haleakalā High Altitude Observatory Site.

Facility	Date	Event
"Reber Circle"	1951	Grote Reber, one of the pioneers of radio astronomy, experimented with radio interferometry using a large steel and wood truss antenna. Site abandoned approximately one year later.
none	1955	Dr. Walter R. Steiger of the UH Department of Physics conducted a site survey study near the summit of Haleakalā to determine the suitability of the location for a solar observatory.
none	1961	EO 1987 from Hawaii's Governor Quinn to UH set aside 18+ acres of land on the summit of Haleakalā to establish the HO site. UH responsible for managing and developing land.
Mees Solar Observatory (MSO)	1957 to 1976	In preparation for the International Geophysical Year, the UH was approached by Dr. C. Kenneth Mees of Eastman Kodak to locate and operate a Baker-Nunn satellite-tracking facility on Haleakalā. In 1964, the MSO facility was named for Dr. C. Kenneth Mees.
	1964 to Present	NSF initially funded, and in later years the National Aeronautics and Space Administration (NASA) funded, the C. E. Kenneth Mees Solar Observatory, which began astronomical studies of the solar corona and chromosphere.
Airglow and Zodiacal Light Programs	1962	Airglow and Zodiacal Light program initiated in the old blockhouse in which Grote Reber had once housed his equipment.
University of Hawai'i Institute for Astronomy (IfA)	1967	The University of Hawai'i founded the Institute for Astronomy. The IfA's primary research activities include the study of galaxies, cosmology, stars, planets, and the Sun. At this point in time, the IfA's assets included the Waiakoa Laboratory in Kula, the Mees Solar Observatory, and the newly constructed Zodiacal Light observatory at the summit.
Airglow Facility	1972	Airglow program equipment moved to new facility.
Lunar Ranging Experiment Observatory (LURE)	1974 to 2004	LURE, which was operated by IfA under contract to the NASA Goddard Space Flight Center, supported the NASA Space Geodesy and Altimetry Projects, has provided NASA with highly accurate measurements of the distance between LURE and satellites in orbit about the Earth, and which was involved in the NASA Crustal Dynamics Project. This project was replaced by the Pan-STARRS test-bed (PS1) in 2006.
Cosmic Ray Neutron Monitor Station	1991 To 2007	Cosmic Ray Neutron Monitor Station, the only such station in the world, operated in association with the University of Chicago Enrico Fermi Institute and the Faulkes Telescope Facility.
Multi-color Active Galactic Nuclei Monitor Project (MAGNUM)	1998 to 2008	The University of Tokyo, the National Astronomical Observatory of Japan, and the Australian National University have installed a 2-meter telescope in the 9-meter North dome of the LURE complex to support the MAGNUM Project.
Faulkes Telescope Facility (FTF)	2004	The Faulkes Telescope Facility at HO houses the largest educational outreach optical telescope in the world in support of astronomy research and education for grades K-college in Hawai'i and the United Kingdom. The FTF on Maui is known as the FTF North and its twin in Australia is known as FTF South.

Table 2-2. Facility History at Haleakalā High Altitude Observatory Site (cont.).

Facility	Date	Event	
Presently known as the Maui Space Surveillance Complex (MSSC)	1963	Construction begins on the Advanced Research Projects Agency (ARPA) Maui Optical Station (AMOS), designated in 1977 as Maui Space Surveillance System (MSSS).	
	1965	AMOS satellite tracking facility achieves first light.	
	1967	ARPA designated MSSS site for Western Test Range midcourse observations, with the University of Michigan (UM) conducting operations and maintenance at the site. About 40 scientists, engineers and technicians worked for UM, about half traveling to the summit on any given day.	
	1969	Routine missile tracking operations began under new contractors AVCO Everett Research Laboratory (AVCO) and Lockheed Missiles and Space Company. AVCO adds about 40 additional personnel for research and development, about half at the summit at any given time.	
	1977	The twin 1.2-meter telescope at AMOS is dedicated to the Maui Optical Tracking and Identification Facility, known now as the MSSC, for daily routine satellite tracking operations. No new personnel were required.	
	1980	Construction begins at MSSS on Ground-Based Electro-Optical Deep Space Surveillance System (GEODSS). Three new domes are built and approximately 10,000 square feet of office and laboratory space on the south side of MSSS.	
	1982	The GEODSS, with three 1-meter telescopes becomes one of four operational sites in the world performing ground-based optical tracking of space objects. It employs about 15 operations and maintenance personnel.	
	1995 to Present	One part of the MSSC is the MSSS, a facility combining operational satellite tracking facilities with a research and development facility. This also includes the Dept. of Defense's (DoD) largest telescope, the Advanced Electro-Optical System (AEOS). Over the years the Air Force operation has grown to include a total of approximately 125 civilian and military personnel housed at the Kihei Research and Technology Park and approximately 115 more based at MSSS.	
Panoramic-Survey Telescope and Rapid Response System (Pan-STARRS) (LURE)	2006	PS1 South Dome	These facilities house a 1.8-meter wide-field optical imaging system equipped with a 1.44-billion pixel charge-coupled device camera. This unique combination of sensitivity and field-of-view will address a wide range of time-domain astronomy and astrophysical problems in the Solar System, Galaxy, and Universe.
	2010	PS2 North Dome	

Exiting Uses

Table 2-3 lists existing astronomical research facilities for advanced studies of astronomy, space surveillance, and atmospheric sciences at HO.

Table 2-3. Existing Facility Uses at Haleakalā High Altitude Observatory Site.

Facility	Primary Function	
U.S. Air Force Maui Space Surveillance Complex	Presently, of the 18.166 acres, 4.5 acres are leased to the United States Army Corps of Engineers for the MSSC. MSSC conducts space surveillance and research activities for the DoD.	
Ground-Based Electro-Optical Deep Space Surveillance System	Another major part of the MSSC, which is one of four operational sites in the world performing ground-based optical tracking of space objects.	
C. E. Kenneth Mees Solar Observatory	Emphasizes studies of the solar corona and chromosphere.	
Zodiacal Observatory	Houses the test-bed Scatter-free Observatory for Limb Active Regions and Coronae (SOLAR-C) Telescope Facility, both supported by UH IfA.	
Panoramic-Survey Telescope and Rapid Response System	PS1 South	These facilities house a 1.8-meter wide-field optical imaging system equipped with a 1.44-billion pixel charge-coupled device camera. This unique combination of sensitivity and field-of-view will address a wide range of time-domain astronomy and astrophysical problems in the Solar System, the Galaxy, and the Universe.
	PS2 North	
Faulkes Telescope Facility	Faulkes houses the largest educational outreach optical telescope in the world in support of astronomy research and education for grades Kindergarten through college in Hawai‘i and the United Kingdom.	
Haleakalā Amateur Astronomers	The IfA dedicated a small building for the Haleakalā Amateur Astronomers to organize and host programs for professors and students at UH Maui College (UH MC), K-12, Boy Scout groups, Akamai students, community members and others to conduct astronomy observations at HO.	

The first major UH facility at HO was the MSO facility. UH has operated the MSO facility since 1964. The scientific programs at the MSO facility emphasize studies of the solar corona and chromosphere. The LURE Observatory was operated by IfA under contract to NASA Goddard Space Flight Center from 1972 until 1993 conducting highly accurate measurements of the distance between LURE and the Moon, as well as measurements of the distance between LURE and satellites in orbit about the Earth. From 1993 to 2004 LURE was operated for the NASA Space Geodesy and Altimetry Projects, and provided NASA with highly accurate range measurements between LURE and satellites, and was involved in the NASA Crustal Dynamics Project.

The Pan-STARRS (PS1) telescope was dedicated on June 30, 2006, and is within the footprint of the former LURE Observatory South Dome. The testing of extremely high resolution camera imagery will lead to development and deployment of a small, economical, four-telescope system for observing the entire available sky several times each month to discover and characterize Earth-approaching objects, both “killer asteroids” and comets, that might pose a danger to our planet.

The Faulkes Telescope Facility (FTF) was originally built by the Dill Faulkes Educational Trust and became operational in 2004. Ownership of the FTF and the lease of the FTF site were assumed by the Las Cumbres Observatory Global Telescope Network, Inc. (LCOGT) in 2005 and continues to be a joint effort with IfA. The goal of this facility is to give students and teachers in Hawai‘i and the United Kingdom (UK) access to a research grade telescope. With its 2-meter diameter primary mirror, this telescope (along with its twin in Australia) is the largest telescope designated solely for educational use in the world. This 2-meter (6.6-foot) telescope is operated remotely over the Internet, without need for permanent on-site operational staff.

The IfA also leases 4.5 acres at HO for the Maui Space Surveillance Complex (MSSC), which supports optical and infrared experiments and observations carried out by the United States Air Force (USAF). The Air Force Research Laboratory (AFRL) is the host command with responsibility for the MSSC. One part of the MSSC is the Maui Space Surveillance System (MSSS), a state-of-the-art electro-optical facility combining operational satellite tracking facilities with a research and development facility. The MSSS houses the largest telescope in the Department of Defense (DoD) inventory, the 3.67-meter (12-foot) Advanced Electro-Optical System (AEOS), as well as several other telescopes ranging from 0.4 to 1.6 meters (1.3 to 5.2 feet).

Another major part of the MSSC is the Ground-Based Electro-Optical Deep Space Surveillance System (GEODSS), which is operated for the Air Force Space Command. The GEODSS at HO is one of four operational sites in the world performing ground-based optical tracking of space objects. The main telescope has a 102-centimeter (3.3-foot) aperture and a 2-degree field-of-view and is used primarily to search the deep sky for faint (+16 magnitude), slow-moving objects. The auxiliary telescope has a 38-centimeter (15-inch) aperture and 6-degree field-of-view, and does wide area searches of lower altitudes where objects travel at higher relative speeds. The telescopes are able to "see" objects 10,000 times dimmer than the human eye can detect.

The IfA has dedicated a small building for the Haleakalā Amateur Astronomers to organize and host programs for professors and students at UH MC, K-12, Boy Scout groups, Akamai students, community members and others to conduct astronomy observations at HO.

2.5 Existing Conservation District Use Permits

Table 2-4 lists Conservation District Use Permits (CDUPs) for HO that has been authorized by the DLNR.

Table 2-4. Conservation District Use Permits for HO.

CDUP No.	Date	Project
MA-386	1973	Lunar Ranging Experiment
MA-386	1998	Site Plan Approval LURE Accessory Trailers
98-164	1999	Accessory Structure Zodiacal Light Observatory/Exempt class
MA-3201	11/04/04	Pan-STARRS (PS1)
MA-3032B	04/29/04	Faulkes Telescope Facility
MA-0516	02/11/05	Site Plan Approval for ATST Geotechnical Soil Coring
MA2705	07/31/06	Advanced Electro-optical System
MA-3308	08/07/06	Transportable Laser Ranging System (TLRS)
MA-3032	11/12/08	Site Plan Approval for Faulkes Telescope Facility Site Improvements
MA-3308	08/06/09	Accessory Trailer TLRS/Exempt class

2.6 Access

Existing access to HO is via HALE (see Fig. 2-11) and then through the entrance to the HO complex just past Puʻu ʻUla ʻUla. There is no general public access to HO and authorized entry only is posted on the sign (see Fig. 2-12) located at the entrance to the facilities. Native Hawaiians are welcome to enter for cultural and traditional practices as indicated on the sign. An unimproved, access road known as Skyline Drive (see Fig. 2-11) originates 0.5 miles away from HO at the Saddle Area. It traverses the Southwest Rift Zone, ultimately leading to Polipoli State Park, which is located at 6,200 feet ASL in the Kula Forest Reserve (DLNR, Hawaiʻi State Parks). Its entire length is located on State land within the Forest Reserve. A locked gate near the Saddle Area restricts vehicle access to the road from the Haleakalā summit to only those holding DLNR permits. Hikers, hunters, and HALE personnel primarily use the unpaved road.

3.0 PROPOSED LAND USES ON PARCEL

3.1 Description of Proposed Land Use

The proposed land use would be located within the 18.166-acre HO site at the summit of Haleakalā, County of Maui, Hawai'i. Presently, facilities located within HO observe the Sun, provide a world-class telescope for education and research outreach to students all over the world, use lasers to measure the distance to satellites, track and catalogue man-made objects, track asteroids and other natural potential space threats to Earth, and obtain detailed images of spacecraft. It is a principal site for optical and infrared surveillance, inventory and tracking of space debris, and active laser illumination of objects launched into earth orbit, activities that are all crucial to the nation's space program. Table 2-3, above, lists existing astronomical research facilities for advanced studies of astronomy, space surveillance, and atmospheric sciences at HO.

Because observatory sites require clear fields-of-view and shielding from warm ventilated air from other facilities, which negatively impact atmospheric "seeing", there are only a limited number of viable sites within HO for observatories. Those are:

1. the areas where existing facilities reside (see Table 2-3), which would be eligible for replacement, renovation, or upgrades, and;

2. two other undeveloped sites that the surveys and studies suggest would not contribute significant impact to the existing facilities. As previously shown in Figure 1-4, these are:

    a. Reber Circle, which is suitable for 2- to 4-meter class telescopes. It is listed in the archaeology inventory as a former radio telescope site that qualifies by its age (1952) for recovery of data, but need not be preserved; and,

    b. The approximately 1.5-acre undeveloped site just to the northeast of the Mees Solar Observatory, which is suitable for 2- to 4-meter class telescopes.

Should the proposed ATST be constructed at the undeveloped site northeast of the Mees Solar Observatory, as selected in the ATST Record of Decision, the Reber Circle site would be the only undeveloped site eligible for new construction. In December of 2006, the United States Air Force published an Environmental Impact Statement Preparation Notice (EISPN) for the University of Hawaii's Pan-STARRS project. The EISPN identified the Reber Circle site as a potential alternative site for proposed Pan-STARRS PS4.

All these areas, including the undeveloped sites, were graded at least once (during the 1950-60 era). They are not host to endangered faunal or botanical species or archaeological, historic, or cultural resources, and they are positioned within HO to provide favorable telescope fields-of-view and atmospheric "seeing".

There is additional undeveloped acreage at HO, but it is not suitable for development for various reasons. Some locations would infringe on the fields-of-view for other observatories, or be disadvantageously positioned with respect to horizon obstruction or wind regime. Importantly, based on available surveys and maps, some of the HO areas probably should not be developed because they are unsuitably close to endangered species habitat or archaeological or cultural resources (see Figs. 2-3 and 2-6).

3.2 Site Plan

The HO site and adjacent properties are shown in Figure 1-3. The boundaries of HO shown in Figure 3-1 are on State Conservation Land, and other lands directly adjacent to HO occupied by the FAA and DOE are also under an EO. Existing facilities located within HO are shown on Figure 1-4.

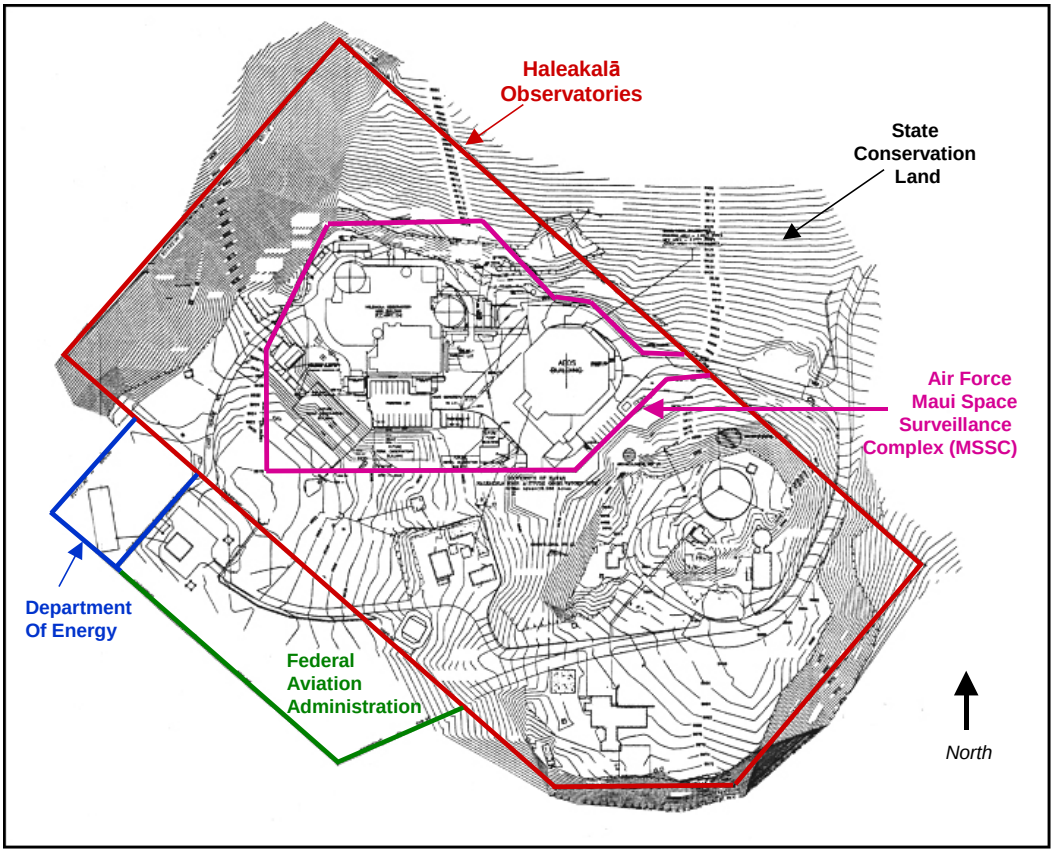


Figure 3-1. HO, Federal Aviation Administration, and Dept. of Energy Properties.

3.2.1 Site Plan Details

Over the past 45 years, HO has experienced managed growth of scientific research within its boundaries The first major UH facility at HO was the MSO facility. UH has operated the MSO facility since 1964. The scientific programs at the MSO facility emphasize studies of the solar corona and chromosphere. The LURE Observatory was operated by IfA under contract to the National Aeronautics and Space Administration (NASA) Goddard Space Flight Center from 1972 until 1993, to conduct highly accurate measurements of the distance between LURE and the Moon as well as measurements of the distance between LURE and satellites in orbit about the Earth. From 1993 to 2004 LURE was operated for the NASA Space Geodesy and Altimetry Projects, providing NASA with highly accurate range measurements between LURE and satellites, and the facility was also involved in the NASA Crustal Dynamics Project.

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lead to development and deployment of a small, economical, four-telescope system for observing the entire available sky several times each month to discover and characterize Earth-approaching objects, both "killer asteroids" and comets, that might pose a danger to our planet.

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Another major part of the MSSC is the Ground-Based Electro-Optical Deep Space Surveillance System (GEODSS), which is operated for the Air Force Space Command. The GEODSS at HO is one of four operational sites in the world performing ground-based optical tracking of space objects. The main telescope has a 102-centimeter (3.3-foot) aperture and a 2-degree field-of-view and is used primarily to search the deep sky for faint (+16 magnitude), slow-moving objects. The auxiliary telescope has a 38-centimeter (15-inch) aperture and 6-degree field-of-view, and does wide area searches of lower altitudes where objects travel at higher relative speeds. The telescopes are able to "see" objects 10,000 times dimmer than the human eye can detect.

The IfA has dedicated a small building for the Haleakalā Amateur Astronomers to organize and host programs for professors and students at MCC, K-12, Boy Scout groups, Akamai students, community members and others to conduct astronomy observations at HO.

3.3 Justification of Identified Land Use

The proposed land use for HO qualifies as an identified use in the General Subzone and is consistent with the objectives of the General Subzone of the land (see Fig. 1-1). The objectives of the General Subzone (HAR 13-5-14) are to designate open space where specific conservation uses may not be defined, but where urban uses would be premature.

The proposed land use is to continue using HO for astronomical research facilities for advanced studies of astronomy and atmospheric sciences. HO is located within a General Subzone of the State of Hawai'i Conservation District that has been set aside for astronomical research (see Fig. 1-1). The objectives of the General Subzone (HAR Chapter 13-5-14) are to designate open space where specific conservation uses may not be defined, but where urban uses would be premature. Identified applicable land uses in the General Subzone, include R-3 Astronomy Facilities, (D-1) Astronomy facilities under an approved management plan (HAR 13-5-25).

3.4 Expected Timing

Ongoing research actions are expected to continue at HO. The scientific programs that UH will develop at HO and potential new facility developments that will keep UH in the forefront of astronomy can have long lead times to be defined, designed, proposed, and implemented. Therefore, the timing of proposed land use for future actions can be defined herein as those that would occur in the reasonably foreseeable future, which for the purposes of the MP are those that would occur during the next decade.

This MP is intended to serve the planning processes for programs and facility developments for an initial term of 10 years, subject to extension. However, the monitoring strategies and steps to ensure that historic preservation concerns are met were both prepared with considerable input from the greater Maui community, Native Hawaiian interests, the Haleakalā neighbors, such as the National Park Service, the U.S. Air Force, and other interested agencies and individuals. One intention for this document is to provide a vehicle for continuing consultations as HO evolves, such that the MP continues to provide the most effective management planning for the site.

3.5 Monitoring Strategies

This section of the MP provides comprehensive monitoring strategies for the proposed land uses at HO. The strategies are based on and expanded from the IfA LRDP.

3.5.1 History of Monitoring Strategies at HO

Beginning about 1980, numerous studies of environmental, cultural, historic, and economic resources, as well as potential impacts to those resources, have been undertaken at HO for various purposes. Construction of the Air Force GEODSS facility was preceded by an EA in 1980, an EA was completed for the AEOS telescope in 1994, another filed with the State of Hawai‘i prior to construction of the Faulkes Telescope Facility in 2001, and a Federal EA was filed for the construction of the Mirror Coating Facility at AEOS in 2005. Other assessments have also been completed for environmental compliance management. While the resource descriptions in these assessments frequently encompassed the entire 18.166 acres of HO, many studies were focused on specific project areas within HO. Some of these assessments addressed cumulative impacts on the site that may have been incurred by new construction of those facilities since 1980.

For the LRDP, comprehensive, site-wide environmental, cultural, historic, and conceptual planning studies, surveys and inventories were completed during 2002 to 2003. The survey work was coordinated with the appropriate State agencies where required, and although much prior work was already available as reference resources, all of the qualified experts involved conducted their own field and laboratory work at the HO site to collect samples, examine in-situ materials, take measurements, etc. The surveys and studies established a baseline for conditions in support of the guidelines for the future physical and management planning that was described in the LRDP. Subsequent to publication of the LRDP, numerous additional studies and surveys were conducted. Some of these were for the proposed ATST Project, and others were conducted under IfA auspices to provide better information needed to effectively manage HO resources.

The surveys and studies include geological history, structure, and geochemistry, soils, distribution and inventory of botanical resources, avifaunal distribution and population analysis, description and inventory of invertebrate species, identification and significance of historic and cultural resources, assessment of traditional practices, inventory and analysis of archeological resources, analysis of visual resources, traffic volume, stormwater flows and effects, ground vibration, and analyses of potential economic

impacts and benefits. In total, the many surveys, studies, inventories, and reports constitute a comprehensive picture of the conditions at HO. In addition, those elements of the dynamic environment at HO, such as invertebrate and botanical species and distribution, stormwater flows and effects, and economic conditions have been re-evaluated to represent the most recent conditions at HO.

During the nine-month public vetting period for the LRDP, IfA conducted consultations with Haleakalā neighbors about various aspects of future planning and conducted initial consultations with the Native Hawaiian community, and individuals in the Upcountry and broader Maui communities. Subsequently, those consultations have been much more extensive, as described below.

The evaluation of resources by specialists and consultations with interested agencies and individuals culminated in the management planning measures implemented through the LRDP published in January 2005. Subsequent consultations for projects such as the Air Force Mirror Coating Facility, Pan-STARRS PS1, and the proposed ATST Project have been useful in further developing the management policies, practices, and procedures implemented in this MP.

3.5.2 MP Monitoring Strategies

The MP is the governing document used for existing and future development at HO. It specifies the design and environmental criteria that would be followed when implementing development, and presents strategies for managing, monitoring, and protecting the various natural and cultural resources and uses of UH-controlled areas.

Management planning addresses:

1. specific requirements and guidelines for future astronomical facilities,
2. guidelines for U. S. Air Force facilities and other scientific activities at the site,
3. terms and conditions that will be applied to leases; and,
4. future planning for IfA in support of HO.

In preparing the general plans for managing HO, IfA has taken into account the data and recommendations from the experts who provided surveys and studies, such as archeological and cultural resources, traditional cultural practices at the summit and other areas, botanical and faunal resources, traffic, and others. Since the LRDP was completed, additional consultations for the Mirror Coating Facility and PS1 provided input to the general plans. In addition, the National Environmental Policy Act (NEPA) and National Historic Preservation Act (NHPA) processes for the proposed ATST Project provided the Maui community and its organizations, State and Federal agencies, and Native Hawaiian interests with opportunities to provide further input for more effective management of HO as a whole. The MP has incorporated many of these recommendations and the intent of the IfA is to continue to provide opportunities for the public to participate with comments and recommendations on these plans from all who wish to provide input.

The overall objective for management of astronomical facilities is to create a structure for sustainable, focused management of the resources and operations of HO, in order to protect historic/cultural resources (e.g. archaeology sites and traditional cultural practices) to protect natural resources, to protect and enhance education and research, and to provide the opportunity, where appropriate, for future expansion of the scope of activities at HO.

3.5.2.1 Cultural and Historic Preservation Management

Workers at HO need to be culturally sensitive to the fact that they are in a place considered sacred by Native Hawaiians. As the responsible agency, IfA is committed to preserving the cultural resources at the site and has sought advice from the Native Hawaiian community on Maui concerning the best methods to achieve that objective. One outcome of those consultations and the cultural resource evaluations of HO is that the IfA has implemented policies and practices for the long-term preservation of archeological and cultural resources within HO, based on recommendations in the Cultural Resources Assessment, the SCIA, and by interested agencies and the Maui community.

Compliance with the IfA policy for the preservation of cultural resources is defined as follows:

1. The sign at the entrance to HO states that Native Hawaiians are welcome to practice traditional cultural practices within the HO property.
2. All contractors and personnel working within HO must receive IfA-approved environmental and cultural training before beginning work. Training programs explain and amplify the requirements applicable to all construction projects within HO boundaries. For environmental protection and preservation of cultural and historic resources, the requirements to protect these resources are as follows:
    a. Any construction within HO requiring a permit from DLNR requires the consultation and monitoring of a Cultural Specialist. This person will be engaged at the earliest stages of the planning process, will monitor the construction process, and will consult with and advise the onsite project manager about any cultural or spiritual concerns. For the purposes of this section, a Cultural Specialist must be a Native Hawaiian, preferably a kupuna (elder) and a Kahu (clergyman, caretaker), and one who has personal knowledge of the spiritual and cultural significance and protocol of Haleakalā.
    b. All cultural and archeological sites and features identified in the Archeological Inventory Surveys should be protected and preserved in accordance with HAR, Title 13, Subtitle 13, Chapter 277, "Rules Governing Requirements for Archeological Site Preservation Development." Protection should include the establishment of clearly marked buffer zones and periodic monitoring by both the project archeologist and cultural specialist throughout any construction.
    c. All construction crewmembers shall attend IfA-approved "Sense of Place" training before working at projects within HO.
    d. All permanent employees working at HO shall attend IfA-approved "Sense of Place" training before working at HO facilities.

The requirements specified above apply to and must be included in all land use-related memoranda, facility use agreements, operating and site development agreements and leases.

Additionally, the area consisting of approximately 24,000 square feet (0.55 acre) and located southwest of the MSSC, as further identified and more particularly described as "Area A" (see Fig. 2-2), will be set aside in perpetuity for the sole reverent use of the Native Hawaiians for religious and cultural purposes, with the understanding that such use will not interfere with other uses and activities within HO.

A preservation plan for archeological sites contained within HO was submitted to IfA with the 2006 archeological inventory survey (Xamanek Researches 2006) to ensure protection of the archeological resources at the site. The preservation plan had been coordinated with and approved by the SHPD, in

accordance with HAR 13 Subtitle 6, Chapter 148 (DLNR 2006). This preservation plan has been adopted by the IfA to protect those resources. In summary, a total of 11 sites are involved in the preservation plan. The majority of sites and features are wind shelters, along with two petroglyph images, a possible burial, and two possible ceremonial platforms. Passive as-is preservation has been adopted for these sites, except for the remnants of Reber Circle. There is no signage proposed for any of these sites, in order to prevent unwanted attention and potential adverse impacts.

3.5.3 Environmental Protection of Site Resources

During the course of more than 40 years of IfA management of the 18.166 acres of HO land near the summit, there has been a significant increase in awareness of the importance of effective, long-term stewardship of the land by the public and U.S. Government. On Maui, the Native Hawaiians who lived and cared for the land and its resources did so for many hundreds of years before the public or government became concerned about conservation, preservation, and restoration during the last century. Centuries before inception of any National or State environmental regulations or policies, the Native Hawaiian Aliʻi imposed strict constraints on use and preservation of resources.

IfA has listened to the recommendations by Native Hawaiians and experts working with IfA at the site; and, in the spirit of the ancient Hawaiians who closely protected the summit and in compliance with the regulatory requirements of the State of Hawaiʻi, IfA has developed principles and practices to which everyone must adhere when working at HO. These principles and practices were developed in cooperation with the DLNR, HALE, the U.S. Air Force, Boeing LTS, Maui Economic Development Board, and other Haleakalā neighbors and summit users.

3.5.3.1 IfA-Implemented Practices

The IfA has implemented a number of measures, as described in the MP. From year-to-year, these are subject to State funding availability, and include, but are not limited to:

1. Weeding of the HO property. (The entire 18.166 acres was weeded in July 2009 to remove weeds and to document likely areas of re-growth.)
2. Vector control for rodents.
3. Soil and erosion control, in accordance with the Storm Water Management Plan (SWMP) (UH IfA 2006), to maintain habitat ecosystem
4. Nighttime lighting restrictions to prevent misdirecting ʻuaʻu.
5. Frequent removal of trash to prevent predators from obtaining food sources.

3.5.3.2 Construction Practices

All subcontractor personnel working at HO must receive IfA-approved environmental training, prior to beginning work. This training program explains and amplifies the requirements imposed on all construction projects within HO boundaries. For environmental protection, the IfA requires the following to protect vital environmental resources:

1. HALE has experienced the introduction of destructive non-native species that compete with and have in some cases displaced native plants and insects. These introductions threaten the ecological balance at the summit area, and in cooperation with HALE, IfA requires any contractor to take the following measures at HO to prevent construction or repair activities from introducing new species:

a. Any equipment, supplies, and containers with construction materials that originate from elsewhere, i.e., the other islands or the mainland, must be checked for infestation by unwanted species by a qualified biologist or agricultural inspector prior to being transported to the summit. Specimens of non-native species found in these inspections are to be offered to the state for curation, and those not wanted are to be destroyed. All construction vehicles that will be used off paved surfaces must be steam cleaned/pressure washed before they travel or are transported through HALE. It shall be the sole responsibility of the contractor to coordinate inspections with the HALE Business and Revenue Program Specialist.

b. Importation of fill material to the site is prohibited, unless such fill (e.g., sand) is sterilized to remove seeds, larvae, insects, and other biota that could survive at HO and propagate. All material obtained from excavation is to remain on Haleakalā. Surplus excavated cinders, soil, etc., is to be offered to other agencies located at the summit or HALE.

c. Contractors are required to participate in IfA-approved pre-construction briefings to inform workers of the damage that can be done by unwanted introductions. Satisfactory fulfillment of this requirement can be evidenced by a signed certification from the contractor.

d. Parking of heavy equipment and storage of construction materials outside the immediate confines of HO property is prohibited.

e. Contractors are required to remove construction trash frequently, particularly materials that could serve as a food source that would increase the population of mice and rats that prey on native species.

2. The endangered ʻuaʻu, or Hawaiian Petrel, occupies burrows on the upper slopes of Haleakalā from February to October. The burrows are located in cinder and are active year after year, since the birds return to the site of their birth. Petrels are night flying birds, leaving their burrows to search for food during nesting and fledgling seasons. The burrows are located on the south slopes below the MSO facility and on the north slopes below the MSSC. The following requirements are in place to ensure that the ʻuaʻu habitat will be protected during any construction activities.

   a. During the months when ʻuaʻu are present on Haleakalā, care must be exercised to ensure that ʻuaʻu will not be disturbed. Therefore, vibration and noise from heavy construction equipment or activities must not impact the normal life-cycle of resident birds. If heavy construction equipment will be necessary at the HO site, consultation with the USFWS, the Division of Forestry and Wildlife (DOFAW), and avifaunal experts will be required to determine feasibility and any applicable mitigation requirements.

      Furthermore, it would be necessary to determine whether human receptors in areas outside of the HO would be affected by construction noise. There are areas within HO close enough to HALE visitors, such that they would be able to detect noise from construction of and traffic at the proposed facilities. These sounds could affect Native Hawaiian cultural practitioners and those engaged in recreation at nearby locations. The analyses provided by the contractor would be used to help develop methods to avoid, minimize, or mitigate such noise where it would or may affect endangered species, sensitive cultural practices, or the experience of visitors to the summit area outside of HO.

      Such methods could include:

      i. Workers at the site must be informed of vibration, noise, and lighting hazards to endangered species, that their activities are to be confined to the construction site to

minimize risk to birds in adjacent areas, and that noise sources should be shielded where possible.

ii. Conducting all noise-emitting activities within strict day and time constraints, with work prohibited during sensitive nighttime periods.

iii. Reducing or substituting power operations/processes through use of proportionally sized and powered equipment necessary only for tasks at hand.

iv. Maintaining all powered mechanical equipment and machinery in good operating condition with proper intake and exhaust mufflers.

v. Turning off or shutting down equipment and machinery between active operations.

b. Contractors will be given current maps of locations of ʻuaʻu burrows to assist with ʻuaʻu conservation. HALE biologists are continuously finding and mapping new ʻuaʻu burrows and these maps are made available to IfA for planning purposes.

c. HO personnel will notify USFWS of any ʻuaʻu mortalities. Contractor personnel will report mortalities to IfA immediately.

d. Construction of fences will be avoided, to prevent ʻuaʻu mortality from collisions.

e. Lighting for construction hazards or night work must be approved by IfA prior to installation. All lighting must be shielded from above, so that night flying birds will not be disoriented by upward projecting lights that are mistaken for natural sources of navigable lighting.

f. To avoid attracting ʻuaʻu, contractors will make every effort not to use safety/security lighting the same color as stars. Other colors, such as red, blue, or orange or similar colors, should be considered.

3. HO is located in a cinder cone in a State Conservation District. Construction at the site requires special care to maintain the unpolluted environment.

a. No hazardous materials are to be released at the site. Substances such as surplus or used paint, oil, solvents, cleaning chemicals, etc., must be removed from the area and disposed of properly.

b. Accidental spills of any hazardous material during the execution of a contractor's project at the site must be reported immediately to the IfA. Spill containment will be supervised by UH personnel at the site.

c. Spill remediation methods must be approved by the University of Hawaii's Environmental Health and Safety Office (EHSO) prior to clean-up, and all costs incurred for clean-up will be paid by the contractor. In the event of a release, the contractor will be liable for any Federal- or State-imposed response action, costs, or penalties.

d. Washing and curing water used for aggregate processing, concrete curing, clean up, etc., cannot be released into the soil at the site. A recovery process is required by the contractor to capture wastewaters.

4. It is of particular importance to maintain a dust-free environment at HO. Telescope mirrors, lenses, and sensors can be quickly damaged by wind born dust. HO is located at 10,000 feet, and is often exposed to winds in excess of 30 miles per hour (mph). Before, during, and after winter storms,

winds can exceed 50 mph. The natural substrate at the site is a mixture of fine volcanic sand and cinders. Fugitive dust from the finer material can be released when the substrate is disturbed. Therefore:

a. Contractors must establish a written dust control plan that must be observed by all contractor personnel during the project. Contractors will adhere strictly to the requirement that dust be controlled at all times, including non-working hours, weekends, and holidays.

b. Dust control must be accomplished by equipment that the Contractor keeps on site and sprinkling or similar methods will be required to keep disturbed finer material from becoming airborne and must result in less than 10 pounds of fugitive dust released into the atmosphere per 24-hour period, as measured by standard collection methods.

c. No oil or chemical treating shall ever be used at the site for dust control.

d. Dust resulting from surface preparation of surfaces to be painted by sanding, power tools, or scraping and brushing shall be controlled by the Contractor by use of catchments and filtering systems/devices to prevent damage to the telescope mirrors, lenses and sensors.

e. Where practical, erect a designated on-site facility with wash racks to clean equipment and machinery before they are removed from construction zones.

f. Reduce vehicle emissions from construction projects and operations at HO by establishing worker carpools and shuttles to and from the job site, and mitigate construction equipment/machinery emissions by using proper emission-control technologies and standard exhaust filtration devices.

5. Construction or refurbishing of existing facilities will result in quantities of solid waste, and remnants of food and packaging that construction crews may bring for consumption at the site. Therefore:

a. Only materials that are not hazardous wastes can be managed as solid waste at the site.

b. Solid waste cannot be stockpiled or dumped at the site or on the slope below the HO facilities. Construction contractors must remove construction trash frequently, particularly food sources that could increase the population of mice and rats that prey on native species. Most construction waste should be removed in roll-off trash receptacles that are covered before transport.

c. Construction and demolition solid waste and debris must be secured such that strong winds cannot disperse materials. This is particularly important during weekends, holidays, and other non-working hours.

d. Construction and demolition solid waste and debris should be transported to the Maui Demolition and Construction Landfill in Maʻalaea.

e. No food is to be left on the ground or in HO solid waste storage areas. This is to prevent attraction of rats and other pests.

f. Non-hazardous trash and solid waste will be transported in covered refuse containers and disposed of off-site at Maui's licensed landfill.

3.5.4 Facility Design Criteria

The IfA requires that facilities designed for construction at HO follow certain guidelines. The IfA has learned from observatories constructed elsewhere and from its own long experience at HO how to incorporate design elements that minimize the impact of new facilities on others on or off the site, as well as how to minimize any environmental and cultural impacts. The intention is to be as appropriate as possible on a mountain summit that has rich natural, cultural, and spiritual resources. The design criteria are in keeping with that intention, as outlined in the LRDP:

1. Existing observatories require a clear line-of-sight in so far as is possible given the terrain. New facilities will not be permitted to obscure the observation function of existing facilities.

2. New facilities will not be permitted to impact the ʻuaʻu habitat. Facilities will not be fenced, in order to protect ʻuaʻu flyways, and they will not have unshielded lights or other attractants. (See Section 3.5.3.2-Construction Practices, Items 2e and f above regarding lighting.)

   During the nesting season (February to November) when birds are present on Haleakalā, care must be exercised to ensure that the birds will not be disturbed. Vibration and noise from heavy construction equipment or activities must not impact the normal life cycle of resident birds. If heavy construction equipment will be necessary at the site, consultation with IfA and avifaunal experts will be required to determine feasibility and any applicable mitigation requirements.

3. New facilities will not impact known archeological resources. The resources at HO have been mapped and those sites nearest to facilities have been delineated with single post and railing buffers. No construction will be permitted within 50 feet of any archeological site or feature.

4. Presently, all HO facilities are painted with a formula that was computer-matched to the most common color of the cinders and lava within HO boundaries. Whenever possible, new buildings will be painted to blend with their surroundings; however, solar observatories that operate during daylight hours will be allowed to be painted white, as it would otherwise be virtually impossible to keep the enclosure and building surfaces cool enough to prevent degradation of seeing conditions.

5. Construction design will consider sight planes to population centers of Maui. Where buildings can be oriented to limit visibility or be built partly underground, they will be. Where they cannot, every effort will be made not to use materials that draw attention from a distance, i.e., reflective surfaces, unusual shapes, incompatible colors.

6. Wherever possible, natural materials from the construction site will be used for building facings, walls, walkways, entryways, etc.

7. IfA will seek early and broad public comments and input concerning any new proposed construction at HO.

8. The summit area poses certain risks to people and structures from natural hazards, and since these are well understood, new projects will be required to be designed such that they would minimize such potential adverse impacts, including structural damage to facilities from wind, storm flooding, earth movement, ice and other natural events, vehicular accidents, and personnel requiring medical treatment for illness.

As HO is located in the Conservation District and not in an area defined in the Maui County General Plan as the Urban Region, Maui County Code 16.26.101.3 exempts HO from County regulation and restrictions.

3.6 Management and Monitoring Strategies Summary

The MP offers a physical plan and management structure that seeks to preserve a balance within HO, in which astronomy can continue to evolve as a premier ground-based viewing location bringing with it the associated economic benefits, while protecting cultural and environmental resources and values. Additionally, the MP provides resource protection and guidelines for future development that are intended to prevent desecration or over-development of the small HO property, as the IfA continues to lead the international scientific community toward a deeper understanding of the Universe in which we live.

3.7 Environmental Assessment

A Draft Environmental Assessment (DEA) for HO has been prepared in accordance with the State of Hawai‘i HRS Chapter 343 to ensure compliance with the policies and goals defined in this statute. The DEA evaluates the potential impacts on HO and relevant neighboring lands that may be incurred by implementation of this MP.

4.0 REPORTING SCHEDULE

4.1 Time Duration of Management Plan

The effective time duration for this MP shall be for an initial term of ten years, beginning December 1, 2010 and ending on November 30, 2020, and may be extended if appropriate.

4.2 Annual Reporting Schedule

The annual reporting schedule shall be June 30th of each year, or the end of each fiscal year for the State of Hawai‘i.

4.3 Annual Reporting Requirements

An annual report to the DLNR will be prepared that will include the status of compliance of permit conditions subsequent to approval of this MP, and the implementation of land uses pursuant to the approved management plan schedule.

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6.0 ACRONYMS, ABBREVIATIONS, AND TERMINOLOGY

ʻahinahina	Haleakalā silversword
AEOS	Advanced Electro-optical System
AFRL	Air Force Research Laboratory
ahu	altar or shrine
ahupuaʻa	land division, usually extending from the uplands to the sea
āina	land
AIS	alien invasive species
Aliʻi	Chief
Aliʻi nui	high chief
AMOS	ARPA Maui Optical Station
ARPA	Advanced Research Projects Agency
ASL	above sea level
ASTM	American Society for Testing and Materials
ATST	Advanced Technology Solar Telescope
AVCO	AVCO Everett Research Laboratory
BLNR	Board of Land and Natural Resources
CDUA	Conservation District Use Application
CDUP	Conservation District Use Permit
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CSH	Cultural Surveys Hawaiʻi, Inc.
DEA	Draft Environmental Assessment
DEIS	Draft Environmental Impact Statement
DLNR	Dept. of Land and Natural Resources
DOD	Dept. of Defense
DOE	Dept. of Energy
DOFAW	Division of Forestry and Wildlife
DOI	U. S. Department of the Interior
e ala e	a chant used to greet ancestors, kupuna, and also greet the Sun as it rises
EA	Environmental Assessment
EHSO	Environmental Health and Safety Office
EIS	Environmental Impact Statement
EISPN	Environmental Impact Statement Preparation Notice
EO	Executive Order
EPA	Environmental Protection Agency
ESA	Endangered Species Act
ESA	Environmental Site Assessment
FAA	Federal Aviation Administration
FTF	Faulkes Telescope Facility
GEODSS	Ground-Based Electro-Optical Deep Space Surveillance System
hā	spiritual breath that comes from above
hālāwai	meeting

HALE	Haleakalā National Park
haole	foreigner
HAR	Hawai‘i Administrative Rules
haumāna	students
Hinala‘anui	name of the West-face ahu
ho‘omahanahana	dedication or “warming” offering
ho‘oponopono	to “make right
HO	Haleakalā High Altitude Observatory
HRS	Hawai‘i Revised Statutes
IfA	Institute for Astronomy
Kahu	clergyman, caretaker
Kāhuna	Priest
Kāhuna Po‘o	head priest
kapu	restricted to all but the highest ranking of Native Hawaiians
ko‘a	ceremonial rock formations
kumu hula	hula teacher
kupuna	elder
LCOGT	Las Cumbres Observatory Global Telescope Network
LRDP	Long Range Development Plan
LUC	Land Use Commission
LURE	Lunar Ranging Experiment
ma‘a	familiar or accustomed
MAGNUM	Multi-color Active Galactic Nuclei Monitor Project
Makahiki	Ancient festival beginning about the middle of October and lasting about four months, with sports and religious festivities and taboo on war
makana aloha	gift of friendship
mana	spirit
Māui	demi-god
Maui Nui a Kama	the greater Maui
Mele	song
mo‘olelo	stories
Moku	districts
MP	Management Plan
mph	miles per hour
MSO	Mees Solar Observatory
MSSC	Maui Space Surveillance Complex
MSSS	Maui Space Surveillance Site
na poāo kāhuna	priest
NASA	National Aeronautics and Space Administration
nēnē	Hawaiian goose
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NOI	Notice of Intent
NPS	National Park Service
NRHP	National Register of Historic Places

ʻopeʻapeʻa	Hawaiian hoary bat
ʻopihi	limpet
oʻmanaʻo	remembrances or recollections
OCCL	Office of Conservation and Coastal Lands
OEQC	Office of Environmental Quality Control
oli	chants
OSDA	Operating and Site Development Agreement
Pāʻele Kū Ai I Ka Moku	name of the East-facing ahu
Pa Kaʻoao	White Hill
Pan-STARRS	Panoramic-Survey Telescope and Rapid Response System
Pele	goddess of fire
piko	navel or umbilical cord
Poliʻahu	the goddess of snow
Puʻu Honua	sacred refuge or place of peace
RAP	remedial action plan
rCL	Cinder Land
ROI	Region of Influence
SAP	Sampling and Analysis Plan
SCIA	Supplemental Cultural Impact Assessment
SHPD	State Historic Preservation Division
SIHP	State Inventory of Historic Places
SWMP	Stormwater Management Plan
TCP	Traditional Cultural Property
TLRS	Transportable Laser Ranging System
ʻuʻau	Hawaiian petrel
UH	University of Hawaiʻi
UH MC	University of Hawaiʻi Maui College
UK	United Kingdom
USAF	U.S. Air Force
USFWS	U.S. Fish & Wildlife Service
Wao Akua	place where gods and spirits walk