Conservation District Use Application (CDUA)

for the

Advanced Technology Solar Telescope (ATST)

Haleakalā High Altitude Observatory Site
Haleakalā, Maui, HI

March 10, 2010

Prepared for:

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EXECUTIVE SUMMARY

This *Conservation District Use Application (CDUA)* is being submitted by the University of Hawaiʻi Institute for Astronomy (IfA) for the development of the Advanced Technology Solar Telescope (ATST) within the 18.166-acre Haleakalā High Altitude Observatory Site (HO) at the summit of Haleakalā, County of Maui, Hawaiʻi. The HO site is located in a General Subzone of the Conservation District, in Tax Map Key (TMK) (2) 2-2-07-008. Maui County Code 16.26.101.3 exempts HO from County regulation.

In 1961, Executive Order (EO) 1987 established HO and placed it under the control and management of the Board of Regents of the University of Hawaiʻi. EO 1987 has no expiration date and stipulates: "That the lands… set aside shall be used for Haleakalā High Altitude Observatory Site purposes only."

Public Access

As stipulated in EO 1987, the HO is not open to the general public. Most observatory personnel working at HO during daylight hours are involved in maintenance and engineering activities that do not facilitate tours. However, by special arrangement, the University of Hawaiʻi does provide educational tours of its facilities. During nighttime hours, observatories at HO are conducting research employing the most advanced astronomical and space surveillance instruments in the world. HO's instrumentation is extremely sensitive to light and therefore, vehicle traffic restrictions through HO are rigorously enforced.

Cultural Resources

Those who are descendants of Native Hawaiians who inhabited the Hawaiian Islands prior to 1778 possess Native Hawaiian traditional and customary rights. These rights are uniquely held by this group of people and not shared by the general public. What those rights are and how they are exercised is determined on a case-by-case basis, as there are no definitions that apply across all situations or in all places. Customary practices can also change over time. The IfA has taken steps to help ensure that Native Hawaiians are welcome to enter HO for cultural practices. A sign has been provided by IfA with instructions meant only for Native Hawaiians and is posted at the entrance to HO. Additionally, an area consisting of approximately 24,000 square feet and located on the western side of HO has been set aside in perpetuity for the sole reverent use of Native Hawaiians for religious and cultural purposes. The area includes an ahu and other archaeological features.

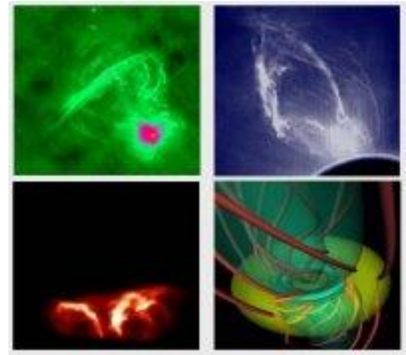
Natural Resources Management

The objective for management of observatory facilities is to create a structure for sustainable, focused management of the resources and operations of the observatories at HO, in order to protect historic/cultural resources: e.g. archaeology sites, traditional cultural practices, to protect natural resources, protect and enhance education and research, and to provide a base for future expansion of the scope of activities at HO. Specific methods and techniques are discussed in detail in this CDUA and the HO Management Plan.

Advanced Technology Solar Telescope

The 1998 National Academy of Sciences/National Research Council report entitled "Ground-Based Solar Research: An Assessment and Strategy for the Future", and the 2000 National Science Foundation (NSF) and National Aeronautics and Space Administration (NASA) "Astronomy & Astrophysics Survey Committee Decadal Survey", highly recommended the development of an Advanced Technology Solar Telescope (ATST). The ATST would be the world's flagship facility for the study of magnetic phenomena in the solar atmosphere and would be the first large, ground-based, open-access solar telescope constructed in the United States in more than 40 years. In December 2009, the Record of Decision (ROD) by NSF on the Final Environmental Impact Statement for this project approved funding for ATST at HO. Frequently asked questions about this project are summarized below:

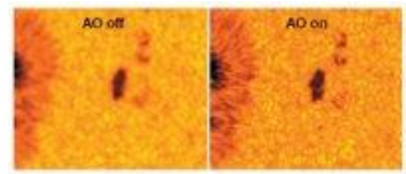
1. What will ATST be used for?



Some of the broad scientific questions we hope to answer are:

- How are cosmic magnetic fields generated and how are they destroyed?
- What role do cosmic magnetic fields play in the organization of plasma structures and the impulsive releases of energy seen ubiquitously in the universe?
- What are the mechanisms responsible for solar variability (that ultimately affects the Earth)?

2. What makes ATST special?



ATST will be the largest solar telescope in the world, with unprecedented abilities to view details of the Sun. Using adaptive optics technology, ATST will be able to provide the sharpest views ever taken of the solar surface, which will allow scientists to learn even more about the Sun and solar-terrestrial interactions.

3. Who are ATST's partners?

The funding agency for ATST is the National Science Foundation (NSF), and the Corporate Office is the Association of Universities for Research in Astronomy (AURA). The principal investigator is the National Solar Observatory (NSO), and there are four co-principal investigators: the High Altitude Observatory, the New Jersey Institute of Technology's Center for Solar Research, the University of Hawaiʻi Institute for Astronomy, and the University of Chicago's Department of Astronomy and Astrophysics. There are 19 collaborators in the project, as well.

4. What will ATST look like?

This rendering may change as the project continues through the design and development phase.

5. Where will ATST be located?

Haleakalā High Altitude Observatory Site, Haleakalā, Maui, Hawaiʻi
East of Mees Solar Observatory
Latitude & Longitude: 20° 42'17" N, 156° 10' 36" W
Height above sea level: 10,023 feet (3,084 meters)

6. The Telescope

Configuration	Altitude over azimuth, off-axis Gregorian-style mount, with independently-rotating coudé lab	
Approximate weights and volumes	Optic Support Structure (including mirror assemblies)	75 tonnes
	Mount Base	90 tonnes
	Coudé Rotator	160 tonnes
	Pier (concrete)	1700 cubic yards + foundations
Height above ground	Coudé Rotator floor	9.6m (31.5 ft)
	Altitude Axis	28m (91.9 ft)
	Top of Assembly	36.7m (120.4 ft)

National Environmental Policy Act and Hawaiʻi Revised Statutes Chapter 343

Because the funding source for ATST is a federal agency, potential construction at HO required extensive environmental impact analysis under the National Environmental Policy Act (NEPA). The proposed project is also subject to Hawaiʻi Revised Statutes (HRS) Chapter 343. The NSF therefore published a federal and state Draft Environmental Impact Statement in September 2006 (DEIS), a federal and state Supplemental Draft Environmental Impact Statement (SDEIS) in May 2009, and a federal Final Environmental Impact Statement (FEIS) in July 2009. On August 8, 2009, the Office of Environmental Quality Control (OEQC) published notice of the state FEIS in The Environmental Notice. On December 3, 2009, a ROD was executed by the Director of NSF to allow funding to be issued to construct the ATST.

National Historic Preservation Act

The NSF, through the consultation process set forth in Section 106 of the National Historic Preservation Act, 16 U.S.C. 470f (NHPA) (the Section 106 consultation process), has determined, in consultation with the Hawaiʻi State Historic Preservation Office (SHPO), and in accordance with the NHPA assessment processes, that the summit of Haleakalā is a historic property that has spiritual and cultural significance to Native Hawaiians and is a Traditional Cultural Place (TCP) that satisfies the criteria to be eligible for listing on the National Register of Historic Places (National Register). Therefore, the NSF invited public participation pursuant to the NHPA Section 106 process to identify and address issues concerning Native Hawaiian Organizations (NHO) and individuals who may attach religious and cultural significance to a historic property that may be affected by the proposed construction. Consultation began in June 2005, and concluded with the execution of a *Programmatic Agreement* in September of 2009 between NSF and participating signatory agencies and individuals.

Programmatic Agreement

Elements of the Programmatic Agreement include the establishment of an ATST Native Hawaiian Working Group (ATST NHWG). The role of the ATST NHWG will be to provide consultation concerning historic property matters related to the construction and operation of the ATST Project. The ATST NHWG will provide consultation on issues such as the retention of a Cultural Specialist for construction monitoring and the naming of the roads at HO.

Decommissioning

The NSF shall decommission and deconstruct the ATST Project within fifty (50) years from the date operations commence, unless, after consultation by NSF with NHOs, NSF decides otherwise. Any decommissioning or deconstruction will be undertaken per the terms and conditions defined in the NSF's lease for the ATST from UH, and in compliance with Hawaiʻi Revised Status Chapter 183 and Hawaiʻi Administrative Rules § 13-5.

Community Benefit

Through the NHPA consultation process, the NSF requested proposals for mitigation and community benefit proposals. Both on-site and off-site mitigation measures were adopted. The largest mitigation commitment was noted in the ATST FEIS and ROD: "-- if the proposed ATST Project is approved -- to make available a total of $20 million ($2 million per fiscal year, commencing in FY 2011, and continuing for a total of ten years) towards an educational program at Maui Community College (MCC/UHMC) designed to cultivate and reinforce the intersection of Hawaiian culture and knowledge with science technology, engineering, and math courses, programs, certifications, and degrees. NSF encourages MCC/UHMC to continue to support this educational program after the initial ten years of NSF financial support, recognizing the importance of the program to the Native Hawaiian community;" Such a commitment is unprecedented by NSF.

Federal Endangered Species Act

Through lengthy consultation related to the NSF's compliance with the Federal Endangered Species Act of 1973, as amended (16 USC1531, et seq.), and pursuant to Chapter 195D, Hawai'i Revised Statutes (HRS 195D), the NSF agreed to, and is in the process of obtaining approval from the Board of Land and Natural Resources to voluntarily implement a Habitat Conservation Plan (HCP) to mitigate, minimize, monitor, and report on any potential negative impact to endangered species related to the construction and operation of the ATST at HO. The HCP will have multiple-year financial assurance from the ATST Project to implement the Plan. The HCP will have multiple year financial assurance from NSF, through the ATST Project, to implement the HCP. The HCP includes full-time staffing at ATST to implement and carry out the required mitigation, minimization, monitoring, and reporting measures and tasks, together with any adaptive management measures that may be necessary to adjust the ATST Project's approach, in order to achieve a net recovery benefit during the duration of the HCP.

Conservation District Use Application (CDUA)

For DLNR Use	
File #	______________
Reviewed by	______________
Date	______________
Accepted by Date	______________
180-Day Exp.	______________
EA/EIS Required	______________
PH Required	______________
Decision	______________
Date	______________

Project Location/Address:
University of Hawai'i, Institute for Astronomy, Haleakalā High Altitude Observatories (HO) Site

District: Waiakoa, Papaanui, Makawao

County: Maui

Island: Maui

Tax Map Key(s): 2-2-2-007-008

Total Area of Parcel: 18.166 acres (HO)

Area of Proposed Use: 0.86 acres (proposed ATST Project)

Commencement Date: 180 days from Submission of CDUA

Completion Date: Approximately 7 years from issuance of CDUP

Indicate which of the following approvals are being sought, as specified in the Hawai`i Administrative Rules (HAR), Chapter 13-5.

_X_ **Board Permit**

___ **Departmental Permit**

___ **Emergency Permit**

___ **Temporary Permit**

___ **Site Plan Approval**

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1.0 APPLICANT

Legal Name: University of Hawai‘i, Institute for Astronomy
Street and Mailing Address: 2680 Woodlawn Drive
City, State and Zip+4 Code: Honolulu, HI 96822

Contact Person & Title: Michael Maberry, Assistant Director
Phone No.: (808) 573-9528
Fax No.: (808) 573-9557
Email: maberry@hawaii.edu

Interest in Property: Owner

***Signature ___________________________ Date____________________**

*If for a Corporation, Partnership, Agency or Organization, must be signed by an authorized officer.

PROPERTY OWNER(S) *(If other than the applicant)*

Legal Name: ____
Mailing Address: ____
City, State and Zip+4 Code: ____
Contact Person & Title:____
Phone No.:(_____)______________________Fax No.:(_____)____________________
Email: ____
***Signature__________________________________Date________________________**

*For private lands with multiple landowners, landowners whose property interests constitute or exceed 85% of the fee ownership of the subject parcel(s) shall sign the application.

AGENT

Name: KC Environmental, Inc.
Street and Mailing Address: P. O. Box 1208
City, State and Zip+4 Code: Makawao, HI 96768

Contact Person & Title: Dr. Charlie Fein, Vice President
Phone No.: (808)-573-1930
Fax No.: (808) 573-7837
Email: charlie@kcenv.com

Signature_________________________________Date__________________________

EMERGENCY CONTACT INFORMATION

Contact Person and Title____
Phone No.:(_____)___________________

2.0 PRIOR CONSERVATION DISTRICT USE PERMITS (CDUP)

Please specify all prior CDUP received for the subject parcel.

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 Obs/Exempt class
MA-3201	11/04/04	Pan-STARRS (PS-1)
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

3.0 PROPOSED USE **Total Area of Proposed Use: .86 acres**

Describe the proposed use in detail. Include secondary improvements such as grading, septic tank placement, utilities, roads, driveways, fences, landscaping, etc. Illustrate general location of improvements on a TMK map; include preliminary architectural renderings with elevations and building footprints with application. Include existing (before) and proposed (after) graphics. If the parcel is or has been the subject of a violation, please include the violation number.

3.1 HISTORY

The summit of Haleakalā has hosted astronomical research for almost half a century. In the early 1950s, Grote Reber, one of the pioneers of radio astronomy, experimented with radio interferometry using a large steel and wood truss antenna. Site testing for a solar observatory began in 1955. In preparation for the International Geophysical Year (1957-58), the Smithsonian Astrophysical Observatory, assisted by Dr. C. E. Kenneth Mees, a retired vice president of Eastman Kodak, approached the University of Hawai‘i (UH) to locate a Baker-Nunn satellite-tracking telescope on the mountain - a facility that remained operational until 1976. Another early astronomy program on Haleakalā was night-sky photometry, including measurements of the airglow and zodiacal light.

In 1961, Executive Order (EO) 1987 from Hawaii’s Governor Quinn to the University of Hawai‘i (UH), set aside 18+ acres of land on the summit of Haleakalā to establish the Haleakalā Observatories site. Other agencies established adjacent facilities through Executive Order during the same period. The University of Hawai‘i Institute for Astronomy is responsible for managing and developing the land.

Planning for a much-anticipated solar observatory began in earnest in 1961 with the founding of the Hawai‘i Institute for Geophysics at UH. Funding for the observatory was obtained from the National Science Foundation (NSF) and ground was broken for the facility in February 1962. The facility was dedicated in January 1964 and was named the C. E. Kenneth Mees Solar Observatory (MSO) to honor the man who did so much to help UH begin its astronomical programs on Haleakalā.

Haleakalā has also been the home of the Air Force Maui Space Surveillance System (MSSS) for more than four decades. Ground was broken for construction of the Advanced Research Projects Agency (ARPA, later DARPA) telescope facility in 1963, and first light was achieved in 1965. In 1967, ARPA designated the site for Western Test Range midcourse observations under the auspices of the University of Michigan, Ann Arbor. The ARPA Midcourse Optical Station, as it was known back then, began routine missile tracking operations in 1969 under contractors AVCO Everett Research Laboratory and Lockheed Missiles and Space Company. In 1975, the site became the ARPA Maui Optical Station, and ultimately the MSSS. Daily routine satellite tracking operations were inaugurated in 1977 as the Maui Optical Tracking and Identification Facility (MOTIF). In addition to MSSS, the Air Force has located three smaller telescopes for deep space surveillance as well as support facilities on Haleakalā. The entire Air Force site, known as the Maui Space Surveillance Complex (MSSC), comprises the largest single user area on the mountain.

Figure 1 is the Tax Map Key (TMK) and general location of the proposed ATST Project. Figure 2 is the HO tax map key and adjacent properties. Figure 3 is an aerial view of HO showing the facilities.

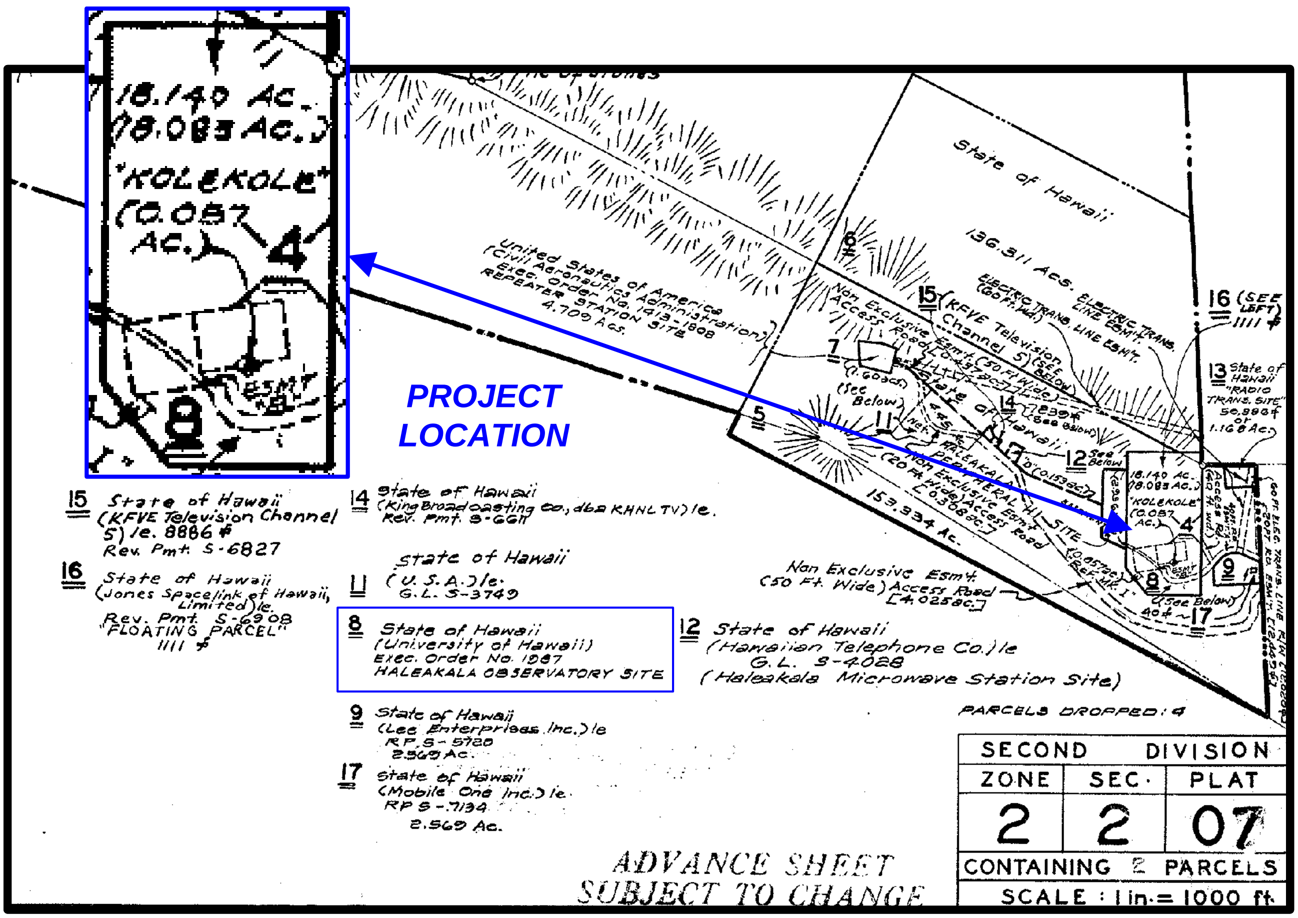

Figure 1. Haleakalā High Altitude Observatory Site Tax Map Key.

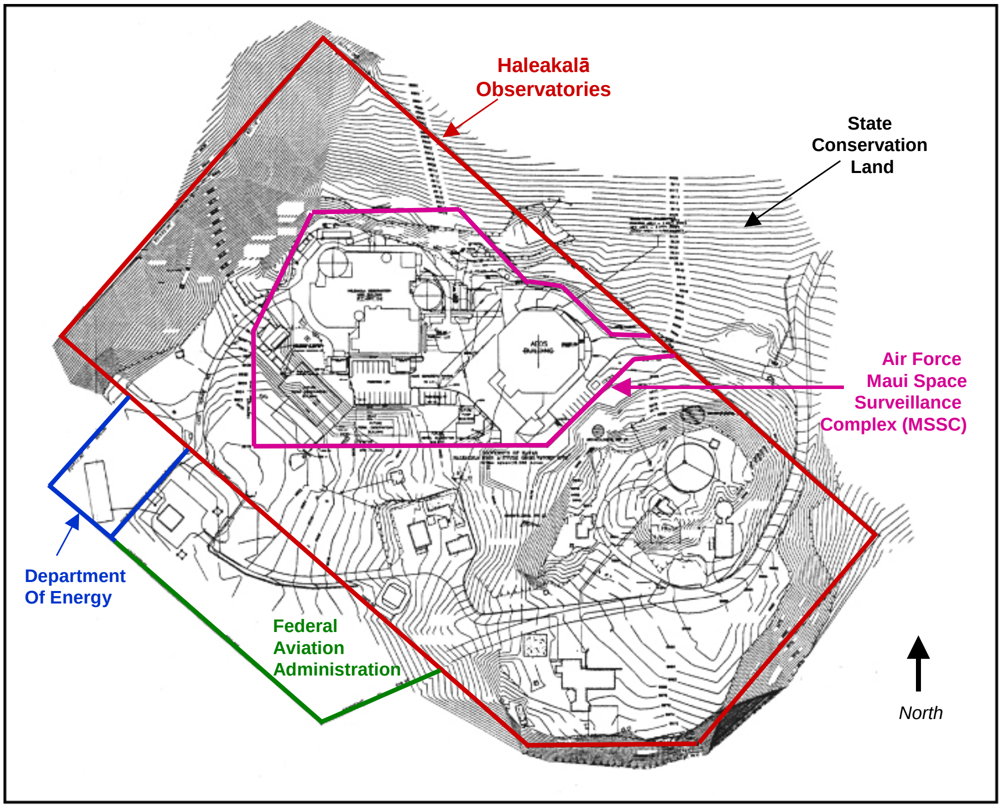

Figure 2. HO, Department of Energy, and Federal Aviation Administration Properties.

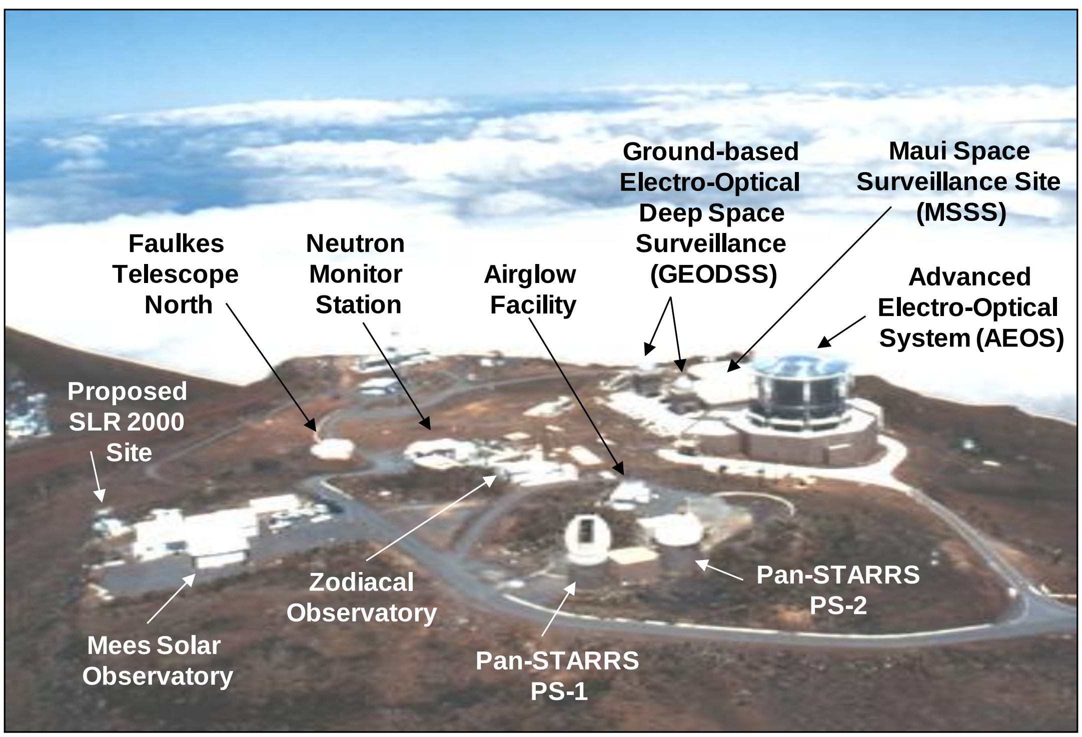

Figure 3. Aerial Haleakalā High Altitude Observatories Showing Existing Facilities.

3.2 PROPOSED USE

This CDUA is an applicant action by the University of Hawaiʻi Institute for Astronomy (IfA) for the development of the Advanced Technology Solar Telescope (ATST) within the 18.166-acre HO at the summit of Haleakalā, County of Maui, Hawaiʻi.

Since George Ellery Hale's 1908 discovery that sunspots coincide with strong magnetic fields, astronomers have become increasingly aware of the Sun's magnetic field as a complex and subtle system. The familiar 11-year sunspot cycle is just the most obvious of its many manifestations. Recent advances in ground-based instrumentation have shown that sunspots and other large-scale phenomena that affect life on Earth are intricately related to small-scale magnetic processes whose inner workings happen on scales that are too small to be observed with current ground- and space-based telescopes.

At the same time, using advances in computer science and technology, scientists have developed intriguing new theories about those small-scale processes, but they lack empirical observational data to verify the validity of their models. Scientists are positioned for a new era of discovery about the Sun and how it affects life on Earth, how distant stars work, and how to possibly control plasmas in laboratories.

The primary goals of the proposed ATST Project are to understand solar magnetic activities and variability, both because the Sun serves as a key resource for understanding the underpinnings of astrophysics and our understanding of magnetic plasmas, and because activity on the Sun drives space weather. Space weather creates hazards for communications to and from satellites, as well as for astronauts and air travelers. Furthermore, and perhaps most importantly, the variability in solar energy induced by solar activity affects the Earth's climate. The key to understanding solar variability and its direct impact on the Earth rests with understanding all aspects of solar magnetic fields, which in turn control the fluctuating Sun.

The existing NSF-funded, ground-based solar telescope facilities operated by the National Solar Observatory (NSO) were built more than a generation ago. The proposed ATST Project represents a once-in-a-life-time investment of significant expense and as such the selection of the site is critically important. The two primary science drivers — highest resolution seeing and dark daylight sky close to the Sun's corona — are the most critical when evaluating potential sites for the telescope.

With its unprecedented 4-meter aperture, integrated adaptive optics, low scattered light, infrared coverage, and state-of-the-art post-focus instrumentation, the ATST would be the largest and most capable solar telescope in the world. It would be an indispensable tool for exploring and understanding physical processes on the Sun that ultimately affect Earth. The ATST would uniquely resolve fundamental length and time scales of the basic physical processes governing solar variability. The ATST represents a collaboration of 22 institutions, reflecting a broad segment of the solar physics community. Potential future development of ATST was considered in the IfA Haleakalā High Altitude Observatory Site Long Range Development Plan (LRDP) as a future, potential facility at HO, and was considered in development of the UH IfA HO Management Plan (MP) attached as a separate document.

The LRDP is on file at the Dept. of Land and Natural Resources (DLNR) and on the Internet at: http://www.ifa.hawaii.edu/haleakala/LRDP/

The ATST Project would construct a reflecting Gregorian-type telescope that would deliver images of the Sun and the solar corona to instrument stations mounted on the telescope and on a rotating platform located below the telescope. The ATST facilities would include:

1. The observatory facility, which includes the telescope, its pier, and the rotating instrument platform,
2. The telescope enclosure,
3. The Support and Operations Building (S&O Building) adjacent to the observatory,
4. A Utility Building attached to the S&O Building by an underground utility chase,
5. Parking for the facility as a whole; and,
6. Modifications to the existing MSO facility.

The entire facility would include approximately 43,980 square feet of new building space (including the telescope enclosure), within a site footprint of 0.74 acres. Figure 4 shows the layout of the site of the ATST Project, with distances from the center of the enclosure to other structures and Figure 5 provides an aerial rendering.

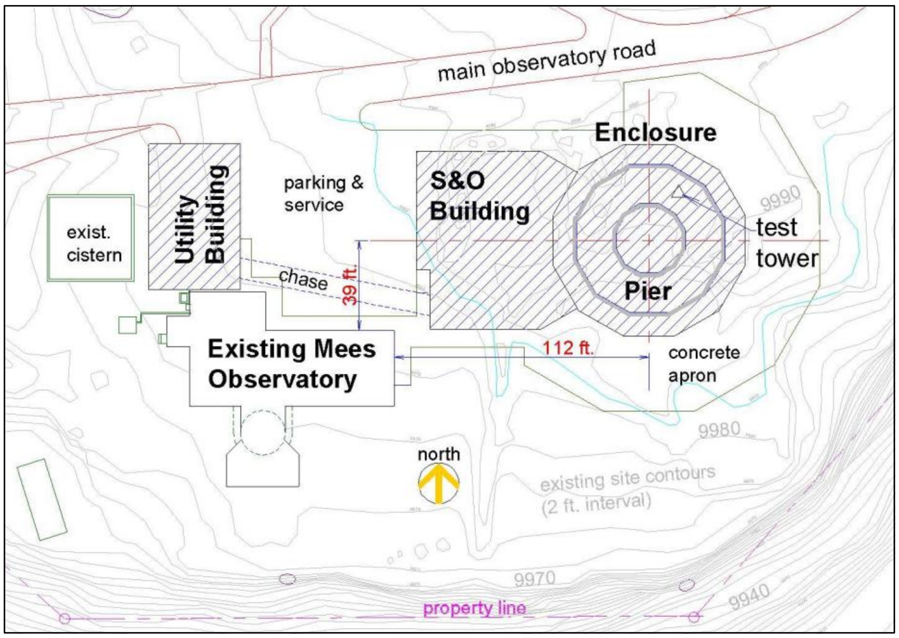

Figure 4. ATST Project at the Mees Site.

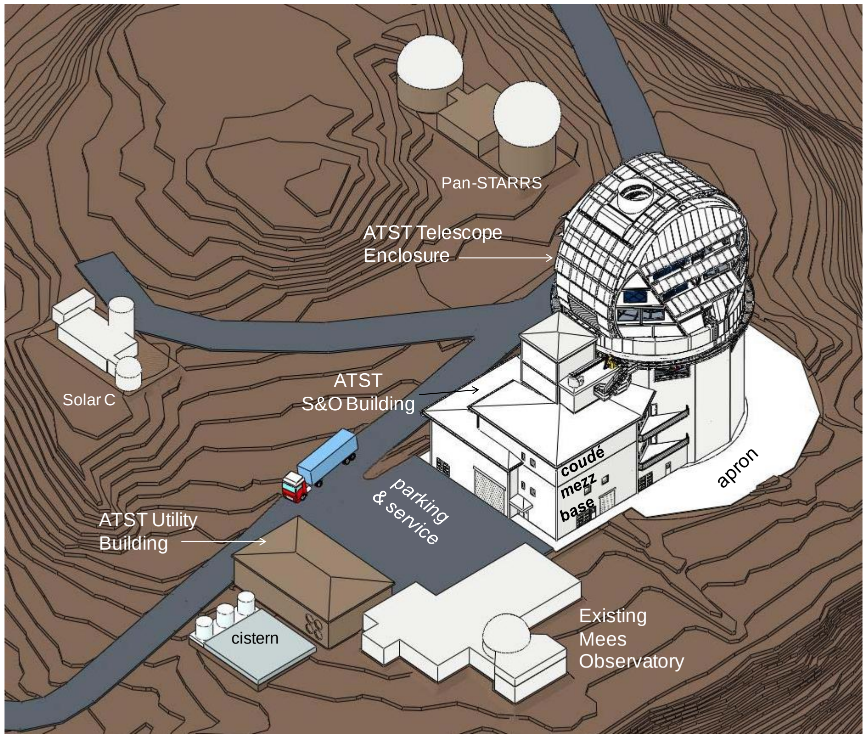

Figure 5. Aerial Rendering of ATST Project.

The height of the telescope — defined as the distance from ground level to the rotational center of the telescope — will be 28 meters (92 feet). This was determined to be the minimum height at which the image resolution required to meet the specified science goals could be achieved. The telescope height dictates an observatory structure that is 43.5 meters (142.7 feet) in height and 25.6 meters (84.0 feet) in diameter.

The S&O Building would be a 23.2 meter (76.3 feet) tall, multi-story structure attached to the lower enclosure, which accommodates observing-related activities that require direct adjacency to the telescope. It would contain a large docking bay with a 20-ton crane, equipment and equipment storage, telescope maintenance facilities, offices and workrooms, laboratories, and the control room for the telescope. The S&O Building would also contain the large-scale platform lift (elevator) needed to move telescope parts between levels. The equipment in the building would include a hydrostatic oil pump, hydrostatic oil tank, helium compressor, vacuum pump, and liquid nitrogen tanks.

The Utility Building would be a rectangular, steel-framed, metal structure, 5.2 meters (17 foot) in height, 12.2 meters (40 feet) wide and 19.5 meters (64 feet) long that would provide space for mechanical and electrical equipment that require complete thermal and vibration isolation from the telescope. The Utility Building would be connected to the S&O Building by an underground utility chase. A preliminary list of the equipment to be housed in the Utility Building includes: a 300 KVA generator and associated automatic transfer switchgear, an 80-ton low-temperature chiller, a 15-ton very-low-temperature chiller, a 10-ton heat pump condenser unit, 2 ventilation fans, an air compressor, a vacuum pump, and 3 uninterruptible power supply units. Because this equipment generates significant levels of audible noise, sound-abatement devices would be built into the equipment, and the walls and roof of the Utility Building would incorporate effective sound blocking materials. An electrical transformer and 3 ice storage tanks would be located outside, adjacent to the Utility Building.

Additional facilities associated with the telescope facility would include the following:

1. A grounding field consisting of a series of shallow trenches around the facility and fanning out to the south of the S&O Building filled with conductive concrete or coke breeze (a granular material with high conductivity) to safely provide an electrical ground for the observatory, which is in an environment with a high risk of lightning strikes.

2. A wastewater treatment plant with a capacity of 1,000 gallons/day and an associated infiltration well, designed in compliance with Hawaiʻi Department of Health regulations.

3. A stormwater management system including gutters, catchment drains, an underground tank, and pipes connecting it to the cistern at the MSO facility.

4. A new electrical transformer next to the Utility Building.

5. A diesel generator for use in case of power outages.

With the exception of the Utility Building, the rest of the ATST facility would be white in order to reduce heat absorption, which would adversely affect telescope operations by heating the adjacent air and thereby introducing turbulence that would degrade the seeing.

The ATST Project construction would involve land clearing, demolition, grading/leveling, excavation, soil retention and placement, construction, remodeling of the MSO facility, paving, and other site improvements. These are discussed in detail in the Final Environmental Impact Statement (FEIS) for the Advanced Technology Solar Telescope.

3.3 PROJECT LOCATION

The proposed ATST Project would be located on State of Hawaiʻi land within the Conservation District on Puʻu (hill) Kolekole, near the summit of Haleakalā. Puʻu Kolekole is about 0.3 miles from the highest point, Puʻu Ulaʻula (Red Hill) Overlook, which is in Haleakalā National Park (HALE). At an elevation of 10,023 feet, 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.

The proposed ATST Project would be located within HO at the summit of Haleakalā, County of Maui, Hawaiʻi, on approximately 0.86 acres of undeveloped, but mostly previously disturbed, land. The 0.86 acres includes the leveling area, buildings, and paved pads (the actual building footprint would be 0.74 acres). The proposed ATST Project site would be east of the existing C. E. Kenneth Mees Solar Observatory (MSO) facility (Fig. 6).

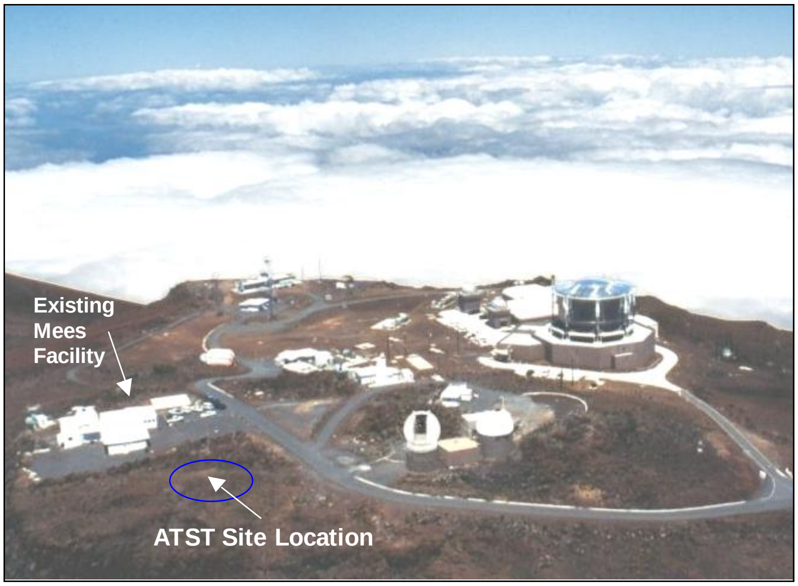

Figure 6. Aerial Showing ATST Site Location Adjacent to Mees Facility.

3.4 SECONDARY SITE IMPROVEMENTS

Appendix A are drawings titled "Schematic Design of the Support Facilities for the Advanced Technology Solar Telescope", showing the planned secondary improvements for the 0.86 acres of the project area within HO. In compliance with the CDUA submittal requirements, 20 copies of these drawings are attached. In addition, Appendix B is a Preliminary Construction Plan describing these improvements and both temporal and physical details of construction.

Appendix C is the Support Facilities Design Requirements Document. The purpose of this Design Requirements Document (DRD) is to establish the basic criteria for design of the Support Facilities for the ATST. The essential functions of the facilities are to structurally support the ATST telescope and the telescope enclosure and to functionally support the operation and maintenance of the telescope, science instruments and related equipment. This document is intended to serve as a design manual for a contracted architectural and engineering team to design the Support Facilities.

For a complex observatory like the ATST, periodic and regular maintenance of facility equipment and subsystems will be required to ensure high reliability and scientific productivity (Appendix D-Maintenance Plan). As the Construction phase is nearing completion, and while the Integration, Test & Commissioning (IT&C) phase is underway, ATST will begin implementing a specialized Preventative Maintenance (PM) program.

3.5 FINAL ENVIRONMENTAL IMPACT STATEMENT (INCLUDED WITH CDUA)

The FEIS for the proposed ATST Project was completed on July 24, 2009. Five copies of the FEIS were submitted to the DLNR Office of Conservation and Coastal Lands (OCCL) at the time of publication. In compliance with the CDUA submittal requirements, 20 copies of the FEIS are included with this CDUA as: 20 hardcopies of Vol. I-FEIS with compact discs (CDs), each CD contains:

Vol. I FEIS
Vol. II Survey and Assessment Reports
Vol. III Public Scoping Meetings Comments and Responses and Meeting Transcripts (2005, 2006, 2008)

Vol. IV Public Comments and Responses to Draft EIS (September 2006) and Supplemental Draft EIS (May 2009); SDEIS Public Hearing Transcripts (June 2009); Facilitator's Notes Section 106 Consultation Meetings (June 2009)

3.6 UH IfA HALEAKALĀ HIGH ALTITUDE OBSERVATORY SITE MANAGEMENT PLAN (SEPARATE DOCUMENT)

A Management Plan (MP) for HO was 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. "Management plan" 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 property, in accordance with Executive Order (EO) 1987, which designated the land for use by HO, and no additional purposes. Therefore an MP may not be required by the HAR. However, the MP is intended to assist IfA to meet the General Provisions of Chapter 13-5-1 above.

3.7 UH IfA LONG RANGE DEVELOPMENT PLAN (ON FILE AT DLNR)

The University of Hawai‘i Institute for Astronomy LRDP, published in January 2005, is a publicly vetted document that 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.

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 management plans in the MP attached to this CDUA.

4.0 CONSERVATION DISTRICT REQUIREMENTS

4.1 Demonstrate that the proposed use is consistent with the following criteria. Refer to HAR, Section 13-5-30, to review criteria. Attach additional sheets if necessary.

In accordance with HAR 13-5-30, the application is consistent with Conservation District requirements, as described in the following paragraphs.

4.2 Is the proposed land use consistent with the purpose of the Conservation District?

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

The objective of the Conservation District is to conserve, protect, and preserve the important natural resources of the State through appropriate management and use to promote their long-term sustainability and the public health, safety, and welfare. The proposed ATST Project is consistent with the intention that conveyed HO to the University of Hawai‘i by Governor's Executive Order 1987, where "…the lands herein set aside shall be used for the Haleakalā High Altitude Observatory Site purposes only." Many facilities conducting astronomy and advanced space surveillance already exist in HO.

4.3 Is the proposed use consistent with the objectives of the subzone of the land in which the use will occur?

The proposed land use is consistent with the objectives of the Subzone of the land on which the use will occur.

The existing State Land Use District for the proposed ATST Project is designated as Conservation District, General Subzone. The objective of the General Subzone is to designate open space where specific conservation uses may not be defined, but where urban use would be premature. During the past few years, the OCCL within the DLNR has administered CDUPs for numerous potential uses, among them astronomical facilities on Haleakalā. The Proposed Action would be located in the area of the Conservation District that has been set aside for astronomical research (§13-5-25: Identified land uses in the General Subzone, which is applicable from R-3 Astronomy Facilities, (D-1) Astronomy facilities under an approved management plan).

4.4 Does the proposed land use comply with provisions and guidelines contained in Chapter 205A, Hawaii Revised Statutes (HRS), entitled "Coastal Zone Management," where applicable?

The proposed land use complies with the provisions and guidelines contained in Chapter 205A, HRS, entitled Coastal Zone Management, where applicable.

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 ATST facility would be located in the HO complex and 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).

4.5 Describe how the proposed land use will not cause substantial adverse impact to existing natural resources within the surrounding area, community or region.

The existing natural resources are described in Section 5.1 and 6.6 of this CDUA. The potential impacts on natural resources of the proposed ATST Project were carefully evaluated during four-year long National Environmental Policy Act (NEPA) and National Historic Preservation Act (NHPA) assessment processes, culminating in the attached joint Federal and State FEIS, published in July 2009.

The criteria for the intensity of impact on each resource, the anticipated impacts on the natural environment, and mitigations for those impacts are described in FEIS Volume I Section 4.0-Environmental Consequences, Cumulative Impacts, and Mitigation. Table 1 below is a summary of the resources, impacts, mitigations, and final impacts for the Mees Site (shown in FEIS Vol. I as Table 4-7.) Table 2 below details the mitigations for those impacts (shown in FEIS Vol. I as Table 4-13) Within the FEIS, potential impacts were characterized with respect to intensities described as major, moderate, minor, and negligible.

Both Tables 1 and 2 below show that the proposed ATST Project would have a substantial (major) adverse impact on cultural resources. Specifically, the proposed ATST Project would be seen as culturally insensitive and disturb traditional cultural practices conducted within the Region of Influence (ROI), which includes parts of HALE. Noise and associated construction-related disturbances would also have a major, adverse impact on traditional cultural practices within the ROI. No mitigation would eliminate these impacts, but numerous mitigation measures would be employed to reduce such impacts as much as possible. As shown from the extensive analysis conducted during the EIS process, no other aspects of the proposed land use would result in substantial (major) adverse impacts.

Volume II of the FEIS consists of numerous studies, inventories, surveys, and evaluations of resources and potential impacts on those resources within HO, the surrounding area, community or region. Volume III of the FEIS consists of the Public Scoping Meetings, Comments and Responses and Meeting Transcripts (2005, 2006, 2008). Volume IV is a continuation of the content in Volume III to include 2009, along with Facilitator Notes from Section 106 meetings in 2009.

Table 1. Impact Summary Table for Mees Site.

FEIS Resource Section	Impact	Mitigation	Final Impact
Impacts of the Mees Site			
4.1-Land Use and Existing Activities	*Minor, Adverse, Long-term* impact on level of use of the land and current land use designation (Conservation District, General Subzone).	MIT-1	Minor, Adverse, Long-term
	Major, Adverse, Long-term impact on the Federal Aviation Administration (FAA) Remote Communications Air/Ground (RCAG) facility by degradation of the communication signal.	MIT-2	Negligible, Adverse, Long-term
4.2 -Cultural, Historic, and Archeological Resources	*Major, adverse, long-term* impact resulting from construction and day-to-day use of the proposed ATST project on the summit area of Haleakalā. The proposed ATST Project would be seen as culturally insensitive and disturb traditional cultural practices conducted within the ROI. Further, noise and construction-related disturbances would have a major adverse impact on traditional cultural practices within the ROI. No mitigation would eliminate these impacts.	MIT-1 MIT-3 MIT-4 MIT-5 MIT-6 MIT-13 MIT-14 MIT-16 MIT-18	Major, Adverse, Long-Term
	Moderate, Adverse, Long-term impact resulting from the potential disturbance to historic resources along the Park road corridor.	MIT-6 MIT-7 MIT-12	Minor, Adverse, Long-term
	Negligible, Adverse, Long-term impact on archeological resources during construction and operation.	MIT-5 MIT-7	Negligible, Adverse, Long-term
4.3-Biological Resources	*Major, Adverse, Short-term* impact on the Hawaiian Petrel during the egg incubation period due to noise and vibration generated by construction activities. Potential major, adverse effects from construction could include the disturbance of the ‘ua‘u habitat at HO, where birds would not be willing to remain in their burrows during the nesting season. Unrestrained construction noise, vibration, or human proximity could affect the nesting habits of the ‘ua‘u to the extent that they may not return to, remain in, or otherwise utilize the burrows that are inhabited each year.	MIT-6	Negligible, Adverse, Short-term
	Major, Adverse, Short- and Long-term impact on botanical resources resulting from earth movement during construction and AIS introduction. Potential effects on ‘ahinahina plants, Geranium multiflorum critical habitat, and ‘ua’u burrows were found to be negligible.	MIT-9	Negligible, Adverse, Short- and Long-term
4.4-Topography, Geology, and Soils	*Minor, Adverse, Short-term* impact resulting from land clearing, demolition, grading/leveling, excavation, and other construction-related earthmoving activities.	N/M	

Table 1. Impact Summary Table for Mees Site. (cont.)

FEIS Resource Section	Impact	Mitigation	Final Impact
Impacts of the Mees Site			
4.5-Visual Resources and View Planes	*Moderate, Adverse, Short-term* impact during the construction period when equipment, specifically cranes, will be visible from the Pu'u Ula'ula Overlook, the western edge of the Haleakalā Visitor's Center, the summits of White Hill (Pa Ka'oao) and Magnetic Peak, and along the Park road corridor near Kalahaku Overlook. No mitigation would adequately reduce this impact.	N/M	
	Moderate, Adverse, Long-term impact after the ATST facility is erected and is visible from Pu'u Ula'ula Overlook, the western edge of the Haleakalā Visitor's Center, the summits of Pa Ka'oao and Magnetic Peak, and along the Park road corridor nearing HO. No mitigation would adequately reduce this impact.	N/M	
4.6-Visitor Use and Experience	*Major, Adverse, Long-term* impact resulting from visual effects on visitor expectations for summit area natural vistas	N/M	
	Major, Adverse, Short-term impact resulting from construction-related noise.	MIT-6	Moderate, Adverse, Short-term
	Negligible, Adverse, Long-term impact resulting from construction-related traffic traversing the Park road corridor.	MIT-10	Negligible, Adverse, Long-term
4.7-Water Resources	*Minor, Adverse, Short- and Long-term* impact on surface water and drainage at HO.	N/M	
	Minor, Beneficial, Long-term impact on groundwater sources and supplies because the existing cesspool would be replaced by an individual wastewater system to treat sanitary waste. The potential for release or failure during installation creates a negligible, adverse, short-term impact.	N/M	
4.8-Hazardous Materials and Solid Waste	*Negligible, Adverse, Long-term* impact resulting from construction debris and hazardous materials used in building construction and operation. Adherence to the LRDP would restrict hazardous material use and guide management practices. There would be no substantive change in solid waste generation or disposal practices.	N/M	
4.9 - Infrastructure and Utilities	*Major, Adverse, Long-term* impact on the FAA RCAG facility by degradation of the communication signal.	MIT-2	Negligible, Adverse, Long-term
	Moderate, Adverse, Short-term impact during the construction period to the roadways within HO.	MIT-11	Minor, Adverse, short-term
	Minor, Adverse, Short- and Long-term impact during the construction period on State and Park roadways. This impact would continue at a lower level during operations.	MIT-12	Minor, Adverse, Short- and Long-term
	Moderate, Beneficial, Long-term impact on electrical systems at HO due to the proposed MECO upgrade.	N/M	
	Negligible, Adverse, Long-term impact on stormwater and communication systems.	N/M	

Table 1. Impact Summary Table for Mees Site. (cont.)

FEIS Resource Section	Impact	Mitigation	Final Impact
Impacts of the Mees Site			
4.10-Noise	*Major, Adverse, Short-term* impact resulting from construction-related noise both within and outside of the project area and along the Park road corridor.	MIT-6 MIT-11 MIT-13	Major, Adverse, Short-term
	Minor, Adverse, Long-term impact resulting from operations-related noise both within and outside of the project area and along the Park road corridor.	N/M	
4.11-Air Quality	*Negligible, Adverse, Short- and Long-term* impact from fugitive dust and during the construction period and during operations.	N/M	
4.12-Socioeconomics and Environmental Justice	*Minor, Adverse, Long-term* impact on population and housing.	N/M	
	Minor, Beneficial, Short- and Long-term impact on the local economy and employment during the construction phase of the project. Also there would be a *Minor, Beneficial, Long-term* impact on schools due to federal funding provided to schools and specifically to Maui Community College (MCC) who would receive data and projects for their studies from ATST.	N/M	
	Negligible, Adverse, Long-term impact on environmental justice and the protection of children	N/M	
4.13-Public Services and Facilities	*Negligible, Adverse, Long-term* impact on park, police, fire, and school personnel and healthcare services as a result of the proposed project.	N/M	
	Moderate, Adverse, Long-term impact on recreational facilities as a result of the change in the viewshed. No mitigation would adequately reduce this impact.	N/M	
4.14-Natural Hazards	*Negligible, Adverse, Long-term* impact on the safety of the public and health of the environment.	N/M	

Table 2. Mitigation Summary.

Mitigation No.	Mitigation Description	Affected Resources (FEIS Section)
MIT-1	NSF would decommission and deconstruct the proposed ATST Project at the end of its productive lifetime (approximately 50 years from the date operations commence), unless decided otherwise in consultation with the Native Hawaiian community. In that case, NSF would take steps to divest itself of all responsibility of the proposed ATST Project.	4.1-Land Use and Existing Activities* 4.2-Cultural, Historic, and Archeological Resources *mitigation not required, but applied to reduce long- term impacts
MIT-2	FAA will erect high-gain antennas in the same location as the current RCAG antennas and modifying/replacing the existing platforms on which the antennas are mounted, to accommodate wind loading and configuration of the new antennas. The FAA has stated that further modification of the site and relocations of the antennas may be needed, but environmental impacts from such a potential modification and relocation would not rise to a level of significance.	4.1-Land Use and Existing Activities 4.9-Infrastructure and Utilities
MIT-3	NSF, the Association of Universities for Research in Astronomy (AURA)/NSO, and UH IfA, in consultation with the Native Hawaiian community, will use best efforts to locate an area for a Hawaiʻi star compass at the summit.	4.2-Cultural, Historic, and Archeological Resources
MIT-4	In accordance with IfA's Long Range Development Plan, all construction crewmembers would attend UH-approved "Sense of Place" training prior to working on the proposed ATST Project.	4.2-Cultural, Historic, and Archeological Resources
MIT-5	AURA/NSO would hire a cultural resource monitor to ensure protection of existing traditional cultural resources during construction. The cultural resource monitor will be a Kanaka Maoli, preferably a kupuna (elder) and if possible a kahu (clergyman) as well, and one who has knowledge of the spiritual and cultural significance and protocol of Haleakalā. The cultural resource monitor's knowledge should be concentrated in traditional and cultural practices and protocols. The cultural resources monitor would be chosen in consultation with appropriate organizations and individuals with knowledge of such traditions and protocols.	4.2-Cultural, Historic, and Archeological Resources
MIT-6	HALE would restrict noise levels during certain hours of the day and during certain months of the year, limit on-site ATST-related construction activities during the time-frame from 30 minutes after sunrise to 30 minutes prior to sunset, limit the hours for wide load vehicles to traverse the Park road (such vehicles need to come through the Park during the night between approximately 8:00 p.m. and 4:00 a.m., and prohibit wide or heavy loads from coming through the Park at night between April 20th and July 15th). The seasonal restriction on wide load traffic is also imposed by USFWS.	4.2-Cultural, Historic, and Archeological Resources; 4.3-Biological Resources; 4.6-Visitor Use and Experience; 4.10-Noise
MIT-7	Special Use Permit (SUP) Pre- and Post-Project Documentation: Prior to and after the proposed ATST Project, all historic features and other areas susceptible to potential impact along the Park road shall be photographed and documented (see Federal Highway Administration (FHWA) report – "Haleakala Highway, Haleakala National Park, Pavement Drainage Condition Investigation, Distress Identification and Recommendations Report # HALA 3-2-2009, March 2, 2009 (revised April 2009)", found in FEIS, Vol. II-Appendix P). This will be completed by a qualified person funded by the proposed ATST Project.	4.2-Cultural, Historic, and Archeological Resources
MIT-8	Remove site Archeological Site 50-50-11-5443, concrete ring, which is a remnant of a 1952 radio telescope experiment, in accordance with the Archaeological Data Recovery Plan.	4.2-Cultural, Historic, and Archeological Resources

Table 2. Mitigation Summary (cont.).

Mitigation No.	Mitigation Description	Affected Resources (FEIS Section)
MIT-9	Mitigation measures developed in coordination with NPS and USFWS would implement monitoring, avoidance, and minimization measures for the project, including the following: 1. The Project will fund an agreed-upon and qualified person to conduct reasonable biological monitoring activities as outlined by the USFWS in its informal consultation. Specifically, the monitor will ensure that any changes in behavior and any petrel mortality associated with the proposed ATST Project are monitored and reported to the NPS and USFWS. The monitor will also monitor the impacts to nēnē and other biological resources. All monitoring activities shall take place during the construction phase of the proposed ATST Project and subsequently during the first three years of the operations phase. 2. The National Park Service, in cooperation with the State Division of Forestry and Wildlife (DOFAW), will likely continue to monitor and manage the ‘ua‘u, as it has for over 25 years. This monitoring has included annual surveys of the Kolekole colony for new burrows, and NPS maps of active burrow locations at the Kolekole colony have been provided to IfA periodically for a number of years. Independently, a biological monitor provided by the proposed ATST Project would work with NPS resource staff to survey the colony routinely for new burrows. Should newly active burrows be found closer to ATST than those shown in FEIS Vol. I, Figure 3-7 (40-feet), additional Section 7 consultation with USFWS would be necessary. 3. Formal Section 7 consultation would take place prior to the possibility of "take". 4. Endangered Species Act Compliance - The construction must adhere to the mitigation measures outlined in the informal Section 7 consultation with the USFWS. The USFWS consultation addressed (a) noise and vibration impacts, (b) ground vibration that could collapse petrel burrows, (c) flight obstacles, (d) spread of AIS from construction vehicles, and (e) increased traffic and potential collisions with wildlife. As requested by DLNR, AURA/NSO would monitor cumulative noise and vibration during construction to ensure that noise and vibration thresholds are not exceeded at the site, in accordance with the USFWS Section 7 Informal Consultation Document (FEIS, Vol. II, Appendix M). Noise and vibration measuring equipment would be monitored to ensure that endangered species are not exposed to potential harm. A summary of the Section 7 informal consultation is included below:	4.3-Biological Resources

Table 2. Mitigation Summary (cont.).

Mitigation No.	Mitigation Description		Affected Resources (FEIS Section)
MIT-9 (cont.)	**Possible Impact**	**Avoidance and Minimization Measure Adopted**	
	Collision of petrels with equipment and buildings	Construction crane will be lowered at night and marked with white polytape for visibility. All structures will be painted white. No outdoor lighting will be associated with the project.	
	Burrow collapse from construction vibration	USFWS set ground vibration thresholds for burrow collapse. Vibration will be monitored to ensure that the burrow collapse threshold is not exceeded.	
	Noise concerns and incubating Hawaiian petrels	Construction noise at burrows within 80 meters will be no louder than 83 dBA measured at 5-feet from the source during incubation periods (April 20^{th} through July 15^{th}). Only two truck round-trips per day will be driven to the construction site during the incubation period.	
	Predator population increase	Trash will be contained. Rat predation at the Haleakalā Observatories will be minimized by vector control methods to protect the Hawaiian petrel.	
	Transport of invasive species to Haleakala	Cargo will be thoroughly inspected for introduced non-native species. All ATST facilities and grounds with 100 feet of the buildings will be thoroughly inspected for introduced species on a semi-annual basis and any introduced floral species found will be removed.	
	Driver education	All drivers will receive a briefing and a breeding season refresher to further reduce the chance that a vehicle associated with the project would cause injury or mortality to nēnē.	
	5. Alien Invasive Species Prevention - NPS vehicle, equipment, and materials washing and inspection protocol will be followed by the proposed ATST Project. Further, to augment prevention, the IfA has implemented weeding throughout HO. This would reduce or eliminate AIS introduction if prevention is not successful. 6. Impact Prevention To Nēnē At Entrance Station - To enable wide loads to clear the Park entrance station, an area 12-feet wide, currently occupied by a septic tank, underground utilities, and native vegetation, would be temporarily developed into a drivable surface. To mitigate the potential impact on nēnē that frequent the area, widening of the shoulder would be completed outside the nēnē nesting season. Park staff would work with the proposed ATST project team to implement nēnē avoidance methods for this road-widening work. Avoidance measures would include survey of the site for nēnē prior to construction and installation of temporary "orange fencing" around the outer perimeter of the construction area to prevent nēnē from walking into the site during construction. The site will be restored with native vegetation after use to further reduce impacts on nēnē. 7. Programmatic Monitoring - A programmatic monitoring plan for invertebrates, flora and fauna during the project has been prepared for the project, as described in the FEIS Vol. I, Table 4-1.		

Table 2. Mitigation Summary (cont.).

Mitigation No.	Mitigation Description	Affected Resources (FEIS Section)
MIT-10	Slow moving vehicles and/or vehicles that are class 5 or larger should not travel through the Park between approximately 11:00 a.m. and 2:00 p.m. These are peak visitation hours. The proposed ATST Project shall provide regular updates to appropriate NPS staff during the project so NPS staff can provide information to Park visitors.	4.6-Visitor Use and Experience; 4.10-Noise
MIT-11	Contractors would be made aware of the potential for road damage and would be required to take measures to minimize the damage. Any damage to HO roadways that does result from ATST construction traffic would be repaired so as to, at a minimum, restore those roadways back its condition before construction of the proposed ATST Project. These mitigation measures, to be negotiated between the affected parties, would reduce the overall impact on HO roadways and traffic down to minor, adverse, and short-term impacts.	4.9-Infrastructure and Utilities
MIT-12	All construction-related traffic within the Park road corridor would be coordinated with HALE and conducted in compliance with an SUP issued by HALE, so as to avoid or minimize: damage to the road pavement, potential damage to historic structures along the park road corridor, traffic congestion, and other potential adverse impacts on Park resources and the visitor use and experience. SUP provisions issued by HALE would include mitigation measures to address traffic issues, potentially including those recommended in the FHWA HALE Road Report. The provision of wide-load truck access at the HALE entrance station would require special mitigations related to that project, as described in Section 2.4.3-Construction Activities, Construction Traffic. This would include: 1. Assurance by the proposed ATST Project that the septic system is adequately protected. Mitigation may include placement of metal plate covers, grade beams, other protective structures, or relocation of utilities as a last resort. 2. Protection of existing utility man-hole covers. Specifically, the Project would: a. avoid direct axle loading on the covers, b. replace the existing covers with heavier gage steel; or, c. reinforce the existing covers with additional steel bracing. 3. Provision of a barricade system, such as a gate, removable bollards or similar devices on the widened shoulder to deter Park visitors and staff from driving on it. 4. To minimize the potential impact to the nēnē habitat in this area, the access widening project would be completed outside the nēnē nesting season, which is November through March. 5. Native plants in the area of the access widening project would be protected when possible and HALE staff would work with the Project on this mitigation. 6. When the widened access is no longer needed for the proposed ATST Project, the area would be fully restored and rehabilitated to its pre-existing condition.	4.9-Infrastructure and Utilities

Table 2. Mitigation Summary (cont.).

Mitigation No.	Mitigation Description	Affected Resources (FEIS Section)
MIT-13	To mitigate construction noise, contractors would implement reasonable noise-reduction practices and abatement procedures. These would include the following source control mitigation measures, all regarded as somewhat standard in the industry. These mitigation measures to minimize expected noise impacts during construction at HO would be as follows: 1. Conduct all noise-emitting activities within strict day and time constraints, with work prohibited during sensitive nighttime periods. 2. Reduce or substitute power operations/processes through use of proportionally sized and powered equipment necessary only for tasks at hand. 3. Maintain all powered mechanical equipment and machinery in good operating condition with proper intake and exhaust mufflers, 4. Turn off or shut down equipment and machinery between active operations; and, 5. Shield noise sources where possible. Contractors would be required to comply with applicable State noise regulations, under HAR 11-46.	4.10-Noise
MIT-14	During the 50-year lifetime of ATST, the Project will periodically reassess technological options for new types of coatings, more efficient cooling methods, or improved compensation for thermal turbulence which may allow the ATST enclosure and buildings to be painted a color other than white. If such future technology is determined to be an effective, reliable and affordable solution that meets the scientific requirements of the proposed ATST Project, NSF will consider repainting the exterior structures of the ATST with a more neutral color.	4.2-Cultural, Historic, and Archeological Resources
MIT-15	If there are Native Hawaiian scientists among the pool of scientists qualified to conduct research at the proposed ATST Project, NSO will reserve up to 2% of total ATST usage time for these Native Hawaiian scientists. Usage time will be provided through the Telescope Allocation Committee process similar to other scientists' requests based on technical feasibility and scientific merit. Unused time will not be carried forward to the next allocation period. Qualifications for usage will be based on established NSO guidelines.	4.2-Cultural, Historic, and Archeological Resources
MIT-16	The exterior design for the lower portion of the ATST building will include a well thought-out representation of traditional Hawaiian culture suitable to the Haleakalā setting, such as artwork depicting Maui and the Sun or other appropriate motifs. These depictions will be developed in consultation with Native Hawaiian artists.	4.2-Cultural, Historic, and Archeological Resources
MIT-17	NSF will support Maui Community College (MCC) in developing an educational initiative (Akeakamai I Ka La Hiki Ola, or Scientific Exploration Beneath the Life-Bringing Sun) on Maui to address the intersection between traditional Native Hawaiian culture and science. To support this educational initiative at MCC, NSF will, if the proposed ATST Project is approved, make available $20 million ($2 million per fiscal year, commencing in FY 2011), subject to applicable Federal law.	4.2-Cultural, Historic, and Archeological Resources
MIT-18	UH IfA will work with appropriate authorities to consider renaming the roads on the summit.	4.2-Cultural, Historic, and Archeological Resources

4.6 Describe how the proposed land use, including buildings, structures and facilities, will be compatible with the locality and surrounding areas, and to the physical conditions and capabilities of the specific parcel or parcels.

The ATST would be in close proximity to other previously developed facilities for astronomy and advanced space surveillance within HO. The HO facilities are closed to the general public; therefore, only HO personnel would see the facility at close range. From the nearest public vantage point, the Haleakalā National Park Puʻu Ulaʻula (Red Hill) overlook, the ATST would sit among the other astronomy and advanced space surveillance facilities within HO.

4.7 Describe how the existing physical and environmental aspects of the land, such as natural beauty and open space characteristics, will be preserved or improved upon.

The proposed ATST Project will be confined in entirety within the boundaries of HO, which has been designated for observatory site purposes. At the proposed ATST Project site, no substantial change to the natural topography will occur. No fences will be permitted around the facility. There will be no new roads.

4.8 If applicable, describe how subdivision of land will not be utilized to increase the intensity of land uses in the Conservation District.

The proposed ATST Project does not involve the subdivision of land. Subdivision of land will not be utilized to increase the intensity of land use in the Conservation District.

4.9 Describe how the proposed land use will not be materially detrimental to the public health, safety, and welfare.

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

Hazardous Materials
Construction of the proposed ATST Project would have negligible, adverse impacts on health and safety relating to the use of hazardous materials (HAZMAT). Hazardous materials may be used during the construction of the proposed ATST Project, however the use would be temporary and applicable Best Management Practices (BMPs) would be implemented to protect the health and safety of the workers and the public.

Site development activities, such as welding and metalworking, could generate minor quantities of hazardous waste and air pollutants. Other HAZMAT or substances that may be used in the construction phase would include fuels, oils, and lubricants in the machinery operations and paints on building structures. No other HAZMAT or substances would be used in construction. Under the MP-imposed construction constraints, no oil or chemical treatments may be used at the site for dust control.

The construction contractor would comply with the requirements in the MP related to hazardous materials during construction (see MP, Section 3.5.3.2-Construction Practices):

1. No hazardous materials are to be released at the site. Surplus or used paint, oil, solvents, and cleaning chemicals must be removed from the area and disposed of properly.
2. Accidental spills of any hazardous material during the execution of a contractor's project at the site must be reported immediately to the on-site IfA supervisor. Spill containment would be supervised by IfA personnel at the site. Spill remediation methods must be approved by the UH's Environmental Health and Safety Office (EHSO) prior to clean up, and all costs incurred for

cleanup would be assigned to the contractor. In the event of a reportable release, the construction contractor would be liable for any Federal- or State-imposed response action, costs, or penalties.

3. Washing and curing water used for aggregate processing, concrete curing, and cleanup cannot be released into the soil at the site. A recovery process is required by the contractor to recapture wastewaters.

Solid Waste

Operation of the proposed ATST Project would have negligible, adverse impacts on solid waste management. No mitigation would be necessary. The operations of the ATST would have no appreciable impact on waste streams. Solid waste generated on-site would be carried out of the building by facility workers and kept in covered refuse containers. In accordance with MP requirements, construction contractors would remove construction trash frequently, particularly food sources that could increase the population of mice and rats. Most construction waste would be removed in roll-off trash receptacles that would be covered before transport. During demolition and construction, solid waste requiring disposal would be generated. Construction waste and debris would be secured to minimize windblown materials, particularly during off-hours. Non-hazardous trash and recyclable material would be disposed of off-site at Maui's licensed landfill. There would be no change in the long-term solid waste disposal practices, although solid waste generation could triple. At present, approximately four to five bags are being disposed of weekly from the Mees facility and other facilities under HO jurisdiction.

After completion of the proposed construction, the facility would be operational; thus, solid waste generated on-site would be carried out of the building by facility workers and kept in covered refuse containers. Non-hazardous trash and recyclable material would be disposed of off-site at Maui's licensed landfill.

Noise

Direct impacts of noise from the construction of the proposed ATST Project are anticipated to be major (substantial), but short-term. Construction noise emissions would increase the existing ambient noise levels at the summit but would be temporary and intermittent. Trucks and mobile construction machinery would also raise ambient noise above background levels during the construction period. While not posing a health hazard, the noise would be detrimental to the welfare of those involved in the Hawaiian cultural practices described in Section 5.1 of this CDUA. The mitigations to be employed during ATST construction to limit, reduce, and prevent noise are discussed above in Table 2-Mitigation Summary.

5.0 ADDITIONAL INFORMATION

Articles IX and XII of the State Constitution, other state laws, and the courts of the State require government agencies to promote and preserve cultural beliefs, practices, and resources of native Hawaiians and other ethnic groups. The Department of Health (DOH), Chapter 343, also requires an Environmental Assessment (EA) of cultural resources in determining the significance of a proposed project.

5.1 If applicable, please provide the identity and scope of "valued cultural, historical and natural resources" in which traditional and customary Native Hawaiian rights are exercised in the area.

Cultural, Historic, and Archeological Resources

According to oʻmanaʻo (remembrances, recollections) of many Native Hawaiians interviewed for the recent cultural impact assessments, for the ancient Native Hawaiian, Haleakalā — which includes the Kolekole area on which HO resides — is considered a piko (the navel), or center of Maui Nui O Kama (Greater Maui). It is a Puʻu 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 kahuna (priest) used the summit area as a learning center. It was a place where the kahuna could absorb the tones of ancient prayer and balance within the vortex of energy, for spiritual manifestations, the art of healing, and for navigation. Kolekole itself was a very special religious place used by the kahuna 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 Evaluation (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 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 provides significant cultural value as a remnant of a Native Hawaiian landscape 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

<u>Gathering of Plants</u>

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, see FEIS Vol. II).

In the past, ‘ōhelo berries (*Vaccinum sp.*) were traditionally offered to Pele by those who frequented the upper elevations of the mountainous regions (SCIA, p. 102, see FEIS Vol. II). Today, upland hikers and those in transit often pick ‘ōhelo 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, see FEIS Vol. II). The SCIA also reported that pūkiawe, *lehua*, māmane and other plants and flowers are used for this same purpose (SCIA, p. 102, see FEIS Vol. II). The trunks and branches of the ‘a‘ali‘i (*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, see FEIS Vol. II). 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, see FEIS Vol. II). 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 la‘au lapa‘au, or Hawaiian medicinal practices. Specifically, they have been used for alleviating sore tendons, muscles, and joints (SCIA, p. 102, see FEIS Vol. II).

<u>Hunting Practices</u>

Traditional hunting of birds for food and feathers was documented at least 100 years ago (SCIA, p. 103, see FEIS Vol. II). The ‘ua‘u (Hawaiian petrel, *Pterodoma 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, see FEIS Vol. II and NPS 2008 Ethnographic Study, p. 36). In addition to the ‘u‘au and nēnē (*Nesochen sandvicensis*), the extinct flightless birds *Platochen pau* and *Branta hylobadisies* were hunted; and today, hunting practices continue. Specifically, 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, see FEIS Vol. II). Feathers from some of the game birds “are highly prized for their use in hatbands” (SCIA, p. 104, see FEIS Vol. II).

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 Ali'i Kakaalaneo and under the direction of the Kahuna Kalaiha'ohi'a (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, Ka'anapali, and Wailuku. The eastern portion of Maui Island, dominated by Mauna Haleakalā, was subdivided into the remaining nine moku: Hāmākua Poko, Hāmākua Loa, Ko'olau, Hāna, Kīpahulu, Kaupō, Kahikinui, Honua'ula, and Kula. There is a naturally circular stone plateau, referred to as Pālaha (Sterling 1998:3), along the summit of Haleakalā where one ahupua'a from each moku, with the exception of Hāmākua Poko, originate. Pōhaku Pālaha, as it is commonly known today, is located on the northeast edge of Haleakalā Crater, at Lau'ulu 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, see FEIS Vol. II) 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, see FEIS Vol. II).

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 ma'a (familiar or accustomed) to this place (SCIA, p. 103, see FEIS Vol. II).

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, see FEIS Vol. II). Some Native Hawaiians involved in the Section 106 consultation process for the proposed ATST Project shared similar sentiments, and their testimonies, letters, and research have been included in Vol. I, Section 5.0 of the FEIS**.**

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 kahuna, 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, see FEIS Vol. II).

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, see FEIS Vol. II).

<u>Ceremonial Practices</u>

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, see FEIS Vol. II). 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, see FEIS Vol. II). 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, see FEIS Vol. II). 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, see FEIS Vol. II).

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., Pu'ukukui. These practices essentially use Haleakalā as a calendar (SCIA, pp. 107-108, see FEIS Vol. II).

<u>Astronomy</u>

As described in oli (chants) and the mo'olelo (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 Koolau 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 Nuu (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).

Evidence of sacred use found within HO includes ko'a (ceremonial rock formations) and temporary habitation shelters. These may have been used for ceremonies by the priesthood during Makahiki festivals. In ancient times, the mo'olelo 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, Kihapi'ilani, Ali'i 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 Honua'lua buried their dead in Haleakalā Crater (Handy and Handy 1972). Several references specify burials of both chiefs and commoners in Haleakalā Crater (SCIA ref. Ka'ai'e, Kamakau; in Sterling, 1998:264-265), and one possible burial is recorded on the northwest boundary of HO property (Fredericksen 2003).

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 Pu'u Ula'ula (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 Pu'u Ula'ula (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).

Traditional and Customary Native Cultural Rights Practiced at HO

The IfA has ensured that Native Hawaiians are welcome to enter HO for cultural practices, with the understanding that such use will not interfere with other uses and activities within HO. A sign has been provided by IfA with instructions meant only for Native Hawaiians. It is posted at the entrance to the HO complex (Fig. 5).

In 2005, in recognition of the cultural importance of Haleakalā and in the spirit of ho'oponopono (to "make right"), UH contracted Native Hawaiian stonemasons to erect a west-facing ahu (altar or shrine) (Fig. 7) within the HO set aside "Area A" for the sole reverent use of Native Hawaiians for religious and cultural purposes (Fig. 8). A ho'omahanahana (dedication or "warming" offering) was held, at which time the ahu was named Hinala'anui.

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 Mees site (Fig. 9), 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.

Figure 7. Sign at Entrance to HO.

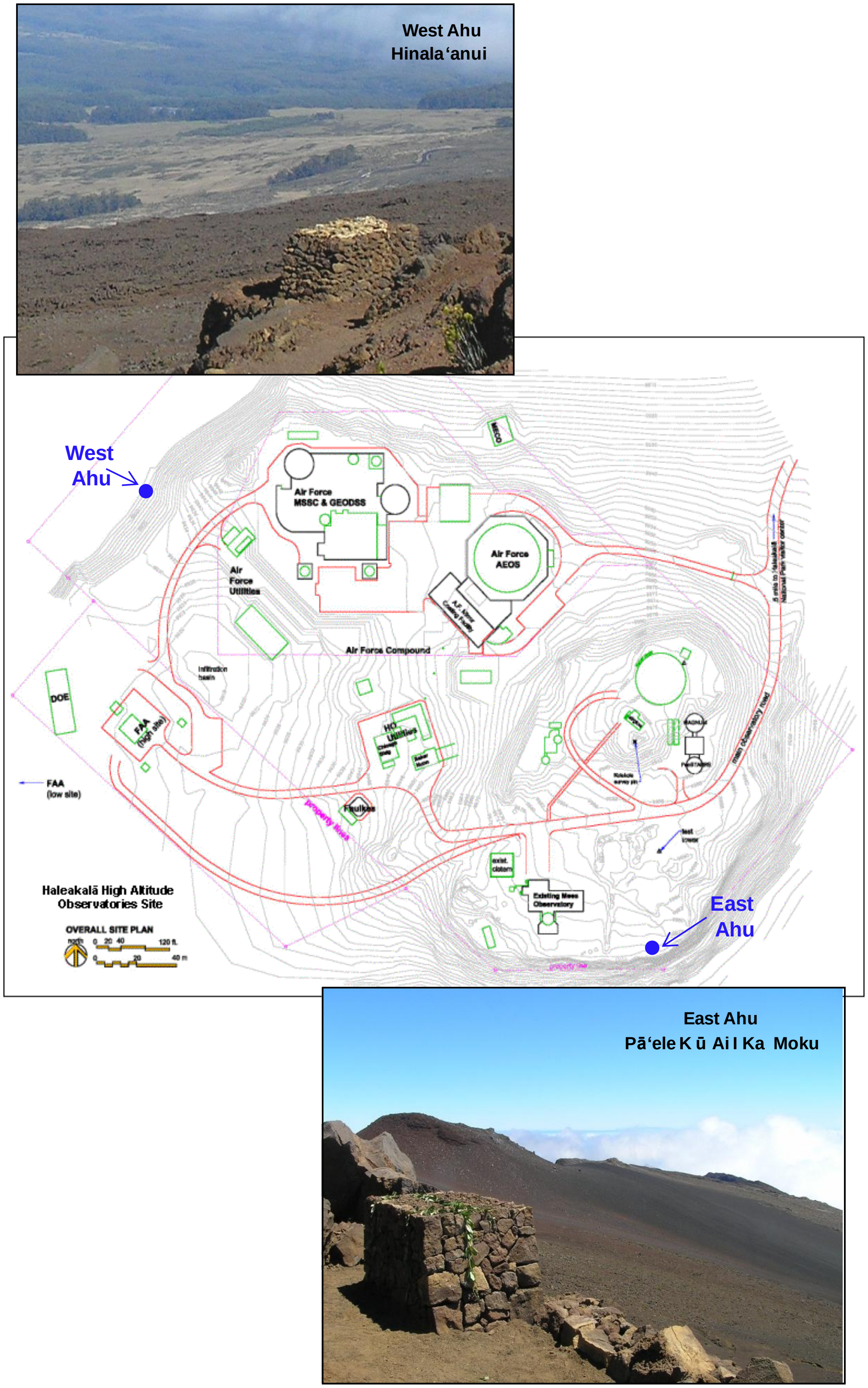

Figure 8. East- and West-facing Ahu Locations at HO.

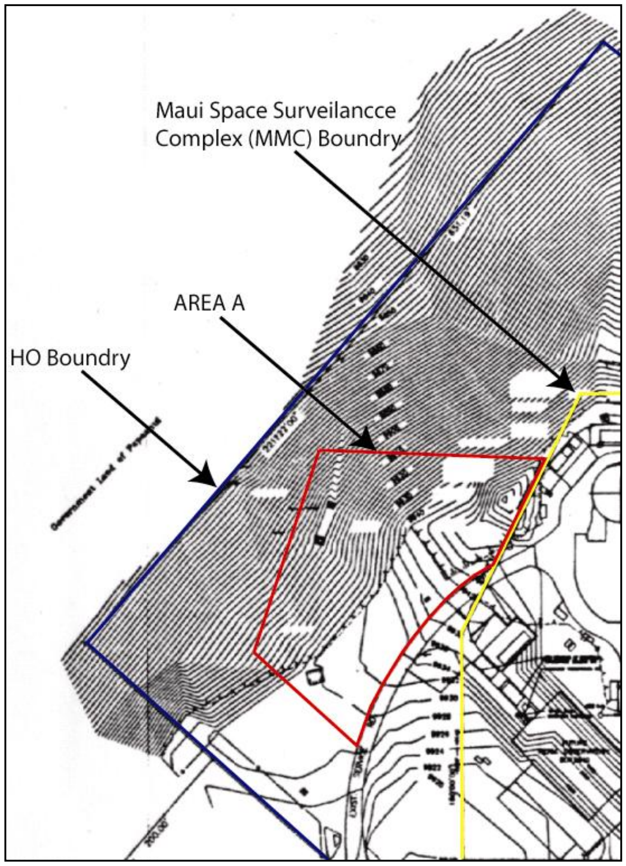

Figure 9. Set aside "Area A" Location at HO.

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 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 1950's 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.

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 Environmental Assessment (AEOS) (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), 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 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 10.

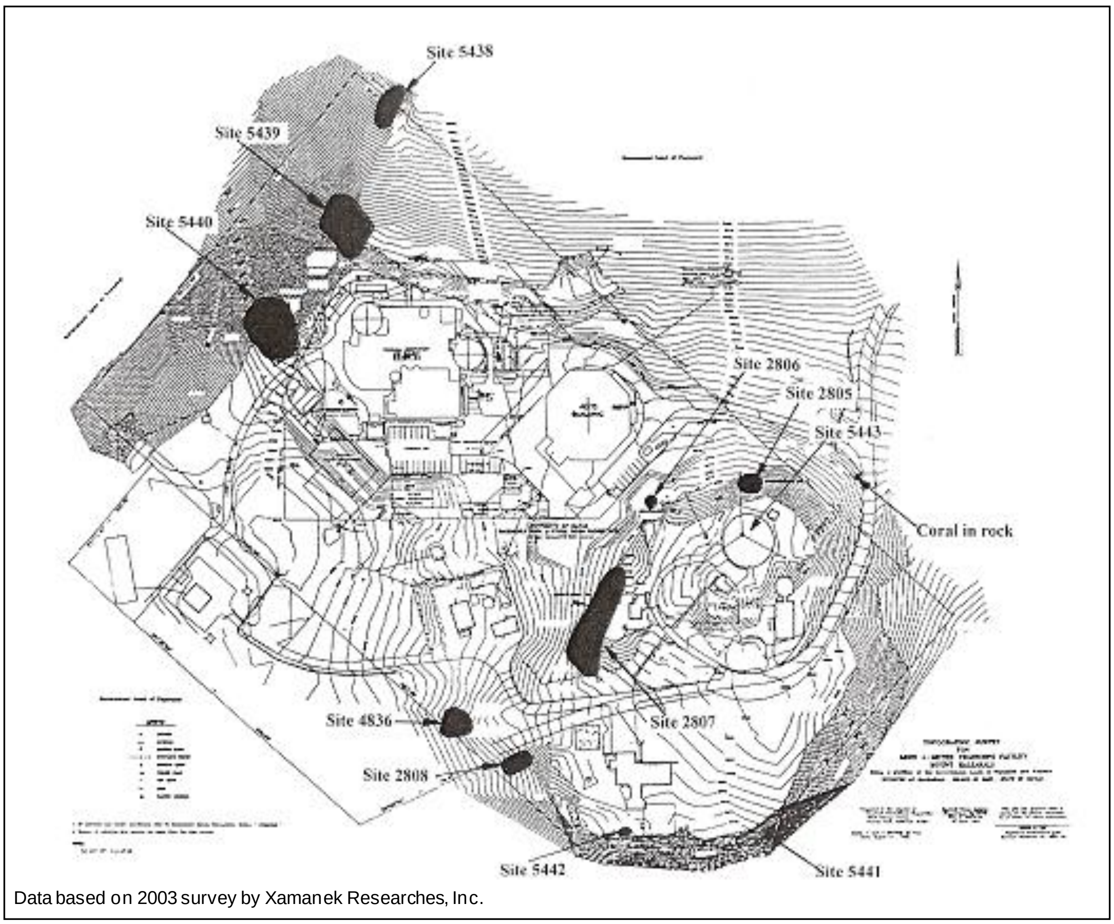

Figure 10. Archeological Sites at HO.

5.2 Identify the extent to which those resources, including traditional and customary native Hawaiian rights, will be affected or impaired by the proposed action.

During construction and operation of ATST, the presence of an additional large, white observatory structure at HO would be considered intrusive on Native Hawaiian cultural practices in the summit area. Also, during construction, noise levels would exceed those currently existing at HO. For those whose traditional and customary Native Hawaiian rights require only the natural soundscape those rights could be affected during periods when construction noise exceeds the ambient noise levels.

5.3 What feasible action, if any, could be taken by the Board of Land and Natural Resources regarding your application to reasonably protect native Hawaiian rights?

IfA requests that the SHPD division of DLNR support and participate in the measures developed to protect Native Hawaiian rights agreed to by signatories of the Programmatic Agreement (PA) in Appendix E regarding the ATST and the IfA MP for HO, as follows:

Programmatic Agreement

For the PA, NSF invited public participation pursuant to the NHPA Section 106 process to identify and address issues concerning Native Hawaiian organizations (NHO) and individuals who may attach religious and cultural significance to a historic property that may be affected by the proposed construction. Consultation began in June 2005 with formal notification letters to the Advisory Council on Historic Preservation (ACHP), the SHPD, and Maui Native Hawaiian individuals. Over the years, a list of interested and potentially interested parties was generated from lists provided by the Office of Hawaiian Affairs (OHA), the U.S. Department of the Interior's Office of Hawaiian Relations website (DOI 2007), through ongoing requests from NSF to the public during Section 106 consultation meetings and information letters about the Section 106 process, and through community interest and participation during consultation meetings. The process culminated in a PA to stipulate measures to be undertaken, a number of which are specifically to protect Native Hawaiian rights, i.e., retention of a cultural specialist, required "Sense of Place training", etc.

Management Plan

With respect to the protection of Native Hawaiian rights in the IfA MP, the IfA has ensured that Native Hawaiians are welcome to enter HO for cultural practices. A sign provided by IfA has been posted at the entrance to HO with instructions meant only for Native Hawaiians. In addition, Native Hawaiian dry stack masons erected two ahu on HO property to delineate ceremonial sites. In addition, the IfA set aside approximately 0.55 acres of HO property around the west-facing ahu 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. 6).

5.4 Does the proposed land use have an effect (positive/negative) on public access to and along the shoreline or along any public trail?

<u>Shoreline Access</u>

The site is located at 9,980 feet above sea level and, therefore, will have no effect on public access to and along the shoreline pursuant to the County of Maui Planning Department map entitled *Island of Maui Showing Special Management Area*. This map is provided by the County of Maui GIS Program, Office of the Managing Director, dated July 2002, and is located in the Zoning and Administration Enforcement Division of the Planning Department, Wailuku, Maui. The map clearly indicates that the proposed ATST facility is not located within a shoreline access area.

<u>Public Trails</u>

There are no public trails within the HO boundaries. The entire HO complex is off limits to the general public as shown on the sign in Figure 5.

5.5 Does the proposed use have an effect (positive/negative) on beach processes?

The site is located at 9,980 feet above sea level and will have no effect on beach processes as indicated in Section 5.4 above.

5.6 Will the proposed use cause increased runoff or sedimentation?

A National Pollutant Discharge Elimination System (NPDES) Permit is required for this project. An application for a permit will be submitted upon issuance of a CDUP.

There are no water bodies at HO. The Polipoli Springs water system is within the project aquifer system. The Polipoli Spring 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 Hawaiʻi and managed by the Hawaiʻi 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 to support design planning for construction of the Proposed Action (see FEIS Vol. II, Appendix K-Soils Investigation Report). 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 HO is controlled and conveyed via natural drainage paths to an infiltration basin at the western extremity of HO property. This infiltration basin is a depression that represents an old vent on the cinder cone, and its substrate is considerably more porous than the lava or spatter portions of Kolekole. 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 HO. In the FEIS Vol. I, Section 3.0, Figure 3-10 illustrates the existing runoff patterns associated with HO and provides a brief description of each flow path in the HO drainage system.

5.7 Will the proposed use cause any visual impact on any individual or community?

An exhaustive analysis of the visual impacts to visual resources and view planes of the proposed ATST Project is found in the FEIS Vol. I, Sections 4.5 and 4.17.8. The proposed use will cause a substantial visual impact on visitors to the summit area of HALE and only negligible impacts on populated parts of the greater Maui community. The viewing areas used to assess and describe visual effects from the proposed ATST Project are:

1. Pu‘u Ula‘ula (Red Hill) Overlook,
2. The areas of HALE adjacent to HO, but not on Pu‘u Ula‘ula (Red Hill), including Magnetic Peak,
3. The upper Park roadway, including the Haleakalā Visitor Center,
4. The crater,
5. The lower Park roadway, including Hosmer Grove; and,
6. Populated areas of Maui, including windward, Upcountry, Central Valley, and South Maui locations.

From Section 4.5 of the attached FEIS, the impact on visual resources at the Pu‘u Ula‘ula (Red Hill) Overlook from the construction and operation of the proposed ATST Project is substantial because of its prominence in relatively close-up views. The location relative to other HO structures would result in the appearance of an increase in the total horizontal space occupied by the HO footprint (see FEIS Vol. I, Section 4.5, Fig. 4-4b). Though it would appear taller than any other structure in the view, it would not appear out of scale or character compared with the existing view toward HO from the overlook.

From areas in HALE adjacent to HO, the proposed ATST Project would appear in views to increase the total amount of horizontal space occupied by HO. The proposed ATST Project would also appear as the tallest man-made structure in views where HO is visible, through it would be subordinate to Magnetic Peak in terms of visual dominance (see FEIS Vol. I, Section 4.5, Fig. 4-8b). The visual character of views toward HO in adjacent areas in HALE remains defined by topography and the general downward slope to the west from Magnetic Peak. The proposed ATST Project would constitute a substantial (major) impact.

From within the upper two miles of the Park roadway, the proposed ATST Project would occupy varying portions of the existing landscape. In closer views, the new structure would occupy greater space than in views from further away (see FEIS Vol. I, Section 4.5, Figs. 4-10b and 4-11b); however, the proposed ATST Project would appear in all such views to increase the horizontal footprint of HO. As with other views, however, the new structure would appear consistent with the existing visual character of its immediate surroundings at HO. The visual effect of adding the ATST structure would be to intensify the appearance of the developed area in closer views. In views from further away in the area, such visual effects would not be as noticeable. As such the proposed ATST Project would result in impacts on visual resources, but those would be less than substantial.

The proposed ATST Project would be intermittently visible in views from the lower Park roadway, including the area from the entry station to just above the Park Headquarters Visitor Center (see FEIS Vol. I, Section 4.5, Fig. 4-12b). In these views, the proposed ATST Project would be barely discernable alongside other existing structures at HO and the footprint of the area would appear to increase slightly. The new structure would not substantially affect the visual quality of such views. The impact to visual resources in this area would be negligible.

From inside the crater, the upper part of the 250-foot crane that would be used during construction of the proposed ATST Project would be visible from trails and camping areas within the crater, during such times when the crane is extended. No other past or present actions at HO are visible within the crater and the crane would not be distinguishable as other than a faint, short segment above the rim. Where visible, it would appear small relative to the 3,000-foot crater walls. To the extent that it could be visible, however, such an object would potentially affect the visual quality of views from within the crater, which consists of mainly undeveloped backcountry. The impact to visual resources resulting from construction activities would be minor.

Where visible in more distant views from populated areas of Maui, the proposed ATST Project would appear as part of the cluster of structures at HO along the ridgeline (see FEIS Vol. I, Section 4.5, Figs. 4-15 through 4-27). While a slight increase in the amount of overall space occupied by HO along the ridgeline would be visible from some locations, from others, the new structure would not be distinguishable from other existing structures. The new building would not appear to substantially increase the size of the developed ridgeline, nor would it substantially alter the existing visual quality of views toward the proposed ATST Project site. The anticipated visual effects from the proposed ATST Project would not contribute to any further loss of visual resources. Therefore, in views from the populated areas of Maui, the proposed ATST Project would result in negligible impacts to visual resources.

6.0 EXISTING SITE INFORMATION

To better understand existing features on and of the land, mapping of existing features is requested. Mapping of existing features may be combined. Please include Titles, Legends and North arrows.

6.1 Are there existing structures on the parcel? ___Yes **_X_ No**
If yes, please describe below and include/illustrate on a map entitled *existing structures*.

6.2 Will any existing structures be demolished or removed? **___Yes _X_No**
If yes, describe how below. Please indicate/illustrate demolished structure on a map entitled *structures to be demolished/removed*.

6.3 Has the parcel been graded or landscaped? **___Yes _X_No**
If yes, describe below. Please describe cubic yards affected and/or area of landscaping on a map entitled *areas previously graded or landscaped*.

6.4 Describe existing utilities. Include electricity, water, telephone, drainage, and sewerage. Please illustrate on a map entitled *existing utilities*.

At the proposed ATST Project site east of the Mees facility, there are currently no existing utilities; however, the following is a description of existing utilities within HO.

Wastewater and Solid Waste Disposal
Septic tanks are the primary means of sewage disposal within the summit area. There is no central waste/sewage collection or storage system at the Haleakalā summit. Each user provides for the collection and proper storage of wastewater and sewage generated by that site.

Trash collection is the responsibility of building maintenance personnel for each facility located within the HO complex. Non-hazardous trash is disposed of off-site in a licensed landfill, with computer paper and aluminum being recycled. Hazardous wastes and petroleum product wastes are segregated at the generation point and handled separately.

Stormwater and Drainage System
On the slopes of Haleakalā, as mentioned in the FEIS Vol. I, Section 3.7-Water Resources, 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 will flow in the path of least resistance. At HO, this confining layer of basalt ranges from depths of 5 to 20+ feet. The significance of a confining layer of basalt near the summit area is that all precipitation falling near the summit is infiltrated and flows subsurface toward the natural drainage courses such as Manawainui Gulch. As a result, runoff from the impervious surfaces associated with HO facilities and adjacent roads may not increase the total volume of stormwater flow entering natural drainages, but may only affect the way it is transported there (UH IfA 2005b). (Hydrologic conditions of stormwater drainage within HO is further discussed in the FEIS Vol. I, Section 3.7–Water Resources.)

Electrical Systems
MECO generates electricity for HO. There is a 3750/4688 kilovolt-ampere (kVA) transformer at the Kula substation that presently serves HO. The site is connected via 23 kV conductors on power lines to a 450

kVA transformer bank and voltage regulators at a substation within HO and distributed from there. See Figure 11.

The reserve capacity in the existing MECO substation at HO is estimated by MECO engineers to be approximately 1900 kVA; which is adequate for the existing connected loads and all currently identified future loads, including the proposed ATST Project. Although the existing HO substation has adequate capacity, the equipment is considered obsolete. MECO is planning to upgrade it to a new 2500 kVA substation with improved efficiency and safer reserve capacity. (Kauhi 2005)

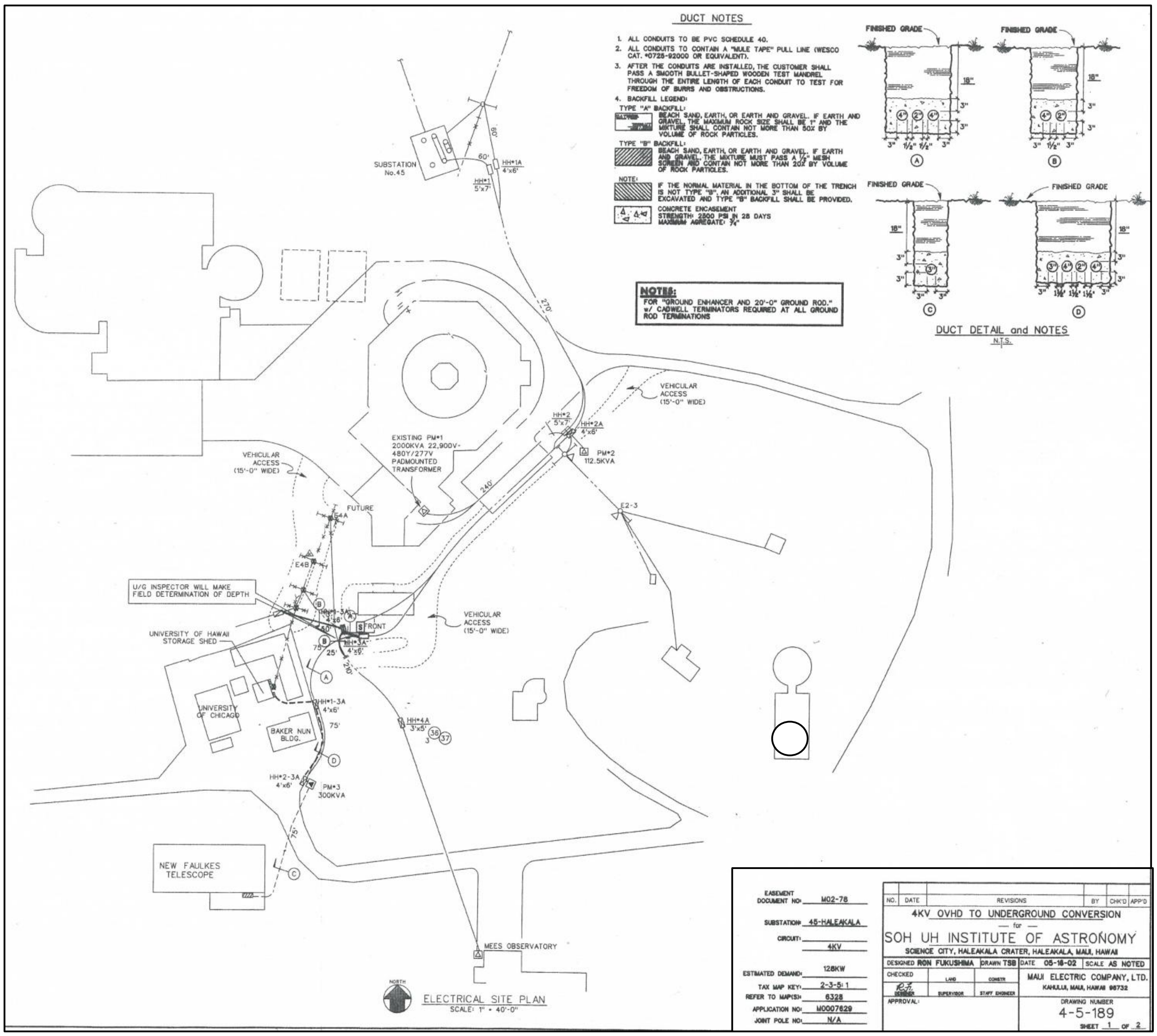

Figure 11. Map Showing the Maui Electric Co. Utility Line in HO.

Communications Systems
Hawaiian Telcom provides telephone and other communications services for the HO complex. HO is currently served by a range of copper and fiber-optics. The U. S. Air Force facilities are served by a dedicated fiber cable with OC3C capacity. The IfA facilities are served by link with fiber cables with OC3C and Gigabit capacity. Hawaiian Telecom provides commercially available copper and fiber-optic lines to HO with more than 100 percent reserve capacity.

The Federal Aviation Administration (FAA) operates and maintains 50-watt transmitter and receiving equipment for remote air/ground interisland and trans-Pacific communications to and from aircraft. The antennas for these transmitters/receivers are located on two towers within the FAA property adjacent to HO. The frequencies for transmission and receiving are in the Very High Frequency (VHF) and Ultra-High Frequency (UHF) radio bands, to and from transiting aircraft at altitudes from 8,000 to 50,000 feet.

6.5 Describe existing access. Illustrate and include roadways and public trails on a map entitled *existing access*. Give major street names if available.

Existing access into and out of HO is exclusively via HALE (Fig. 12) and then through the entrance to the HO complex just past Puʻu ʻUla ʻUla (Red Hill). There is no general public access to HO and authorized entry only is posted on the sign (Fig. 5) located at the entrance to the facilities. Native Hawaiians are welcome to enter for cultural and traditional practices, as indicated on the sign.

There are two other access roads that serve the Haleakalā summit area. The FAA maintains a non-exclusive access road to facilities in the Saddle Area and the FAA Low Site. There is also an unimproved access road known as Skyline Drive (Fig. 12), which originates 0.5 miles away from HO at the Saddle Area. It traverses the Southwest Rift Zone, ultimately leading to Spring State Recreation Area (also known as Polipoli State Park), which is located at 6,200 feet above sea level (ASL) within the fog belt of 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 and hunters use the unpaved road. There are sections of this trail that have a steep grade and soft cinder roadbed that will not support standard construction truck traffic, only smaller vehicles with four-wheel drive.

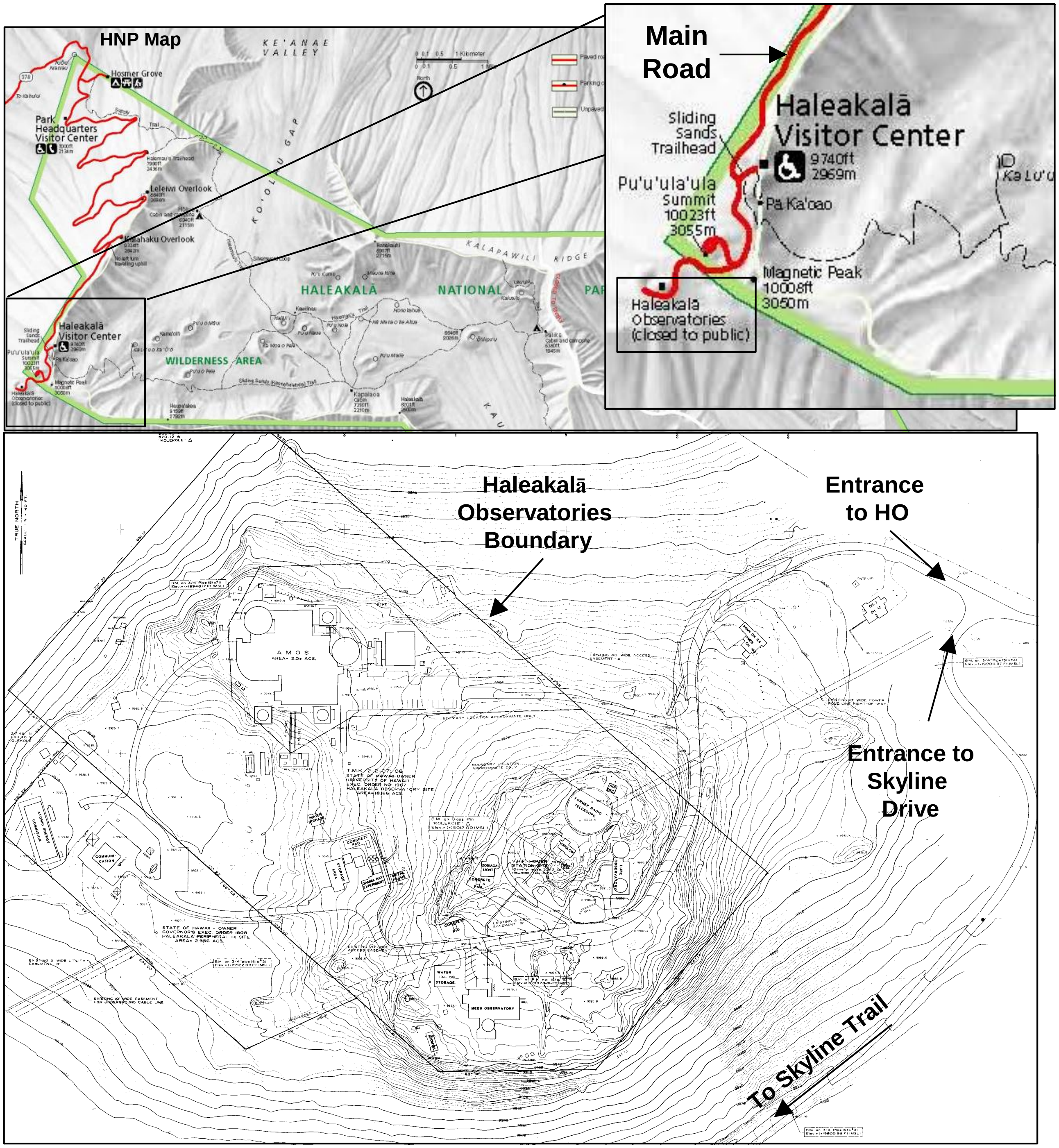

Figure 12. Existing Access to HO.

6.6 Describe Flora and Fauna. Illustrate general location and types of flora and fauna on a map entitled *resources*. Indicate if rare or endangered native plants and/or animals are present.

Detailed botanical and avifaunal survey information and management plans can be found in the FEIS Vol. I, Section 3.3-Biological Resources and Vol. II, Appendices C(1), C(2), C(3) and E, and in the LRDP.

BOTANICAL RESOURCES

The landscape at HO is considered to be an *Argyroxiphium*/*Dubautia* alpine dry shrubland vegetation type. Dry alpine shrublands are typically open communities, occurring between about the 9,800 to 11,100-foot elevations in Hawaiʻi, predominantly on barren cinders, with very sparse vegetation cover (UH IfA 2005a). The substrate is a mixture of ash, cinders, pumice, and lava (UH IfA 2005a). Vegetation is sparse, varying from a near barren landscape (<1 percent cover) to about 10 percent cover. Vegetation is low to the ground, no more than 3 feet (1 meter) tall anywhere on the site. During the November 2002, LRDP survey conducted by Starr Environmental (UH IfA 2005a), a total of 32 plant species were observed, consisting of 11 (34 percent) native species and 21 (66 percent) non-native species. The December 2005 survey identified 25 plant species, consisting of 11 native species and 14 non-native species (see FEIS, Vol. II, Appendix E-Botanical Survey).

A more recent survey was conducted in June 2009 (see FEIS, Vol. II, Appendix E-Botanical Survey). It indicated that, in general, the number of species has increased over time and it appears the distribution and abundance of both native and non-native plants has increased. Global Positioning System (GPS) work conducted during this latest study will allow for greater resolution detail of future vegetation changes.

At HO, the total number of plant species has increased from a total of 32 plant species (11 were native and 21 were non-native) in 2002, to a total of 44 plant species (3 new natives and 9 new non-natives, for a total of 14 native species and 30 non-native species) in 2009. Species previously reported from HO that were not observed in 2009 include *Anthoxanthum odoratum* and *Senecio sylvaticus*. These species may have disappeared, may have been overlooked, or may persist as seed in the soil. The 9 new non-native species recorded in 2009 included *Ageratina adenophora, Bromus diandrus, Conyza bonariensis, Dactylis glomerata, Festuca rubra, Pennisetum clandestinum, Trifolium repens,* Unknown sp., and *Vulpia myuros*. These species may be new arrivals, they may have been overlooked in previous studies, or perhaps they were persisting as seeds in the soil and have recently germinated. The 3 new native species recorded in 2009 included *Dryopteris wallichiana*, *Pteridium aquilinum* var. *decompositum*, *Silene struthioloides*. These could be new arrivals, but these inconspicuous natives could have just as easily been overlooked in previous surveys.

The land in HO can be divided into two general areas: undisturbed and disturbed (i.e. those where construction or other human influence has occurred). Undisturbed areas are comprised of predominantly native plants including shrubs, herbs, and grasses. Three species of native ferns are found in rock crevices and overhangs around the Pan-STARRS (PS-1) observatory and on the steep slopes on the southeast portion 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 ʻahinahina, or Haleakalā silversword, which is found exclusively on areas where construction has occurred. The only tree species found at HO were two unidentified pines (*Pinus* sp.) located between a weather station tower and the MSO facility, which were approximately 20 cm (7.87 inches) tall and looked more like a small multi-branched shrub than a tree. This was the first record of pines on the summit of Haleakalā. It was not known if the trees were planted, arrived as contaminants in soil, or arrived through natural wind dispersal. These trees were thought to be many years old despite their minimal height (compared to other pine species). At the recommendation of the Friends of Haleakalā National Park, these trees were removed.

There are ten native species and nine non-native plants species found on the Mees site. Portions of the site which were moderately disturbed, especially areas near buildings and roads, contain the most weeds (non-native species) and fewest native species. Non-native plants found on the Mees site include thyme-leaved sandwort (*Arenaria serpyllifolia*), storksbill, hairy cat's ear, black medick (*Medicago lupulina*), evening primrose (*Oenothera stricta* subsp. *stricta*), pine (*Pinus* sp.), English plantain (*Plantago lanceolata*), Kentucky bluegrass (*Poa pratensis*), and common or spring vetch (*Vicia sativa* subsp. *nigra*). (see FEIS Vol. II, Appendix E-Botanical Survey).

Portions of the site that were the least disturbed contain the most native plant species and the least weeds. Native plants found on the Mees site include Hawaiian bentgrass, ʻiwa ʻiwa, ʻoaliʻi, hairgrass (*Deschampsia nubigena*), kupaoa, kalamoho (*Pellaea ternifolia*), pukiawe (*Styphelia tameiameiae*), tetramolopium (*Tetramolopium humile*), mountain pili (*Trisetum glomeratum*), and ohelo. (see FEIS Vol. II, Appendix E-Botanical Survey).

The most undisturbed areas of HO hold remnant pockets of native plants indicative of relatively pristine conditions. Two native shrubs, ohelo and pukiawe, appear to be sensitive to disturbance/urbanization on Puʻu Kolekole, and were found on the proposed construction site adjacent to the MSO facility.

Alien Invasive Species

The introduction of alien invasive species (AIS) was evaluated based upon what is known about existing and past loss of habitat at HO. According to the botanical survey of HO conducted in 2005, there were more non-native plants relative to similar adjacent "pristine" areas, such as HALE, the Kahikinui Forest Reserve, and the Kula Forest Reserve. The report cited a number of reasons for this. To some extent, development seems to promote plant growth, both native and non-native. This is likely due to disturbance to the soil from construction, additional water sources from discharge pipes and gutters, and protection from the elements by objects such as building foundations and sidewalks. As a result, both native and non-native plants are able to find refuge in otherwise inhospitable locations.

Endangered, Threatened, Listed, or Proposed Plant Species

For detailed information, see FEIS Vol. I, Section 3.3.3.1- Endangered, Threatened, Listed or Proposed Avifaunal Species.

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. No ʻahinahina were located on or around the proposed ATST Project area.

<u>FAUNAL RESOURCES</u>

Fauna at HO consist of avifaunal species, mammals, and invertebrates. Three Federal- and State-listed animal species, described below, occur in the summit area and slopes of Haleakalā. For detailed information, see FEIS Vol. I, Section 3.3.3-Faunal Resources.

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. Approximately 85 percent of the world's known ʻuaʻu population nests on Haleakalā, near the summit. Approximately 30 known burrows are along the southeastern perimeter of HO and several burrows are northwest of HO (Fig. 13), with a large number of burrows in and around HO (Fig. 14). 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.

ʻUaʻu are believed to navigate by stars, so man-made lights may confuse flying 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; however, this has not been observed at HO. 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.

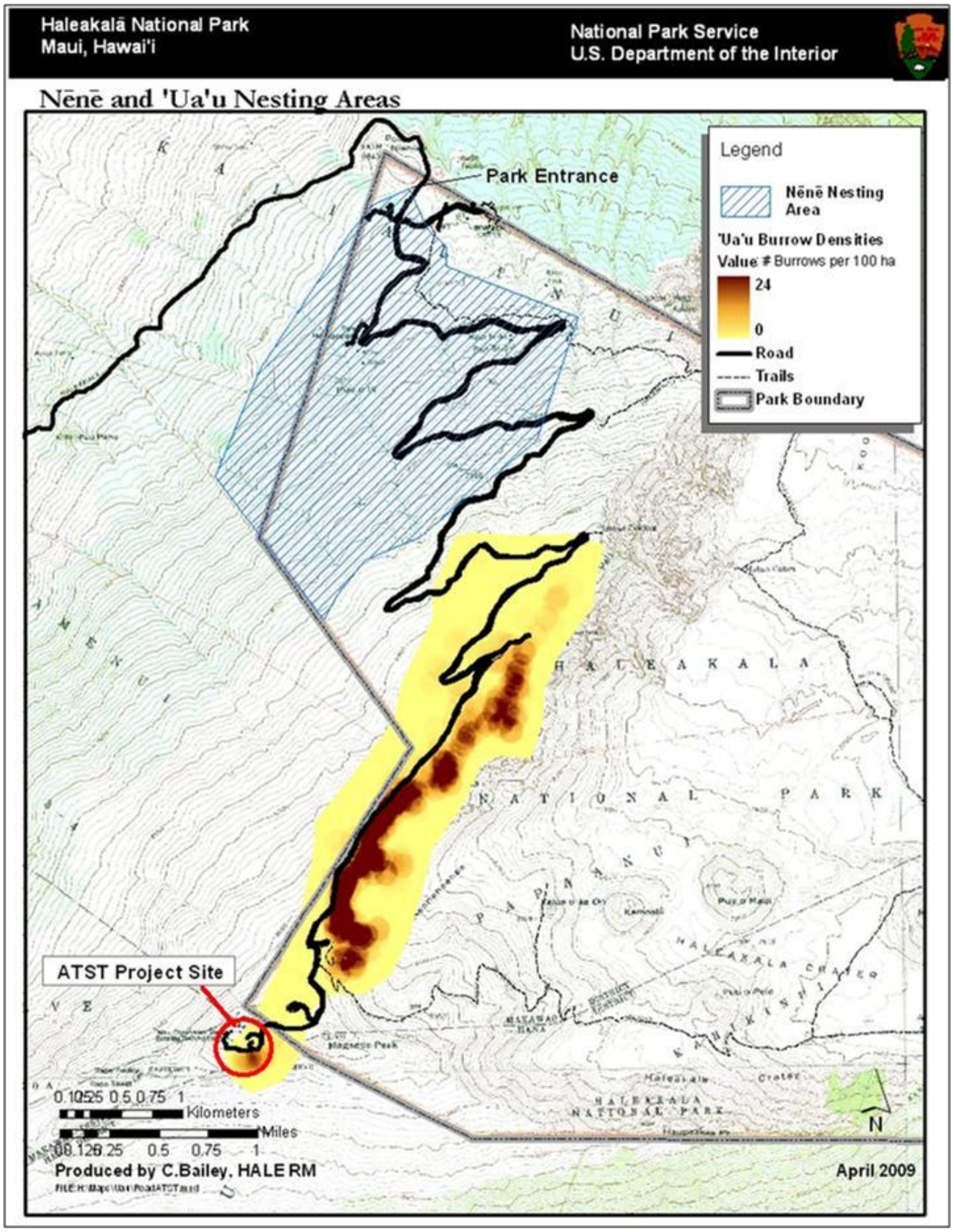

Figure 13. Petrel Burrows Near Summit of Haleakalā.

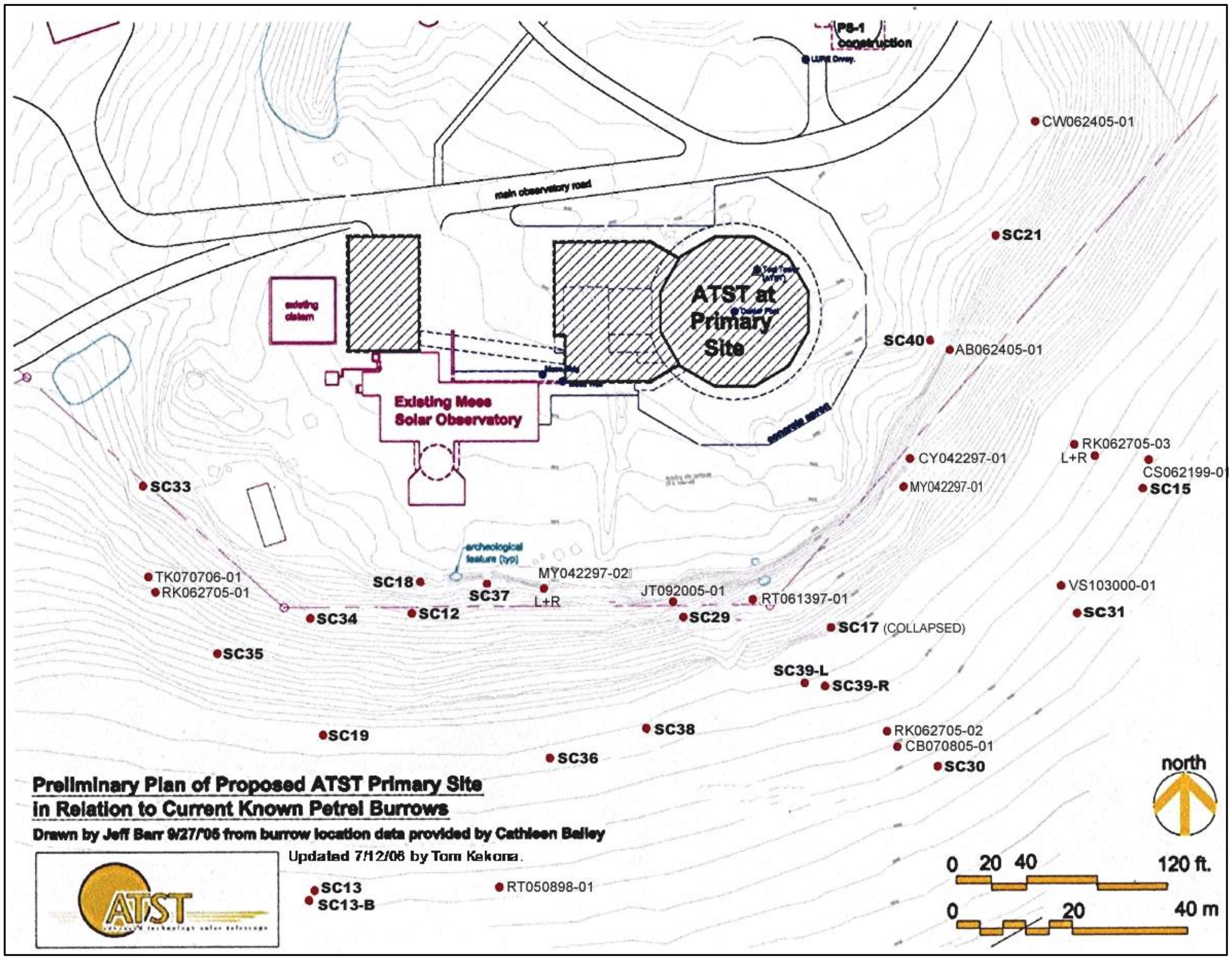

Figure 14. Petrel Burrows In and Around HO.

Nēnē (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 Hawaiʻi, Kauaʻi and Maui. Nēnē seem to be adaptable and are found at elevations ranging from sea level to almost 8,200 feet (Fig. 15) 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.

The non-migrating, highly terrestrial goose nests 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 Kauaʻi nēnē have built nests under alien species. Nēnē are browsing grazers, eating over 50 species of native and introduced plants.

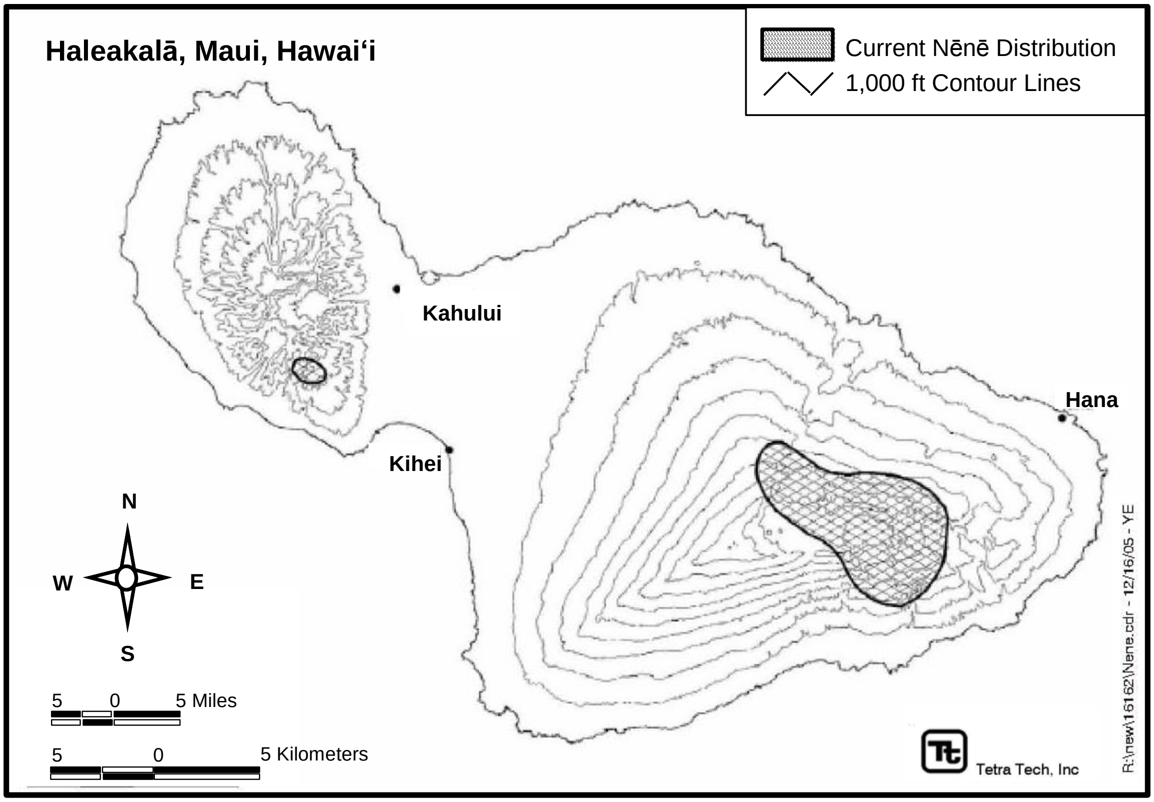

Figure 15. Current Distribution of Nēnē on Maui.

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, lack of lowland habitat, human-caused disturbance, 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)* can alter and degrade nēnē habitat through their foraging activities.

Potential threats to the nēnē are identified below and follow 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.

A recovery plan for the nēnē (USFWS 2004) indicates there is a high degree of threat, but also a high recovery potential because it is taxonomically a full species and as such does not interbreed with domestic geese and is generally not in conflict with human activities.

‘Ope‘ape‘a (Hawaiian Hoary Bat)

The ‘ope‘ape‘a, or Hawaiian hoary bat *(Lasiurus cinereus semotus),* is a federal-listed endangered species that resides on the lower slopes of Haleakalā. The ‘ope‘ape‘a is found on Hawai‘i Island, Maui, O‘ahu, Kaua‘i and Moloka‘i. On the island of Hawai‘i, 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).

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.

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, et al, 1994). On Haleakalā there is an aeolian ecosystem extending 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. 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 site for the proposed ATST Project (see FEIS Vol. II, C(1)-Arthropod Inventory). The arthropod species that were collected in the 2005 study were typical of what had been found during previous studies. 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.

Through a desire to have a comprehensive arthropod inventory and in response to comments submitted for the ATST DEIS published in September 2006, supplemental sampling for arthropods at the sites was conducted in March 2007 (see FEIS Vol. II, Appendix C(2)-Supplemental Arthropod Sampling). 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. The results of the arthropod survey indicate there are no special concerns or legal constraints related to invertebrate resources in the 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 at the project site.

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.

The proposed project site represents an even smaller portion of the habitat overall on Haleakalā. The Mees site is partly undisturbed. Native vegetation is more abundant, and the undisturbed nature of the substrate provides excellent microhabitats for arthropods. Overall, the Mees site contains fewer microhabitats than can be found elsewhere within HO.

Comments on the DEIS of September 2006, indicated that the collective invertebrate inventories obtained at HO did not address certain "Species of Concern" (SOC), although these were not specified (HALE, 2008). Therefore, USFWS was contacted to obtain a list of SOC for the ROI so that future surveys could include those. It should be noted that SOC is an informal term. It is not defined in the Federal Endangered Species Act. The term commonly refers to species that are declining or appear to be in need of conservation. Many agencies and organizations maintain lists of at-risk species. These lists provide essential information for land management planning and conservation efforts. According to the USFWS, these species are not directly addressed by the USFWS Section 7 consultations (D. Greenlee, USFWS, personal communication, April 2009). Using an updated (2008) version of the Hawai'i Biodiversity and Mapping Program data set, which includes map locations for SOC, the USFWS imported the data to the Hawai'i Biodiversity and Mapping Program and no invertebrate SOC were identified in the ROI for the proposed ATST Project (D. Greenlee, USFWS, personal communication, April 2009).

In response to comments about SOC that might have been missed during earlier surveys, a third arthropod survey was conducted in June 2009 (See FEIS Vol. II, Appendix C(3)-Arthropod Inventory and Assessment, HALE and HO). 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.

One of the biggest concerns of past evaluations was the presence of ants. None were found during this study within HO, but ants are reported from nearby National Park facilities. Since ants are not a common endemic species in Hawai'i (Wilson & Taylor, 1967), introduced species are often successful in the favorable environment. The Argentine ant is one of about 60 species that has flourished since invasions of biological organisms were aided by humans to enter in the Hawaiian Islands. With HALE's large visitor population and vehicular traffic from lower elevations, it is not surprising that several of these predatory ant species have found their way into the Park. The invasive potential of the Argentine ant requires active management by HALE to prevent further spread of the species, including such methods as inspection, when warranted, of vehicles, freight, and soils that may contain individuals capable of colonizing areas. With some practical precautions, HO should remain ant free.

The Yellow-jacket is also a predator within the upper shrubland of HALE and at HO that has an impact on the varied arthropods on which it preys. It poses a substantial threat to biodiversity within the Park, and since its introduction to Maui in 1978, it has experienced a population explosion in subsequent years (Gambino, et. al., 1990). The identity of its diet and location in HALE (Gambino, 1992) suggests that it is a threat to biodiversity in wide areas of the Park and HO, at lower and upper elevations. In particular, this predator is found within the ROI for the proposed ATST Project, where active management for prevention of widened invasion is required. With a capability to colonize in massive numbers (*ibid*, 1990), any reproducing individuals of this species introduced to the upper slopes of HALE could prove damaging to the biodiversity of the Park taxonomy. Therefore, active management of this species is needed at HO in addition to HALE. It should be noted, however, that none were identified in the 2009 survey at the Park road entrance station (see FEIS Vol. II, Appendix C(3).

6.7 Describe topography and submit a map entitled *topography*. If ocean area, give depths. Submit detailed contour maps for ocean area and areas where slopes are 20% or more. Contour maps will also be required for uses involving tall structures, gravity flow and other special cases.

Figures 16 and 17 show large- and small-scale topographic maps, respectively.

HO is wholly contained within Pu‘u Kolekole. The Kolekole volcanic center is located in East Maui on the southwest rift of Haleakalä, 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.

The 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 — 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 LURE facility, and one prominent likely secondary event is within the wide depression near the western border of the property as described in the FEIS Vol. II, Appendix G-Geological Survey.

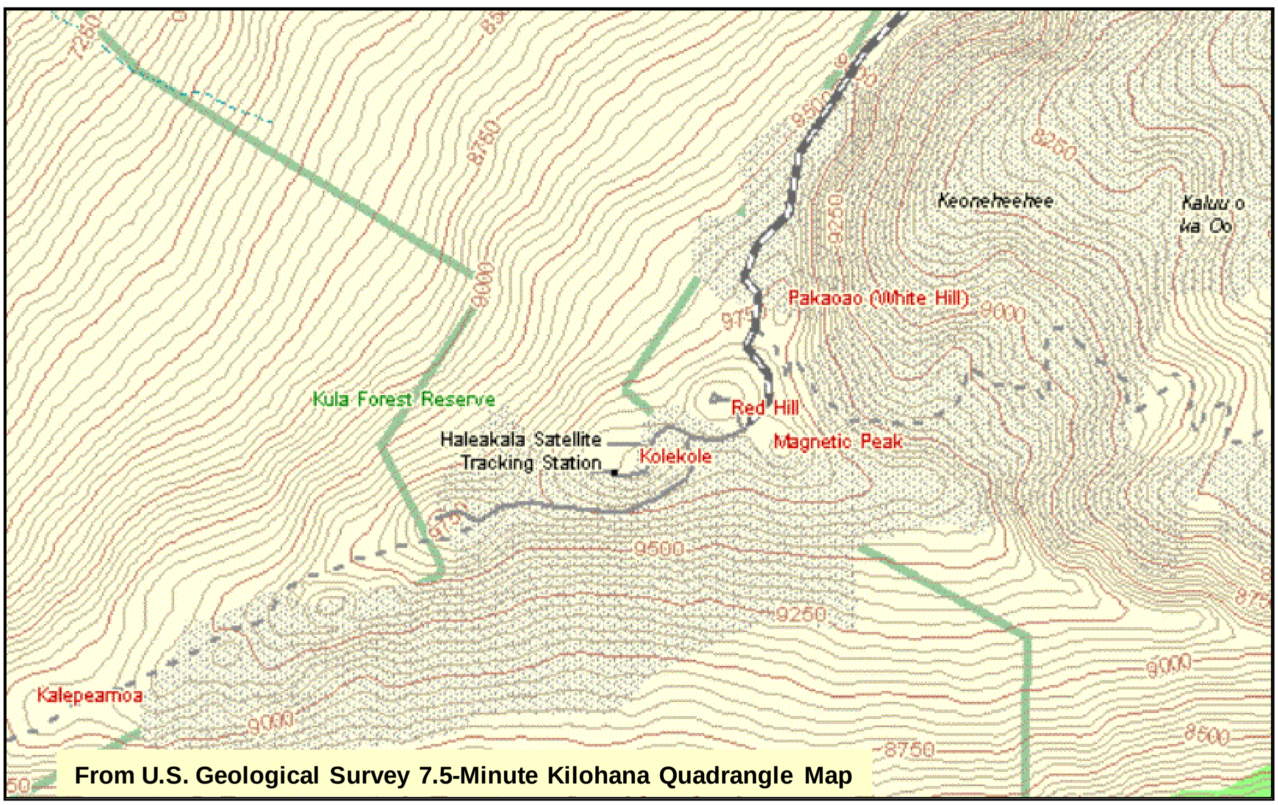

Figure 16. Large Scale Topographic Map for HO.

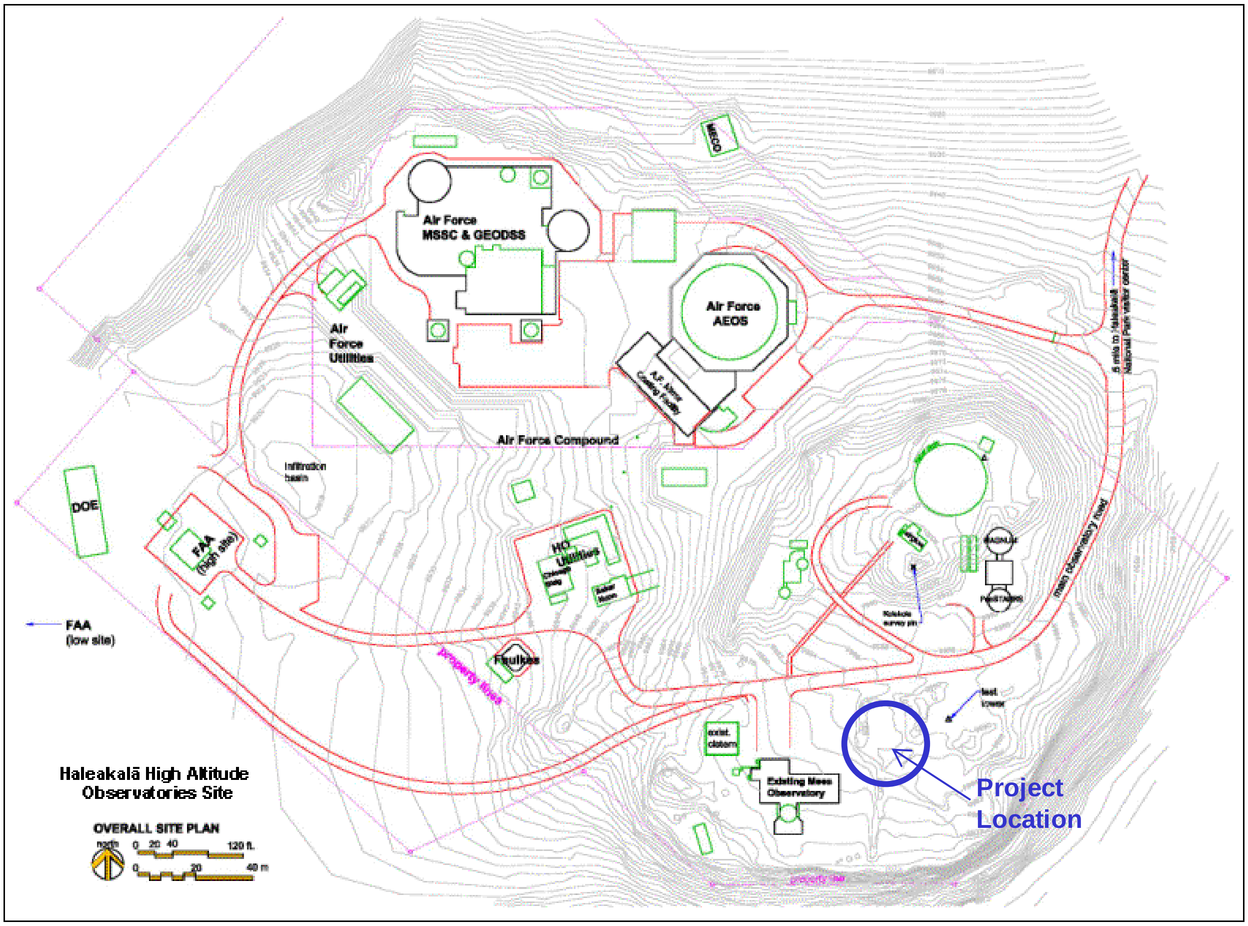

Figure 17. Small Scale Topographic Map of HO.

6.8 If shoreline area, describe shoreline and surrounding area. Indicate and illustrate if shoreline is sandy, muddy, rocky, cliffs, reefs, or other features (such as access to shoreline) on a map entitled *coastal resources.* A current shoreline certification is required for uses that may affect shoreline resources.

The proposed project site is not located in a shoreline area pursuant to the County of Maui Planning Department map entitled *Island of Maui Showing Special Management Area*. This map is provided by the County of Maui GIS Program, Office of the Managing Director, dated July 2002; and is located in the Zoning and Administration Enforcement Division of the Planning Department, Wailuku, Maui. The map clearly indicates that the proposed ATST facility would not be located within a shoreline access area. Figure 18 is a copy of the May 2010 County of Maui Dep. of Planning Zoning and Flood Confirmation Form.

6.9 If shoreline area, describe and illustrate any coastal hazards such as erosion, flooding, tsunami, etc. Attach any relevant maps delineating the hazard zone (FEMA, FIRM maps).

N/A

COUNTY OF MAUI
DEPARTMENT OF PLANNING
Kalana Paku`i Building
250 South High Street
Wailuku, Hawaii 96793

COUNTY OF MAUI · STATE OF HAWAII

Zoning Administration
and Enforcement Division
Telephone: (808) 270-7253
Facsimile: (808) 270-7634
E-mail: planning@mauicounty.gov

ZONING AND FLOOD CONFIRMATION FORM

APPLICANT INFORMATION *(To be completed by Applicant)*	
APPLICANT	Charles Fein
TELEPHONE	281-7094 E-MAIL
PROJECT NAME	ATST
ADDRESS/LOCATION	
TAX MAP KEY NO(S)	(2) 2-2-007:008
ZONING INFORMATION *(To be completed by ZAED)*	
COMMUNITY PLAN DESIGNTION(S)	Conservation
COUNTY ZONING(S)	Interim
STATE LAND USE DISTRICT(S)	Conservation
SPECIAL DISTRICT(S)	None
FLOOD INFORMATION *(To be completed by ZAED)*	
FLOOD HAZARD AREA ZONE(S)	C
BASE FLOOD ELEVATION(S)	N/A mean sea level, Local Tidal Datum
For Flood Zone AO, FLOOD DEPTH	N/A
FLOODWAY	☐ Yes ☑ No
FLOOD DEVELOPMENT PERMIT REQUIRED	☐ Yes ☑ No

*For flood hazard area zones X or XS; a flood development permit would be required if any work is done in any drainage facility or stream area that would reduce the capacity of the drainage facility, river, or stream, or adversely affect downstream property.

FOR COUNTY USE ONLY

REMARKS/COMMENTS:

Reviewed and Confirmed by:

(Signature)	5/7/10 (Date)

For: AARON SHINMOTO, Planning Program Administrator
Zoning Administration and Enforcement Division

S:\ALL\FORMS\ZAED\ZoneFldConf\ZonFldConf.doc (Rev. 2.10)

County of Maui, Department of Planning
SMA Assessment Application (Revised 2/2010) Page 6 of 10

Figure 18. County of Maui, Dept. of Planning Zoning and Flood Confirmation Form.

6.10 Describe existing covenants, easements, and restrictions. If State-owned land, indicate present encumbrances.

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

6.11 Identify any historic, archeological or cultural sites within or near the parcel. Submit or include any current management plan. If applicable, indicate location on a map entitled *historical, archaeological, and cultural resources* and describe.

The cultural, historic, and archeological resources have been mapped and none are located within or adjacent to the proposed ATST Project construction site. The cultural, historic, and archeological sites near the parcel are described in detail along with the description and maps of those resources in Section 5.1 of this CDUA. In addition, the results of all cultural, historic, and archeological resources assessments are provided in the FEIS Vol. II, Appendices A, B, and F.

7.0 ADJACENT PROPERTY OWNERS

Please list all adjacent property owners. If no address is available indicate north, south, east and west or mauka, makai or other common county directionals.

Tax Map Key property information was obtained from the County of Maui Real Property Tax website. Figure 2 is a graphic of the tax map key for HO and the following adjacent properties:

1) **TMK: 2-2-3-005-002** **Legal Name: KJC LLC**
Street Address:
Mailing Address: Phone No.:

2) **TMK: 2-2-2-007-005** **Legal Name: State of Hawai`i**
Street Address: Top of Haleakalā
Mailing Address: Phone No.:

3) **TMK: 2-2-2-007-006** **Legal Name: State of Hawai`i**
Street Address: Top of Haleakalā
Mailing Address: Phone No.:

4) **TMK: 2-2-2-007-007** **Legal Name: United States of America**
Street Address: Haleakalā Crater Road
Mailing Address: Phone No.:

5) **TMK: 2-2-2-007-009** **Legal Name: State of Hawai`i; Lee Enterprises, Inc.**
Street Address: Top of Haleakalā
Mailing Address: Lee Enterprises, Ltd., 1534 Kapiolani Blvd.
City, State and Zip: Honolulu, HI 96814
Phone No.:

6) **TMK: 2-2-2-007-012** **Legal Name: State of Hawai`i;**
Street Address: Top of Haleakalā **GTE Hawaiian Telephone Co., Inc.**
Mailing Address: Attn: Land and Bldg (HIUP4), P. O. Box 2200, Honolulu, HI 96841
Phone No.:

7) **TMK: 2-2-2-007-013** **Legal Name: State of Hawai`i, Kula Forest Reserve**
Street Address: Haleakalā Hwy.
Mailing Address: Phone No.:

8) **TMK: 2-2-2-007-014** **Legal Name: State of Hawai`i, Raycom National, Inc.**
Street Address: Top of Haleakalā :
Mailing Address: 150-B Puuhale Road, Honolulu, HI 96819
Phone No.:

9) **TMK: 2-2-2-007-016** **Legal Name: State of Hawai`i**
Street Address: Haleakalā Crater
Mailing Address: Phone No.:

10) **TMK: 2-2-2-007-017** **Legal Name: State of Hawai`i**
Street Address: Top of Haleakalā
Mailing Address: Phone No.:

8.0 REFERENCES

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CKM [CKM Cultural Resources, LLC]

______ 2006. Cultural Resource Evaluation and Traditional Practices of the Proposed Advanced Technology Solar Telescope (ATST) at Haleakalä High Altitude Observatories. Final Report. January 2006.

______ 2003. "Cultural Resources Evaluation for the Summit of Haleakalā". March 2003.

______ 2002. Traditional Practices Assessment for the Summit of Haleakalā, December 2002.

DLNR [State of Hawai'i, Department of Land and Natural Resources]

______ Conservation Lands. Web site: http://hawaii.gov/dlnr/occl/conservation.
Web site accessed June 17, 2009.

______ Hawai'i State Parks, Polipoli Spring State Recreation Area.
Web site: http://www.hawaiistateparks.org/parks/maui/Index.cfm?park_id=39
Web site accessed February 26, 2008.

______ 2006. Letter to Erik Fredericksen, Xamanek Researches, from Peter Young, DLNR. Subject: National Historic Preservation Act (NHPA) Section 106 Review – Preservation Plan for 11 Sites at Science City, Haleakalā, Papa'anui Ahupua'a, Makawao, Island o Maui, TMK: (2)2-2-007:por. 008.

______ 2003. Doc. No. 0307MK03, Log No. 2003.1138, Letter from P. Holly McEldowney, Acting Administrator, to Erik Fredericksen, Xamanek Researches, dated July 10, 2003.

DOI [U. S. Department of the Interior].

______ 2007. Web site: http://www.doi.gov/ohr/nativehawaiians/list.html.
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______ 1994. "Guidelines for Evaluating and Documenting Traditional Cultural Properties", National Register Bulletin 38.

EO [Executive Order] 1987. State of Hawai'i, Setting Aside Land for Public Purposes. December 12, 1961.

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9.0 ACRONYMS, ABBREVIATIONS, AND TERMINOLOGY

ACRONYMS

ACHP	Advisory Council on Historic Preservation
AEOS	Advanced Electro-Optical System
AFRL	Air Force Research Laboratory
AIS	alien invasive species
ARPA	Advanced Projects Research Agency
ASL	above sea level
ATST	Advanced Technology Solar Telescope
AURA	Association of Universities for Research in Astronomy
BLNR	Board of Land and Natural Resources
BMPs	Best Management Practices
CD	compact disc
CDUA	Conservation District Use Application
CDUP	Conservation District Use Permit
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CSH	Cultural Surveys Hawaiʻi, Inc.
CZMA	Coastal Zone Management Area
DARPA	Defense Advanced Research Projects Agency
DEIS	Draft Environmental Impact Statement
DLNR	State of Hawaiʻi Department of Land and Natural Resources
DOE	U.S. Department of Energy
DOFAW	Division of Forestry and Wildlife
DOI	U. S. Department of the Interior
DRD	Design Requirements Document
EHSO	Environmental Health and Safety Office
EIS	Environmental Impact Statement
EO	Executive Order
EPA	U. S. Environmental Protection Agency
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FEIS	Final Environmental Impact Statement
FHWA	Federal Highway Administration
FTF	Faulkes Telescope Facility
GPS	global positioning system

HALE	Haleakalā National Park
HAR	Hawai‘i Administrative Rules
HAZMAT	hazardous materials
HO	Haleakalā High Altitude Observatories
HRS	Hawai‘i Revised Statues
IfA	University of Hawai‘i, Institute for Astronomy
IT&C	Integration, Test & Commissioning
LRDP	Long Range Development Plan, UH IfA
LUC	Land Use Commission
LURE	Lunar Ranging Experiment
MCC	Maui Community College
MECO	Maui Electric Co., Inc.
MOTIF	Maui Optical Tracking and Identification Facility
MP	Management Plan
MSO	C. E. Kenneth Mees Solar Observatory
MSSC	Maui Space Surveillance Complex
MSSS	Maui Space Surveillance System
NEPA	National Environmental Policy Act
NHO	Native Hawaiian Organization
NHPA	National Historic Preservation Act
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NRHP	National Register of Historic Places
NSF	National Science Foundation
NSO	National Solar Observatory
OCCL	Office of Conservation and Coastal Lands
OEQC	Office of Environmental Quality Control
OHA	State of Hawai‘i Office of Hawaiian Affairs
Pan-STARRS	Panoramic-Survey Telescope and Rapid Response System
PA	Programmatic Agreement
PM	Preventative Maintenance
RCAG	Remote Communications Air/Ground
RCRA	Resource Conservation and Recovery Act
ROI	Region of Influence
SCIA	Supplemental Cultural Impact Assessment
SDEIS	Supplement Draft Environmental Impact Statement
SHPD	State Historic Preservation Division
SIHP	State Inventory of Historic Properties
SOC	species of concern
SUP	Special Use Permit
TCP	Traditional Cultural Property
TMK	Tax Map Key
TLRS	Transportable Laser Ranging System

UH	University of Hawaiʻi
USFWS	U.S. Fish & Wildlife Service

ABBREVIATIONS AND TERMINOLOGY

ʻahinahina	Haleakalā Silversword, *Argyroxiphium sandwicense subsp. Macrocephalum.* Low-growing plant found only in volcanic craters on Hawaiʻi having rosettes of narrow pointed silver-green leaves and clusters of profuse red-purple flowers on a tall stem
ʻāina	land
ahu	altar or shrine
akamai	smart, clever
centimeter	A metric unit of measure where 2.5 centimeters equals 1 inch
Haleakalā	House of the Sun; mountain at 10,023 ft ASL on island of Maui
haole	foreigner
haumana	students
HazMat	hazardous material
Hawaiian Petrel	ʻUaʻu, *Pterodoma phaeopygia sandwichensis*
Hawaiian Goose	Nēnē, *Branta sandvicensis or Nesochen sandvicensis*
Hawaiian Hoary Bat	ʻOpe ʻape ʻa, *Lasiurus cinereus semotus*
Haleakalā Silversword	ʻahinahina, *Argyroxiphium sandwicense subsp. Macrocephalum* Low-growing plant found only in volcanic craters on Hawaiʻi having rosettes of narrow pointed silver-green leaves and clusters of profuse red-purple flowers on a tall stem
Hinalaʻanui	Name dedicated to West-facing ahu on Haleakalā
Honuaʻlua	area of Maui once inhabited by Hawaiian people
hoʻomahanahana	dedication or "warming" offering
hoʻoponopono	to "make right
I na ʻōiwi Hawaiʻi Aloha ʻāina	To the native caretakers of the land, please enter.
Indian mongoose	Herpestes auropunctatus
kahu	clergyman

Kahuna Po‘o	head priest
ko‘a	ceremonial rock formations
Kolekole	Land section in Kilohana and Mākena. (1) One account explicates that Kolekole was named after the first Kole, for its similarity in the abundance of the rusty hue. (2) The second account stated that Kolekole means to “talk story”. Some believe it was an area where Kahuna Po’o or High Priests would come to delve over tough issues.
Kumu Hula	hula master
kupuna	elder
ma‘a	familiar or accustomed
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 O Kama	the greater Maui
mele	song
meter	A metric unit of measure that equals 39.37 inches
mo‘olelo	stories
na poāo kāhuna	priest
Nēnē	Hawaiian Goose, *Branta sandvicensis or Nesochen sandvicensis*
o‘mana‘o	remembrances, recollections
oli	chants
‘Ope ‘ape ‘a	Hawaiian Hoary Bat, *Lasiurus cinereus semotus*
‘opihi	limpet, *Cellana spp.*
Pā‘ele Kū Ai I Ka Moku	Name dedicated to East-facing ahu on Haleakalā
Pa Ka’oao	White Hill
Pele	Goddess of the Volcano
piko	navel

Poli‘ahu	goddess of snow
pu‘u	hill
Pu‘u Honua	sacred refuge, or place of peace
Pu‘u Kolekole	land near the summit of Haleakalā
Pu‘u Ula‘ula	Red Hill Overlook
Star Compass	A learning tool used to teach direction without instruments: The star compass is the basic mental construct for navigation, to help one memorize what is needed to navigate.
‘ua‘u	Hawaiian Petrel, *Pterodoma phaeopygia sandwichensis*
Wahi Pana	a legendary place

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APPENDICES
for

Conservation District Use Application (CDUA)

for the

Advanced Technology Solar Telescope

Haleakalā High Altitude Observatory Site
Haleakalā, Maui, HI

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APPENDIX A

SCHEMATIC DESIGN OF THE SUPPORT FACILITIES FOR THE ATST

(*SEPARATE DOCUMENT)*

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APPENDIX B

PRELIMINARY CONSTRUCTION PLAN

for the

Advanced Technology Solar Telescope

Haleakalā High Altitude Observatory Site
Haleakalā, Maui, HI

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PRELIMINARY CONSTRUCTION PLAN

1.0 Project Overview and Construction Schedule

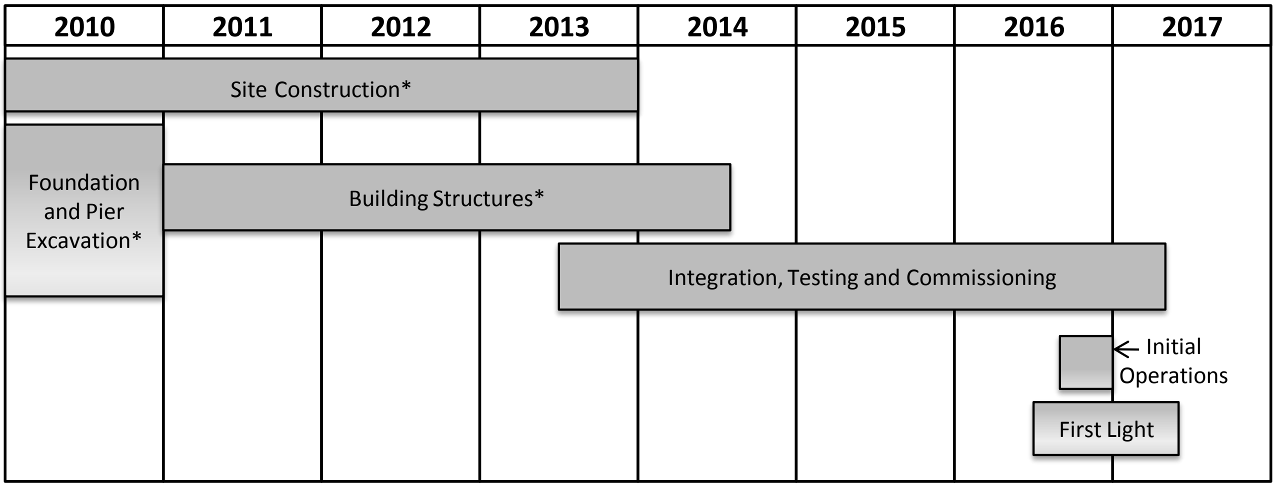
The following description corresponds to the Advanced Technology Solar Telescope (ATST) Final Environmental Impact Statement (FEIS) Section 2.4.3, pages 2-21 to 2-35 that describes the construction of the ATST Project at the Mees site location. The FEIS also provides references to appendices and corollary documents that may be useful to the reviewer of the Conservation District Use Application (CDUA). For the purposes of this CDUA, the description is revised to suit the requirements of the CDUA Preliminary Construction Plan and also to focus on the specific site location that is identified in the Record of Decision for the FEIS. This written description relates closely to the graphic depiction of the ATST facility in the Schematic Design Drawings (DWG-00124) provided as CDUA Appendix B. Specific references to those drawings are provided where appropriate. Approximate durations of the progressive stages of construction are provided in Table 1, which also provides a synopsis of the construction activities.

Construction of the ATST Project would involve: land clearing and demolition; grading/leveling; excavation and soil placement; geotechnical testing; concrete foundations and walls; structural steel; cladding and weatherproofing; mechanical and electrical work; staging and assembly of complex mechanical structures (telescope & rotating enclosure); paving and other final site improvements.

<u>Construction Schedule</u>

The earliest possible construction start for the ATST facility would be during the Federal fiscal year 2010, which is October 1, 2009 to September 30, 2010. Depending on the timing of permitting and the window for site work allowed by biological and other mitigations, excavation and construction of the foundations and pier would take place in the first year of construction, followed by erection of the telescope pier, buiding structures and enclosure in the second, third, and fourth years. Once the enclosure is in position, the telescope mount would be installed and the majority of the remaining work would be inside the buildings and enclosure. The optics, control systems, and instrumentation would progress toward the end of construction and into integration, testing, and commissioning of the various systems and instruments. The final phase of construction would be the verification of the science and the transition into a fully operational system. The site would be in full operation during the 7th year after construction begins. Figure 1 shows an overall graphic timeline of these activities. Table 1 provides a more task-specific breakdown of the anticipated construction activities.

Decommissioning of facilities constructed with the financial assistance of the National Science Foundation is determined on a case-by-case basis. Decommissioning is taken into consideration as part of life-cycle project planning. With regard to the ATST Project, NSF anticipates that the estimated lifetime of the telescope would be at least 45 years (spanning two 22-year solar cycles) after it becomes operational (if funding for construction is approved). As discussed in the FEIS, NSF would consider decommissioning, deconstruction or divestment of the ATST Project at the end of its productive lifetime.



*Tasks related to these activities that have potential to generate noise or vibration would be curtailed or restricted during the ‘u‘au (Hawaiian petrel) nesting and egg-incubation periods, as required by the mitigations defined in the USFWS Informal Consultation Document (FEIS, Vol. II, Appendix M).

Figure 1. ATST Construction Schedule.

Table 1. Summary of Scheduled Activities for Construction of the ATST Facility.

Duration[1]	Work Phase	Description of On-site Activities	DWG-00124 Sheet References
3 months	Contract start-up. Mobilization, Clearing, Demolition.	Delivery and set-up of trailers and other construction infrastructure. Initial excavation and material-handling equipment deployed on site. Site cleared of minimal vegetation. Test tower, weather station, and other items dismantled and removed from site.	C1(staging) C5 (clearing)
3 months	Major earthwork and leveling. Additional geotechnical testing.	Excavation equipment deployed as required to level site (back-hoe, bulldozer, hydraulic hammer, excavator, etc). Water from tank trucks utilized to control dust. Geotechnical testing conducted (additional borings, dynamic analysis, ground penetrating radar, etc.) as required to fully characterize site soil conditions.	C5 (leveling)
3 months	Final excavation, Utility trenching. Drilling/pouring caissons. Initial utility installation.	Refined excavation for foundations of pier, enclosure and buildings. Trenching and related excavation for utility lines and underground utility equipment, including a new Individual Wastewater System (IWS). Special truck-mounted auger utilized to drill for caissons. Caissons are expected to be poured contemporaneously with drilling process. Soil from all leveling and refined excavation placed at designated approved locations on the HO property.	S1, S3, A11 (foundations) C2, C3 (utilities) C3 (soil)
3 months	Pouring foundations. Placement of utilities.	Reinforcing steel delivered and placed. Concrete delivered (or batched on site, see Section 10.0-Concrete Delivery) and placed in formed excavations. Concrete waste removed from site. Continued installation of utilites as required, including utility chase.	S1, S3, A11 (foundations) C2, C3, A15 (utilities)
5 months	Pouring of telescope pier. Erection of utility building.	Forms and scaffoldings for telescope pier erected. Reinforcing steel placed in advance of ongoing work. Concrete delivered and pumped (or lifted) into forms. Concrete waste removed from site. Pre-engineered components delivered to site and utility building erected. (Note: The early completion of this building is to provide containment and sound isolation of other assembly tasks as construction progresses.)	S3 (pier) C6 (site layout) S2, A8, A15 (utility bldg)
3 months	Completing slabs, pits and other building concrete. Utility building completed.	Concrete formed reinforced and poured for slabs on grade, elevator/lift pits and other finish surfaces prior to main building erection. Utility building enclosed and prepared for construction-related uses.	S1 (concrete) S2, A8, A15 (utility bldg)
5 months	Steel erection.	Steel for building and lower enclosure delivered in phases as required for advance of work. Scaffolding, crane(s), lifting equipment, assembly tools and equipment deployed as required. Primary and secondary structure of lower enclosure and operations building erected.	S2, A14 (struct. steel) A13 (steel stairs)

NOTES: [1] Some of the activities described in the table have potential to generate noise or vibration between March and November. These activities would be curtailed or restricted during the ‘u‘au nesting and egg-incubation periods, as required by the mitigation measures identified in the USFWS Informal Consultation Document (FEIS, Vol. II, Appendix M-USFWS Section 7 Informal Consultation Document, 2007). The durations indicated here are approximations for the purposes of assessing the duration and intensity of construction activities and do not correlate to any specific calendar schedule.

Table 1. Summary of Scheduled Activities for Construction of the ATST Facility. (cont.)

Duration[1]	Work Phase	Description of On-site Activities	DWG-00124 Sheet References
3 months	Roof and wall panel installation.	Precast panels for lower enclosure cladding delivered and installed using crane and other access/installation equipment. Insulated metal panels or exterior insulation finish system installed on operations building exterior walls. Roofing substrate and roofing panels installed on operations building. Doors and windows installed.	A8-10, S3-4 (precast) A8-10, A14 (wall panels) A5 (roofing) G1 (doors)
6 months	Enclosure framing starts. Major utility equipment installation. Building interior construction.	Enclosure contractor's trailers, containers and upper enclosure structure delivered to site. Main structure of enclosure installed utilizing crane, welders, access and installation equipment as required. Platform lift, elevator & lift delivered and installed Building fixtures and materials delivered and interior construction of operations building begins. Utility equipment delivered and installed in utility building and elsewhere.	A8-11, S3-4 (enclosure) A13-14 (lifts & elev) A1-15 (plans sections, details) G1 (finishes)
9 months	Enclosure work: Cladding, mechanical fit-up, testing, Building finishes.	Enclosure cladding panels, plate-coil, and mechanical equipment delivered and installed. Building interior and exterior systems completed and finishes installed. Assembly of coudé rotator inside pier begins, concurrent with completion of enclosure. Materials and support equipment delivered to site as required for advance of enclosure and coudé rotator work.	A8-11, S3-4 (enclosure) A1-15 (plans sections, details) G1 (finishes) S3-4 (coudé rotator)
12 months	Telescope and coudé rotator installation.	Telescope contractor's trailers, containers and telescope assemblies delivered to site as required for advance of work. Telescope assembled utilizing large construction crane and other equipment as required.	A7, S3-4 (telescope)
3 months	Finish site work: Paving of apron and service yard. Concrete walks, finish utilities.	Final grading and preparation of finish surfaces around ATST facility, water trucks deployed for dust control. Concrete and related materials delivered to site and installed Asphalt paving materials and equipment delivered. Paving of apron, service yard, walks, and other areas completed.	C6, S1, A11 (site finish work)
6 months	Primary mirror and other optics coated and installed.	Primary mirror delivered to site, integrated in ATST receiving/staging area and aluminized at the U.S. Air Force Advanced Electro-optical System (AEOS) coating facility. Primary mirror and other optics installed on telescope.	A1 (receiving) A7, A11 (telescope)
2 years	Integration Testing and Commissioning.	Continued final assemby, testing, alignment and calibration of telescope optics, and scientific intruments. Final furnishing and outfitting of building for operational use.	A7, A11 (telescope) A3, A4 (control & instruments)
~45 years	Operational life of ATST Project.	Telescope and instuments in scientific operation. Periodic deliveries and installation of new instruments. Shuttling of observatory support personnel and visiting observers to the ATST facility. Maintenance undertaken as required (CDUA Appendix E-Maintenance Plan).	All Plans

NOTES: [1]Some of the activities described in the table have potential to generate noise or vibration between March and November. These activities would be curtailed or restricted during the ‘u‘au nesting and egg-incubation periods, as required by the mitigation measures identified in the USFWS Informal Consultation Document (FEIS, Vol. II, Appendix M-USFWS Section 7 Informal Consultation Document, 2007). The durations indicated here are approximations for the purposes of assessing the duration and intensity of construction activities and do not correlate to any specific calendar schedule.

2.0 Mobilization, Clearing and Demolition

At the initiation of construction, and periodically during the course of the project, contractors' trailers, storage containers, waste receptacles, and equipment would be transported to the site. Other than the ATST construction site itself, the main area identified for staging these facilities is a portion of the Federal Aviation Administration (FAA) property as shown in the DWG-00124, sheet C1. Use of this area, and augmentation with any other ancillary staging areas, would be negotiated with the property owners.

Minimal removal of vegetation would be necessary to clear the site. Existing vegetation is very sparse and no Federally-threatened ʻahinahina (Haleakalā silverswords, or Argyroxiphium sandwicense) or other protected species have been identified on the construction site. Land clearing would be done using bulldozers and other heavy machinery.

Facilities required to be demolished or removed to clear the site would include:

1. The ATST test tower and its foundations,

2. Tower and weather station belonging to the Institue for Astronomy (IfA),

3. Driveway, parking area, and rock wall borders at the Mees Solar Obsrvatory (MSO) facility,

4. MSO generator and other selective demolition at the MSO shop/utility area; and,

5. MSO facility underground cesspool. (Removal of the cesspool would require testing of the surrounding soil and possible remediation measures. Proper disposal of the cesspool, treatment of the soil, and all other aspects of this work would comply with applicable regulations of the Environmental Proection Agency (EPA) and Hawai'i Department of Health.)

Clearing and demolition work would be staged, beginning with the removal of the test tower and other on-site structures and continuing later with the cesspool (when the transition can be made to the new individual wastewater treatment plant) and finally the interior demolition work in the MSO facility after the ATST structure is nearly complete. The exterior site demolition would require the use of bulldozers, dump trucks, Bobcat-type excavators, and other heavy machinery.

3.0 Grading/Leveling

The construction of the ATST facility would require the creation of a level pad at least 20 feet wider in all directions than the base level footprint of the enclosure and the operations building (see DWG-00124 sheet C6 for overall building layout). The critical nature of the structural bearing condition requires that the level area be achieved primarily by removal of soil and rock rather than by a cut and fill approach. The initial grade cut at this site would be at approximately 1 foot above the finished grade around the ATST facility, which is expected to be at the 9,980-foot contour level. This would be done using a bulldozer, backhoe, jackhammer, dump truck, and other standard heavy equipment. An estimated 2,500 cubic yards of soil and rock would be removed for leveling in order to prepare the site for construction. Figure 2 (and DWG-00124, sheet C-5) shows the extent of the leveling necessary for the ATST Project.

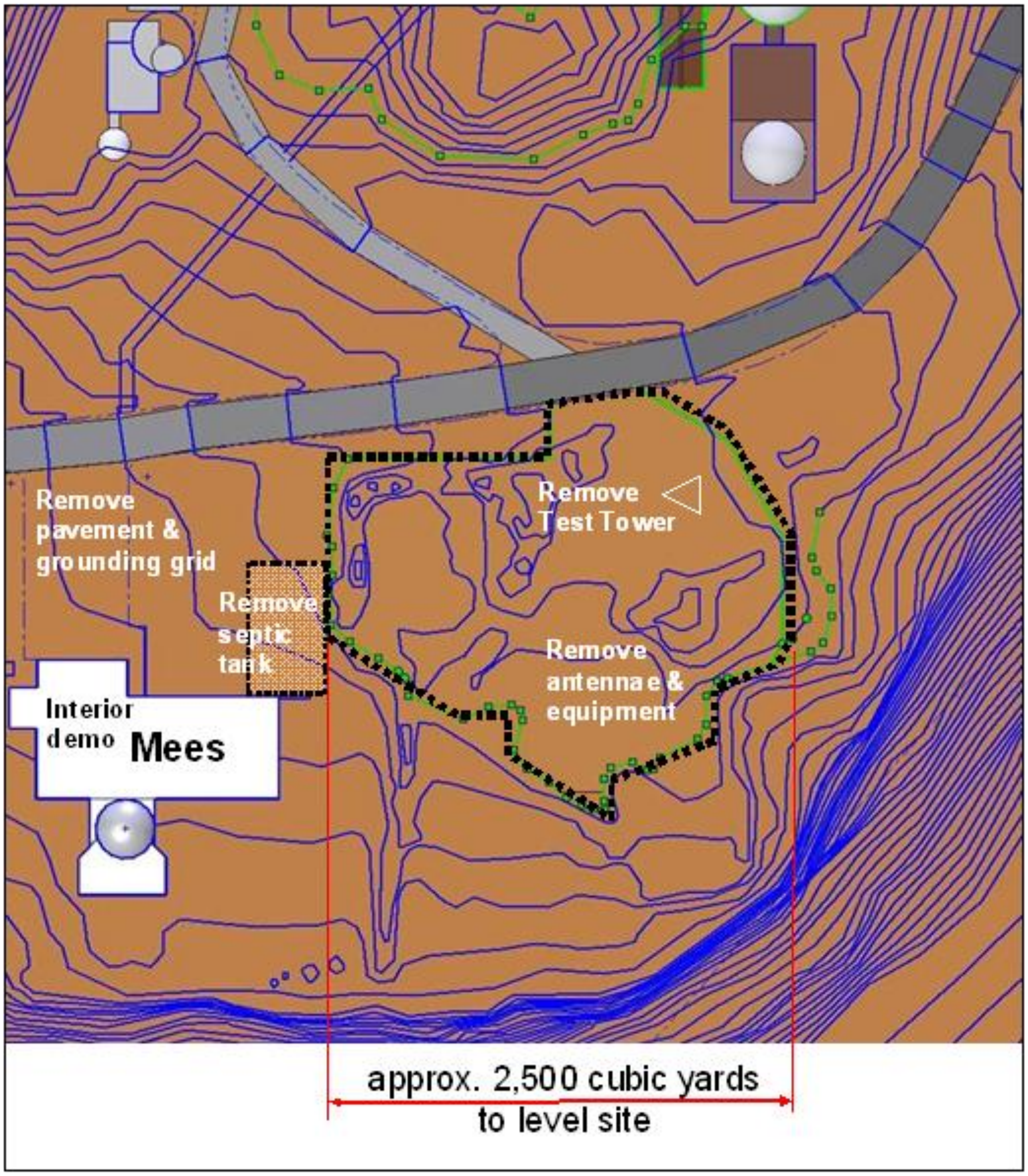


Figure 2 Grading/Leveling Footprint.

4.0 Additional Site Geotechnical Testing

Initial geotechnical testing (see FEIS, Vol. II, Appendix K-Soils Investigation Report) has previously been completed to allow completion of a preliminary foundation design, which is described below. The extent of this initial testing was limited by the existence of on-site equipment and natural rock features that precluded some locations of the testing/boring equipment. Once the site-leveling excavation is complete, it will then be feasible to deploy a boring rig and other testing equipment as needed to more fully characterize the natural soil conditions of the site.

This testing is expected include soil borings down to solid rock (up to 20 feet deep) in critical locations required to adequately characterize the soil/rock substrate under the telescope and enclosure foundation (see DWG-00124, sheets C5 and S1). Laboratory testing will be conducted on samples taken from the site. On-site testing may also include ground penetrating radar and/or downhole-crosshole dynamic vibration analysis. The results of this additional testing would allow definitive design of the final excavation and foundation systems for the ATST facility

5.0 Foundation and Utility Excavation, Cesspool Removal

The second phase of excavation would include the removal of rock and soil as required to accommodate the foundation systems of the telescope pier, the telescope enclosure, the operations building, the elevator and platform lift, the utility building, and the utility chase. This major structural excavation is expected to follow the leveling work and the additional site testing. Additional excavation would also be needed in order to trench for utility lines, all of which would be installed underground. It is estimated that approximately 2,150 cubic yards of soil would be excavated for construction purposes, for a combined excavation total of 4,650 cubic yards when added to the 2,500 cubic yards of soil removed during grading/leveling activities. The majority of this second phase excavation work would be done using bulldozers, backhoe, trencher, and a hydraulic hammer or jackhammers to break up larger lava sections. In addition to the general excavation methods, a truck-mounted augur is expected to be deployed for drilling holes for caissons down to bedrock, as described below in the Section 5.0-Foundation and Utility Excavation.

The removal of the existing cesspool, which serves the Mees facility, is also expected to be accomplished during this second phase of excavation and site preparation. The new individual wastewater system (IWS) (as indicated on DWG-00124, sheets C2 & C5 and described in the FEIS, Vol. I, Section 2.4.4) would be installed to serve as the long-term wastewater system for ATST and Mees. If the installation of the IWS is not logistically feasible at this point, a temporary holding tank for catchment of the Mees facility wastewater may be installed and periodically pumped out until the permanent IWS can be implemeted. All aspects of the removal of the cesspool and the conversion to the IWS would comply with applicable regulations of the State of Hawai'i Department of Health.

6.0 Soil Retention or Repair Measures

Some soil retention and fill are likely to be advantageous to provide support for the extended apron around the base of the enclosure and at other peripheral areas. This retention would be achieved using on-site native rock to form a sloped rip-rap embankment.

In some places, especially in the area where the existing cesspool is removed, there is an expected requirement for over-excavation, fill, and re-compaction. In this area, and anywhere else that fill would be required, every effort would be made to utilize existing on-site soil. Any required importation of outside fill would comply with sterilization procedures and other required precautions against unintentional importation of invasive biological species.

7.0 Placement of Excess Soil and Rock

At an average volume of 20 cubic yards per normal truckload, approximately 250 truckloads of rock and soil would be excavated and relocated. To some extent, especially at the utility excavations, the soil would be replaced in its original location as backfill. However, a significant percentage of the excavated material would be displaced by site leveling and foundations. All of this native rock and soil removed from the site would be placed at locations within HO boundaries under supervision of a Cultural Monitor. The placement areas, as identified in the FEIS, are shown in DWG-00124 sheet C2. The final determination of appropriate soil placement will be subject to approval by the corresponding land owners and tenants of adjacent properties.

All soil placement and backfill would be configured to maintain the established stormwater management flow paths for HO (FEIS, Vol. II, Appendix L-Stormwater Management Plan for HO). For example, material will be kept clear of the concrete drainage channels. The embankment of the fill material along the edges of any drainage channels or swales would be stabilized with native rocks sloped at an angle that would not result in erosion into the drainage paths. The slope of newly placed soil would also be configured to maintain vehicular access to required areas.
A significant percentage of the material that would be excavated from the site is expected to be in the form of large intact pieces of rock. Subject to approval by IfA, other HO tenants, and the Cultural Monitor, these large rocks may be placed at locations around the HO property. As an additional strategy for beneficial use of on-site soil material, sandy and silty material may be taken from the infiltration basin area to be utilized for backfill around the ATST structures. This could potentially eliminate the need for imported backfill material and would also augment periodic removal of finer material that must be done to maintain the capacity and percolation of the infiltration basin to help reduce potential erosion.

8.0 Concrete Work - Foundations

To determine the extent of work required for the most significant and critical underground support structures of the ATST facility, a preliminary design for the telescope and enclosure foundations has been established (see DWG-00124, sheet S1). For The purposes of that design, the bearing capacity of the natural rock and soil were taken from the preliminary geotechnical report (FEIS, Vol. II-Appendix K) prepared by Island Geotechnical Engineering, Inc. Based on that report and load conditions stipulated by the ATST engineering team, M3 Engineering and Technology, Inc., a firm knowledgable in the design of telescope facilities, was contracted to recommend an appropriate foundation system for the ATST facility. Figures 3 and 4 are excerpted from the M3 Engineering design. Their recommndation is for a concrete mat foundation approximately 1 meter thick supported from the solid basalt layer that underlies the site. Because the basalt layer is sloping, poured concrete caissons (underground columns) extending from underneath the mat down to the solid basalt layer would be necessary in some locations. A total of approximately 21 caisssons would be required 1 meter (3 feet 3 inches) in diameter and of lengths varying from 2 meters (6 feet 6 inches) to a maximum of approximately 6 meters (20 feet). These caissons would be installed by drilling holes, using a truck-mounted auger, and then pouring concrete into the holes. No blasting or impact driving of piles would be done. Figure 5 shows the depth and location of the caissons in relation to the telescope pier, the enclosure, and the natural rock layer of the site. In addition to this caisson/mat system, ATST foundations would include relatively shallow (less than 3 ft. deep) pad and linear footings for the building columns and walls.

9.0 Concrete Work – Walls and other Above-ground Structures

The walls of the ATST telescope pier are to be formed of cast-in-place reinforced concrete, as depicted in the illustrations below and DWG-00124, sheet S3. The construction of formwork for these walls will be an extensive construction task requiring a large crane, scaffoldings and lifts, hand/power tools for assembly and a crew of carpenters. Reinforcing steel will be placed prior to erection of each section of formwork, and the concrete for the telescope pier walls will be pumped or lifted in a crane-mounted bucket for placement in the forms. Similar placement of cast-in-place concrete is also expected to be utilized for other above-ground structures such as elevated floor slabs and retaining walls.

Precast concrete panels are proposed for exterior cladding of the lower enclosure as depicted on DWG-00124, sheets S3-4 & A8-10. These panels are expected to be fabricated at an off-site location and transported to the site. Delivery and installation of these and any other precast elements of the facility would follow the erection of the steel structure as described below.

10.0 Concrete – Delivery

The method for delivery of concrete for structures to be cast on site will be based, to some extent, on the type of structure to be built. Concrete for foundations and slabs may be truck-delivered or may be mixed on-site in a portable batch plant utilizing cement, water and aggregates delivered to the site. The latter strategy would be employed in part to reduce the impact of construction traffic on the roadways leading to the site, especially large trucks during peak daily traffic hours. (For extensive discussion of the stipulated mitigations of construction-related traffic see the related sections of the FEIS.) Concrete for structures such as the telescope pier, which require high strength, precise quality control measures, and possible special admixtures, will likely be delivered in concrete mixer trucks from one of the concrete batching plants on Maui.

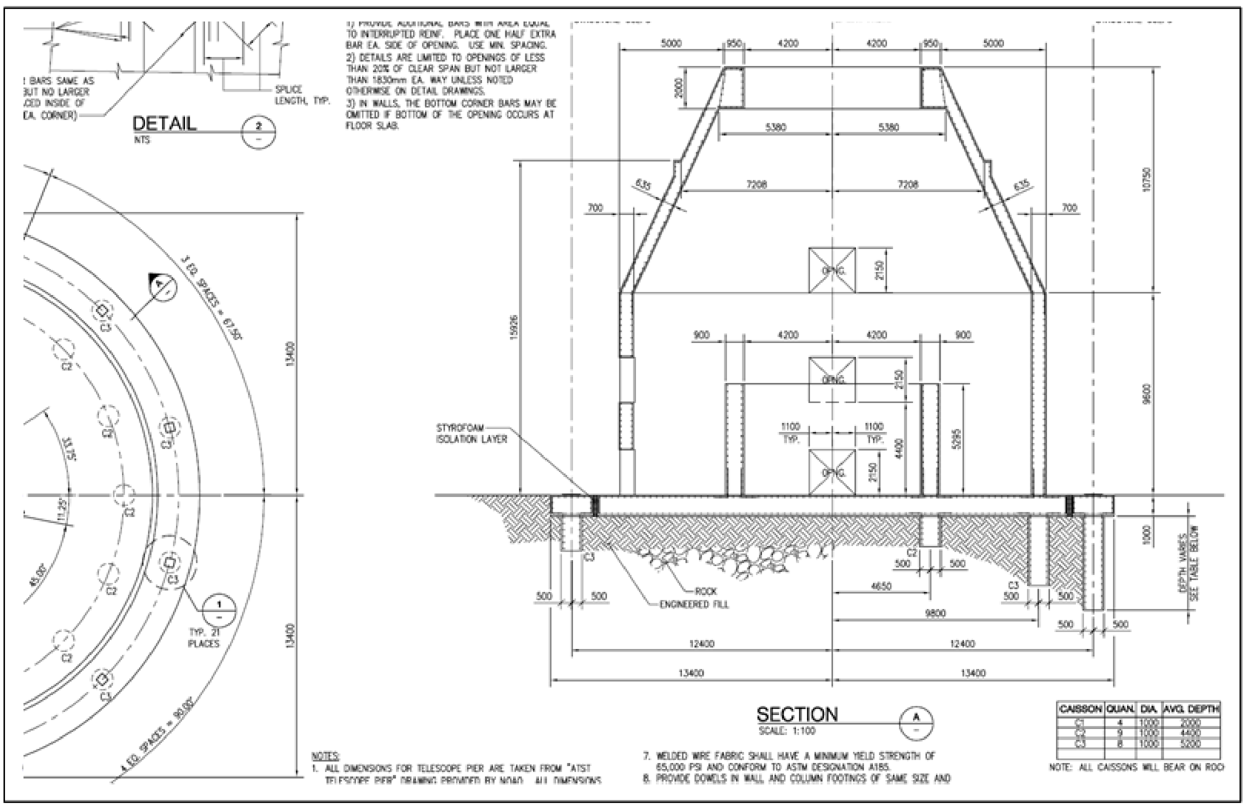


Figure 3. M3 Engineering, Inc. Drawing of Foundation System for Telescope and Enclosure.

1. All dimensions are in millimeters.
2. Caissons are drilled-and-poured, underground, concrete columns extending down to solid rock layer.
3. Abbreviations: Quan. – Quantity, Dia. – Diameter, Avg. – Average, Opng. – Opening, Eq. – Equal, Typ. – Typical.
4. Other abbreviations and technical terms refer to internal reinforcing steel and are not material to this Preliminary Construction Plan.

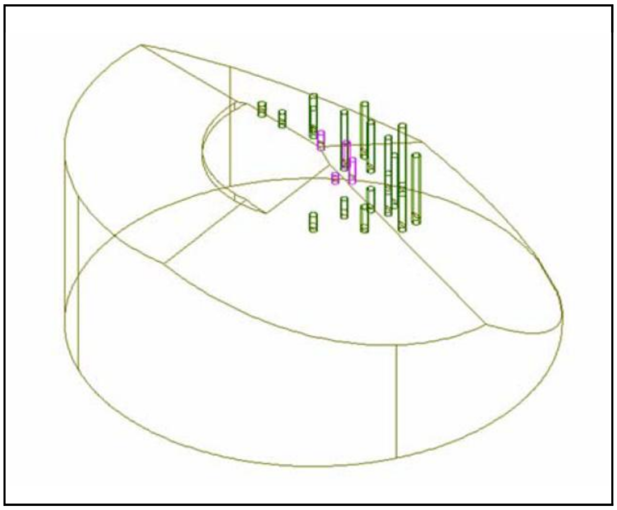


Figure 4. Diagram of Caissons on Rock Layer.

Shows an abstract depiction of a portion of the rock beneath the site and the approximate distribution of the required caissons.

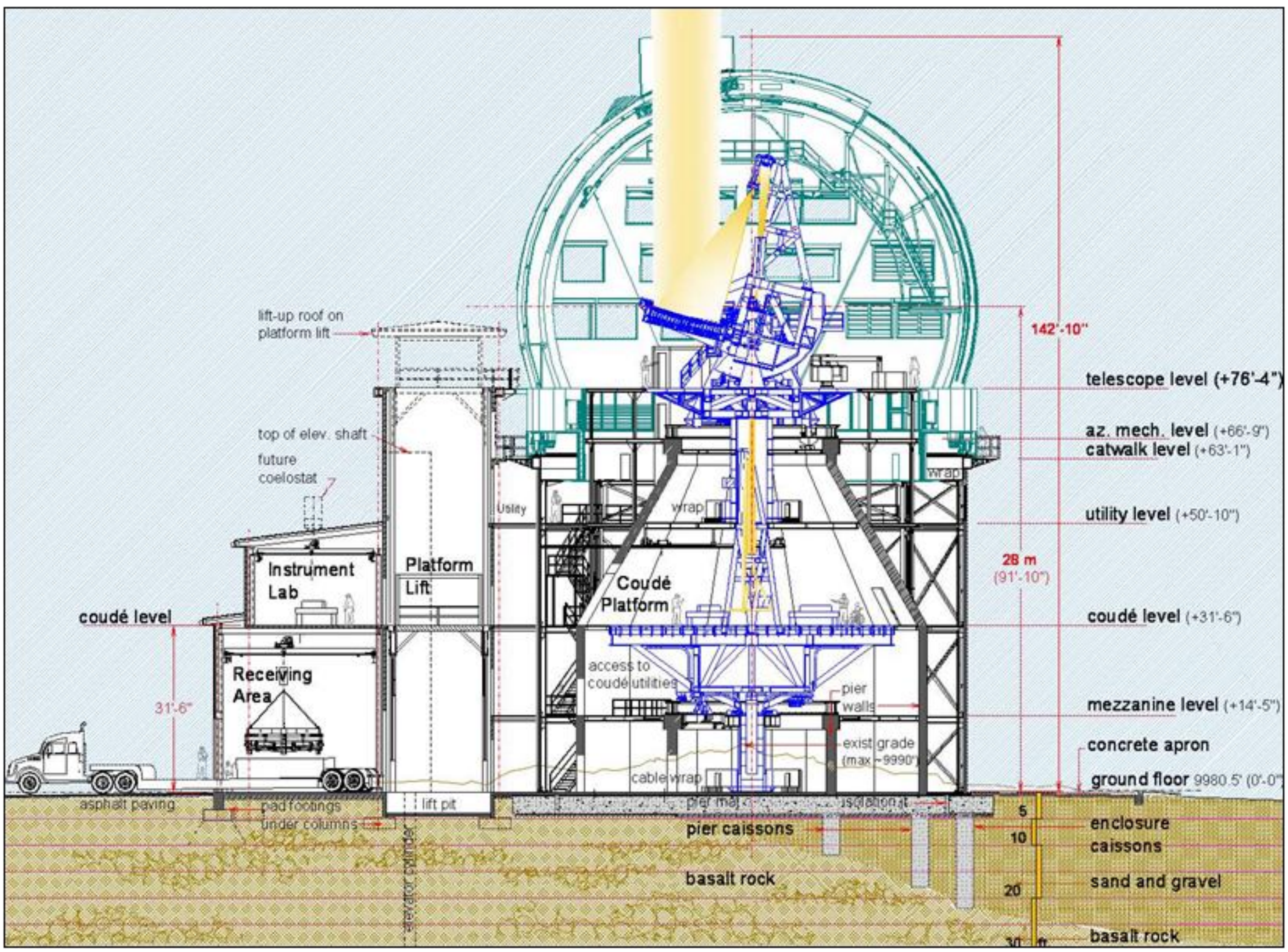


Figure 5. ATST Facility Section Drawing Showing Depth of Foundations in Relation to Building and Natural Rock.

11.0 Structural Steel

Following the installation of foundation systems and other cast-in-place concrete structures the structural steel elements of the ATST facility will be installed (see DWG-00124, sheet S2). The columns, beams, bracing, railings, stairs and other complex elements would be fabricated at an off-site shop and transported to the site. Erection on-site would require a large construction crane, welding equipment, hand/power tools for assembly as well as scaffoldings lifts and other temporry access equipment.

The lower enclosure and the operations building are multi-level custom-designed steel structures. The utility building is to be a pre-engineered steel structure manufactured by a standard metal building fabricator. .As indicated in Table 1, the utility building is expected to be built as early as possible in the overall construction sequence to allow for its use as a protected and sound-contained facility for construction assembly tasks.

All of these structures will be designed to withstand the gravity and lateral loads as defined below in Section 21.0-Structural Criteria.

12.0 Cladding, Roofing and Weatherproofing

The exterior walls of the lower enclosure will be clad in precast concrete panels, as previously noted. The roof of the lower enclosure will be formed by the rotating, upper enclosure as described below. The walls of the operations building will be insulated metal panels or exterior insulation finish system. The roof of the operations building as well as the roof and exterior walls of the utility building will be constructed of a pre-manufactured metal panel system. All of these exterior wall materials and a preliminary set of details for their installation are depicted on the building elevations (DWG-00124, sheets A8 to A13).

Insulation, seals, doors and windows installed in the exterior walls of the ATST facility would be as depicted in DWG-00124 floor plan, elevations and schedules. All of these materials would be fabricated off-site and delivered to the site for installation during the exterior wall/roof construction phase of the project.

Installation of the exterior walls, roofs and associated materials would require a crane, lifting and access equipment, standard power/hand tools, and specialized work crews for the various materials being iintalled.

13.0 Interior Construction

Following the completion of exterior walls and roof, the interior build-out of the ATST facility would begin. This would include interior partitioning, doors, ceiling systems, finishes and built-in equipment as shown on the DWG-00124 floor plans and schedules. This work would be coordinated and contemporaneous with the installation of interior mechanical and electrical equipment as described below. This phase of the project would overlap with the construction of the enclosure and continue until the final completion of the facility construction project.

Installation of the interior building systems would require lifting and access equipment, standard power/hand tools, and specialized work crews for the various materials being installed.

14.0 Mechanical and Electrical Equipment

Mechanical equipment for the ATST facility includes heating ventilation and air-conditioneing (HVAC) equipment, facility cranes, elvators, and a large platform lift. Electrical equipment includes primary switchgear and transformer; a diesel generator and transfer switch; power and energy management system; motor controls; distribution panels; circuit protection devices, outlets, switches and lighting. Preliminary specification of this mechanical and electrical equipment is decribed in DWG-00124 sheets A15, U1-3 & G30. Specification data is described below in Section 13.0-Mechanical Criteria and Electrical Criteria. Specific manufacturers and models will be subject to final specification and competitive procurement. All of this equipment will be specified and installed in compliance with applicable State of Hawai'i codes and regulations.

Mechanical and electrical equipment will be factory fabricated and will arrive at the site in the largest feasible components for on-site installation. Piping, ducting and conduit runs will be largely assembled and installed on site. Installation and interconnection of equipment will require a crane, access equipment, welding and pipe-fitting equipment, standard hand/power tools and specialized work crews.

15.0 Construction of Complex Mechanical Structures - Telescope and Enclosure

The support structures for the telescope and enclosure (the pier and the lower enclosure) will be completed as part of the fixed building construction described above. Following completion of the lower enclosure, installation of the (upper, rotating) enclosure will begin. The work will commence with installation and alignment of the enclosure azimuth track. Following this, the large steel structural framing will be erected, including the ring beam, arch girders, and all secondary bracing and support members. Azimuth support bogies will also be installed and shimmed/braced in place. The up-and-over shutter assemblies will then be framed and installed on the carousel structure. Following this, cladding and insulation will be installed to make the enclosure weather tight. At this point, mechanical equipment, such as azimuth drive bogies, shutter drives, interior cranes and platforms and other subsystems will be installed and tested. The enclosure control system will then be installed, along with the local interlock controllers, and final enclosure acceptance testing carried out.

The installation of the Telescope Mount Assembly (TMA) will begin in parallel with construction of the enclosure. Specifically, the coudé rotator assembly components will be pre-positioned inside of the telescope pier, with a safety cap installed on top of the pier. This will allow work on the coudé rotator to continue inside of the pier whilst enclosure construction (above) begins. This coudé rotator work will commence with installation and alignment of the coudé rotator azimuth track assembly. The coudé rotator structure will then be installed, followed by flooring, thermal systems, and coudé drives and other mechanical subsystems.

For safety reasons, the remainder of the TMA site construction will not commence until the enclosure construction is complete. Once this enclosure milestone is reached, the mount azimuth track assembly will be installed and aligned inside the enclosure. Following this, the mount structure will be installed, bearings and drives installed and aligned, and all other mechanical equipment added. Mass balance of the telescope will then begin, followed by installation and test of the mount control system and interlocks.

Once the TMA assembly is complete, the formal start of Integration, Test, and Commissioning (IT&C) will begin. (IT&C includes the installation of the optics assemblies, wavefront control system, instrumentation, high-level software, and other scientific equipment inside the observatory). In parallel with the start of IT&C will be the installation and test of the enclosure thermal systems, including the exterior plate coil system, piping and plumbing, and thermal control systems. Other mechanical systems, such as coudé environmental control, chillers, and related equipment will also be installed and tested at this point.

Construction of both the telescope and enclosure will require continued use use of the staging areas, a large crane, and the other temporary construction facilities described previously and further elaborated in the Section 17.0-Staging below.

16.0 Site Completion Work

Once the heavy material handling for enclosure and telescope construction is completed, the exterior site finish work will commence. This will include: installation of the concrete apron around the lower enclosure; pavement of the service and parking area; installation of walks, railings, signage and other site improvements; and final site utility work. The final utility work will include the placement of the grounding field as indicated on DWG-00124 sheet C2 and other final equipment that would be subject to damage during the preceding construction phases. The grounding field will be a primary element of the grounding and lightning protection system described below in Section 23.0-Electrical Requirements and in the FEIS, Vol. I., Section 2.4.4.

Site completion work will involve: final blading, leveling and compaction with graders, rollers and other heavy equipment; delivery and placement of concrete and asphalt; and finished utility equipment installation using lifting equipment, hand/power tools, and specialized work crews.

17.0 Staging

Contingent on completion of written agreement with the FAA property owner, the primary staging area for the storage of construction materials for the entire duration of the construction of the ATST facility would be a portion of the open area southwest of the Faulkes Telescope Facility, which is approximately 0.9 acres (Fig. 6 and DWG-00124, sheet C1). The majority of on-site construction materials and temporary facilities would be confined to this area. Contractors' trailers and storage containers, parking for large construction equipment and vehicles, lunch/break area for workers, roll-off dumpsters and other receptacles, portable toilets, and other temporary facilities normally needed for construction sites would be accommodated at this location. A large open area would be reserved for lay down and pre-assembly of large structural pieces or other staging activities that can be done away from the main site.

If the primary staging area described above is not available and another suitable on-site area could not be identified, the Project would pursue more extensive utilization of off-site staging, and the site space directly around the construction site would be utilized for staging and storage of only the essential construction facilities. In any case, many of the activities requiring space-intensive staging would take place at the material manufacturers' facilities or other off-summit locations. On-site administrative space for contractors would be limited to shared work areas in one or two common job site trailers. Only the materials and assemblies required for immediate installation would be transported to the site, as there is not expected to be space available for extensive, advanced stockpiling or storage of future required materials.

Regardless of the off-site and primary on-site staging area strategy, space would also have to be reserved immediately in close proximity to the construction site (Fig.7 and DWG-00124, sheet C4). This would serve as maneuvering space for cranes and lifts, an unloading area for construction materials, a lay-down area for materials to be picked up by the crane, and a temporary parking area for concrete trucks and other vehicles. The areas identified at this site are the service area to the west of the operations building and the relatively flat area northeast of the enclosure and south of the road. The area south of the operations building and the MSO facility may also serve this purpose, if not otherwise occupied by the staging and storage requirements described above.

During construction, there would be no fencing of the construction site or contractors' storage areas. The construction crane and other tall lifting devices would be lowered at night and when not in use to avoid creating a hazard to night-flying birds and for personnel safety in the potentially high-wind environment. Existing roads at HO would continue to be open for traffic for other HO facilities. If barricading roads becomes necessary, it would be temporary and would be prearranged with other HO facilities. Some temporary road widening may be necessary to allow through-traffic during construction. The access road that leads from north of the MSO facility down to the main staging area would be reopened for use during construction. This would require removing rock and soil that is currently placed at the entrance to the road as a surface water diverter. The diverter would be reconstructed after completion of the ATST facility.

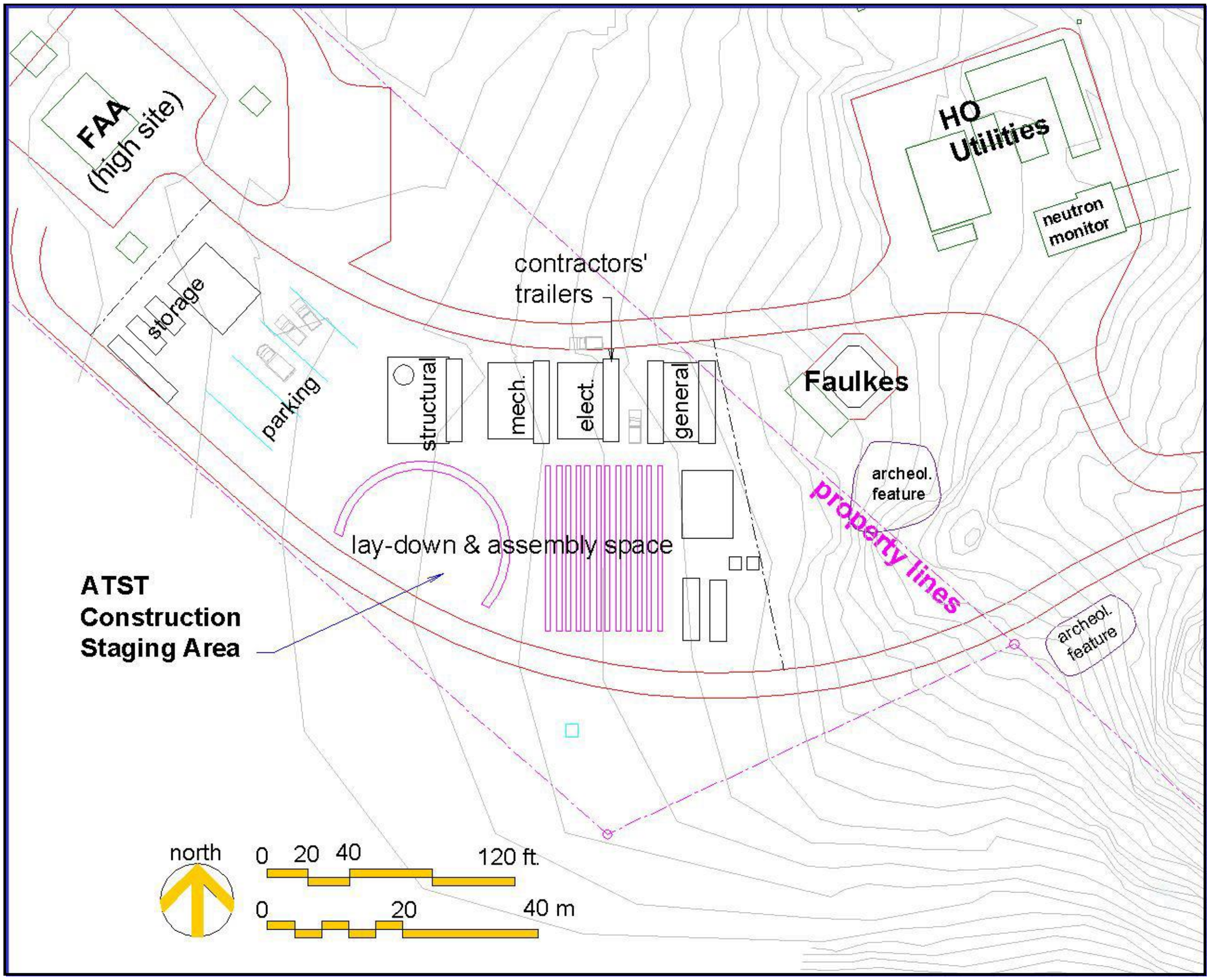


Figure 6. Construction Staging Area.

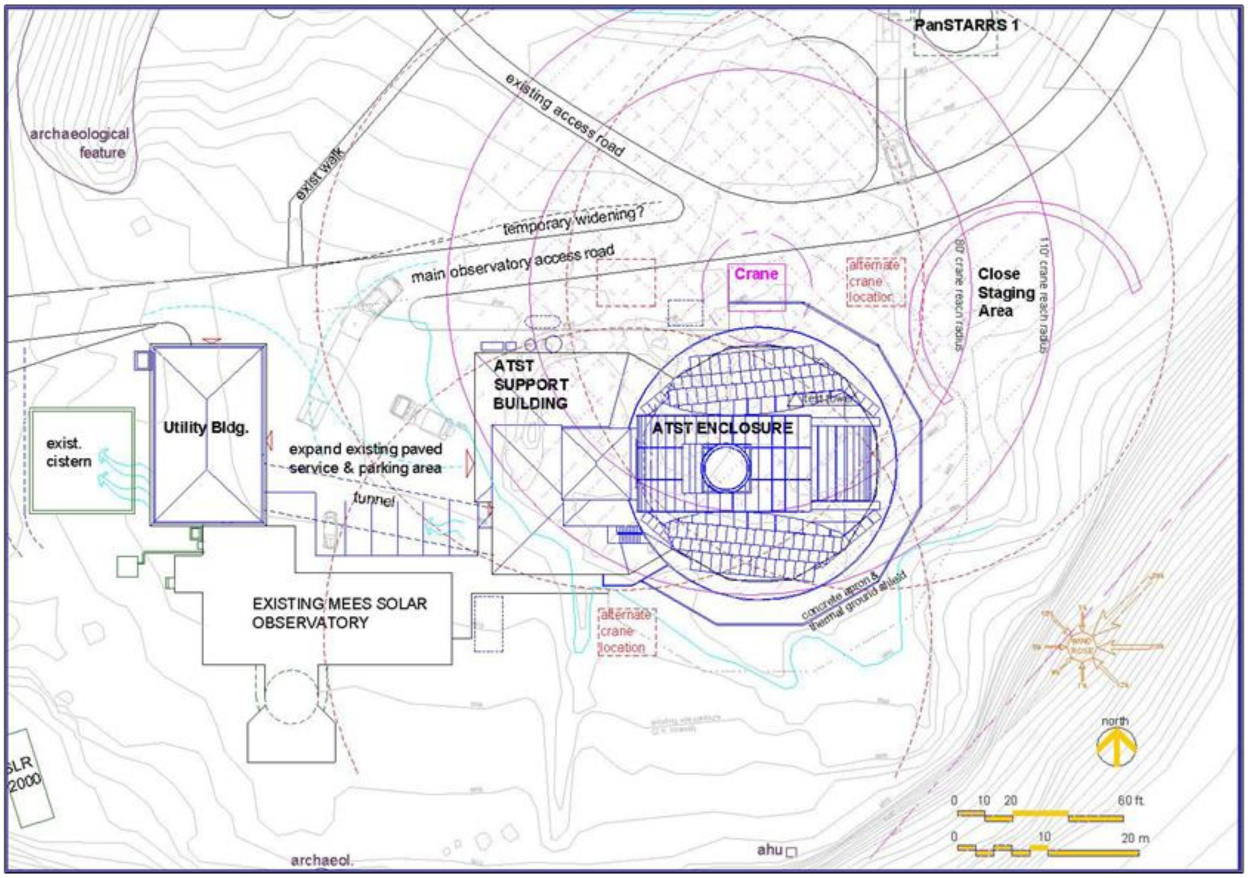


Figure 7. Staging Area in Close Proximity to Construction Site.

18.0 Construction Traffic

The extent of traffic required for construction of the ATST facility has been extensively examined as part of the Federal environmetal permitting process. This analysis, conducted in cooperation with theHaleakalā National Park (HALE) and the Federal Highways Administration (FHWA), is fully documented in the FEIS.

The total number of truck and automobile trips anticipated to be required over the 7-year construction, integration and commissioning phases of the ATST Project is approximately 25,000, as listed and described in the FEIS, Vol. I, Table 2-4. Less than 800 of these anticipated vehicle-trips are by large trucks (FHWA class 5 and larger). The majority of the anticipated trips are by small pick-up trucks, vans and passenger vehicles as required for the commuting of workers, small equipment or material deliveries, and passenger car traffic for inspection and supervision. During all phases of the ATST Project, carpooling by workers to the summit would be mandated, to the maximum extent practicable, in order to minimize traffic impacts and to address parking space limitations on the site.

Following the defined five-year construction phase of the ATST Project, the integration, testing and commissioning phase would extend for approximately two years, during which the anticipated traffic on the Park road would be limited to approximately 4 passenger vehicles per day, 4 pick-up trucks or vans per day and 2 truck deliveries per week. Following that, and extending for the operational life of the project, the ATST-related use of the roads leading to the site would be approximately 3 roundtrips for a van shuttle per day, 3 roundtrips for passenger vehicles per day, 1 truck-trip per month for delivery of domestic water, liquid nitrogen, or diesel fuel for the generator, and 3 truck trips per year for occasional transportation of scientific instruments. Traffic during these phases is also included in the FEIS, Vol. I, Table 2-4.

19.0 Basis of Design

The criteria used to develop the current preliminary design and for further development into construction documents are fully described in CDUA Appendix D-ATST SPEC-0032 Design Requirements for the ATST Support Facilites.

20.0 Regulatory Criteria

All aspects of the ATST facility are to comply with the following codes:

1. International Building Code, 2006 edition
2. Code of Federal Regulations 10 CFR Parts 433 & 434
    a. Energy Efficiency Standards for Design and Construction of New Federal Commercial and High-Rise Residential Buildings (433)
    b. Energy Code for New Federal Commercial & High-Rise Residential Buildings (434)
3. International Energy Efficiency Code (IEEC) , 2006 edition; applicable provisions of IEEC in coordination with the above CFR standards
4. International Mechanical Code, 2006 edition
5. International Plumbing Code, 2006 edition
6. National Electric Code, 2005 edition
7. Occupational Safety and Health Act (OSHA)
8. American Concrete Institute (ACI) 301, 318 and other applicable specifications
9. American Institute of Steel Construction (AISC) - Structural Steel for Buildings
10. American Welding Society (AWS) D1.1-92 - Structural Welding Code – Steel
11. American Society for Testing and Materials (ASTM) (various applicable standards)
12. American Society of Mechanical Engineers (ASME) A17.1 Elevator and Escalator Code (Personnel Elevator & LU/LA Lift)
13. ASME B20.1 Safety Standard for Conveyors and Related Equipment (Platform Lift)
14. The Americans with Disabilities Act Accessibility Guidelines (ADAAG)
15. Uniform Federal Accessibility Standards (UFAS)
16. Materials and methods specifications as stipulated by Maui Electric Co., Inc. (MECO)
17. Specifications of Hawaiian Telecom, and other utility authorities
18. Manufacturer’s specifications and trade standards for all materials and equipment
19. Hawai‘i Department of Health standards for wastewater processing and disposal

20. Haleakalā High Altitude Observatory (HO) Long Range Development Plan (LRDP)

21. Final Environmental Impact Statement (FEIS) for the ATST Facility at HO, including all stipulated mitigations and conditions

21.0 Structural Criteria

For design of the foundation systems and other structural elements of the ATST facility, the following structural criteria have been determined:

1. Lateral force design (wind and seismic), at a minimum, will comply with the load criteria dictated by the 2006 International Building Code and its associated companion codes. (This set of codes provides for a more conservative site-specific approach to lateral seismic loads than is dictated by the 1997 Uniform Building Code, currently adopted by Maui County).

2. Seismic design of all elements of the ATST facility is a critical concern. The telescope pier will be designed using finite element analysis to assure compliance with stiffness and survivability requirements.

3. The ATST telescope and instruments will be extremely sensitive to any impacts or vibrations induced on the structures that directly or indirectly support them. All possible strategies will employed to isolate the building foundations and structure from the telescope pier or other potential paths of vibration transmission. Specifications and mounting conditions for facility equipment shall be designed to minimize potential induced vibration.

4. Floor loading throughout the ATST facility of at least 100 pounds per square foot and higher in some locations based on special loading conditions.

5. The foundations of the ATST facility will be sized to support and carry all operational and survival loads. In particular, long-term creep and/or settling of the pier foundation shall be strictly minimized, as this can impact performance of the telescope. All foundation systems of the ATST facility will be designed to be compatible with the soil properties expected at the site, as characterized by the preliminary Island Geotechnical Soils Report (see FEIS, Vol. II, Appendix K-Soils Investigation Report) and future testing.

22.0 Mechanical Criteria

1. The heating ventilation and air-conditioning (HVAC) requirements for the ATST facility will be based on the climatic conditions of the site and the requirements described in the SPEC-0032 for each of the building spaces. In general, the HVAC system will be as normally provided for typical office, laboratory, shop and other functional areas.

2. The primary means for cooling and heating the building spaces in the operations building is a heat pump and air handler system. The total capacity of the system is expected to be approximately 10 tons (120,000 BTU/h). Other alternatives to this system may be considered for better economy or more refined control.

3. A special concern for the ATST facility will be the prevention of undesirable migration of heated air from sources in the building to the coudé lab and telescope levels of the enclosure. Creating negative relative pressure in air spaces adjacent to those areas, effective door seals in vestibules, physical barriers to the passage of air in concealed spaces and other strategies will be employed.

4. The coudé lab inside the pier will be conditioned by a dedicated clean-room-type HVAC system.

5. The lower enclosure will be actively ventilated by fans at two locations between the ground level of the lower enclosure and the operations building, as shown in DWG-00124 sheet A1. The ventilation air will be exhausted through actively controlled louver panels in the walls of the operations building.

6. The surface of the upper rotating enclosure will be actively cooled with a liquid cooling system. That system will include provision for supply and return piping runs; building space for chillers and other equipment; power for chillers and pumps; spill containment and other elements. Specific requirements for this system will be further developed as part of the full enclosure design process.

7. An integrated system for control of the facility HVAC equipment will be provided as part the ATST support facility.

23.0 Electrical Criteria

1. The design of the ATST facility provides adequate electrical power for all observatory systems. The primary source for this power will be the HO substation of Maui Electric Co. (MECO). A back-up generator with automatic transfer switch will be included in the design. The anticipated electrical loads for equipment will be further refined as part of the final construction documents. Appropriate switchgear, over current protection, distribution systems, and other elements of the electrical system will be included. The preliminary schedule for the peak electrical demand for the ATST facility is included below:

a.	Lights and general use outlets	50 kVA
b.	Chiller, pumps and air-handling units	160
c.	Fans for Lower Enclosure and utility bldg.	100
d.	Lifting devices	160
e.	Instrument utilities	50
f.	Enclosure mechanisms	80
g.	Telescope mount and hydrostatic bearings	90
h.	Computer control hardware	15
i.	Instruments and rotating platform	60
j.	Mirror mechanisms and thermal control	15
k.	Mirror coating facility	50
	TOTAL	830 kVA

2. The distribution system will include provision for all required voltage levels and include a separate wiring system for Uninterruptible Power Supply (UPS) protected circuits for critical equipment. An approximation of the different levels and types of power required in the individual building spaces is provided in DWG-00124 and in the ATST Interconnects and Services document.

3. A power and energy management system (PEMS) will be included in the design of the electrical system. A primary objective of the PEMS will be to maintain the peak power utilization of the facility below a MECO-established threshold to keep the utility rate paid by ATST in the lowest possible bracket. A power monitoring unit and a programmable logic controller will be located near the main electrical switchgear in the utility building (see DWG-00124, sheet A15).

4. The design of the ATST facility electrical system will minimize electromagnetic interference with scientific instruments and other telescope systems.

5. A special concern for the entire ATST observatory electrical system is achieving an effective earth ground for protection of equipment and personnel against lightning. Based on preliminary consultation, this is expected to be an earth electrode system, composed of a set of conductors in shallow trenches filled with conductive concrete. (see DWG-00124, sheet C2) The concrete and conductors would be kept moist by water, gravity-fed through perforated pipe that runs the extent of the trenches and is embedded with the conductors. The entire system, including surge-suppression devices and cad-welded connection to the steel structure of the buildings, will be specified by the grounding and lightning-protection consultant.

6. Data and control cabling, low voltage wiring, and other specialized observatory systems will be included as required. Final requirements for fire alarm system, an electronic card access system and other special building-related systems will be developed as part of the final construction documents.

24.0 Best Management Practices

A variety of best management practices (BMPs) (required practices established in the Management Plan and policies reflecting public consultation during the EIS process) would be implemented during construction to prevent damage to the natural environment. These BMPs would include the following:

1. Implementation of the Stormwater Management Plan (SWMP), specific to HO, which is included in the FEIS as Appendix L. This would include all BMPs in Sections 3.1 and 3.2 of Appendix L for recommended construction practices and stormwater control.

2. During construction, temporary diverters and hard surfaces would be utilized to direct surface water flow to the existing stormwater drainage system. As soon as possible, permanent gutters and leaders would be installed on the buildings to capture rainwater and direct it to the underground cistern.

3. Portable toilets with containment tanks would be utilized during early construction work. As soon as possible, a permanent wastewater treatment facility would be installed, which uses aeration and biologically accelerated treatment techniques that achieve effluent standards acceptable for infiltration back to groundwater.

4. Cultural resources monitoring during all leveling and excavation activities in order to prevent damage to undiscovered cultural resources.

5. Using native soils to fill holes upon completion of construction, and replanting grounding trenches, other excavated areas, and soil deposition areas with native vegetation to prevent erosion.

6. Scheduling deliveries of concrete and other materials at times that minimize conflict with tourist traffic on the Park road to Haleakalā.

7. Using signage at the project site and along the roadways to ensure vehicle, pedestrian, and bicycle safety during construction.

8. Dust control would be done by watering the disturbed ground using non-potable water trucked to the site by the contractor specifically for that purpose. Potable water would not be used for dust control.

25.0 Acronyms

‘ahinahina	Haleakalā silverswords, or Argyroxiphium sandwicense
ACI	American Concrete Institute
ADAAG	Americans with Disabilities Act Accessibility Guidelines
AEOS	U.S. Air Force Advanced Electro-optical System
AISC	American Institute of Steel Construction
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATST	Advanced Technology Solar Telescope
AWD	American Welding Society
BTU/h	British thermal units per hour
CDUA	Conservation District Use Application
DWG	drawing
EPA	Environmental Proection Agency
FAA	Federal Aviation Administration
FEIS	Final Environmental Impact Statement
FHWA	Federal Highways Administration
HALE	Haleakalā National Park
HO	Haleakalā High Altitude Observatory
HVAC	heating ventilation and air-conditioning
IEEC	International Energy Efficiency Code
IfA	Institute for Astronomy
IT&C	Integration, Test, and Commissioning
IWS	Individual Wastewater System
kVA	kilovolt-ampere
LRDP	Long Range Development Plan
MECO	Maui Electric Co., Inc.
MSO	Mees Solar Obsrvatory
OSHA	Occupational Safety and Health Act
PEMS	power and energy management system
SWMP	Sotrmwater Management Plan
TMA	Telescope Mount Assembly
UFAS	Uniform Federal Accessibility Standards
UPS	Uninterruptible Power Supply

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APPENDIX C

SUPPORT FACILITIES
DESIGN REQUIREMENTS DOCUMENT

for the

Advanced Technology Solar Telescope

Haleakalā High Altitude Observatory Site
Haleakalā, Maui, HI

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Project Documentation
SPEC-0032
Draft 4

Support Facilities
Design Requirements Document

Jeff Barr

July 14, 2009

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Appendix C

REVISION SUMMARY:

1. Date: January 6, 2006
   Revision: Initial Draft
   Changes: Draft used at January 2006 SDR.

2. Date: September 11, 2006
   Revision: Draft 2
   Changes: Draft used at October 2006 PDR.

3. Date: October 7, 2008
   Revision: Draft 3
   Changes: Updated for November 2008 SDR

4. Date: June 29, 2009
   Revision: Draft 4
   Changes: Revisions from SDR, FDR and ATST team comments

5. Date: July 14,2009
   Revision: 5
   Changes: Finalized for A&E RFP

TABLE OF CONTENTS

1. REQUIREMENTS OVERVIEW

1.1 SCOPE AND PURPOSE OF THIS DOCUMENT

The purpose of this Design Requirements Document (DRD) is to establish the basic criteria for design of the Support Facilities for the Advanced Technology Solar Telescope (ATST). The essential functions of the facilities are to structurally support the ATST telescope and the telescope enclosure and to functionally support the operation and maintenance of the telescope, science instruments and related equipment. This document is intended to serve as a design manual for a contracted architectural and engineering team, herein collectively referred to as the Architect, to design the Support Facilities.

The Schematic Design of the Support Facilities has been completed by the ATST project. The drawings representing that work together with this document form the technical starting point for the Contract for the Architect's services. These services shall include design development, preparation of construction documents, construction procurement, support during construction and final acceptance of the ATST Support Facilities as specified in the Statement of Work for: 6.0 Architectural and Engineering Services for ATST Support Facilities.

1.2 RELATED DOCUMENTS

1.2.1 Related ATST Project Documents

The following documents are explicitly relevant or complementary to this DRD and are provided to the Architect for direct reference in the architectural and engineering design of the Support Facilities:

- DWG-00124: ATST Support Facility Schematic Design Drawings
- TN-0046: ATST Facility Design – Assessment of Code Requirements
- CON-0014: Soils Investigation Report – May 2005, Island Geotechnical Engineering
- CON-0017: Foundation Design Study – August 2006, M3 Engineering & Technology
- TN-0094: Environmental Conditions at Haleakalā
- SPEC-0063: Interconnects and Services Specification
- SPEC-0030: Conditions for Working at the ATST Project Site

The following documents are related to the architectural and engineering design of the Support Facilities and will be provided or referred to as required during the Architect's work.

- SPEC-0012: ATST Glossary of Terms and Abbreviations
- SPEC-0031: ATST Safety and Health Specification for Contractors
- TN-0095: Preliminary Seismic Design Analysis for the ATST Facilities
- SPEC-0011: Telescope Mount Assembly Specification
- SPEC-0010: Enclosure Design Requirements Document
- SPEC-0077: Enclosure Thermal Systems Design Requirements Document
- ATST Environmental Impact Statement (EIS) KC Environmental Engineering, Inc. (Draft EIS completed Final EIS pending; completion anticipated in 2009)

- Haleakalā High Altitude Observatory Long Range Development Plan
- SPEC-0035: ATST Hazardous Material and Hazardous Waste Management Program
- CON-0010: Energy Efficiency Design Assistance Study

1.2.2 Interface Control Documents

It is the intent of the ATST project to integrate the design and development of the Support Facilities with other major ATST subsystem engineering efforts, such as the design of the upper (rotating) enclosure, the telescope Pier, telescope/instrument utilities, and control systems. Contractor shall coordinate with ATST project personnel and outside vendors that are designing these related subsystems.
The Support Facilities shall interface with other major ATST project elements as described in the following Interface Control Documents, which are provided to the Architect along with this DRD:

- ICD-1.1/6.2 Telescope Mount Assembly-to-Buildings
- ICD-3.1/6.2 Coudé Environmental Systems-to-Buildings
- ICD-5.0/6.2 Enclosure-to-Buildings
- ICD-5.0/6.5 Enclosure-to-Handling Equipment

2. SUPPORT FACILITIES DEFINITIONS

The Support Facilities consist of: Site Infrastructure, Buildings, and Handling Equipment, which are defined as follows:

2.1 SITE INFRASTRUCTURE

2.1.1 Demolition & Clearing:

Removal of the existing structures and utilities in the site area where the telescope enclosure and related Support Facilities are to be constructed.

2.1.2 Major Earthwork:

Excavation as required to provide level platforms for the Support Facilities and to prepare for foundation installation and forming.

2.1.3 Roads & Driveways:

Provision of exterior access ways, including a paved service yard.

2.1.4 Site Utilities:

Provision of exterior main utility lines and fixtures, including main electrical service, raceways for telephone and data connection lines, site drainage, water collection system, wastewater treatment system, and an underground utility chase between the S&O Building and the Utility Building.

Also included in site infrastructure but not included in the scope of this document are the following:

- Site Permits
- Environmental Impact Statement
- Geotechnical Testing

- Construction Infrastructure

Although the specification, definition and provision of these elements are not included in the scope of this professional services contract, applicable aspects of these processes and documents shall be incorporated into the design of the Support Facilities.

2.2 BUILDINGS

2.2.1 **Support & Operations (S&O) Building:**

The supporting pier for the telescope (<u>Pier</u>); the lower, non-rotating portion of the telescope enclosure (<u>Lower Enclosure</u>), and the multi-story structure directly attached to the Lower Enclosure that houses the control room and other ancillary support spaces (<u>Operations Building</u>) are all included as constituent parts of a contiguous structure referred to as the Support & Operations (S&O) Building. General descriptions of these major elements are as follows:

- <u>The Pier</u> is a poured-in-place concrete structure, the essential function of which is to provide stable support for the telescope at the height required to achieve the science objectives of the project. As such, the structural stiffness and vibration isolation of the Pier are critical parameters. Further information regarding these criteria will be provided to the Architect by the Telescope Mount Assembly (TMA) vendor. In addition to the telescope, the Pier also supports a rotating coudé instrument platform which is housed within the interior volume of the Pier. Detailed information regarding the dynamic loads of the telescope and the coudé platform will be provided to the Architect by AURA. The specific interface between the structural design of the Pier and the mechanical and structural design of the telescope and coudé platform is addressed in the TMA to Buildings Interface Control Document, and will be the subject of an information exchange as defined and scheduled in the TMA Contract Statement of Work.

- <u>The Lower Enclosure</u> is a steel frame structure, the essential function of which is to support the Enclosure which rotates with and protects the telescope while providing the observing aperture. The protection of the telescope from wind, heat, precipitation and other potentially deleterious environmental conditions is a major factor in the design of both the upper and the lower enclosures. Notable requirements in this regard for the Lower Enclosure include vibration isolation from the structure of the Pier and telescope floors as well as incorporation of passive and active thermal stabilization measures. The specific interface between the Lower Enclosure and the mechanical and structural design of the upper rotating enclosure is addressed in the Enclosure-to-S&O Building Interface Control Document, and will be the subject of an information exchange as defined and scheduled in the Enclosure Contract Statement of Work.

- <u>The Operations Building</u> is a steel-framed structure that houses the operational and maintenance functions of the ATST observatory that require close proximity to the telescope. It is directly attached to the Lower Enclosure and accommodates a control room, instrument preparation lab, computer room, equipment spaces, large-assembly handing devices, office space and other ancillary functions.

The Schematic Design of the S&O Building consists of a series of floor levels The basic elements of the Pier, Lower Enclosure, and Operations Building at each level are described as follows (in order of increasing height above ground):

2.2.1.1 **Ground Floor:**

<u>Pier</u>: Access to utility equipment as well as general storage space.

Lower Enclosure: Access to utilities, duct space, a ventilation plenum, stairs to the levels above, and a concrete apron surrounding the exterior of the Lower Enclosure
Operations Building: Receiving/staging area, multi-use shop or coating facility, mechanical equipment area, stairs, elevator and other ancillary spaces.
The Operations Building, at all levels, also includes a platform lift, described below in the Handling Equipment section.

2.2.1.2 **Mezzanine Level:**

Pier: Access floors and other structures inside the Pier are not included in the Support Facilities design contract.
Lower Enclosure: Service access, ventilation, stairs and other egress provisions.
Operations Building: Offices, a workstation area, break area, platform lift, restrooms and other ancillary spaces. An expansion of the mezzanine level, as shown in the Schematic Drawings, shall be designed by the Architect as an Add Alternate to the construction contract.

2.2.1.3 **Coudé Level**

Pier: The rotating coudé platform and other structures inside the Pier are not included in the Support Facilities design contract.
Lower Enclosure: Service access, ventilation, stairs and other egress provisions.
Operations Building: Control room, computer room, instrument preparation lab, platform lift and other ancillary spaces.

2.2.1.4 **Utility Level:**

Pier: A floor surrounding the outside of the Pier and supported from it is included in the Support Facilities design contract. This floor provides work space as well as stairs and a lift to the levels above. Access floors and other structures inside the Pier are not included in the Support Facilities design contract.
Lower Enclosure: Service access, large vent windows, and work space on an annular floor ring that is non-contacting and isolated from the Pier-supported floor.
Operations Building: Elevator, stairs and platform lift to below. This is the highest accessible floor level of the Operations Building.

2.2.1.5 **Catwalk Level:**

Pier: No floor area
Lower Enclosure: an exterior, approximately circular catwalk around the outside of the enclosure for access to the bogies (trucks). This is the highest level of the Lower Enclosure and incorporates the fixed ring beam that supports the rotating enclosure above.
Operations building: Platform lift and an articulating boom lift that provides access to exterior areas of the Enclosure.

2.2.1.6 **Azimuth Mechanical Level:**

Pier: A floor surrounding the outside of the Pier and supported from it is provided as part of the building contract. This floor provides access to the main azimuth bearings of the telescope as well as stairs and a lift to adjacent levels.
Lower Enclosure: No floor area
Operations Building: Platform lift only

2.2.1.7 **Telescope Level:**

Pier: An annular floor above the Pier and supported from it is included in the S&O Building design contract. This provides stationary floor area for access to the telescope as well as

stairs and a lift to levels below. This floor interfaces to the rotating floors of the TMA and the Enclosure as described in the corresponding Interface Control Documents.
Lower Enclosure: No floor area
Operations Building: Platform lift only

2.2.2 Utility Building:

This is a separate, steel-framed structure west of the S&O Building that houses mechanical and electrical equipment, which for reasons of heat and vibration are to be located remotely from the telescope. The Utility Building is connected to the S&O Building by an underground chase, which provides space for primary utility lines.

2.2.3 Mees Building Modifications (N.I.C):

The existing Mees Solar Observatory building may be modified to provide a larger shop area or other supporting facilities. If undertaken, this work will likely be deferred to the operational phase of the project and is not included in the Support Facilities design contract.

2.3 HANDLING EQUIPMENT

2.3.1 Platform Lift:

The equipment lift at the center of the Operations Building, which provides access for the primary mirror (M1) and other large heavy equipment to all levels of the S&O Building and Enclosure. The interface between the Enclosure and the platform lift is defined in the Enclosure-to-Handling Equipment ICD.

2.3.2 Personnel Access Equipment:

The hydraulic elevator in the Operations Building, and the limited-use, limited-applicability (LU/LA) lift that is supported from the Pier.

2.3.3 Cranes:

Bridge cranes in the receiving area and the instrument preparation lab.

2.3.4 Articulating-Boom Lifts:

Two articulating-boom personnel lifts which are permanently installed – one outside on the roof of the Operations Building and one inside on the fixed telescope level floor. The interface between the Enclosure and the articulating-boom lifts is defined in the Enclosure-to-Handling Equipment ICD.

3. DESIGN REQUIREMENTS

3.1 ADHERENCE TO SCHEMATIC DESIGN AND APPLICABLE REGULATIONS

The location, dimension and general arrangement of buildings, utilities, major excavations, pavements and other elements of the Support Facilities shall adhere to the Schematic Design Drawings (ATST-DWG-00124) and other related documents as specifically cited. This design has been extensively reviewed and has been utilized to assess the environmental impact of the project. Any perceived requirement for significant deviation from the design depicted in these documents shall be brought to the immediate attention of AURA.

All aspects of the Support Facilities design shall comply with the Haleakalā High Altitude Observatory Long Range Development Plan and the specific conditions and mitigations stipulated in the Final Environmental Impact Statement for ATST. The relevant site-specific requirements are summarized in SPEC-0030: Conditions for Working at the ATST Project Site. These and other applicable codes and regulating authorities are identified in Section 4.2.

3.2 SITE

For the purposes of this Design Requirements Document the site for the ATST facilities shall be the primary (Mees) site as defined in the EIS and shown in the Schematic Design Drawings (ATST-DWG-00124). In the unanticipated event that any other site is identified as the final location for ATST, a revised version of this DRD will be provided.

3.3 SITE INFRASTRUCTURE

3.3.1 Demolition and Clearing

3.3.1.1 Required Demolition

The following items have been identified as necessary to be removed to allow the construction of the proposed ATST facilities at the primary proposed (Mees) site at Haleakalā. The Architect shall specify the extent and conditions for their removal as well as, per AURA direction, the disposition of any salvaged materials.

a) ATST test tower and foundations

b) Antenna and weather station

c) Mees facility underground cesspool

d) Exterior rock walls at Mees facility

e) Driveway and parking area

f) Mees generator

g) Selective demolition at the Mees shop/utility area

3.3.1.2 **Clearing**

The site areas that will be utilized for the ATST facilities are relatively clear of vegetation. The Architect shall specify the extent of clearing required as well as any specific environmental precautions and procedures that are to be observed.

3.3.2 Major Earthwork

The Architect shall specify the dimensions and requirements for all necessary excavation, backfill and placement of excess soil including the following:

3.3.2.1 **Leveling**

The site for the ATST enclosure and Support Facilities is a natural terrain of volcanic rock and outcroppings as shown by the topographical contours on the Schematic Design site plans. The Architect shall specify the horizontal dimensions and elevation of the level graded pads needed to accommodate all of the ATST Support Facilities and related site areas.

Following the leveling work, an assessment shall be made by the project engineers, the Architect, and other contracted engineers as to the extent of additional geotechnical testing that is warranted. This additional testing will be separately contracted by AURA and the results shall be utilized by the Architect to refine the specification of further excavation and design of the foundations.

3.3.2.2 **Foundation Excavation**

The Architect shall describe the required removal of rock and soil to accommodate the foundation systems of the telescope Pier, the Lower Enclosure, the Operations Building, the elevator & platform lift, the Utility Building, and the underground utility chase. These foundations are expected to include the use of concrete caissons in drilled excavations extending down to rock bearing structure below the surface strata. (See CON-0017, M3 Engineering, Foundation Design Study). The other foundation elements are expected to be concrete pads bearing either on natural basaltic rock structure or on the volcanic sand and gravel of the upper site strata.

3.3.2.3 **Utility Trenching and Excavation**

All exterior utility lines for ATST will be installed underground. This will include trenching for a new underground electric line from the existing MECO substation at HO, and for new communications cabling as required. Trenching will also be a required for underground water and sewer lines in the vicinity of the S&O and Utility Buildings. A wider and deeper trench will be required for the underground utility chase that connects the Utility Building to the Operations Building.

3.3.2.4 **Soil Retention or Repair Measures**

Some retainage and fill is likely to be advantageous to provide support for the extended apron around the Lower Enclosure or at other areas. This will likely utilize on-site native rock material in a sloped rip-rap embankment. In some areas, especially in the area where the existing cesspool is removed, overexcavation, fill and recompaction will likely be required. The Architect shall specify the extent and methodology for any required repair, fill, and retention measures.

3.3.2.5 **Placement of Excess Soil**

All native material removed from the site is required to be placed in a culturally appropriate manner at locations within the HO area. These placement areas and methods, as preliminarily identified in the Draft Environmental Impact Statement, shall be fully specified in the Architect's Construction Documents.

3.3.3 Roads & Driveways

3.3.3.1 **Paved Service Areas**

Adjacent to the operations and Utility Buildings there will be a main service/parking area of approximately 7000 sq.ft. The Architect shall ensure that this area will accommodate safe approach to the vehicular access doors of the facility for trucks of a size and type that will be defined by AURA. Suitable sloping of the pavement to ensure adequate surface drainage and convenient vehicular and pedestrian access to the buildings shall be included in the Architect's design. A minimum of eight parking spaces (~10ft. x 20ft.) will also be provided in this area. In addition to the main service yard there will be a need for vehicular access to several ancillary service areas that will be defined during design development of the site. Pavement in these areas shall be asphalt, concrete, or other material based on durability and thermal properties as determined in consultation with AURA.

3.3.3.2 **Roadway Modifications**

The existing HO roadways provide vehicular access to the ATST Site. Retaining walls and other roadway improvements, such as extension and/or widening of pavement, may be required to accommodate ATST construction or long-term operation. Any such improvements shall be determined by the Architect in consultation with AURA and HO management, and fully defined in the Architect's Construction Documents.

3.3.3.3 **Construction Infrastructure**

Provisional construction infrastructure, such as cranes, staging areas, and temporary utilities, will be determined by the General Contractor for construction and will not be defined as part of the Support Facilities design contract. The building design team shall, however, take these requirements into consideration in the final specific location of building and site utility elements.

3.3.4 Site Utilities

3.3.4.1 **Main Electrical Service**

The ATST facilities will be served by an electrical power connection from the Maui Electric Company (MECO) substation on HO. The routing, conductors, raceways, switchgear, overprotection devices, transformers, methods and other specifics of this connection shall be determined by the Architect in consultation with MECO and AURA, and included in the Architect's Construction Documents.

3.3.4.2 **Communications**

ATST will require connection to the existing fiber-optic data/voice communication lines of the telecommunications provider for HO, Hawaiian Telecom. Appropriate routing, cabling, and connection devices for that service shall be determined by the Architect in consultation with the utility company and AURA, and included in the Architect's Construction Documents.

3.3.4.3 **Water Supply**

Domestic water for ATST will be provided from the existing on-site 64,000 gallon cistern that currently serves the Mees facility, augmented by new underground holding tank(s) with a total capacity of approximately 40,000 gallons.. Rainwater collected from the ATST roof surfaces will be fed through the holding tank(s) to the cistern in order to supplement the existing water collection system from the roof of the Mees building. The Architect shall design appropriate systems for piping and pumping the collected rainwater to the holding tank(s) and to the cistern, and for subsequent treatment and distribution of the cistern water for use in the ATST Building. The cistern water will be used directly for the domestic fixtures in the Buildings and will be filtered and treated to minimize contaminants. Potable water for human consumption, however, will be provided separately from bottles (N.I.C.). Any special treatment of the cistern water for mirror washing or other processes will be specified and provided by others. (N.I.C.)

3.3.4.4 **Wastewater Treatment**

An individual treatment plant adequate to process the domestic wastewater from both ATST and the Mees facility will be provided. This plant will be installed underground and will generate effluent suitable for direct disposal in an on-site infiltration well. The Architect shall determine the appropriate type and capacity for this plant and its related piping and discharge system based on the anticipated occupancy of the facility, the fixture units served, and consultation with the State Department of Health and other regulating authorities.

3.3.4.5 **Electrical Grounding**

AURA will retain a separate consulting firm to evaluate the on-site soil conductivity conditions and to provide a specific recommendation on the appropriate methods and materials to achieve the required electrical and lightning ground for the facility. Based on preliminary consultation, this is expected to be an earth electrode system, composed of a set of conductors in shallow trenches filled with conductive concrete. The concrete and conductors would be kept moist by water, gravity-fed through perforated pipe that runs the extent of the trenches and is embedded with the conductors. The entire system, including surge-suppression devices and cad-welded connection to the steel structure of the buildings, will be specified by the grounding and lightning-protection consultant. The Architect shall include the necessary elements in the site and building design and associated Construction Documents to implement the recommended system.

3.3.4.6 **Other Site Utilities**

Other miscellaneous requirements for cabling and mounting of a weather station, low voltage wiring, and other potential site utilities shall be included in the Architect's design as required.

3.3.4.7 **Underground Utility Chase**

The Utility Building and the S&O Building are to be connected by an accessible, underground chase for utility lines. In the Schematic Design this chase is conceived of as an 8-ft. diameter concrete or steel tunnel with an access hatch on each end. Precast concrete culvert segments or other alternative designs shall be explored by the Architect. Conceptually, on one side of the chase would be mounted "dry" utilities such as electrical and communications conduits, and on the other side would be water piping and other "wet" utility lines. Systematic arrangement of the utility lines, designated space for future additional lines, and orderly transition of lines in and out of the chase shall all be incorporated into the Architect's design. Sump pumps, interior lighting, and other practical and ergonomic considerations shall be incorporated into the design. The Architect shall coordinate the design of the underground utility chase with the development of utility requirements by others.

3.4 BUILDINGS

3.4.1 Overview

The buildings included in the ATST Support Facilities (Buildings) consist of the telescope Pier, the Lower Enclosure, the Operations Building, and the Utility Building. The Schematic Design Drawings (ATST-DWG-00124) describe the relationship of the required spaces and the overall size and shape of these structures. The Architect shall specify the dimensions, details, structural systems, utility systems, finishes and other aspects of the Buildings as required for design development and a completion of the Construction Documents.

The following sections describe the essential functions that will be performed and activities that will be supported by each of the separately identified elements and spaces of the Buildings. Dimensions of the structural elements and spaces; utility requirements; finishes and the general anticipated layout of fixtures and equipment are indicated on the Schematic Design floor plans and accompanying schedules. More detail with regard to structural, functional and utility requirements will be provided by AURA commensurate with the progression of the Architect's design.

3.4.2 Telescope Pier

The Pier is a fundamental element in the support system for the telescope mount assembly (TMA) and for the optics and instruments that the TMA in turn supports. The primary structural and dimensional criteria for the Pier are therefore derived from the essential scientific objectives of the project. Preliminary design and analysis of the Pier has resulted in a poured-in-place concrete structure with the configuration and dimensions depicted in the Schematic Design Drawings (DWG-00124) and in the Telescope-to-S&O Building Interface Control Document (ICD-1.1/6.2). The Architect shall fully design that structure to meet all the loads that the Pier is required to support and all the dimensional tolerances that it is required to maintain. Any recommended revisions to the basic dimensions and configuration of the Pier, based on the Architect's analysis and professional judgment, shall be brought to the attention of AURA for consideration. The Pier design is also expected to be reviewed, and to some extent refined, as part of the TMA design process, which will be simultaneous with the design Contract for the Support Facilities. The Architect shall interact with the TMA Contractor as specifically called for and scheduled in their respective Contract Statements of Work. Any revisions to the Pier design directed by AURA shall be incorporated by the Architect into the final Support Facilities construction documents.

The following basic parameters of the Pier design are intended to inform the Architect regarding the rationale for the preliminary Pier design, and as a supplement to the other technical information provided in the Schematic Design Drawings and in the TMA-to-S&O Building ICD.

3.4.2.1 **Basic Structural Requirements of the Pier:**

The minimum lowest resonant frequency of the Pier, as defined by AURA, shall be verified by the Architect through finite element analysis and other analytical methods as required.

Deflection of the Pier under the gravity and dynamic loads of the TMA, wind pressure and other anticipated forces shall be verified by the Architect to be within the tolerances defined by AURA.

Vibration coupling of the Pier with the telescope enclosure shall be verified by the Architect to be below a threshold level defined by AURA. Vibration isolation of supported floors, air conditioning plenums and other sources of vibration shall also be included in the Architect's design.

Interfaces to azimuth tracks for the TMA and Coudé Platform shall be as described in the TMA-to-Buildings ICD.

Survival of the Pier in seismic events – with acceptable damage levels associated with specific seismic spectra, as defined by AURA – shall be verified by the Architect. The Architect shall perform dynamic finite element analysis of the Pier to quantify and limit, in consultation with AURA, the seismic response of elements that interact with other systems.

The Architect shall design the Pier foundation to support all of the defined loads on the natural rock and soil of the site. Anticipated long-term settling of the Pier on the natural substrate shall be verified to be within limits defined by AURA. The Preliminary Foundation Design Study completed by M3 Engineering & Technology, Inc. (CON-0017) provides the initial basis for the Architect's design. The proposed foundation design described in that study shall be revised or refined as recommended by the Architect and approved by AURA.

Lift points with appropriate attachment brackets for portable hoists or cables, at locations and with load capacities as defined by AURA, shall be designed into the interior walls of the Pier

3.4.2.2 **Basic Dimensional Requirements of the Pier:**

The overall dimensions of the Pier – heights to top of ring beams, diameters of ring beams, interior shape and dimensions of the base region of the Pier, interior and exterior floor heights – are integrally tied to the TMA, to other observatory systems and to the basic science requirements of the project. These dimensions are <u>not</u> expected to change significantly as the designs of all these systems are finalized.

Other, secondary dimensions – Pier wall thickness, foundation mat thickness, location and diameter of caissons, etc. – shall be determined by the Architect to satisfy the structural criteria of the Pier as described above and as defined by AURA.

3.4.2.3 **Basic Functional and Spatial Requirements of the Pier:**

In addition to its primary structural support function, the Pier provides operational and maintenance floor space, both in its interior volume and on the exterior floors supported from it.

<u>Base Level Service and Storage Areas</u>: The ground level areas inside the Pier provide access to the coudé cable wrap inside the inner Pier and air handling units between the inner and outer Pier walls. The design and specification of these pieces of equipment are to be provided by others (N.I.C.). A portion of the base level of the pier may be partitioned off at a future date to provide a small-optics coating facility. The Architect shall incorporate the operational and maintenance requirements of these immediate requirements and potential future uses, as provided by AURA, into the design of base level of the Pier.

<u>Interior Pier Areas Above Ground Level</u>: The design of the coudé platform, and all other above-ground areas inside the Pier, is not included in the Support Facilities design Contract. The Architect shall, however, incorporate the anticipated loads of these floors and other structures into the structural design of the Pier and shall provide anchor bolts or other supporting embedments, openings for ducts or utilities, and any other provisions determined necessary in interactions with the designers of these systems.

Exterior Floors Supported from the Pier: At the utility level, azimuth mechanical level, and telescope level of the facility, floor structures supported from the upper walls of the Pier shall provided as part of the Support Facilities design Contract. These floors, as shown in the Schematic Design Drawings, serve to access TMA-related systems and provide for vertical circulation (stairs and LU/LA lift) between the levels. The interface of these floors to the TMA and to the rotating enclosure shall be as defined in the corresponding Interface Control Documents and as determined necessary in interactions with the designers of these systems.

3.4.3 Lower Enclosure

The Lower Enclosure is an integral part of the protection system for the telescope. It provides a protective shield for the telescope Pier and structural support for the upper, rotating enclosure that protects the telescope. The primary structural and dimensional criteria for the Lower Enclosure are dictated by gravitational and dynamic loads of the Enclosure and by the relationship of the Lower Enclosure to the Enclosure, to the telescope Pier and to the attached Operations Building. The preliminary design of the Lower Enclosure envisions a steel-framed structure clad in pre-cast concrete panels with the basic configuration and dimensions depicted in the Schematic Design Drawings (DWG-00124) and in the Enclosure-to-S&O Building Interface Control Document (ICD-5.0/6.2). The Architect shall revise and refine that design including design and specification of: all structural elements, all connection details, weather-protection systems, ancillary structures, coatings and other required elements of the Lower Enclosure. The Architect shall verify the adequacy of the final design for all the loads that the Lower Enclosure is required to support and for the dimensional tolerances that it is required to maintain. The Lower Enclosure design is also expected to be reviewed, and to some extent refined, as part of the design process for the Enclosure, which will be simultaneous with the design Contract for the Support Facilities. The Architect shall interact with the enclosure Contractor as specifically called for and scheduled in their respective Contracts. Any revisions to the Lower Enclosure design directed by AURA shall be incorporated by the Architect into the final Support Facilities construction documents.

The following basic design parameters are intended to inform the Architect regarding the rationale for the preliminary Lower Enclosure design, and as a supplement to the other technical information provided in the Schematic Design Drawings and in the Enclosure-to-S&O Building ICD.

3.4.3.1 **Basic Structural Requirements of the Lower Enclosure:**

Vertical and horizontal deflection of the ring beam at the top of the Lower Enclosure under the gravity and dynamic loads of the Enclosure, wind pressure and other anticipated forces shall be designed by the Architect to be within the tolerances defined by AURA.

Vibration coupling of the Lower Enclosure to the telescope Pier shall be verified by the Architect to be below a threshold level defined by AURA.

Survival of the Lower Enclosure in seismic events – with acceptable damage levels associated with specific seismic spectra, as defined by AURA – shall be verified by the Architect. The Architect shall perform dynamic finite element analysis of the Pier to quantify and limit, in consultation with AURA, the seismic response of elements that interact with other systems.

The adequacy of the Lower Enclosure foundation to support all of the defined loads on the natural rock and soil of the site shall be verified by the Architect. The Preliminary Foundation Design Study completed by M3 Engineering & Technology, Inc. (CON-0017) provides the initial basis for the Architect's design. The proposed foundation design described in that study shall be revised or refined as recommended by the Architect and approved by AURA.

3.4.3.2 **Basic Dimensional Requirements of the Lower Enclosure:**

The overall dimensions of the Lower Enclosure – height and diameter of the top ring beam, size and shape of the exterior envelope, interior floor heights, catwalk height and width – are integrally tied to the configuration of the Enclosure and of the Operations Building. The defined exterior materials and dimensions of the entire enclosure have also been subject to extensive thermal and environmental impact analysis. These major dimensions and conditions are <u>not</u> expected to change significantly as the designs of the Enclosure and Support Facilities are finalized.

Other secondary dimensions, the detailed relationship of elements, and the specifications of all Lower Enclosure materials shall be determined by the Architect to meet the structural and functional criteria of the Lower Enclosure as required.

3.4.3.3 **Basic Functional Requirements of the Lower Enclosure:**

In addition to its primary structural support function, the Lower Enclosure provides operational and maintenance floor space, ventilation plenums, and egress provisions, in its interior volume and on an exterior catwalk.

<u>Space Between Lower Enclosure and Pier</u>: At the ground level, mezzanine level, and coudé level the space between the inside face of the Lower Enclosure wall and the outside face of the concrete Pier provides access to utilities, ventilation plenum, duct space and a stair that connects the first four floor levels of the S&O Building. Floors, platforms, stairs landings, ladders and other elements in this space, as indicated in the Schematic Design Drawings, shall be refined by the Architect and verified to satisfy egress and functional requirements as defined by applicable codes and by AURA. The structural support for all floors and platforms in this area shall be designed to cantilever off of the enclosure columns and to be structurally isolated from the telescope Pier. At ground level personnel egress doors shall be provided as well as a roll-up service door leading from the exterior to an aligned service door into the telescope Pier.

<u>Utility Level Floor</u>: At the utility level the Lower Enclosure structure includes a cantilevered floor that interfaces to a fixed floor supported off of the telescope Pier. These two floors form a continuous, level surface while remaining structurally separated for vibration isolation. Together these floors provide a functional area for staging of maintenance and operational activities related to the telescope. The Lower Enclosure floor at this level also incorporates grated vent openings for extraction of air into the area below. Passive ventilation openings with roll-up doors are provided in the exterior walls of the Lower Enclosure at the utility level.

<u>Enclosure Areas Contiguous with Operations Building</u>: At the ground level, mezzanine level, coudé level and utility level where the Lower Enclosure meets the Operations Building the floor areas of the two buildings are functionally and structurally integrated. This occurs at the mechanical equipment area (ground level), the open workstation area (mezzanine), the control room (coudé level) and at the vestibule that connects the operation buildings to the Pier at all four levels. Functional requirements for those spaces are described below in the Operations Building section.

3.4.3.4 **Passive Thermal Performance Requirements of the Lower Enclosure**

The Architects design of the Lower Enclosure shall incorporate passive thermal strategies as defined in the Schematic Design and as refined in consultation with AURA.

In the Schematic Design, this includes cladding the exterior of the Lower Enclosure in 6-inch thick concrete panels. The finish of the panels, as determined by thermal modeling, is a coating having adequate thermal characteristics (absorptivity α=0.16, and thermal emissivity ε=0.93) as well as adequate weathering characteristics to be defined by AURA. Preliminary specification in the Schematic Design is an elastomeric system manufactured by Advanced Coating Systems, Inc. (base coat of Energy Seal Acu-Tac base coat and two coats of Acu-Shield ESC-0407-TS). Other products of equivalent or better performance may be considered. The Architect's design of the Lower enclosure wall panels shall include provision for the installation of thermal sensors, as determined in consultation with AURA. The design and specification of the sensors and the thermal monitoring system will be by others (N.I.C.)

Passive thermal, measures also include a horizontal concrete apron extending 32'-10" (10 m) from the base of the Lower Enclosure, finished with a coating system similar to the wall panels. The Architect's design for the apron shall be adequate for vehicle/equipment loading and include an integral rainwater collection system as indicated in the Schematic Design and refined in consultation with AURA. The apron shall be designed to be installed as a later work package after completion of the Enclosure and TMA construction.

3.4.4 Operations Building

The Operations Building, a multi-story structure attached to the Lower Enclosure, accommodates observing-related activities for which it is beneficial or necessary to be near the telescope. This building also provides space for equipment that requires proximity to the telescope for reasons of robust rapid data transmission, utility run length or minimizing transport of critical assemblies.

The following descriptions of spaces within the Operations Building are intended to inform the Architect about the essential activities and criteria related to each space and to promote appropriate decision making regarding the detailed design. Additional information will be conveyed by AURA as dictated by progress in the design work.

3.4.4.1 Control Room

As the operational center of the ATST facility, the control room supports multiple activities conducted by personnel of different disciplines. Ample circulation and adequate zoned areas for the varying functional tasks of telescope operators, observing scientists, engineering teams, IT support personnel and others is essential to the efficient use of this space. Dedicated space for the telescope control console and additional work counters is provided. Other contractors designing the telescope, control systems for the observatory, and other specific subsystems will provide the dimensional and utility requirements for the console area. Flexibility for future rearrangement of the space and optimization of the control room layout shall be allowed for in the Architect’s design. Close proximity and a large observation window between the control room and the coudé laboratory are considered essential to observing operations and have been accommodated in the Schematic Design. One exterior window and vestibule access to an exterior balcony are provided for day-lighting, checking weather and visual relief. The window in the control room – and all other windows provided throughout the Operations Building – shall be equipped with black-out shades and/or other devices to allow full darkening of the interior spaces and to protect adjacent nighttime observatories from stray light. From the control room convenient access and/or monitoring of all other areas of the ATST facility is required. Overhead accessible cable trays are provided around the perimeter of the room and to other adjacent rooms for flexible routing of data cables and other utilities.

3.4.4.2 Computer Room

This area houses data-processing hardware, instrument modules, power supplies and other similar rack-mounted or self-contained equipment that can be remotely located from the main console and instruments. Convenient access to the control room and instrument work area shall be provided. To minimize background noise in these adjacent areas, the computer room shall be effectively sound isolated. Thermal insulation and air conditioning for this area shall be designed to provide for the special environmental requirements of the equipment with reserve capacity for future additional equipment. The computer room will be served by a separate dedicated air conditioning system. In-room cooling units shall be explored by the Architect as an option. The layout of the space will allow for a minimum of 16 standard computer hardware racks with access to both the front and back of all modules. Each rack will require a UPS-protected power connection (see Section 4.6 – Electrical Requirements) of 3kVA minimum capacity. Adequate rack space in the computer room for the telescope, instrument, and data processing related equipment shall be verified during design development. Cable trays shall be provided along the length of the room and over each bay of racks.

3.4.4.3 Instrument Preparation Lab

Instruments normally utilized on the telescope or in the coudé lab will be repaired, tested and prepared for observing in this area. The differing requirements of short-term staging/testing activities and long-term repair will be accommodated with convenient access to common resources (tools, optical benches, fixtures, utilities, etc.). A 5-ton bridge crane for maneuvering large instrument components and equipment shall be provided – as described in the Handling Equipment section below. The floor of the instrument prep lab shall be capable of supporting a live load of 100 lbs/sq.ft. minimum over the entire surface. Support for point loading that satisfies stiffness criteria and variability of load condition as defined by AURA shall be provided. The basic anticipated load cases are support of a movable instrument weighing up to 6500 lbs. and a single support point load of up to 1000 lbs. The Architect shall design this space to suit the specific functional requirements, to be provided by AURA, of the suite of facility instruments and potential visitor instruments. A light-feed tube and support points on the roof of the instrument prep lab for a future coelostat – as defined by AURA and provided by others (N.I.C.) – shall be included in the Architect's design. The viability of utilizing a deployable soft-wall clean room (N.I.C.) shall be explored as part of the Architect's design of the instrument prep lab. Overhead cable trays shall be provided around the perimeter of the room. Adequate space for approximately 12 storage cabinets, as indicated in the Schematic Design Drawings, shall be provided in the corridor adjacent to the instrument prep lab or other adjoining area.

3.4.4.4 Site Manager's Office

This office is utilized daily by the observatory operations manager for administrative work, interactions with staff, telephone & video conferencing, and other normal office activities. Effective sound privacy is required.

3.4.4.5 Office/Conference Room

This is expected to be utilized as a general purpose meeting room and as office space for visiting scientists and other staff when more privacy is required than is afforded by the open workstation area. Telephone & video conferencing capability are required as well as effective sound isolation.

3.4.4.6 Open Workstation Area

This large common work area provides for efficient flexible accommodation of the office space needs of staff and visiting personnel. This area will likely be subdivided into multiple workstations with office partitioning - the design of which is N.I.C. Provisions for power and communications to the workstations shall be incorporated into the Architect's design as directed by AURA.

3.4.4.7 **Mezzanine Level Extension (Additive Alternate**

A potential extension of the mezzanine level of the Operations Building, as an additive alternate to the contract for construction, shall be provided for in the Architect's design. As indicated in the Schematic Design Drawings this would be located in the north area of the Operations Building above the multi-use shop or coating facility area. The anticipated use of the mezzanine extension would be as an electronics shop or auxiliary instrument work area. The Architect's design of this area shall include adequate utility connections and provision for benches, tools, and test equipment, as defined by AURA

3.4.4.8 **Kitchen Break Area**

This area is to provide a comfortable space for informal meeting and dining for approximately 10 to 12 people. The Architect’s design shall include a kitchenette, a window and access to an exterior balcony. A table and other appropriate portable furnishings will be provided (N.I.C.)

3.4.4.9 **Restrooms**

The Schematic Design includes two restrooms (Men’s and Women’s) on the mezzanine level and one unisex restroom on the Coudé level. Alternate arrangements of restrooms may be explored by the Architect for improved efficiency or as required to allow flexible planning of other adjacent spaces. The dimensions and design of all restrooms shall comply with handicapped accessibility standards, and minimum sanitary fixture requirements defined in the codes listed below in the Applicable Regulations section.

3.4.4.10 **Receiving and Staging**

This area will accommodate handling of large assemblies including: the primary mirror and its support cell; observing instruments; subassemblies of the telescope mount and enclosure, and other observatory equipment. Activities here include loading, unloading, assembly, disassembly, staging for installation, and transfer of materials onto the adjacent platform lift. A 20-ton bridge crane is to be provided (see Handling Equipment section below). A service door 20 ft. wide by 16 ft. high provides direct access to the main service yard.

3.4.4.11 **Multi-use shop or Coating Facility**

This area is expected to be used during construction as a general machine shop with a drill press, lathe, milling machine, chop saw, grinder, welding equipment, benches and other equipment as defined by AURA. During future observatory operations this area may continue to serve as a shop or may be converted to a small-optics coating facility. Further direction regarding the accommodation of future flexible use of this space will be provided by AURA.

3.4.4.12 **Platform Lift Shaft**

A shaft at the center of the building is provided for a large platform lift that will serve four floor levels that are common to the Operations Building and the Lower Enclosure (ground, mezzanine, coudé, utility) and three higher levels of the Lower Enclosure (azimuth mechanical, catwalk & telescope). The functional requirements of the lift are described below in the Handling Equipment section. The shaft has roll-up doors at each level on the east and/or west sides sufficient to allow passage of the equipment that will be utilized at that level (see door schedule in ATST-DWG-00124). At the bottom of the shaft is a pit as required by the lift manufacturer and applicable codes. When the lift is raised to the highest (telescope) level, the roof of the shaft is lifted up by arch-irons that are integrally attached to the lift carriage. The separable connection between the walls of the shaft and the lift-up roof require appropriate seals and uplift restraint to ensure effective weather protection when the roof is in its normal (down) position under all survival environmental conditions.

3.4.4.13 **Entry Vestibules**

At each of the three main levels of the S&O Building (ground, mezzanine & coudé) the Schematic Design provides a transitional space between the east side of the platform lift and the outer wall of the telescope Pier. The floor of this space serves as a landing platform for the lift and will be capable of supporting a live load of 100 lbs/sq.ft. and special loading as defined by AURA. This space also serves as an air-separation vestibule connecting the adjacent rooms in the Operations Building with the spaces in the Lower Enclosure. Effective environmental isolation will be most critical at the coudé level where the vestibule connects the control room to the rotating coudé instrument platform. The coudé platform (N.I.C.) is to be environmentally conditioned as a clean room (N.I.C.). The doorways and vestibule walls, floor and ceiling at this level, which shall designed as part of the Buildings, shall be appropriate to serve as a clean room air lock. At all levels the vestibules will have self-closing doors at all entry points. The area of the vestibules is expected to be useful as ancillary staging/work space related to the spaces inside the Pier. The Architect’s design shall accommodate all of these functional requirements.

3.4.4.14 **Elevator Shaft**

On the south side of the platform lift a shaft is provided for the personnel elevator that will serve the four levels of the S&O Building. The structure and dimensions of this shaft will be determined by the requirements of the elevator, described below in the Handling Equipment section. The wall materials, opening details, the pit and the top clearance will be determined by the elevator manufacturer and applicable codes.

3.4.4.15 **Stairs**

There are three sets of interior stairs that serve the support facility: one at the southwest corner adjacent to the main entry serving the three main levels of the Operations Building, another in the Lower Enclosure serving the first four levels of the Lower Enclosure and Operations Building, and a third connecting the utility level of the Lower Enclosure with the azimuth mechanical and telescope levels. All of these shall be designed as part of the S&O Building. They all serve as code mandated vertical exits from the upper levels of the S&O Building. In addition to complying with dimensional and construction details defined in the IBC, the stairs shall be given appropriate consideration in the Architect’s design as frequently used primary circulation for the facility. Light colored wall/floor surfaces and contrasting stair tread edges shall be specified to allow for safe use of the stairs with minimal required lighting.

There is one set of exterior stairs that connects the utility level of the Operations Building to the exterior catwalk at the top of the Lower Enclosure. Like the interior stairs, this stair serves as a functional route for maintenance and operation as well as an emergency exit from the upper levels of the enclosure.

Possible minor revision of levels in Lower Enclosure or rearrangements of floor areas during design development may impact the design of any or all of these stairs. Final optimal and code-compliant configuration and dimensions of the stairs shall be verified by the Architect.

3.4.4.16 **Utility Level Spaces**

The utility level of the Operations Building is expected to serve only as a landing for access to the utility floor of the Lower Enclosure and the telescope-related levels above. The utility level is the highest stop for the elevator in the Operations Building. The platform lift also stops at this level, and there are doors that open into the Lower Enclosure and out to the exterior stair leading to the catwalk. A frequent anticipated path of travel for operational and maintenance personnel will be from the control room up to the utility level via the elevator then into the Lower Enclosure and up the stairs or LU/LA lift to the telescope level.

3.4.4.17 **Mechanical Equipment Area**

A separate room is provided in the base level of the Operations Building to house the mechanical equipment that requires proximity to the telescope for effective operation, but needs to be isolated for sound, vibration and thermal control. This room is to be thermally and acoustically buffered from the rest of the facility. Fire separation from other areas may also be required for this space, depending on the nature and volume of flammable utility materials to be utilized or stored here. Ventilation openings in the exterior walls of this room will allow warm air from the equipment to be exhausted away from the telescope enclosure. Potential exterior noise from the equipment in this area is a significant environmental concern. In addition to sound abatement equipment integral to the equipment, the walls and ventilation openings of the mechanical equipment area shall incorporate effective sound blocking materials. The underground utility chase, which is accessed through a hatch in the floor, connects the mechanical equipment space to the separate Utility Building described below. The Architect's design of this space shall consider the maintenance requirements of the equipment and the length of required utility runs to other areas. A preliminary list of the equipment to be housed here includes:

- Hydrostatic bearing oil pump for telescope mount & coudé rotator assemblies.
- Hydrostatic oil tank
- Helium compressor(s)
- Vacuum pump
- Liquid nitrogen tanks
- Telephone connection board
- Main grounding bus for the facility
- Electrical distribution panels

Details regarding the dimensions, utility connections and maintenance requirements of these pieces of equipment will be provided by AURA.

The open space at the west end of mechanical equipment space is expected to serve as a small shop for tasks related to the telescope and instruments.

3.4.4.18 **Machine & Service Rooms**

Enclosed spaces required for special equipment, such as the machine room for the elevator and the plenum rooms for the enclosure ventilation fans, shall be designed for the particular requirements of the equipment to be housed. Manufacturer's specified clearances for maintenance shall be provided. Materials, finishes, sound treatment, security, and other design aspects of these spaces shall comply with applicable codes and AURA specified requirements.

3.4.4.19 **Miscellaneous Support Spaces**

Other ancillary spaces within the building (corridors, vertical chases, small vestibules, accessible ceiling areas, etc.) as well as incidental materials, finishes, and building elements not specifically defined shall be designed to comply with applicable codes, special requirements as conveyed by AURA, and generally in accord with normal standards for research facilities.

3.4.5 Utility Building

The Utility Building encloses and protects the mechanical and electrical equipment which requires complete thermal and vibration isolation from the telescope. The basic structure is expected to be a pre-engineered metal building. The interior space is partitioned in the Schematic Design to provide a separate space for the generator and electrical equipment. The Utility Building is connected to the S&O Building by an underground utility chase accessed by a floor hatch. Potential exterior noise from the equipment in this area is a significant environmental concern. In addition to sound abatement equipment integral to the equipment, the walls and roof of the Utility Building shall incorporate effective sound blocking materials. The west wall includes large louver panels for ventilation which shall be designed to minimize sound transmission. The preliminary list of the equipment to be housed at the Utility Building includes:

- 1000 kVA main transformer (to be located outside the Utility Building)
- 300 kVA generator and associated automatic transfer switchgear
- Power and Energy Management System main control unit
- Uninterruptible power supply (UPS) units (2 or 3)
- 80-ton, low-temperature chiller
- 15-ton, very-low-temperature chiller
- 3 plate & frame heat exchangers
- Ice storage tanks (3) (to be located outside, west of the Utility Building)
- Feed unit for anti-freeze agent for heat-transfer fluid
- Pumps as required for distribution of heat-transfer fluid
- Tank to drain a specified subsection of plate-coil on the enclosure (~1000 gal.) (may be underground or elevated to save space)
- 10-ton heat pump condenser unit
- Vane-axial ventilation fan with VFD speed control
- Air compressor with dryer and filter

The layout of the Utility Building shown in the Schematic Design is preliminary. It is intended to depict the space requirements of the equipment and to verify the basic dimensional adequacy of the building. Further consideration shall be given in the Architect's design to alternative layouts, the possible inclusion of other equipment as identified by AURA, as well as potential location of some equipment outside the building or elsewhere.

3.5 HANDLING EQUIPMENT

The following equipment shall be designed as an integral part of the Support Facilities and shall be specified in the Architect's Construction Documents. The dimensions, mounting conditions, imposed structural loads and other critical aspects of the equipment shall be fully considered and accommodated. Wherever possible, designs and specifications shall allow for multiple competitive vendors of the equipment to fulfill the requirements.

3.5.1 Platform Lift

The platform lift shall be a vertical reciprocating conveyor as defined by ASME B20.1, Safety Standard for Conveyors and Related Equipment. The maximum design lift task shall be safe and efficient conveyance of the primary mirror assembly (M1) between the receiving area in the ground level of the Operations Building and the telescope level in the enclosure. The platform lift will also be utilized during construction and operation to convey large optical instruments and other telescope-related assemblies to the coudé level labs and to the telescope. Dimensions of the lift; safe capacity of its drives and mechanisms; and interface to landings and shaft openings shall accommodate M1 and its handling cart as well as instruments and their handling fixtures. The specifications for these items will be provided by AURA.

The minimum capacity of the lift shall be 22 tons (44,000 lbs.)

The approximate horizontal clear dimensions of the lift platform shall be 19’-0” in both directions. Specific clearance requirements of the M1 cart and other large handling rigs will be provided by AURA as they are developed and shall be verified by the Architect as safely accommodated in the lift design.

The maximum vertical travel of the platform lift will be approximately 76’-6”.

The effective travel speed of the platform lift shall be a minimum of 5 ft. per minute. The Architect shall consult with AURA and the lift manufacturer to determine the optimal reliable and cost-effective speed.

The lift shall be designed to stop at six different levels (ground, mezzanine, coudé, utility, catwalk, and telescope). The floor of the platform shall stop level with each floor to within 1/4” over the entire length of the joint on both sides of the platform (as applicable). When not in use for transport of equipment, the platform lift is expected to be stationed at one of the primary functional floors of the facility – especially the coudé or ground floor – to provide supplemental floor space for operational or maintenance activities. When stationed at the catwalk level, the platform lift will provide necessary additional space for maintaining the bogies that support the Enclosure. Stow pins or other method for safely securing the platform at each of the levels it serves shall be provided in the design.

The design of the lift shall incorporate arch irons to lift the roof of the shaft approximately 10 ft. above the top of the shaft walls when the lift is raised to its maximum stop (level with the telescope floor). This aspect of the lift design shall be developed and coordinated integrally with design of the building structure and roof flashing system.

The design of the platform lift shall comply with the requirements of ICD 5.0/6.5, Enclosure-to-Handling Equipment Interface Control Document. The Architect shall interact as required with the contractor of the Enclosure structure to ensure that the functional and dimensional requirements of the platform lift interface are satisfied.

The platform lift shall comply with ASME Standard B20.1, Safety Standards for Conveyors and Related Equipment as regards the safe design and implementation vertical reciprocating conveyors. Applicable safety standards of OSHA and the 2006 IBC shall be complied with as well.

3.5.2 Operations Building Elevator

The personnel elevator in the Operations Building is expected to be the primary means of circulation for personnel and equipment between the four levels of the support facility (base, mezzanine, coudé, and utility). The elevator that has been incorporated into the Schematic Design, is a manufacturer's standard hydraulically-operated personnel elevator.

The dimension of the cab and the capacity of the mechanisms shall be designed for a load rating of 3,500 lbs.

The maximum vertical travel of the elevator will be approximately 50'-10".

The effective travel speed of the elevator shall be a minimum of 150 feet per minute.

The elevator shall comply with ANSI 17.1 standards for hydraulic personnel-rated elevators, and applicable regulations of the State elevator inspection authority. All components and dimensions of the elevator shall comply with all applicable standards of ADA and other accessibility regulations.

The Schematic Design anticipates a requirement for bidirectional entry doors to accommodate opposite side access at the utility level. The Architect's design of the elevator shall include consideration of alternative arrangements of the entrance door(s) at each level and other potentially advantageous options.

3.5.3 Limited-Use Limited-Application (LU/LA) Lift

The personnel lift in the telescope enclosure will be a primary means for conveying personnel and equipment between the three upper levels of the enclosure (utility, azimuth mechanical, and telescope). The equipment that has been incorporated into the Schematic Design, is a manufacturer's standard limited-use/limited-application (LU/LA) electrically-operated personnel lift. The typical use of the LU/LA lift will be transporting as many as three workers, one worker and a cart of tools, or one person in a wheelchair or mobility scooter between the three levels.

The dimension of the cab and the capacity of the mechanisms shall be designed for a maximum loading of approximately 1,400 lbs.

The maximum vertical travel of the LU/LA lift will be approximately 24'-2".

The effective travel speed of the LU/LA lift shall be 25 feet per minute.

The LU/LA lift shall comply with ANSI 17.1 standards for Limited-Use/Limited-Application Elevators and applicable regulations of the State elevator inspection authority. All components and dimensions of the elevator shall comply with all applicable standards of ADA and other accessibility regulations.

A critical aspect of the LU/LA lift design will be minimizing the potential rising of warm air through the lift shaft up into the telescope area. Appropriate door seals and other strategies shall be specified for that purpose. The lift will be mounted directly to the telescope Pier. All measures to minimize the transmission of vibration from the lift mechanisms to the telescope Pier and mount structure shall be incorporated into the design. This shall include the selection of the most vibration-free equipment available and the provision of appropriate vibration isolating elements.

3.5.4 Facility Cranes

All of the following cranes shall comply with Crane Manufacturer's Association of America (CMAA) standards for Class C indoor use, applicable OSHA and NEC standards and other applicable regulations.

Architect's specification for cranes shall include proof loading to verify safe capacity.

The acceleration/deceleration of crane trolleys and lifting devices shall be as smooth and linear as possible within the manufacturer's standard equipment. The Architect shall consult with AURA and the crane manufacturer(s) to determine the optimal drives and control mechanisms.

3.5.4.1 **Receiving and Staging Area Crane**

This crane will be used to lift and maneuver the components of the M1 assembly, including the 4.2 m diameter mirror itself, for initial integration and for subsequent recoating preparation. It will also be used to handle telescope subassemblies, optical instruments, as well as other observatory equipment and general materials. It shall be designed with a hoist mechanism that moves along a bridge structure which in turn travels along a set of primary side rail beams. The design of the crane and all its components shall be developed, in consultation with AURA, to insure its adequacy for critical tasks and in general to maximize its functionality.

The capacity of the receiving area crane is expected to be approximately 20 tons (40,000 lbs.) (to be verified)

The minimum hook height above the base level floor shall be 25’-6”. Alternate beam and hoist configurations, and the specification of low-headroom trolleys shall be considered as a means of maximizing the hook height.

Horizontal coverage area of this crane will be a critical to its functionality. Optimal coordination with the building structure design and alternate configurations of the main crane rail beams shall be considered in the Architect’s design to maximize the crane coverage area.

The trolleys for travel in both (X-Y) horizontal directions shall be motor driven with continuously varying speed control (approximately 1 to 30 feet per minute – to be verified)

The lifting device shall be a wire rope hoist with continuously varying speed control. (approximately 1 to 10 feet per minute – to be verified)

3.5.4.2 **Instrument Preparation Lab Crane**

This crane will be used to lift and maneuver optical instruments and their components as required for repair activities and preparation for their use on the coudé platform. This will involve precise placement of optical elements and careful maneuvering of instrument components for alignment, assembly and other critical operations. The heaviest task that this crane is expected to be designed for is maneuvering the large optical benches that form the stable base for many solar instruments. The ATST instruments are still in a formative stage of design. As the specific handling requirements are developed they will be conveyed by AURA to the Architect and shall be incorporated into the design of this crane.

The capacity of the instrument preparation lab crane is expected to be approximately 5 tons (10,000 lbs.) (to be verified)

The minimum hook height above the coudé floor level shall be 13’-4”.

This crane shall be designed in a bridge configuration for optimal horizontal coverage and utility.

The trolleys for movement of the crane along its rail(s) shall be motorized with continuously varying speed control (approximately 1 to 20 feet per minute – to be verified)

The lifting device shall be a wire rope hoist with continuously varying speed control. (approximately 1 to 10 feet per minute – to be verified)

The crane shall be equipped with a shield device to protect the instruments that are being serviced from debris or lubricants falling from crane mechanisms. The effective design of that shield shall be determined in consultation with AURA and the crane manufacturer.

3.5.4.3 **Coudé Lab Crane**

An overhead monorail crane (N.I.C.) will be provided inside the coudé lab extending to the entry vestibule outside the Pier. This crane will provide for lifting and maneuvering of instruments and other equipment as they are transferred out of the telescope Pier and onto the landing in front of the platform lift. While this crane is <u>not</u> to be designed or specified by the Architect, the related elements of the Support Facilities shall be coordinated with the design of this crane to ensure clear passage of the beam and hoist, adequate travel range for the anticipated tasks, and adequate structural support for the crane and its payloads.

3.5.5 Articulating Boom Lifts

Two articulating boom lifts on fixed mounts are to be provided as an integral part of the Support Facilities, as indicated in the Schematic Design Drawings. One is mounted inside the enclosure on the fixed telescope floor and the other is mounted outside on the roof of the Operations Building at the level of the Lower Enclosure catwalk. These lifts will be utilized by observatory personnel for inspection and maintenance of the telescope and Enclosure.

The Schematic Design is based on the inside lift as a modified Genie S-45 and the outside lift as a modified Genie Z-80/60, or equivalent models of other manufacturers having similar reach range, capacity and dimensions. <u>Both articulating boom lifts shall have the following basic characteristics</u>:

The minimum payload carrying capacity of the lifts shall be 600 lbs.

Reach range of the lift platform shall be 80 ft. vertically and 60 ft. horizontally.

Rotation of the lift base shall be 360° continuous. Horizontal rotation of the lift platform shall be 160° minimum. Vertical rotation of the main jib shall be 110° minimum, with a separate articulating extension connecting it to the lift platform.

The lift platform shall be 2'-6" x 6'-0" minimum. The platform shall be equipped with guard rails, safe tie-off points, manufacturer's standard set of controls, and electrical outlets – including an outlet suitable for arc welding equipment. AURA will provide additional information regarding specific functional capabilities and accessories of the lifts.

Stowed dimensions of the lifts and accessibility of the lift platforms shall be approximately as indicated on the Schematic Drawings. The Architect's design for structural mounting of the lifts shall ensure that all moments and eccentric loads induced by any potential position and loading condition of the lifts are safely reacted in the fixed building structure.

The design of the articulating boom lifts shall comply with the requirements of ICD 5.0/6.5, Enclosure-to-Handling Equipment Interface Control Document. The Architect shall interact as required with the contractors of the Enclosure and the telescope mount assembly to ensure that the functional and dimensional requirements are satisfied. The basic design and installed configuration of the articulating boom lifts shall comply with OSHA requirements and other applicable safety standards.

4. GENERAL AND TECHNICAL REQUIREMENTS

4.1 OVERALL DESIGN OBJECTIVES

4.1.1 Minimize Thermal Turbulence

An essential goal in the Architect's design of the ATST Support Facilities shall be to minimize contribution by the buildings to thermal turbulence in the telescope optical path. All viable strategies shall be employed towards this goal. To the extent possible the buildings shall be constructed of materials with beneficial thermal inertia properties. Exposed exterior surfaces shall be white. All coatings shall be selected for low heat absorption and high emissivity, especially where exposed to daytime insolation. Wall and roof assemblies that enclose conditioned spaces shall be designed as effective barriers to air infiltration and shall have composite minimum thermal insulation values of R-30 for roofs and R-20 for walls or as required by applicable codes. Air conditioning and other mechanical equipment shall be remotely located or ventilated to a remote outlet. Vertical shafts and chases shall be effectively sealed to prevent chimney-effect rising of warm air that could migrate into the telescope optical path. Forced and natural ventilation shall be employed to promote thermal equilibrium in the entire vicinity surrounding the telescope.

4.1.2 Efficiency, Standardization, and Simplicity

Controlling construction cost within a defined budget will be a major factor in evaluation of the Architect's design of the Support Facilities. Efficient use of standard commercially available materials and an effort to avoid costly construction procedures shall be an integral part of all aspects of the design. Equipment and materials that are off-the-shelf or previously successfully utilized by the Architect or by AURA will be favored, in order to reduce cost and risk and to enhance maintainability of the facility. Standard details and solutions utilized in other observatories or buildings of similar function will be employed wherever possible.

An important factor in evaluation of the Architect's design will be economy of means and simplicity of detailing. Design solutions that achieve secure, simple connection of materials using a minimum of fasteners and components will be favored. Dependable performance and functionality shall be achieved through fundamental elegance of design and efficient use of appropriate materials. Space efficiency, functional efficiency, and energy efficiency shall be maximized in all aspects of the Architect's design.

All elements of the Support Facilities shall be designed or selected to allow for straightforward handling and installation at the remote construction site. Special consideration shall be given to service and replacement part availability on the Island of Maui. Components shall be sized to allow passage for installation or replacement through standard doors and openings.

4.1.3 Reliability & Durability

All building systems shall be designed to meet the 50-year anticipated service life of the telescope. Wherever possible and affordable, building components and systems shall be designed to exceed the lifetime of the facility.

The remote nature of the site will necessitate robust systems that are highly reliable and can be readily repaired. The rated duty cycle of all facility equipment shall allow for 24 hour-a-day everyday use of the facility with no more than 10 days total down time per year for maintenance and repair. Wherever possible and affordable, redundancy of equipment shall be provided to allow continuation of observing operation in the event of equipment failure. The Mean Time Between Failure (MTBF) for critical facility equipment shall be no less than 5000 hours, or approximately 2 years.

4.1.4 Provision for Maintenance

Architect's design shall minimize concealed or inaccessible spaces, surfaces, and components that may be subject to deterioration or failure. All facility equipment and moving parts of the building shall be designed to be easily cleaned, inspected, maintained or replaced.

All routing of utility lines shall be subject to approval by AURA. Where specifically required, piping and conduit runs shall be accessible.

The Support Facilities shall be designed such that all necessary maintenance operations can be easily carried out without risk to personnel or critical equipment. Equipment and materials shall be selected and designed such that routine servicing and general maintenance tasks are expected to take no longer than 8 hours by two trained observatory staff members.

All areas of the building and all finished surfaces shall promote general cleanliness of the facility. Concealed or difficult to clean surfaces where dust, moisture or contamination could collect shall be avoided. All exposed surfaces shall be painted or otherwise permanently protected against corrosion. All finishes shall be durable against atmospheric and sun exposure, airborne dust impact, personnel access on and around the building, and any other expected wear-inducing conditions.

Hatches and access panels for entry into concealed spaces shall be designed to be easily opened or removed by one person, and to not present a hazard when open.

4.1.5 Adaptability

Wherever possible the Architect's design shall allow for adaptability to meet unanticipated future needs. In utility areas and chases 100% extra space shall be allowed for future additional piping, conduits or equipment. Consideration shall be given, in consultation with AURA, to specific ways that the facility could be modified or expanded in the future to accommodate new instruments, additional personnel or other functionality enhancements.

4.2 APPLICABLE CODES, REGULATIONS, & STANDARDS

The following codes and regulations shall form a partial basis of compliance for design of the ATST Support Facilities. Unless specified otherwise by AURA, the most current edition shall govern. In the case of conflict between the published standards, the standard affording the most protection to the ATST Project shall prevail. In the case of conflict between a standard and this document, the more stringent of the two shall prevail.

- International Building Code, 2006 edition;
- Code of Federal Regulations 10 CFR Parts 433 & 434
  Energy Efficiency Standards for Design and Construction of New Federal Commercial and High-Rise Residential Buildings (433);
  Energy Code for New Federal Commercial & High-Rise Residential Buildings (434)
- International Energy Efficiency Code, 2006 edition; applicable provisions of IEEC in coordination with the above CFR standards

- International Mechanical Code, 2006 edition;
- International Plumbing Code, 2006 edition;
- National Electric Code, 2005 edition;
- Occupational Safety and Health Act (OSHA);
- American Concrete Institute (ACI) 301, 318 and other applicable specifications;
- AISC American Institute of Steel Construction - Structural Steel for Buildings;
- AWS American Welding Society AWS D1.1-92 - Structural Welding Code – Steel;
- ASTM American Society for Testing and Materials (various applicable standards)
- ASME A17.1 Elevator and Escalator Code (Personnel Elevator & LU/LA Lift)
- ASME B20.1 Safety Standard for Conveyors and Related Equipment (Platform Lift)
- The Americans with Disabilities Act Accessibility Guidelines (ADAAG)
- Uniform Federal Accessibility Standards (UFAS);
- Materials and methods specifications as stipulated by Maui Electric Co. (MECO),
- Specifications of Hawaiian Telecom, and other utility authorities;
- Manufacturer’s specifications and trade standards for all materials & equipment;
- Hawaii Department of Health standards for wastewater processing and disposal;
- Haleakalā High Altitude Observatory Long Range Development Plan
- Final Environmental Impact Statement for the Proposed ATST Facility at Haleakala Observatory, including all stipulated mitigations and conditions;

TN-0046 ATST Facility Design – Assessment of Code Requirements provides a background reference to the applicable codes and code assumptions that have been applied in the Schematic Design and which are presumed to be applicable to the Architect's design of the Support Facilities. Any codes or regulations, other than those listed above and referred to in TN-0046, utilized by the Architect to establish minimum design standards for the ATST facility shall be approved by AURA, and copies of the referenced standards shall be provided when requested.

4.3 General Site and Climatic Conditions

The site for the ATST facility is at the summit of Haleakalā, 9,990 feet above sea level, on the rim of a volcanic cinder cone near the center of the east portion of the island of Maui. Haleakalā Observatory is at a remote location approximately 45 minutes by car from the nearest populated support communities. Detailed information regarding logistical information for the site is provided in SPEC-0030 Conditions for Working at the ATST Project Site. Detailed climatic data – including defined observing and survival conditions – are provided in TN-0094, Environmental Conditions at Haleakalā.

Local air pressures, temperatures, precipitation, wind and other environmental conditions that are affected by the altitude and by local weather conditions will impact the design of the ATST Support facilities. All assemblies, subassemblies, parts and components of the Support Facilities shall be selected and designed to withstand these conditions. Equipment capacities and specifications based on standard atmospheric air pressures or incorporating air cooling shall be de-rated for the reduced air density at the site. Freeze-thaw cycle and icing conditions shall be considered in the design of concrete structures and other susceptible elements. Coatings on structural steel and other interior elements that will be exposed for lengthy periods during construction shall be specified to withstand the site conditions without unacceptable deterioration.

Seismic design of the all of the ATST Support Facilities shall consider the levels of ground acceleration expected during the maximum anticipated earthquake, defined in the 2006 IBC. Design of the telescope Pier and foundation shall additionally analyze the full spectral range of accelerations experienced in recent maximum events in the region. Architect's analysis shall verify that under the highest anticipated seismic loading, the maximum stresses in the structure shall not exceed allowable, safe, and elastic stress levels. TN-0095 Preliminary Analysis of Seismic Design for the ATST Facilities provides an initial study of seismic design criteria that was used to determine structural parameters for the Schematic Design.

4.4 Structural Design Requirements

Stresses in all components of the building structure shall be maintained within safe working values for all possible combinations of fabrication, erection, operation, and survival conditions. Dead loads, live loads, temperature effects, wind effects, and seismic loads shall be combined per 2006 IBC requirements when determining the critical cases for maximum stresses and deflections. Unless otherwise specified by AURA, the design live load factor of all floor areas shall be 100 pounds per square foot.

Seismic design of all elements of the Support Facilities in relation to adjacent structures is a critical concern. The Architect shall perform a detailed, dynamic, systems-level FEA on the Pier, Lower Enclosure, and other building elements to ensure that no pounding or collision between elements will occur during a maximum defined seismic event, to be determined in consultation with AURA. The Architect shall also provide frequency and amplitude predictions for the movement of the telescope-level and azimuth mechanical-level flooring, where such flooring comes in close proximity to the TMA and/or the Enclosure.

The ATST telescope and instruments will be extremely sensitive to any impacts or vibrations induced on the structures that directly or indirectly support them. All possible strategies shall be implemented in the Architect's design for isolation of building foundations and structure from the telescope Pier or other potential paths of vibration transmission. Specifications and mounting conditions for facility equipment shall be designed to minimize potential induced vibration. Vibration transference to the pier/telescope assembly shall be strictly minimized in the Architect's design. Isolation joints shall be included to effectively isolate the Pier and any structures directly mounted on it from any other structures of the Support Facilities.

The foundations of the Support Facilities shall be sized to support and carry all operational and survival loads. In particular, long-term creep and/or settling of the Pier foundation shall be strictly minimized, as this can impact performance of the telescope. All foundation systems of the ATST Support Facilities shall be designed to be compatible with the soil properties expected at the site, as characterized by CON-0014 Island Geotechnical Soils Report. Any insufficiency in the provided information shall be brought to the attention of AURA. Following the initial leveling excavation, described above in the Site Infrastructure section, the Architect shall consult with AURA regarding the potential requirement and scope of any additional geotechnical testing to verify the adequacy of the foundation design.

4.5 Mechanical HVAC Requirements

The Heating Ventilation and Air Conditioning (HVAC) requirements for the ATST facility shall be based on the climatic conditions described in TN-0094 and the requirements described in the Schematic Design

Requirements for each of the building spaces. In general, the HVAC system will be as normally provided for typical office, laboratory and other functional areas as described in this document.

The primary means for cooling and heating the building spaces in the Schematic Design is a heat pump and air handler system. The total capacity of the system is expected to be approximately 10 tons (120,000 BTUH). In consultation with AURA, the Architect shall consider alternatives to this proposed system that may result in better economy or more refined control. The preferred system shall be fully designed and specified for the heat loads and environmental control requirements to be developed in consultation with AURA.

A special concern will be the prevention of undesirable migration of heated air from sources in the building to the coudé lab and telescope levels of the enclosure. Creating negative relative pressure in air spaces adjacent to those areas, effective door seals in vestibules, physical barriers to the passage of air in concealed spaces and other strategies shall be included in the overall environmental system design of the facility.

The coudé lab inside the Pier will be conditioned by a dedicated clean room HVAC system that is not included in the design of the Support Facilities. The Pier and Lower Enclosure do, however have interfaces to this system which are defined in ICD-3.1/6.2 Coudé Environmental Systems-to-Buildings.

The Lower Enclosure will be actively ventilated by fans at two locations between the ground level of the Lower Enclosure and the Operations Building, as shown in the Schematic Design Drawings. The ventilation air will be exhausted through actively controlled louver panels in the walls of the Operations Building. Requirements for the fans louvers and other components of that system shall be further developed and fully specified as part of the Architect's work. Specific requirements for this system that will impact the design of the Support Facilities will be developed by AURA and provided to the Architect.

The surface of the upper rotating enclosure will be actively cooled with a liquid cooling system (N.IC.). Provision for supply and return piping runs; building space for chillers and other equipment; power for chillers and pumps; spill containment and other elements of that system have been included in the Schematic Design of the Support Facilities and shall be further developed and specified as part of the Architect's work. Specific requirements for this system that will impact design of the design of the Support Facilities will be developed by AURA and provided to the Architect.

Design of an integrated system for control of the facility HVAC equipment shall be provided as part the Architect's Construction Documents. That control system shall be designed to interface appropriately with the Observatory Control System (OCS) the Enclosure Control System (ECS) and other related systems. The specifics of the required sensing and control and the relevant details of the related control systems will be developed by AURA and provided to the Architect.

4.6 ELECTRICAL DESIGN REQUIREMENTS

The design of the Support Facilities shall provide adequate electrical power for all observatory systems. The primary source for this power will be the Haleakalā Observatory substation of Maui Electric Co. (MECO). A back-up generator with automatic transfer switch shall also be included in the Architect's design. The anticipated electrical loads for equipment not designed and specified as part of this Contract will be determined by AURA and provided to the Architect. Appropriate switchgear, overcurrent protection, distribution systems, and other elements of the electrical system shall be fully designed and specified as part of the Architect's work. The preliminary schedule for the peak electrical demand for the ATST facility is included below. The information from other Project elements required for finalization of this schedule will be provided by AURA following the 50% Design Development Review as defined in the Statement of Work.

▪	Lights & general use outlets	50 KVA
▪	Chiller, pumps and air-handling units	160
▪	Fans for Lower Enclosure & utility bldg.	100
▪	Lifting devices	160
▪	Instrument utilities	50
▪	Enclosure mechanisms	80
▪	Telescope mount & hydrostatic bearings	90
▪	Computer control hardware	15
▪	Instruments & rotating platform	60
▪	Mirror mechanisms & thermal control	15
▪	Mirror coating facility	50
	TOTAL	830 KVA

The Architect's design of the distribution system shall include provision for all required voltage levels and shall include a separate wiring system for Uninterruptible Power Supply (UPS) protected circuits for critical equipment as identified by AURA. An approximation of the different levels and types of power required in the individual building spaces is provided in the Schematic Design Drawings and in SPEC-0063 Interconnects and Services. The specific requirements for generator backed-up power, UPS power and normal building power at different voltage levels will be further developed in consultation with AURA.

A power and energy management system (PEMS) shall be included in the Architect's design of the electrical system. A primary objective of the PEMS will be to maintain the peak power utilization of the facility below a MECO-established threshold to keep the utility rate paid by ATST in the lowest possible bracket. A power monitoring unit and a programmable logic controller will be located near the main electrical switchgear in the Utility Building. Current transformers and other monitoring hardware will be installed on the primary entrance conductors and at major power-consuming equipment throughout the observatory. Distributed control wiring and relays will be employed to implement computer-controlled load shedding to control peak power consumption. The Architect shall consult with potential vendors to effectively integrate the PEMS into the electrical design of the facility. All major equipment that requires electrical power shall be specified to be compatible with BACnet or other ethernet/IP communications protocol to allow energy management, control, and status monitoring. Additional detail regarding the PEMS and the distributed monitoring system will be determined in consultation with AURA.

Architect's design of the support facility electrical system shall minimize electromagnetic interference with scientific instruments and other telescope systems.

A special concern for the entire ATST observatory electrical system will be achieving an effective earth ground for protection of equipment and personnel against lightning. Another important function of this system will be to minimize unintended voltage potentials between separate instrument and control system components. A separate consultant will be engaged by AURA to recommend an appropriate grounding system for the facility. The Architect shall interface with this consultant as required to coordinate elements of the electrical system and other aspects of the facility design with the recommended grounding measures. These measures are expected to include an earth electrode system as shown in the Schematic Design Drawings, embedding of grounding grids into concrete building elements, surge suppression devices and other means. Any infrastructure required for these measures shall be incorporated into the Architect's design.

Design of data and control cabling, low voltage wiring, and other specialized observatory systems will be by others (N.I.C.). Where required and as specified by AURA the Architect's design shall include cable trays, conduit runs, pull boxes and other special provisions for those systems.

Requirements for fire alarm system, an electronic card access system and other special building-related systems will be developed in consultation with AURA and shall be incorporated by the Architect into the design of the Support Facilities.

5. SAFETY REQUIREMENTS

The Architect's design shall impose no circumstances whereby any part, component, subassembly, or assembly of the ATST Support Facilities is unsafe for personnel or equipment, either during construction or during the operational lifetime of the facility. Safety is a prime consideration for all aspects of the design.

Appropriate guards and safety interlock systems shall be designed into all potentially hazardous moving components of the support facility, in accordance with OSHA and other applicable standards.

Requirements for fire detection and other special safety systems shall be determined during design development in consultation with AURA, the local Fire Marshall and other authorities.

All assemblies, subassemblies, parts and systems that comprise the ATST Support Facilities shall be designed and implemented in compliance with the SPEC-0031 ATST Safety and Health Specifications for Contractors.

6. DRAWINGS & SPECIFICATIONS

The Construction Documents for the ATST Support Facilities shall be provided by the Architect in accordance with the Statement of Work. All design documentation, including: plans, elevations, sections, detail drawings, schedules, calculations of materials, analysis reports, and other relevant documentation shall be submitted to AURA for approval per the requirements of the Contract.

AURA shall have free access to all design calculations, and if considered inadequate, may require that further calculations shall be made to ensure that the requirements are met.

All detail design drawings shall be in Imperial (feet and inches) units with System International (metric) secondary units shown in parentheses. All analyses may be performed in either Imperial or System International units. Final derived values from analyses shall be shown in Imperial units with System International equivalents shown in parentheses.

All design drawings shall be generated in (or compatible with) the latest version of AutoCAD. Electronic files of these drawings, along with printed hard copies, and PDF files shall be provided to AURA upon completion of the Contract as required by the Statement of Work.

All computer aided design (CAD) 3D models of the Support Facilities shall be provided to AURA in a file format compatible with the latest version of SolidWorks.

APPENDIX D

MAINTENANCE PLAN

for the

Advanced Technology Solar Telescope

Haleakalā High Altitude Observatory Site
Haleakalā, Maui, HI

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MAINTENANCE PLAN

For a complex observatory like the Advanced Technology Solar Telescope (ATST), periodic and regular maintenance of facility equipment and subsystems will be required to ensure high reliability and scientific productivity. As the Construction phase is nearing completion, and while the Integration, Test & Commissioning (IT&C) phase is underway, ATST will begin implementing a specialized Preventative Maintenance (PM) program. This PM program will be managed by a full-time engineer, who will work with a staff of trained technicians and service personnel.

To help organize and plan the PM program, a Computerized Maintenance Management System (CMMS) will be used to manage both time-based and performance-based maintenance activities. Work orders generated with the system will be linked to information about the tools, parts, drawings, manuals, and instructions needed for each maintenance activity including preventative, predictive, and corrective actions. It is anticipated that the system will be integrated as an enterprise-based system in order to be used to track part inventories and order spare parts as required. Predictive maintenance activities are likely to include technologies such as thermography, oil analysis, ultrasonic leak detection and equipment monitoring, vibration analysis, motor analysis, and other trend analyses. The CMMS will be a PC-based system with either stand-alone specialized software, or it will be implemented as part of the Facility Control System. All facility equipment and systems will be included as a part of this system in order to document and schedule all maintenance of the equipment and systems in compliance with the manufacturer requirements by trained technicians.

Other, non-facility equipment, such as optic assemblies, instruments, and polarization and calibration equipment, will be maintained by ATST project engineers and scientists assigned specifically to those pieces of equipment. For example, periodic cleaning and recoating of optic assemblies will be performed by ATST optics engineering and specialty-trained staff, and scheduled in advance of need and at regular intervals.

All PM tasks will be conducted on a daily, weekly, monthly, and/or yearly basis, depending on the needs of the individual subsystem and the manufacturers' requirements and recommendations. The following chart shows the approximate PM frequency for the major subsystem areas of the ATST.

System	Daily	Weekly	Monthly	Yearly
1.0 Telescope				
1.1 Telescope Mount Assembly	X		X	
1.2-1.5 Optic Systems		X	X	X
1.7-1.8 Alignment & Acquisition Systems			X	
2.0 Wavefront Correction			X	
3.0 Instrument Systems				
3.1 Instrument Lab Facility		X	X	
3.2-3.6 Instruments & Camera Systems			X	
4.0 High-Level Controls & Software				X
5.0 Enclosure				
5.1, 5.2, 5.5-5.8 Enclosure Carousel, Drives & Controls		X	X	X
5.4 Enclosure Thermal System	X		X	X
6.0 Support Facilities & Buildings				
6.1, 6.2, 6.5, 6.6 Buildings & Infrastructure		X	X	
6.3 Facility Equipment	X		X	X
6.4 Coating & Cleaning Facilities				X
7.0 Remote Operations Building			X	

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APPENDIX E

Programmatic Agreement

for the

Advanced Technology Solar Telescope

Haleakalā High Altitude Observatory Site
Haleakalā, Maui, HI

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National Science Foundation
4201 Wilson Boulevard
Arlington, Virginia 22230

November 25, 2009

Dear Consulting Parties,

I am writing to inform you that the final version of the Programmatic Agreement (PA) has now been fully signed by all primary and invited signatories. The fully executed document will be posted on the website within the next week at: http://atst.nso.edu/library/NHPA. As I mentioned in my last letter, if any of the consulting parties wish to sign the PA as "concurring parties," they may still do so by signing the signature page on page 21 of the PA, entitled, "Concurring Parties to this Programmatic Agreement," and either scan it and e-mail it to me at: cblanco@nsf.gov, or fax it to me at: 703-292-9041. Please then mail the original signature page to me at the following address: Caroline M. Blanco, Assistant General Counsel, National Science Foundation, 4201 Wilson Blvd., Suite 1265, Arlington, VA 22230.

I also wish to take this opportunity to invite all Native Hawaiian Organizations (NHOs), regardless of whether they participated as consulting parties in the Section 106 process, to the first meeting of the ATST Native Hawaiian Working Group (ATST NHWG). The meeting, which will be focused on the logistics and agenda for the Group, will take place on Tuesday, December 15, 2009, from 3:00 p.m. to 5:00 p.m. (HST) in the conference room at the Institute for Astronomy, Maikalani Office, 34 Ohia Ku Street, Pukalani, Hawaiʻi 96768. A map of this location can be found at: http://www.ifa.hawaii.edu/maps/Maui-ATRC.html. If you are a representative of a NHO, I hope that you will join us for this important first meeting. Please also pass on this invitation to any other NHOs that you believe may be interested in participating in the ATST NHWG.

Thank you all, again, for your valuable contributions to the Section 106 process. I hope that those of you who are representatives of NHOs will be available to participate in the meeting on December 15th. If you are able to attend the meeting, I would greatly appreciate receiving an e-mail to that effect so that I can begin to assemble an e-mail list of ATST NHWG members.

Best regards,

Caroline M. Blanco

Caroline M. Blanco
Assistant General Counsel
National Science Foundation
4201 Wilson Blvd., Suite 1265
Arlington, VA 22230
(703) 292-4592
cblanco@nsf.gov

PROGRAMMATIC AGREEMENT
among
The National Science Foundation,
The National Park Service,
The Advisory Council on Historic Preservation,
The Hawai'i State Historic Preservation Officer,
The Association of Universities for Research in Astronomy, and
The University of Hawai'i (for the benefit of its Institute for Astronomy)
Regarding the Advanced Technology Solar Telescope Project,
Haleakalā, Maui, Hawai'i

WHEREAS, the National Science Foundation (NSF) received a proposal from the Association of Universities for Research in Astronomy (AURA) to fund the construction and operation of the Advanced Technology Solar Telescope (ATST Project). If approved by NSF, the proposed ATST Project would be located within the University of Hawai'i (for the benefit of its Institute of Astronomy) (UH IfA) Haleakalā High Altitude Observatory (HO) site at the summit of Haleakalā, County of Maui, Hawai'i. If the proposed ATST Project is approved for funding by NSF, this Programmatic Agreement (PA), prepared pursuant to 36 C.F.R. § 800.14(b), shall be effective for a period of ten (10) years beginning from the "Effective Date" defined in Section IV. K., herein. If unresolved issues remain within two years of the expiration date of this PA, NSF shall consult with the other Signatories regarding the appropriateness of developing a subsequent agreement;

WHEREAS, the Haleakalā National Park (HALE) road is the only access to HO and, therefore, the National Park Service (NPS), pursuant to 36 C.F.R. § 5.6, is mandated to issue a Special Use Permit (SUP) to allow commercial vehicles to operate on the HALE road during the construction and operation phases of the proposed ATST Project;

WHEREAS, the "proposed Undertaking" that is the subject of this PA encompasses both the construction and the initial phase of the operation of the proposed ATST Project, which includes an observatory facility, telescope enclosure, support and operations building, utilities building, and parking area. The proposed Undertaking will, if approved, also include all of the following activities in support of the ATST Project construction and operation: land clearing, demolition activities, grading/leveling, excavation, soil retention and placement, construction, remodeling of the Mees Solar Observatory building, paving, and other site improvements. The proposed Undertaking further includes the use of the HALE road for the construction and operation of the ATST Project, in accordance with the SUP to be issued by the NPS. Because of the complexity of the proposed Undertaking and its impacts on historic properties (as that term is defined in 36 C.F.R. § 800.16(l)(1)) within the Haleakalā summit area, a Traditional Cultural Property (TCP), this PA has been prepared in accordance with 36 C.F.R. § 800.14(b);

WHEREAS, NSF has defined, and by letter of July 21, 2009, the State of Hawai'i State Historic Preservation Officer (SHPO) concurred that the Area of Potential Effects (APE) for the proposed Undertaking includes the HO site, a 50-foot corridor along the historic

Haleakalā National Park road measured 25 feet from each side of the center line (Park Road Corridor), both of which are located within the Crater Historic District. HO and part of the Park Road Corridor are also located within the Haleakalā summit area, a TCP. A map of the APE and a tax map are attached hereto as, "Exhibit A";

WHEREAS, NSF, through the consultation process set forth in Section 106 of the National Historic Preservation Act, 16 U.S.C. 470f (NHPA) (the Section 106 consultation process), has determined, in consultation with the SHPO, that the summit of Haleakalā is a historic property that has spiritual and cultural significance to Native Hawaiians (Kanaka Maoli) and is a TCP that satisfies the criteria to be eligible for listing on the National Register of Historic Places (National Register);

WHEREAS, through the Section 106 consultation process, it is acknowledged that Haleakalā has spiritual and cultural significance, and is a very sacred place to Kanaka Maoli and continues to be used by them for ceremonial practices;

WHEREAS, through the Section 106 consultation process, it is acknowledged that the proposed Undertaking will have an adverse effect on the TCP and associated cultural practices as a result of the location, height, volume, and color of the proposed observatory facility, telescope enclosure, support and operations building, utilities building, and parking area for the proposed ATST Project;

WHEREAS, the Park Road Corridor is located within the Crater Historic District, which is listed on the National Register and the State of Hawai'i Inventory of Historic Places. The Park Road Corridor is also partially located within the Haleakalā summit area, a TCP. The historic properties within the Park Road Corridor have been determined eligible for listing on the National Register by the NPS in consultation with the SHPO;

WHEREAS, NSF has coordinated with the NPS on ways to avoid, minimize, or mitigate the adverse effects the proposed Undertaking has on historic properties pursuant to the regulations implementing Section 106 of the National Historic Preservation Act, 16 U.S.C. 470f (NHPA), 36 C.F.R. Part 800. NPS, because of its role in issuing the SUP, has Section 106 responsibilities for this Undertaking, and has, therefore, participated in the development of this PA and is a Signatory herein in order to fulfill those duties;

WHEREAS, NSF has consulted with the SHPO on ways to avoid, minimize, or mitigate the adverse effects the proposed Undertaking has on historic properties pursuant to the regulations implementing Section 106 of the NHPA, 36 C.F.R. Part 800. The SHPO participated in the development of this PA and is a Signatory herein;

WHEREAS, the Advisory Council on Historic Preservation (ACHP) has participated in the Section 106 consultation process, pursuant to 36 C.F.R. § 800.2(b), and NSF has consulted with the ACHP on ways to avoid, minimize, or mitigate the adverse effects the proposed Undertaking has on historic properties pursuant to the regulations implementing Section 106 of the NHPA, 36 C.F.R. Part 800. The ACHP participated in the development of this PA and is a Signatory herein;

WHEREAS, AURA, through the National Solar Observatory (NSO or AURA/NSO), is the ATST project applicant. AURA/NSO will be responsible for the construction, installation, operation, and management of the proposed ATST Project if it is approved. Because it is the ATST project applicant, AURA/NSO has participated as a consulting party in NSF's Section 106 consultation process for the proposed ATST Project pursuant to Section 106 of the NHPA. AURA/NSO participated in the development of this PA and was invited to sign as a Signatory herein;

WHEREAS, UH IfA has the responsibility for the overall control and management of HO. UH IfA has also developed the Long Range Development Plan (LRDP) for HO, which includes Best Management Practices directed at the preservation and protection of cultural, archeological, and historic resources outlined in Section 9.3.2 of the LRDP for HO, attached hereto as, "Exhibit B." Accordingly, UH IfA has participated as a consulting party in NSF's Section 106 consultation process for the proposed ATST Project. UH IfA participated in the development of this PA and was invited to sign as a Signatory herein;

WHEREAS, NSF has identified and consulted with Native Hawaiian Organizations (NHOs) and Kanaka Maoli on ways to avoid, minimize, or mitigate the adverse effects the proposed Undertaking has on historic properties pursuant to the regulations implementing Section 106 of the NHPA, 36 C.F.R. Part 800, and invited them to participate in this process as consulting parties. Those NHOs who became consulting parties were invited to participate in the development of this PA and sign herein as Concurring Parties. A list of NHOs who became consulting parties in this Section 106 consultation process is attached hereto as "Exhibit C";

WHEREAS, NSF has identified through both the Section 106 and National Environmental Policy Act processes other interested parties and members of the public who were interested in participating in NSF's Section 106 consultation process as consulting parties. NSF consulted with those who joined NSF's process as consulting parties on ways to avoid, minimize, or mitigate the adverse effects the proposed Undertaking has on historic properties pursuant to the regulations implementing Section 106 of the NHPA, 36 C.F.R. Part 800. NSF also invited all consulting parties to participate in the development of this PA and sign as Concurring Parties;

WHEREAS, NSF carried out consultation by holding over 30 formal and informal consultation meetings that took place both in person and via teleconference during the period from January, 2006, through August, 2009; and

NOW, THEREFORE, NSF, the ACHP, the SHPO, the NPS, AURA/NSO, and UH IfA (collectively referred to herein as, "the Parties" or "the Signatories") agree that NSF shall ensure that this PA will be implemented after the Effective Date, as defined in Section IV. K. of this PA; the NPS shall ensure that all stipulations listed under Section III of this PA (NPS Area of Responsibility) are implemented.

STIPULATIONS

NSF, in coordination with the proposed ATST Project applicant, AURA/NSO, shall ensure that all of the stipulations in Sections II (NSF Area of Responsibility) and IV (Administrative Stipulations) of this PA are carried out. NPS shall ensure that all stipulations under Section III (NPS Area of Responsibility) are carried out.

I. Roles and Responsibilities

On the Effective Date, as defined in Section IV. K., herein, the following entities are obligated to carry out their distinctive roles and responsibilities as set forth in this PA:

A. NSF

NSF is the lead federal agency responsible for ensuring that the measures in this PA are carried out. NSF's primary areas of responsibility are set forth in Sections II and IV of this PA. NSF's role includes both directly carrying out certain activities and working with non-federal entities to ensure that certain stipulations contained in this PA are implemented.

B. NPS

The NPS is a federal agency that has a co-lead responsibility with NSF for ensuring that the measures in this PA are carried out. The NPS' role in this PA derives from its issuance and enforcement of the SUP and, as such, the NPS is responsible for ensuring that the stipulations in Section III of this PA are implemented.

C. AURA/NSO

AURA/NSO is the project applicant and, as such, has specific responsibilities throughout this PA related to the construction and operation of the ATST Project. Some of these responsibilities are to be carried out solely by AURA/NSO, and others are shared with NSF and/or non-federal entities. The responsibilities of AURA/NSO will be assumed by any successor entity.

D. UH IfA

The HO site, which is near the summit of Haleakalā, is under the management and control of the UH through its IfA. The IfA establishes and enforces policies regarding access, use, and protection of HO. Under this PA, should the proposed ATST Project be approved for construction, UH IfA has specific responsibilities, some of which are shared with AURA/NSO and others which must be carried out in consultation with the ATST Native Hawaiian Working Group (ATST NHWG) and the SHPO.

E. SHPO

The SHPO's role in this PA is one of consultation with those parties having responsibilities for carrying out certain provisions of this PA.

F. ACHP

The ACHP's role in this PA is one of consultation and, also, to assist in the administration of this PA, particularly the resolution of disputes that may arise during post agreement activities.

G. ATST NHWG

The ATST NHWG's role in this PA is one of consultation concerning historic property matters related to the construction and operation of the ATST Project. This group will be established pursuant to Section II. A. of this PA to assist NSF, AURA/NSO, and UH IfA in carrying out their responsibilities under this PA.

H. CONSULTING PARTIES AND THE PUBLIC

All consulting parties, regardless of whether they elected to sign as a Concurring Party to this PA, and members of the public may continue to participate in this Section 106 consultation process by reviewing the status of implementation of this PA through information available on either the project website or at the project office and by raising any objection pertaining to the treatment of an historic property associated with the construction or operation of the proposed ATST Project. The process for raising such an objection is set forth in Section IV. F. of this PA.

II. NSF Area of Responsibility

A. Establishment of the ATST Native Hawaiian Working Group

NSF shall establish the "ATST Native Hawaiian Working Group," (defined previously as the "ATST NHWG"), comprised of NHOs, whose representatives will serve on a volunteer basis to provide input to NSF, AURA/NSO, and UH IfA on historic property matters related to the construction and operation of the ATST Project as referred to in this PA. The ATST NHWG shall formally meet twice each year; the first meeting shall take place within 60 days from the date this PA is fully executed by all Signatories (which may occur before the "Effective Date" of this PA, as defined in Section IV. K., herein). Informal contact may occur at any time on an as-needed basis. A framework for conducting the ATST NHWG shall be established by NSF during, or within a month after, the first formal meeting of the ATST NHWG. Any NHO that served as a consulting party in this Section 106 consultation process, but elected not to sign this PA as a Concurring Party, shall not be precluded from becoming a member of the ATST NHWG.

B. Implementation of Best Management Practices

AURA/NSO and UH IfA will, if the proposed Undertaking is approved, jointly implement the Best Management Practices directed at the preservation and protection of cultural, archeological, and historic resources outlined in Section 9.3.2 of the UH IfA Long Range Development Plan (LRDP) for HO (*see* Exhibit B).

C. Naming of HO Roads

UH IfA will consult with the ATST NHWG regarding the naming of the roads within HO and, informed by such consultation, will take reasonable steps to pursue the naming of the roads, recognizing that such naming is subject to state review and approval. UH IfA will work with AURA/NSO to post the decision regarding the naming of the roads within HO on the project website.

D. Retaining a Cultural Specialist

AURA/NSO will, after consultation with the ATST NHWG, hire a Cultural Specialist, as defined in Section 9.3.2 of the LRDP, to help ensure protection of existing historic properties and their traditional cultural values during construction. The Cultural Specialist will be a Kanaka Maoli, preferably a kupuna (elder) and if possible a kahu (clergyman) as well, and one who has knowledge of the spiritual and cultural significance and protocol of Haleakalā. The Cultural Specialist's knowledge should be concentrated in traditional and cultural practices and protocols. This commitment is consistent with consultations held during this Section 106 consultation process and Hawaiian culture. The formal involvement of a Cultural Specialist who understands Native Hawaiian culture is important for this site.

E. Decommissioning of the ATST

In all cooperative agreements governing the operation of the ATST Project entered into between NSF and AURA/NSO (or any successor entity), NSF shall include a provision requiring NSF to decommission and deconstruct the ATST Project within fifty (50) years from the date operations commence, unless, after consultation by NSF with NHOs, NSF decides otherwise, in which case NSF shall notify the ACHP, the SHPO, and the NPS.

F. Possible Repainting

In all cooperative agreements governing the operation of the ATST Project entered into between NSF and AURA/NSO (or any successor entity), NSF shall include a provision requiring the responsible entity to periodically [every two (2) years following the effective date of each cooperative agreement] reassess technological options for new types of coatings, more efficient cooling methods, or improved compensation for thermal turbulence, which may allow the ATST enclosure and buildings to be painted a color other than white to make the structures less noticeable, as requested by consulting parties during the Section 106 consultation process. If NSF and AURA/NSO (or any successor entity) determines that such future technology is an effective, reliable, and affordable solution that meets the scientific requirements of the ATST Project, NSF will consult with the ATST NHWG and the NPS regarding the repainting of the exterior structures of the ATST enclosure and buildings with a more neutral color. If the result of such consultation is that repainting is favored by the ATST NHWG and NPS, NSF will work with AURA/NSO (or any successor entity) to repaint the exterior structures of the ATST enclosure and buildings with a more neutral color.

AURA/NSO will post the results of each bi-annual reassessment of technological options on the project website.

G. Removal of Unused Facilities at HO

UH IfA, subject to funding and authorizations, will remove facilities, poles, antennae, and lines at HO that are determined by UH IfA to be unused or in excess of that which is needed. The removal of any such facilities, poles, antennae, or lines at HO pursuant to this stipulation shall be reported on the project website.

H. Removal of Reber Circle Site #50-50-11-5443

AURA/NSO, with the approval of UH IfA, shall remove Reber Circle Site #50-50-11-5443 in accordance with the data collection and documentation requirements set forth in the letter from Peter Young, Chair of the State Board of Land and Natural Resources and the State Historic Preservation Officer, State of Hawai'i Department of Land and Natural Resources to Erik Fredericksen, Xamanek Researchers, regarding Data Recovery Plan for SIHP 50-50-11-5443, dated June 14, 2006. After the removal is completed, AURA/NSO will post notice of such removal on the project website.

I. Hawaiian Star Compass

NSF, AURA/NSO, and UH IfA, in consultation with the ATST NHWG, will evaluate the feasibility of locating an area for a Hawaiian star compass at the summit. If determined feasible and subject to funding and authorizations, NSF, AURA/NSO and UH IfA will place the Hawaiian star compass at the designated site. The decision regarding feasibility and the final result will be provided to the ATST NHWG and posted on the project website.

J. Required "Sense of Place" Training

In order to sensitize them to the significance of Haleakalā as a TCP, all employees, including scientists/researchers who engage in any on-site construction or operation activities associated with the proposed ATST Project, shall undergo UH IfA approved "Sense of Place" training, as set forth in the LRDP. Specifically, NSF, through AURA/NSO, will ensure that all persons involved with the construction and operations of the ATST Project shall be required, within a thirty (30) day period of commencing their job, to attend a worker orientation session and view a UH IfA approved "Sense of Place" training videotape and/or presentation which shall address the historic/cultural significance of Haleakalā to Native Hawaiians. AURA/NSO will maintain a list that can be periodically reviewed by the Signatories and Concurring Parties, of all personnel attending the worker orientation sessions and viewing the training videotape. AURA/NSO will also notify the ATST NHWG of the selection of the training provider.

K. Exterior Design
AURA/NSO, in consultation with the ATST NHWG and the NPS, will incorporate a representation of traditional Hawaiian culture suitable to the Haleakalā setting, such as artwork depicting Maui and the Sun or other appropriate motifs, on the exterior design for the lower portion of the ATST building.

L. Possible Shelter for Cultural Practitioners
NSF, UH IfA, and AURA/NSO, in consultation with the SHPO, the ACHP, and the ATST NHWG, will determine the feasibility of a shelter at HO, with access to restroom facilities, for use by Native Hawaiian cultural practitioners. Consultations will include the location, design, and use of such a shelter. If determined feasible, and subject to available funding, NSF will fund the shelter.

M. State Road 378
NSF, through AURA/NSO, will fund an assessment of historic properties associated with State Road 378 similar to the assessment entitled, "Historic American Engineering Record Haleakala Highway HAER No. HI-52" that was done for the Park road. The scope of work for this assessment shall be developed by AURA/NSO in consultation with the SHPO. Prior to construction of the ATST Project (if approved), AURA/NSO will ensure that all historic properties along State Road 378 are photographed and documented. In addition, AURA/NSO will avoid adverse effects to and preserve the integrity of State Road 378 during the construction phase of the proposed ATST Project to the extent feasible. Where adverse effects cannot be avoided, AURA/NSO, in consultation with the SHPO and the Hawai'i State Department of Transportation, will develop and ensure the implementation of a SHPO approved scope of work to repair any damage caused by the proposed ATST Project.

N. Acknowledgment of Significance of Haleakalā and NSF's Gratitude
NSF and AURA/NSO will ensure that all scientific publications and other scholarly work utilizing data obtained with the ATST will be required to include either a footnote on the title page or an entry in the "Acknowledgment" section that: 1) notes that the ATST is located on land of spiritual and cultural significance to the Kanaka Maoli; and 2) acknowledges NSF's gratitude for the use of this important site to the Kanaka Maoli. The exact wording of the acknowledgment will be developed by NSF and AURA/NSO in consultation with the ATST NHWG.

O. Status of Implementation of this PA Reported on Project Website
To keep the public and all consulting parties apprised of the status of the implementation of the Stipulations in this PA, AURA/NSO will maintain the project website with relevant information. In addition, as required by Sections II. C., F., G., H., I., and III. A., specific information regarding the obligations set forth in those Stipulations will be posted on the project website. Hard copies of

this information will also be made available to the public and all consulting parties at the ATST Project office.

III. NPS Area of Responsibility

The NPS, as the entity responsible for issuing and overseeing the SUP, shall be responsible for ensuring that the following stipulations are carried out:

A. Documentation of Historic Features within the Park Road Corridor

AURA/NSO, in coordination and consultation with the NPS and pursuant to the terms of the SUP, will ensure that all historic features associated with the Park Road Corridor are photographed and documented prior to and after construction of the ATST Project. AURA/NSO shall submit such photographs and documentation to the NPS and post them on the project website.

B. Limitations on Heavy Loads

AURA/NSO, pursuant to the terms of the SUP, will ensure and certify to the NPS that no loads heavier than the current load rating for the historic Park bridge will be allowed within the Park Road Corridor.

C. Temporary Improvement of Shoulder at HALE Entrance

AURA/NSO, pursuant to the terms of the SUP, will temporarily improve the shoulder of the in-bound lane at the Park entrance to accommodate wide loads. After the improved shoulder is no longer needed, AURA/NSO, in accordance with the SUP, will restore it to its original condition.

D. Limitations on Number of Wide Loads

AURA/NSO, pursuant to the terms of the SUP, will ensure that the number of wide loads will not exceed 25, including no more than two loads up to 10 meters (32 feet, 10 inches), over the course of the construction phase of the ATST Project. AURA/NSO will ensure that these wide loads will not exceed the clearances along the Park Road Corridor and that the vehicles transporting such wide loads will avoid driving on the edges of the road.

E. Time Limitations on Construction Traffic

AURA/NSO will coordinate with HALE to establish time periods during which construction traffic, especially slow moving and/or FHWA Class 5 or larger vehicles, can traverse the Park Road Corridor. The NPS will ensure that these time limitations are set forth in the SUP.

F. Time Limitations on Construction Activities

AURA/NSO, in accordance with the terms of the SUP, will ensure that outside, on-site, construction activities will be limited daily to between 30 minutes after sunrise and 30 minutes prior to sunset.

G. SUP Monitor

AURA/NSO, in accordance with the terms of the SUP, will fund a NPS monitor to ensure that the SUP referred to in this PA is followed. Any non-compliance with the SUP will be dealt with by the NPS in accordance with 36 C.F.R. Part 1.6. The NPS shall report any non-compliance with the SUP related to historic features within the Park Road Corridor to the SHPO and the ACHP.

H. Reimbursement for Damage to Historic Features

AURA/NSO, pursuant to the terms of the SUP, will reimburse the NPS for any expenditure required for repairing damage to historic features within the Park Road Corridor, if such damage results from construction-related traffic associated with the ATST Project. In the event that such damage occurs, the NPS will notify the SHPO.

I. Reasonable Deviations in Exceptional Circumstances Reviewed by Park Superintendent

Pursuant to the terms of the SUP, the Park Superintendent may, in exceptional circumstances, authorize reasonable deviations from paragraphs III. B., D., E., and F., above. AURA/NSO will request such deviations from the Park Superintendent in advance. The Park Superintendent will review the request and render a decision to approve, deny, or approve with conditions. If any historic resources may be impacted as a result of such reasonable deviations, the NPS will promptly notify the SHPO and the ACHP.

IV. ADMINISTRATIVE STIPULATIONS

A. Compliance with Applicable Law and Anti-Deficiency Provision

This PA shall be carried out consistent with all applicable federal and state laws. No provision of this PA shall be implemented in a manner that would violate the Anti-Deficiency Act. All obligations on the part of NSF and the NPS shall be subject to the availability and allocation of appropriated funds for such purposes. While NSF and the NPS will make efforts to seek adequate funding to carry-out the terms of this PA, should NSF or the NPS be unable to fulfill the terms of this PA due to funding constraints, the relevant agency will immediately notify the ACHP, the SHPO, and the other Signatories, and consult with them to determine whether to amend or terminate the PA pending the availability of resources. All obligations on the part of UH IfA herein shall be subject to the availability and allocation of appropriated funds for such purposes and UH IfA obtaining all of the necessary authorizations. While UH IfA will make efforts to seek adequate funding and the necessary authorizations to carry-out UH IfA's obligations under the terms of this PA, should UH IfA be unable to fulfill the terms of this PA due to funding constraints or lack of necessary authorizations, UH IfA will immediately notify NSF, the NPS, the ACHP, the SHPO, and the other Signatories, and consult with them to determine whether to amend or terminate this PA pending the availability of resources and the receipt of the necessary authorizations.

B. Discoveries

All unanticipated discoveries of historic properties and human or burial remains within the APE revealed during the construction and operation phases of the ATST Project shall be addressed in the following manner:

1. AURA/NSO shall promptly notify NSF, the SHPO and the ATST NHWG of the discovery.

2. If NSF determines, in consultation with the SHPO, that the discovery is eligible for listing in the National Register, NSF will initiate consultation with the consulting parties to draft a plan with measures that will avoid, minimize, or mitigate adverse effects. If agreement is reached regarding such a plan, NSF shall implement the plan. If the discovery is made during the construction phase, construction in the affected area must cease until the discovery process in this Stipulation has been concluded either through a finding that the property is not eligible for listing in the National Register, or through finalization of the plan referenced herein.

3. If the consulting parties cannot reach agreement regarding the development of a treatment or mitigation plan, then the matter shall be referred to the ACHP for guidance. NSF shall address the ACHP's guidance in reaching a final decision regarding implementation of the plan.

4. If any previously unidentified human or burial remains are discovered during implementation of the Undertaking, AURA/NSO shall immediately cease construction work and adhere to applicable state and federal laws regarding the treatment of human or burial remains.

With regard to any previously unidentified discoveries found within the Park Road Corridor, the process outlined in Sections IV. B.1. through 4., above, shall apply except that NPS shall replace NSF as the relevant federal agency.

C. Duration

This PA will expire ten (10) years from the Effective Date of this PA as defined in Section IV. K., herein. Prior to such expiration date, NSF may consult with the other Signatories to reconsider the terms of this PA and amend it in accordance with Stipulation IV. H., below. If unresolved issues remain within two years of the expiration date of this PA, NSF shall, at that time, consult with the other Signatories regarding the progress of implementation of this PA and to consider the appropriateness of developing a subsequent agreement or amendment to the PA.

D. Incorporation of PA in Future Cooperative Agreements and Reference to PA in Construction-Related Agreements

This PA shall be incorporated into all future cooperative agreements entered into between NSF and any entity responsible for carrying-out the construction and operation phases of the ATST Project. If AURA/NSO is no longer the entity responsible for carrying-out the construction and operation phases of the ATST Project, the successor entity shall assume all responsibilities under this PA where AURA/NSO currently appears. This PA shall also, as appropriate, be referenced in construction-related agreements.

E. Dispute Resolution

In the event one of the Signatories objects to the manner in which any term of this PA is implemented, the following dispute resolution process shall be followed:

1. The objecting Signatory shall notify all other Signatories to this PA, in writing, of the objection or disagreement, request written comments on the objection or disagreement within ten (10) business days following receipt of such notification, and then proceed to consult with the Signatories to resolve the objection. If at any time during consultation, NSF determines that the objection or disagreement related to the construction or operation of the ATST Project cannot be resolved through consultation, NSF shall forward all documentation relevant to the dispute to the ACHP. Within 30 days after receipt of all pertinent documentation, the ACHP will provide NSF with comments and recommendations, which NSF will take into account in reaching a final decision regarding the dispute. Any recommendation or comment provided by the ACHP will be understood to pertain only to the subject of the dispute. The responsibility of NSF to carry out all actions under this PA that are not the subject of the dispute will remain unchanged.

2. With regard to any dispute regarding the terms of this PA related to HALE, the process outlined in Section IV. E.1., above, shall apply except that the NPS shall replace NSF as the relevant federal agency.

3. Unless the Signatories agree that the dispute warrants a cessation of construction work, AURA/NSO will not be required to cease construction work on the ATST Project while the dispute is being reviewed.

F. Continued Participation by the Public and Consulting Parties

At any time during the implementation of the Stipulations set forth in this PA, any member of the public and any consulting party, including a consulting party who has decided not to sign this PA as a Concurring Party, may continue to participate in the Section 106 consultation process as follows:

1. Any member of the public may raise an objection to NSF pertaining to the treatment of an historic property associated with the construction or operation of the ATST Project (if approved). In the event such an objection is raised, NSF shall consult with the SHPO regarding the objection, and, following such consultation, will provide the objecting member of the public with a decision on the objection.

2. Any consulting party, including any consulting party who has decided not to sign this PA as a Concurring Party, may raise an objection to NSF and the SHPO pertaining to the treatment of an historic property associated with the construction or operation of the ATST Project (if approved). In the event such an objection is raised by a consulting party, NSF and the SHPO shall consult regarding how to resolve the objection. If NSF and the SHPO are unable to resolve the objection, they shall consult with the ACHP. NSF will consider any advice on the objection provided by the ACHP within 10 days of being notified of it, before making a final decision on the matter. NSF will communicate such a final decision to the objecting consulting party and the Signatories.

If an objection is made pursuant to either Section IV. F.1. or F.2., above, NSF, in consultation with the SHPO, will determine whether the objection warrants a cessation of construction work on the ATST Project while the objection is being reviewed.

G. Follow-up Meetings to Discuss Implementation
NSF will invite the Signatories to this PA to a meeting and/or teleconference every three years to discuss implementation of the terms of this PA and determine whether revision, amendment, or termination is needed. NSF shall schedule the first such meeting/teleconference within three years of the Effective Date of this PA, as defined in Section IV. K., herein.

H. Amendments and Noncompliance
This PA may be amended upon written agreement by all of the Signatories, including the invited Signatories, herein.

I. Termination
If any Signatory to this PA, including any invited Signatory, determines that the terms of this PA will not or cannot be carried out, that Signatory shall immediately consult with the other Signatories to develop an amendment to this PA pursuant to Section IV. H., above. If this PA is not amended following that consultation, then it may be terminated by any Signatory or invited Signatory through written notice to all other Signatories. Within thirty (30) days following termination, NSF shall notify the Signatories if it will initiate consultation to execute a new PA with the Signatories under 36 C.F.R. § 800.6(c)(1) or request and consider the comments of the ACHP under 36 C.F.R. § 800.7 and proceed accordingly.

J. Effect of PA Execution

Execution of this PA by NSF, the ACHP, the SHPO, the NPS, AURA/NSO, and UH IfA prior to NSF's approval of the proposed ATST Project and NPS' issuance of the SUP, evidences that NSF and the NPS have taken into account the effects of this proposed Undertaking on historic properties, and have afforded the ACHP an opportunity to comment on the proposed Undertaking.

K. Effective Date

This PA shall be executed in counterparts, with a separate page for each Signatory, and NSF shall ensure that each Signatory is provided with a fully executed copy. This PA will become effective upon:

1. Execution of this PA by NSF, the NPS, the SHPO, AURA/NSO, UH IfA, and the ACHP;

2. A decision by the NSF Director authorizing the funding of the construction of the proposed ATST Project;

3. The issuance of the SUP by the NPS;

4. Receipt of a Conservation District Use Permit from the State of Hawai'i Board of Land and Natural Resources; and

5. The execution of a lease between the UH IfA and AURA/NSO and/or NSF for the property within HO upon which the ATST Project would, if approved, be built.

Nothing, however, shall preclude NSF from initiating the establishment of the ATST NHWG prior to the effective date of this PA.

Attachments: **Acronym Key**
Exhibit A (Map of the Area of Potential Effects (APE) and Tax Map Key)
Exhibit B (Best Management Practices Excerpted from the Long Range Section 9.3.2. of the Long Range Development Plan for the Haleakalā High Altitude Observatory)
Exhibit C (List of Native Hawaiian Organizations that Are Consulting Parties)

SIGNATORIES TO THIS PROGRAMMATIC AGREEMENT:

FOR THE NATIONAL SCIENCE FOUNDATION:

By: Craig B Foltz Date: 9/21/09

Printed Name: Craig B. Foltz

Title: Acting Division Director
Division of Astronomical Sciences

FOR THE NATIONAL PARK SERVICE:

By: Patricia L. Neubacher Date: 9/28/09

Printed Name: PATRICIA L. Neubacher

Title: Deputy Regional Director

FOR THE ADVISORY COUNCIL ON HISTORIC PRESERVATION:

By: [signature] Date: 11/13/09

Printed Name: Reid Nelson

Title: Acting Executive Director

FOR THE HAWAI'I STATE HISTORIC PRESERVATION OFFICER:

By: ____________ Date: 10/6/09

Printed Name: Laura H. Thielen

Title: Chairperson, DLNR Hawaii

INVITED SIGNATORY TO THIS PROGRAMMATIC AGREEMENT:

FOR THE ASSOCIATION OF UNIVERSITIES FOR RESEARCH IN ASTRONOMY:

By: [signature] Date: 9/21/09

Printed Name: William S. Smith

Title: PRESIDENT

INVITED SIGNATORY TO THIS PROGRAMMATIC AGREEMENT:

FOR THE UNIVERSITY OF HAWAI'I (for the benefit of its Institute for Astronomy):

By: MRC Greenwood Date: 10-9-09

Printed Name: M.R.C. Greenwood

Title: President

CONCURRING PARTIES TO THIS PROGRAMMATIC AGREEMENT:

By: [signature] Date: 20 September 2009

Printed Name: Warren S. Shibuya

Title: Volunteer Maui County, Planning Commissioner
Retired Space & Missile Systems Center

CONCURRING PARTIES TO THIS PROGRAMMATIC AGREEMENT:

By: H. Kanoeokalani Cheek Date: 10-10-09

Printed Name: H. Kanoeokalani Cheek

Title: President

Ms. H. Kanoeokalani Cheek, President

NA KU'AUHAU 'O KAHIWAKANEIKOPOLEI

P. O. Box 5411

Kane'ohe, HI 96744

Approved at the regular monthly meeting of Na Ku'auhau 'o Kahiwakaneikopolei held on Saturday, October 10, 2009 at the University of Hawaii Manoa Campus.

ACRONYM KEY

A-E

Advisory Council on Historic Preservation (ACHP)

Advanced Technology Solar Telescope (ATST)

Area of Potential Effects (APE)

Association of Universities for Research in Astronomy (AURA)

ATST Native Hawaiian Working Group (ATST NHWG)

Air Force Environmental Compliance Assessment and Management Program (ECAMP)

University of Hawaiʻi's Environmental Health and Safety Office (EHSO)

H-M

Haleakalā High Altitude Observatory (HO)

Haleakalā National Park (HALE)

Heating Ventilation and Air Conditioning (HVAC)

Kanaka Maoli (Native Hawaiians)

Kupuna (elder)

Kahu (clergyman)

Long Range Development Plan (LRDP)

N

Native Hawaiian Organizations (NHOs)

National Historic Preservation Act (NHPA)

National Park Service (NPS)

National Register of Historic Places (National Register or NRHP)

National Science Foundation (NSF)

National Solar Observatory (NSO)

O

Office of Hawaiian Affairs (OHA)

P

Programmatic Agreement (PA)

S

Hawai'i SHPO (SHPO)

Special Use Permit (SUP)

T

Traditional Cultural Property (TCP)

U

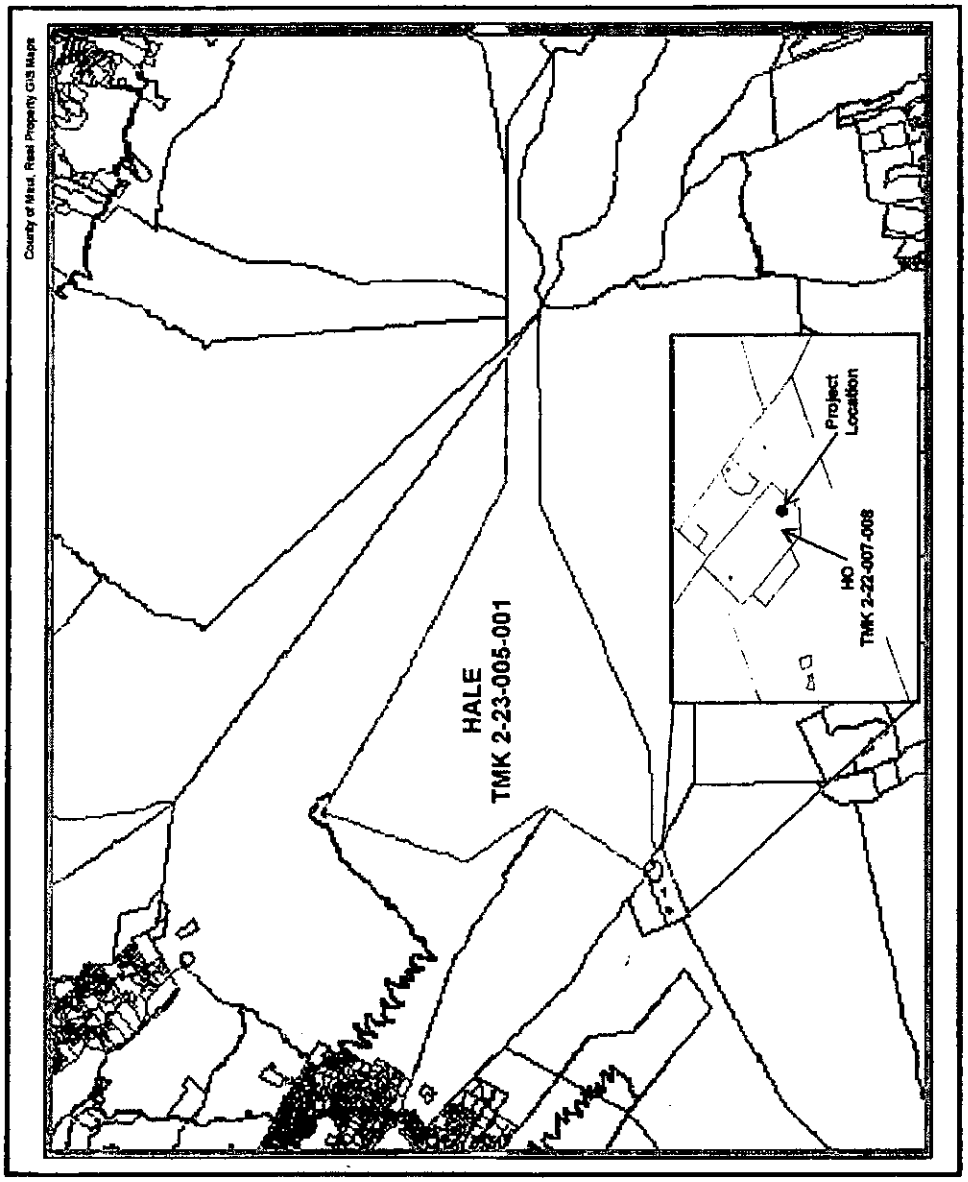
University of Hawai'i (for the benefit of its Institute of Astronomy) (UH IfA)

Exhibit A

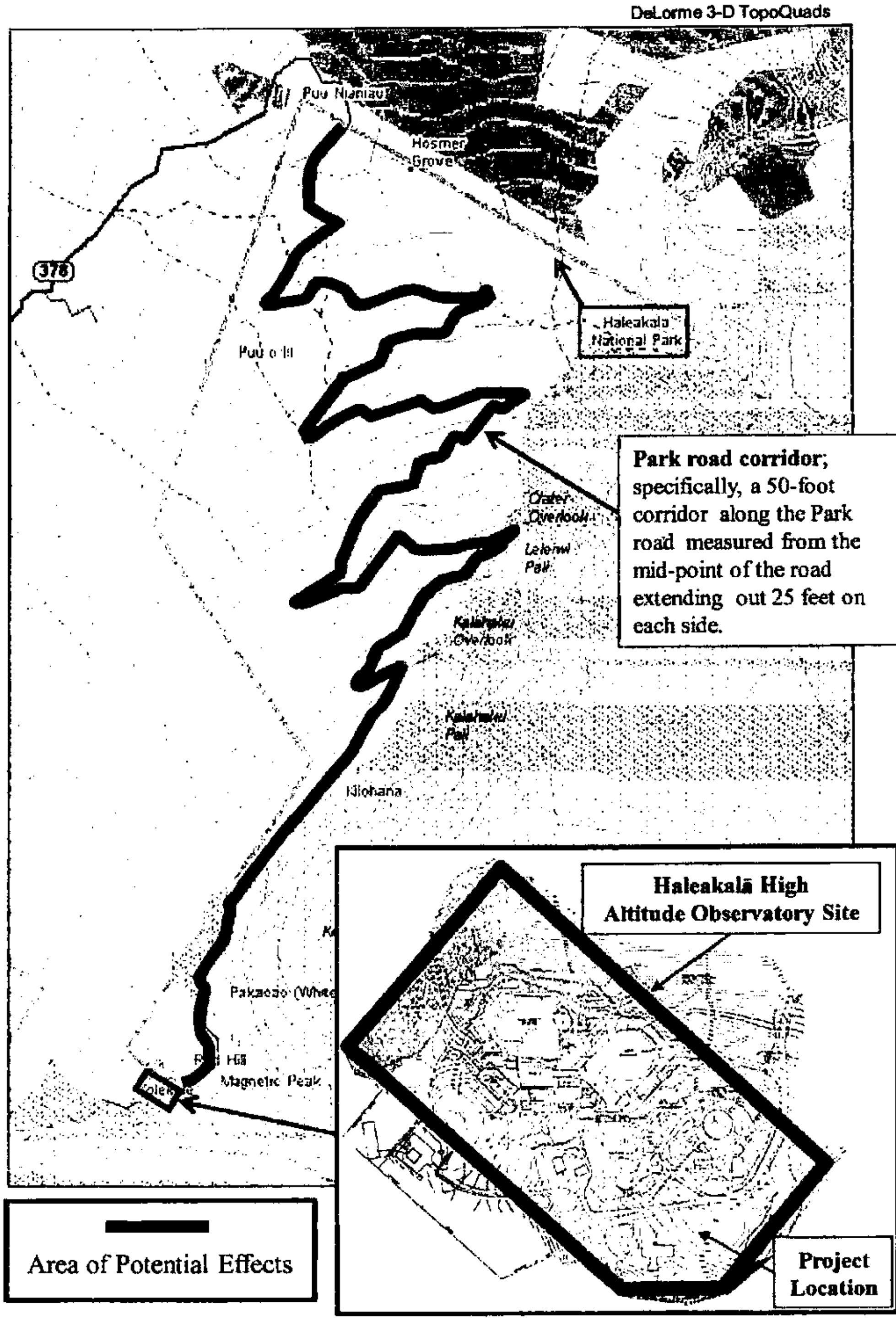
Map of the Area of Potential Effects (APE)

and

Tax Map Key



TMK Maps: HALE and HO With Project Location



DeLorme 3-D TopoQuads
Puu Nianiau
Hosmer Grove
378
Haleakala National Park
Puu o Ili
Park road corridor; specifically, a 50-foot corridor along the Park road measured from the mid-point of the road extending out 25 feet on each side.
Crater Overlook
Leleiwi Pali
Kalahaku Overlook
Kalahaku Pali
Kilohana
Pakaoao (White
Magnetic Peak
Haleakalā High Altitude Observatory Site
Project Location
Area of Potential Effects

Exhibit B

Best Management Practices
Excerpted from the
Long Range Development Plan for the
Haleakalā High Altitude
Observatory

[PREVIOUS TEXT OMITTED]

9.3.2 **Protection of Historic and Cultural Resources**

For the kanaka maoli, the lava, cinders, dust, rocks and boulders are all sacred to Pele, the goddess of the volcano. In fact, Pele means *lava* in Hawaiian. Workers at HO need to be culturally sensitive to the fact that they are in a place still considered sacred by Native Hawaiians. As the responsible agency, UH If A 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 use to achieve that objective. One outcome of those consultations and the cultural resource evaluations of H 0 is that the If A has adopted rules for the long-tern preservation of archaeological and cultural resources for all facilities, past, present, and future, based on recommendations in the Cultural Resources Assessment (Appendix F). The preservation of cultural resources is defined as an If A policy as follows:

1. Any construction within HO requiring a permit from the Department of Land and Natural Resources shall require the consultation and monitoring of a Cultural Specialist. The Cultural Specialist will be engaged at the earliest stages of the planning process, monitor the construction process, and consult with and advise the on-site Project Manager with regard to any cultural or spiritual correction. For the purposes of this section, a Cultural Specialist must be a kanaka maoli, preferably a kupuna (elder), and a kahu (clergyman) as well, and one who has personal knowledge of the spiritual and cultural significance and protocol of Haleakala.

2. All cultural and archaeological sites and features identified in the HO Archaeological Inventory Survey shall be protected and preserved per Hawai'i Administrative Rules, Title 13, Sub-Title 13, Chapter 277 "Rules Governing Requirements for Archaeological Site Preservation Development". Protection shall include the establishment of clearly marked buffer zones and periodic monitoring by both the project Archaeologist and Cultural Specialist throughout any future construction process.

3. All construction crewmembers shall attend UH-approved "Sense of Place" training prior to working at projects within HO.

4. A Cultural Specialist shall conduct a cultural inspection of HO two times a year, to ascertain that HAR Title 13 Chapter 277 rules are being followed.

5. All permanent employees working at HO shall attend UH-approved "Sense of Place" training prior to working at facilities within HO.

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, an area consisting of approximately 24,000 square feet and located

Southwest of the Maui Space Surveillance Complex, as further identified and more particularly described as Area A in Figure 9-1, will be set-aside in perpetuity for the sole reverent use of the kanaka maoli for religious and cultural purposes, on a noninterference basis with site activities.

Recommendations were submitted with the latest archaeological inventory survey concerning protection of the archaeological resources at the site, and they have been coordinated with the State Historic Preservation Division (Appendix H). These recommendations have been adopted by the If A to protect those resources. Passive in-place preservation will be continued for features that were identified and listed with State Historic Preservation Division during the J. C. Chatters 1994 survey, i.e., sites 4836,2806, and 2805 were delineated with post and railing boundaries in 1995. Discussions during the latest survey indicate that no fencing or other demarcation should be added to the most recently described features, so as not to draw attention to them. However, site 5440 will be part of the "set-aside" for kanaka maoli in Area-A described above, and the remaining four sites on HO property will be monitored routinely by the Cultural Specialist during inspections.

Exhibit C

List of Native Hawaiian Organizations that Are Consulting Parties

Aha Ali'i O Kapu'aiwa O Kamehameha V
Ali'i Sir and Grand Master Clifford Hashimoto
P. O. Box 836
Hana, HI 96713

Central Maui Hawaiian Civic Club
Leone Purugganan
1126 Hoomalu Place
Wailuku, HI 96793

Historic Hawai'i Foundation
Kiersten Faulkner, AICP
Executive Director
680 Iwilei Road Suite 690
Honolulu, HI 96817

Kilakila O Haleakala
Ki'ope Raymond, President
310 W. Ka'ahumanu Avenue
Kahului, HI 96732

Maui Community College
Kaleikoa Ka'eo
310 W. Ka'ahumanu Ave.
Kahului, HI 96732

Maui Native Hawaiian Chamber of Commerce
Howard S. Kihune, President
P. O. Box 350
Kahului, HI 96732

Na Kupuna O Maui
Patty Nishiyama
320 Kaeo Place
Lahaina, HI 96761

Office of Hawaiian Affairs
Clyde Nāmu'o, Administrator
711 Kapiolani Boulevard, Suite 500
Honolulu, HI 96813

Office of Hawaiian Affairs
Jason Jeremiah, Policy Advocate, Preservation Native Rights, Land, and Culture
711 Kapiolani Boulevard, Suite 500
Honolulu, HI 96813

Office of Hawaiian Affairs
Thelma Shimaoka
Community Resource Coordinator
140 Ho'ohana Street, Suite 206
Kahului, HI 96732

Royal Order of Kamehameha I
Ali'i Sir William Garcia, Jr., CK
Office of the Ku' auhau Nui
P. O. Box 1072
Wailuku, HI 96793

Royal Order of Kamehameha I
Ali'i Sir George Kaho'ohanohano CK
2723 Kamelani Loop
Pukalani, HI 96768

Royal Order of Kamehameha I
Kahu Po'o Iki Clarence Solomon
P. O. Box 1072
Wailuku, HI 96793

Roselle Bailey
Ka Imi Na'auao '0 Hawai'i Nei
485 Lilihui Place
Wailuku, HI 96793

Lee Ann DeLima, Headmaster
Kamehameha Schools
275 A'apueo Parkway
Pukalani, HI 96768

Rose Marie Duey
Alu Like, Inc.
1977 Ka'ohu Street
Wailuku, HI 96793

Blossom Feiteira
Hui Kako'o 'Aina Ho'opulapula and Na Po'e Kokua
P. O. Box 2963
Wailuku, HI 96393

Kehaulani Filimoe'atu
Hui of Hawaiians
P. O. Box 492
Kahului, HI 96732

Lei Ishikawa
Na Leo Pulama
P. O. Box 337
Wailuku, HI 96793

Kekealani Ishizaka
Hawaiian Homes Waiehu Kou 1
684 Kohomua Street
Wailuku, HI 96793

David Keala
Native Hawaiian Educational Council
240 Elilani Street
Pukalani, HI 96768

Velma Mariano
Paukukalo Hawaiian Homestead
Community
Association
644 Waihona Street
Wailuku, HI 96793

Dept. of Hawaiian Homelands
655 Kaumualii Street, Suite I
Wailuku, HI 96793

Iris Mountcastle
Queen Lilioukalani Children's Center
1791 Wili Pa Loop
Wailuku, HI 96793

Robin Newhouse
Keokea Hawaiian Homes
P. O. Box 748
Kula, HI 96790

Sheila Ople
A'o A'o O Na Loko I'a O Maui
140 Uwapo Road, #45-103
Kihei, HI 96753

Joann Ridao
Lokahi Pacific
1935 Main Street, Suite 204
Wailuku, HI 96793

Patrick Ryan
Fishpond Ohana
552 Kaiola Street
Kihei, HI 96753

Dancine Takahashi
Kamehameha Schools Alumni
P. O. Box 880069
Pukalani, HI 96788

Jim Wagele
Hawaiian Community Assets, Inc.
655 Kaumualii Street, Suite 3
Wailuku, HI 96793

Maui Community College – Ku'ina
Program
310 Ka' ahumanu Avenue
Kahului, HI 96732

Thomas T. Shirai, Jr.
Kawaihapai Ohana
P.O. Box 601
Waialua, HI 96791

Hui Kako'o 'Aina Ho'opulapula
767 Kailua Road, #212
Kailua, HI 96734

Hawai'i Maoli
P.O. Box 1135
Honolulu, HI 96807

Royal Hawaiian Academy of Traditional
Arts 835 Anuwale Street
Honolulu, HI 96821

Na Ku'auhau'o Kahiwakaneikopolei
P.O. Box 5411
Kane'ohe, HI 96744

Malu'ohai Residents Association
Ms. Shirley S. Swinney
P. O. Box 700991
Kapolei, HI 96707

The Friends of 'Iolani Palace
Kippen de Iba Chu
P. O. Box 2259
Honolulu, HI 96804

Hawaiian Civic Club of Hila
Mr. Arthur Hoke
P. O. Box 543
Hila, HI 96721

Papa Ola Lokahi
894 Queen Street
Honolulu, HI 96813

Kanu a ke 'Aina Learning 'Ohana
Ms. Taffi Wise
P.O. Box 6511
Kamuela, HI 96743

The I Mua Group
422 Iliaina Street
Kailua, HI 96734

Council for Native Hawaiian
Advancement 1050 Queen Street
Suite 200
Honolulu, HI 96814

Akoni Akana
Executive Director, Friends of Moku'ula
505 Front Street, #234
Lahaina, HI 96761

Mei-Ling Chang
Hui No Ke Ola Pono
P. O. Box 894
Wailuku, HI 96793

Kili Namauu
Punana Leo O Maui
P. O. Box 377
Wailuku, HI 96793

Clifford Libed
Dept. of Hawaiian Homelands Grants
Review Advisory Committee
P. O. Box 885
Wailuku, HI 96793

Haleakala National Park Kupuna Groups:

Kipahulu Kupuna Group
Alexander & Angie Aina
Shelia Agnitsch
Clifford Hashimoto
Henry Sr. & Annie Kahula-Rahl
Roland Kanuha
Ed Lincoln
Daisy Lind
Tweetie Lind
Sharon Mynar
Lyons Naone
Ida & Raymond Oliveria
Valerie Park
Terry Poaipuni
Eddie Pu
Caroline Smith
Nani Smith
Angela Tavares

Summit Kupuna Group
Charlie Aki
Gordean Bailey
Robert Garcia
Dana Hall
Clifford Hashimoto
Kaleikoa Ka'eo
Sam Ka'ai
George Kaho'ohanohano
Geraldine Kaiwi
Les Kuloloio
Florence Lani
Charlie Lindsey
Charles Maxwell, Sr.
Lyons Naone
Francis Poouahi
Leone Pugrugganan
William Roback
Leiohu Ryder
Maano Smith
Kalei Tsuha
John Belles
Ki'ope Raymond
Makaala Yates