FINAL ENVIRONMENTAL IMPACT STATEMENT
PROPOSED TELESCOPE AND OBSERVATORY FACILITIES

MAUNA KEA (SUMMIT), HAWAII

CANADA-FRANCE-HAWAII
TELESCOPE CORPORATION
Honolulu, Hawaii

NEIGHBOR ISLAND CONSULTANTS

190 Keawe Street
Hilo, Hawaii 96720
Phone: (808) 935-6654

May, 1974

#00113

TABLE OF CONTENTS

4/21

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

LIST OF FIGURES

CHAPTER I

INTRODUCTION

STUDY PURPOSE

The purpose of this environmental impact statement is to provide all concerned parties with:

A description of selected aspects of the Mauna Kea Summit environment.

An analysis of environmental impact resulting from proposed developments at the Summit of Mauna Kea in the near and distant future.

A determination of the type and amount of irretrievable resources required to accomplish the proposed development program.

An analysis of alternative actions which could be implemented to accomplish the goals and objectives of the proposed development program.

A document which has been prepared in accordance with the Governor's Executive Order of August 23, 1971 and the State Office of Environmental Quality Control Manual for the Preparation and Processing of Environmental Impact Statements (Final Draft, October 4, 1972).

SCOPE OF STUDY

The project site at the Summit of Mauna Kea has been limited to the area depicted in figure 2 while the greater tributary area (figure 1) includes the remaining environment of Mauna Kea, as well as the population and economy of Hawaii County. The discussion of physical and biological characteristics is generally within the context of the project site; however, the analysis of cultural characteristics primarily considers the tributary area with a lesser discussion of the project site.

RELATED PROJECT AND EIS DOCUMENTS

The proposed development program is directly related to four other proposed projects on Mauna Kea which include the construction of the Mauna Kea Observatory Access Road, the installation of electrical power to the summit of Mauna Kea, the proposed development of a permanent mid-level facility, as well as the proposed expansion of the temporary base camp at Hale Pohaku. In coordination with the State Office of Environmental Quality Control (OEQC), the University of Hawaii (UH) and the State Department of Accounting and General Services (DAGS) are jointly preparing individual environmental impact statements (EIS) for each of the four related projects. The present status of each project and its related EIS is as follows:

Project	EIS Status	Construction Status
Mauna Kea Observatory Access Road (from Saddle Road to Hale Pohaku)	EIS approved	Near completion
(from Hale Pohaku to Summit)	Draft submitted to OEQC for review and circulation	Final plans and specifications completed
Power to Summit	Draft submitted to OEQC for review and circulation	Conduit laid by Mauna Kea Electric from Summit to one-mile below
Permanent Mid-Level Facility	Draft submitted to OEQC for review and circulation	Awaiting EIS approval--Preliminary plans completed
Hale Pohaku Base Camp Expansion	Draft submitted to OEQC for review and circulation	Awaiting EIS approval--Preliminary plans completed
New Observatory Development	Draft submitted to OEQC for review and circulation	Awaiting EIS approval--Preliminary plans in preparation for foundation

LIST OF CONTRIBUTORS

Neighbor Island Consultants

James Pedersen

Environmental Planner

Robert Page

Civil Engineer

Fred Zobrist

Engineer-Economist

Leonard Ah Sing

Graphics and Report Production

COORDINATION WITH OTHERS

Data and analyses required for the preparation of this report resulted in the coordination of the proposed project with each of the following agencies:

Federal

Department of Interior, National Park Service, Honolulu
Department of Agriculture, Soil Conservation Service, Hilo
Department of Agriculture, Forest Service Institute of Pacific Islands Forestry, Honolulu
Department of Commerce, National Oceanic Atmospheric Administration, National Weather Service, Honolulu

State

University of Hawaii, Institute for Astronomy, Hilo and Honolulu
University of Hawaii, Office of Physical Planning & Construction, Honolulu
Department of Health, Research Unit, Honokaa
University of Hawaii, Institute of Geophysics, Honolulu
Department of Land and Natural Resources, Division of Fish and Game, Hilo and Honolulu
Department of Land and Natural Resources, Division of Parks, Hilo
Department of Land and Natural Resources, Division of Land Management, Hilo and Honolulu
Department of Land and Natural Resources, Division of Forestry, Hilo
Office of Environmental Quality Control, Honolulu
Department of Accounting and General Services, Honolulu

County of Hawaii

Department of Planning, Hilo

Private

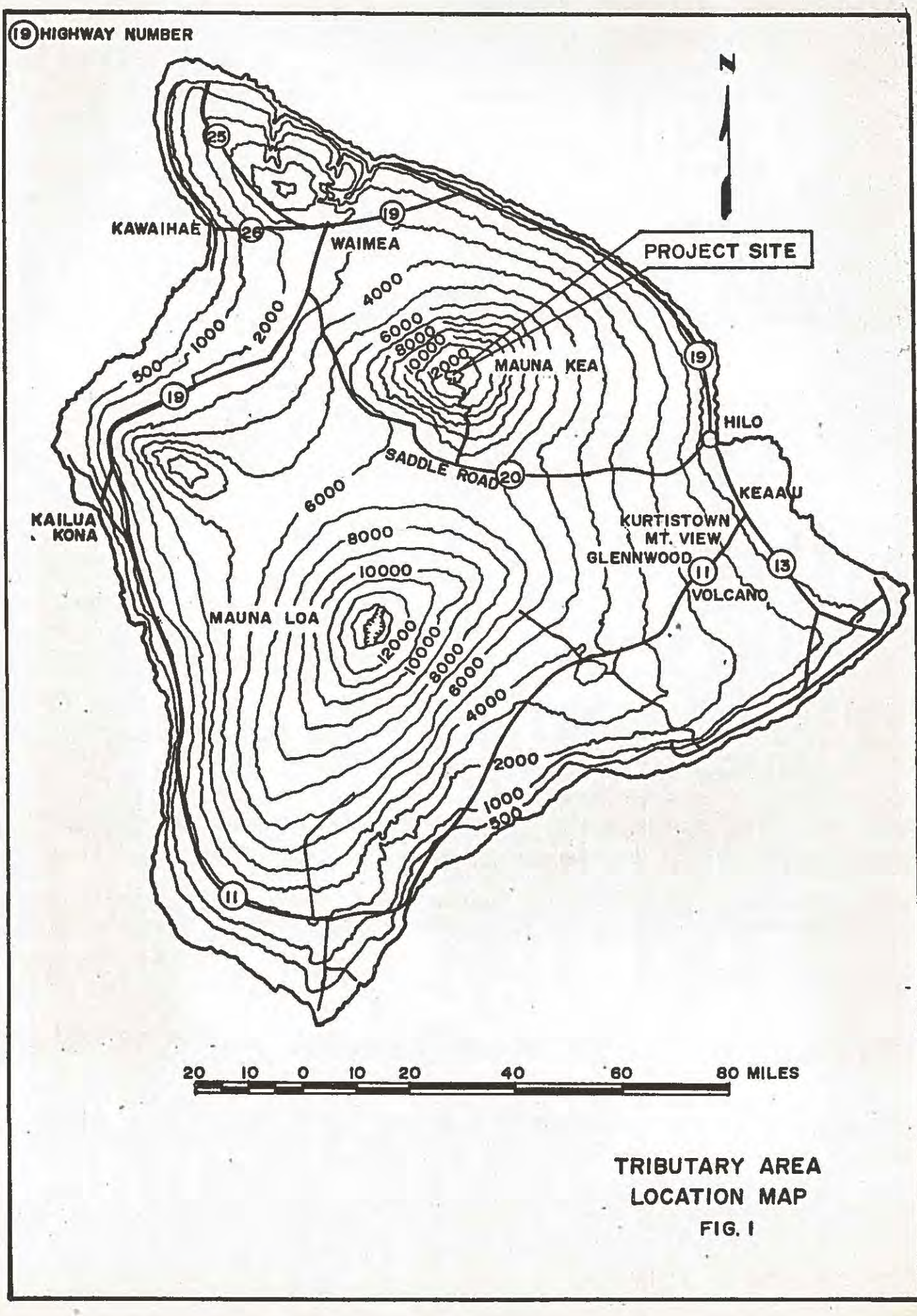
Institut National d'Astronomie et de Geophysique, Paris, France

Mr. Stephen C. Porter, University of Canterbury, Department of Geology, Christchurch, New Zealand

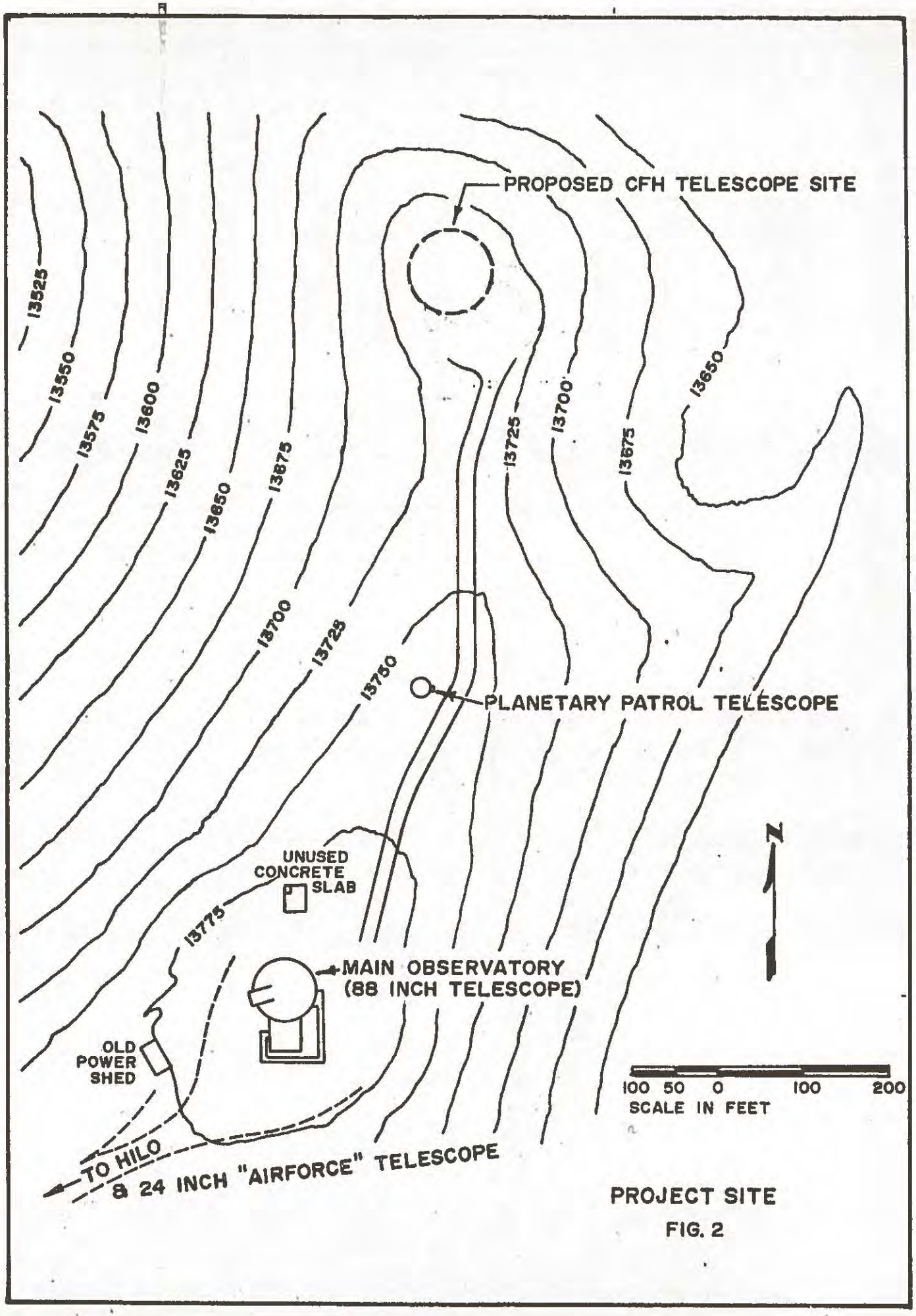
Mrs. Violet Hansen, Field Associate, Bishop Museum, Volcano

Mr. Yosihiko Sinoto, Department of Anthropology, Bishop Museum, Honolulu

Mr. Glen Mitchell, Hilo



TRIBUTARY AREA
LOCATION MAP
FIG. 1



PROJECT SITE

FIG. 2

CHAPTER II

OBJECTIVES OF THE DEVELOPMENT PROGRAM

The purpose of the proposed development program is to accomplish each of the following objectives:

To construct and operate a large optical telescope of 3.6 m (142 inches) aperture, in conjunction with laboratories, equipment and associated installations, on the Summit of Mauna Kea;

To minimize ground vibrations generated by construction equipment and other vehicular traffic during construction of the observatory;

To minimize fugitive dust during excavation and grading for the proposed facilities.

CHAPTER III

PROJECT DESCRIPTION

PROJECT ORIGIN

For the past several years, the Centre National de la Recherche Scientifique (CNRS) of France, the National Research Council (NRC) of Canada, and the University of Hawaii (UH) have considered the joint design, construction and operation of a large optical telescope on the Summit of Mauna Kea. A "tripartite agreement" has been signed which outlines the organization of a proposed, joint Hawaii corporation to be named the Canada-France-Hawaii Telescope Corporation (Appendix A) and the obligations of each of these three agencies.

DEVELOPMENT COSTS/SOURCE OF FUNDS

Under the "tripartite agreement", the CNRS and the NRC would provide the proposed Corporation with the work, components and sums necessary for the construction of the telescope, its basic instrumentation, its dome and associated buildings. In this regard, the CNRS and the NRC would provide all funds necessary for the design and construction of the proposed, expanded base camp facilities at Hale Pohaku. The estimated telescope and related observatory construction cost of $21,375,160 as well as an estimated $100,000 cost for expansion of the existing temporary base camp facilities, would be shared equally by CNRS and NRC.

Even though the University of Hawaii would not be providing funds for development of the base camp expansion, its proposed obligation of approxi-

mately $4,072,200 to the overall observatory development would include its:

Furnishing of a sub-lease at no cost to the Corporation until the year 2033 for part of the land UH now holds under Lease Number S4191 from the State of Hawaii, the boundaries of which are shown on the site plan, dated 15 December 1973, at Annex C. The University of Hawaii also agrees to seek from the State the renewal or extension of its Lease during the life of the Corporation and, if received, to renew or extend the Corporation's sub-lease for the life of the Lease or the life of the Corporation whichever is shorter.

Construction and maintenance of an access road - having characteristics consistent with the overall plan for the development of the Mauna Kea Observatory area -- to a boundary line of the sub-leased property.

Construction of an electric power line to a central terminal near the Mauna Kea Observatory area, of approximately 750 KW capacity to meet the projected installations of the Corporation (approximately 350 KW) and the presently anticipated needs of the existing UH installations and to grant to the Corporation access to this power through an easement over UH leased land. The cost of connection from the telescope site to the central terminal, and of electric power, are to be paid by the Corporation.

Construction at a mid-level station two family dwellings with a total area of approximately 220 sq. m. for exclusive use by permanent personnel associated with the Corporation. In the same general area, UH will also construct an office and laboratory building. This structure is presently expected to contain 10 offices - of which 5 (containing approximately 70 sq. m.) will be made available to the Corporation. In addition, a data analysis laboratory of approximately 60 sq. m. and two darkrooms are contemplated, access to which will be accorded to the Corporation on an equitable basis between the UH and the Corporation. These facilities will be maintained by UH. The Corporation will, however, be charged on an equitable basis for operating costs incurred by UH in providing such facilities.

Undertaking to provide at the same mid-level station, dormitory type living accommodations (including kitchen and dining facilities) sufficient to meet the combined needs of the University and the Corporation. The UH will assume responsibility for construction, subsequent operation and maintenance with the understanding that the pro rata cost of providing these accommodations, including amortization, shall be charged direct to the individual who uses them.

Obtaining for the Corporation, should the need arise, authority to construct on the mid-level area additional offices, laboratories and housing on condition that such construction be undertaken within five years from signature of this agreement, that financing be arranged by NRC and CNRS, and that the proposed style, materials, and location of such building be approved by the State and the University of Hawaii.

Furnishing of 75 sq. m. of office space to the Corporation, for its permanent staff, in the new buildings of the Institute for Astronomy on the Manoa campus. This space will be maintained by the UH and all operating costs will be charged to the Corporation on a basis of no profit to the UH.

Placing at the disposition of visiting astronomers using the CFH telescope, two offices in the Manoa campus building, and afford to them the same facilities as those available to the members of the staff of the Institute for Astronomy, on a basis of no profit to the UH.

Soliciting of maximum cooperation from the local authorities and users of the site in protecting the natural qualities of the site for astronomical observations.

In consideration of their respective contributions totalling $25,547,360 the three agencies would receive equitable interest in the Corporation as follows:

CNRS	42.5%
NRC	42.5%
UH	15.0%

DEVELOPMENT PROPOSAL

General

The proposed development program would consist of the construction of a large optical telescope of 3.6 m aperture (141.2 inches), in conjunction with laboratories, a workshop and other facilities required for the operation and maintenance of the telescope. The proposed telescope development would be a four year construction program which will consist of the placing of the observatory foundation and piers in 1974; construction of the cylinder in 1975;

construction of the hemisphere in 1976; and the installation of the telescope in 1977. Each of these aspects is generally depicted in figure 3.

Optical Parameters

The telescope would have a primary mirror of CERVIT material of outside diameter 3.6 meters and would have a focal length corresponding to an aperture ratio of approximately 3.8, and the figure of the primary mirror will be parabolic.

The telescope would have several secondary mirrors, the largest of which would give an effective aperture ratio of approximately 8.0 at the Cassegrain focus. Other secondary mirrors would provide coude foci and an infra-red Cassegrain focus. Other Cassegrain mirrors may be added later.

Mechanical Description

The mounting will be of the "horse-shoe" type, similar to the well-known "Palomar 200" telescope which is of proven design and very suitable to low latitudes. However, modern developments such as upper-end exchanges and computer controlled devices will be included.

Enclosure

The telescope would be enclosed in a metallic dome and supported on a suitable pillar which will also support the coude spectrograph. The proposed dome, approximately 105 feet (32 meters) in diameter, would be founded on eighteen individual footings joined together by the beams while the telescope itself would be mounted on a concrete pier with an isolated foundation. Both the metallic dome structure footings and the concrete pier would be

buried at least one meter below the immediate surrounding grade (Dames and Moore, 1973).

Underground Support Facilities

Transformers, water storage, pumps and compressors would be housed in small underground service buildings near the dome. Their precise location has not been decided upon at the time of this report. In addition, associated utilities such as cesspool or septic tank, pipe lines and electrical service ducts would also be located underground.

Utilities

All utility lines for power, water and sewage would be installed underground. The precise location of the utility lines has not been decided upon at the time of this report.

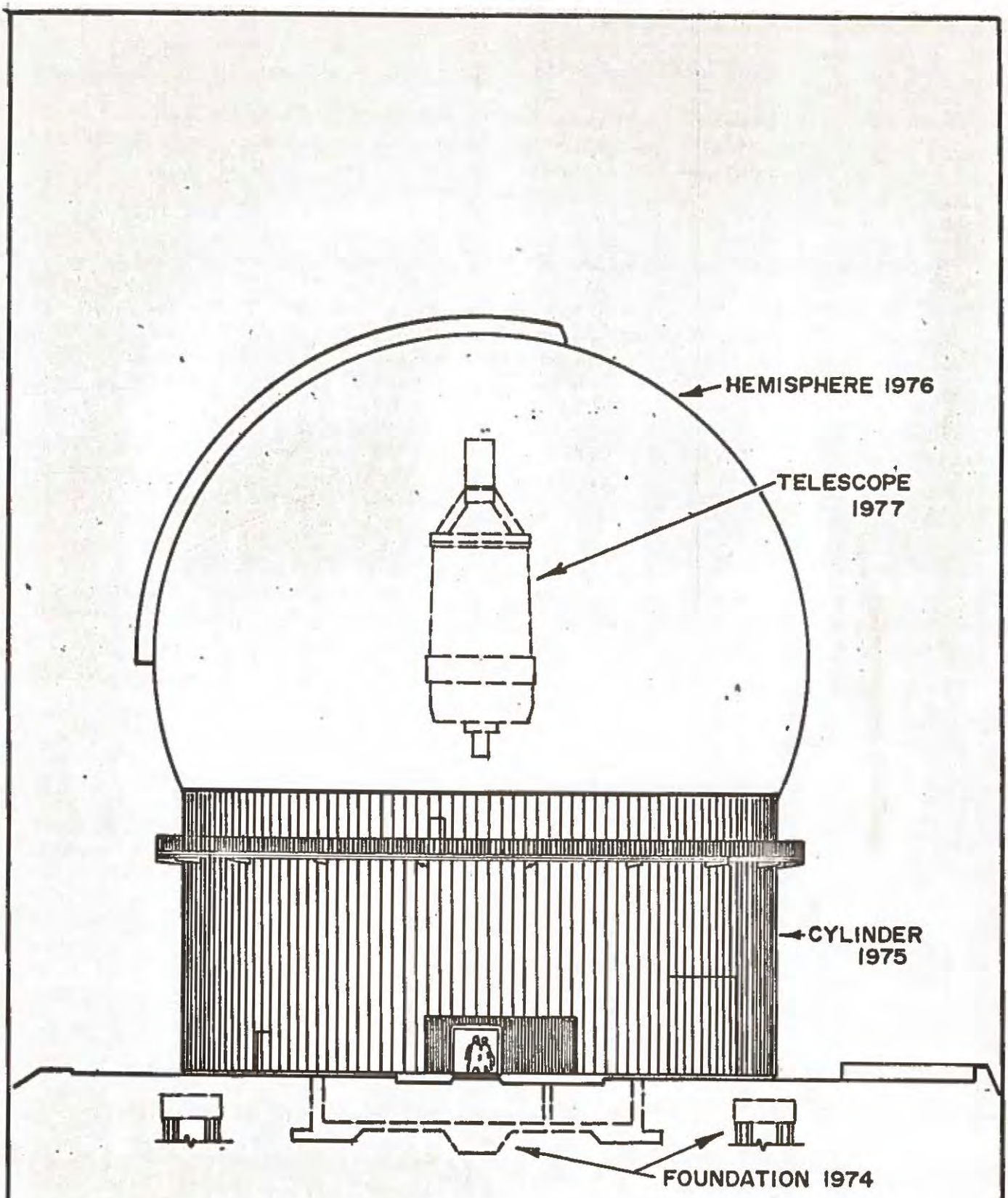
Earthwork

A graded area of about 60 x 80 meters would be prepared at the proposed location of telescope structure (figure 4). The final grade surrounding the planned facilities would be designed to direct surface run-off away from the foundation area. Drainage facilities would be provided in the general project area to dispose of concentrated surface run-off that might otherwise cause erosion of the ground surface. Both cut and fill embankments would be constructed with maximum slopes of 1.5 horizontal to 1 vertical, 1 horizontal to 1.5 vertical if they are fortified with additives or a surface treatment such as soil cement. Embankments constructed from fill would be carefully keyed into the underlying, natural soil. Compaction would be performed under the technical supervision of a qualified soils engineer (Dames and Moore, 1973).

Temporary excavations in the general cinder cone material would stand unsupported with vertical cuts although minor sloughing would occur almost immediately and large slides would occur if the unsupported excavations were disturbed by ground vibration of the magnitude caused by heavy vehicular traffic within the general construction area. For safety reasons, shoring would be provided in all major excavations i.e. underground support facility structures, with depths of more than 1.5 meters.

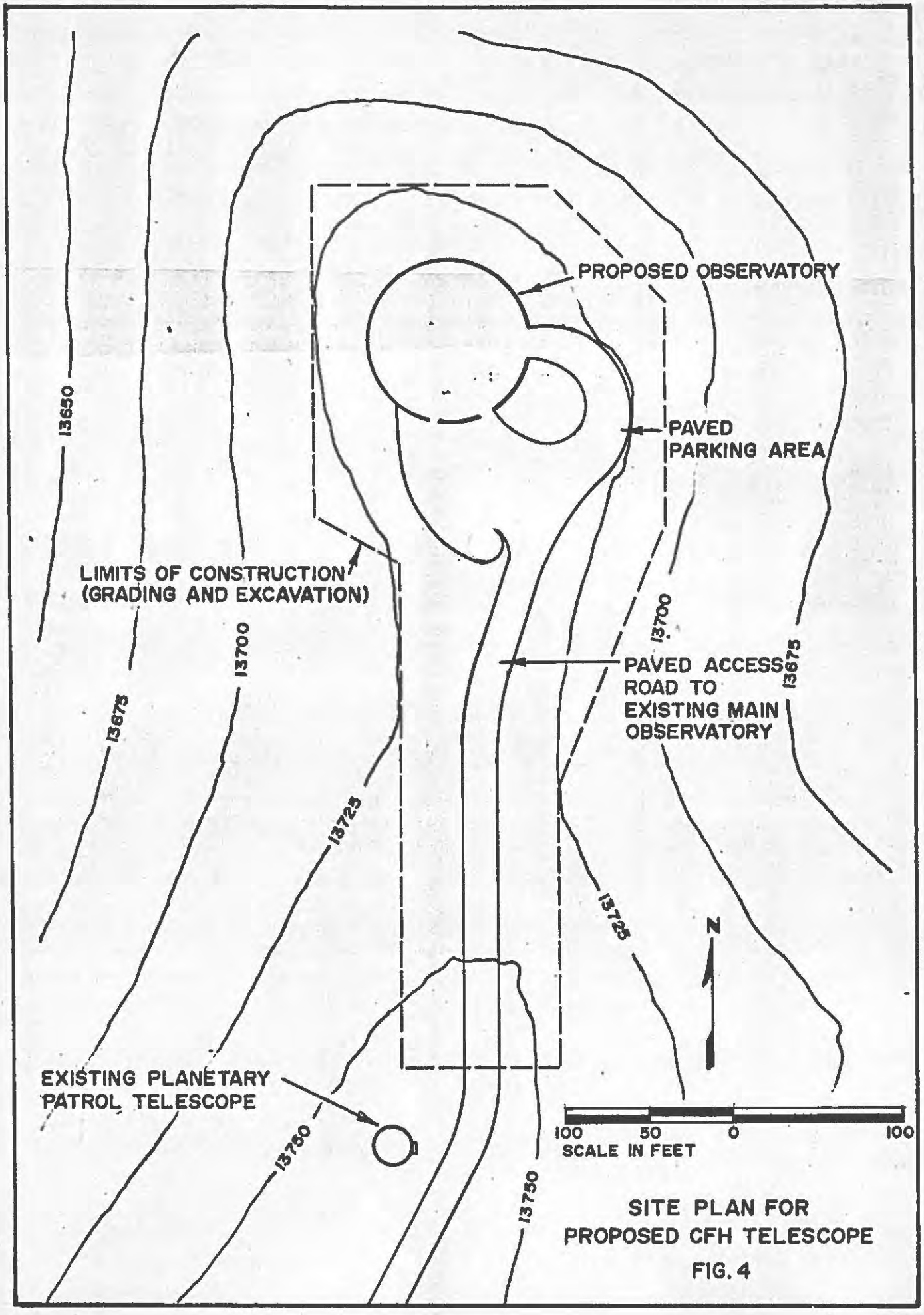
Because of the close proximity of the proposed construction site to the existing UH observatory, fugitive dust would have to be minimized. Fugitive dust would be partially controlled by sprinkling the construction site with heavy applications of water or low grade fuel oil while earthwork is in progress. In this regard, a substantial amount of liquid would have to be imported to the Summit for this purpose. In addition, construction work schedules would be coordinated with activities at the UH Observatory in order to avoid any possibility of damaging instrumentation of the existing observatories.

Blasting or heavy pounding of the subsoil would be avoided to prevent possible damage to the soil structure under the nearby existing observatory. Ground vibrations generated by accessory equipment would be reduced by isolating the equipment as far as practical from the planned facilities while ground vibrations, induced by vehicular traffic in the immediate vicinity of the proposed telescope site, would be minimized by the proposed paving of an 18-foot wide roadway from the main observatory to the site of the proposed observatory.



PROPOSED DEVELOPMENT PROGRAM
CONSTRUCTION SCHEDULE

FIG. 3



SITE PLAN FOR PROPOSED CFH TELESCOPE

FIG. 4

CHAPTER IV

DESCRIPTION OF THE ENVIRONMENT

PHYSICAL CHARACTERISTICS

Location

The project site is situated on the Summit of Mauna Kea and is accessible via the Saddle Road from either Hilo or Kona.

Geology

> "Mauna Kea volcano (4,206 m) on the Island of Hawaii erupted intermittently during late Pleistocene glacial ages, as shown by lava flows and pyroclastic sediments intercalated between four recognized sheets of glacial drift on the upper slopes of the mountain. Certain flows lying within the limits of the outermost drift sheet display a variety of features indicating eruptions through an ice cap (Porter, 1973)."

Since the cinder cones and lava flows on the mountain top erupted beneath ice, these natural features will probably be of continuing interest to geologists and volcanologists concerned with Hawaiian rocks and volcanic history.

Within the project site,

> "The summit cone consists essentially of volcanic ash and cinders except for intermittent zones of cementation and localized inclusions of spatter lava (tephra). There is no evidence of any cavities or faults in the cinder cone structure (Dames and Moore, 1973)."

Climate

Table 1 summarizes average daily temperature extremes and median nighttime wind velocities which characterize the Summit throughout the year.

Such data indicate that the mean temperature at the Summit is usually at, or a few degrees above, freezing ($0^{o}C$) while winds generally blow from the east at 10 to 15 mph. Data obtained by Morrison, Murphy et al also indicate that diurnal temperatures do not vary more than $1^{o}C$ between sunset and sunrise.

Most of the precipitation (approximately 15 inches annually) at the Summit is in the form of freezing fog or snow which can fall during any month of the year. However, only between December and March is the accumulation of ice and/or snow more than transitory (Morrison, Murphy et al, 1973).

TABLE 1

AVERAGE DAILY TEMPERATURE AND NIGHTTIME WIND VELOCITIES
MAUNA KEA SUMMIT

Month	T_{max}(^{o} C) (1965-69)	T_{min}(^{o} C) (1965-69)	Nighttime Wind Speed (mph) (1965-69)
Jan	3	-4	11
Feb	3	-4	20
Mar	5	-1	17
Apr	5	-3	24
May	5	-1	17
Jun	10	0	15
Jul	10	0	15
Aug	11	-1	13
Sep	11	+1	13
Oct	10	0	15
Nov	6	-3	13
Dec	3	-4	19

Source: Morrison, Murphy et al, 1973.

Topography

Elevations on the entire project site vary from 0 to over 57 percent. Steeper elevations are encountered downslope of the immediate and existing observatory site, as well as the area downslope of the proposed observatory

platform. In the immediate vicinity of both the existing and proposed observatory, elevations are not greater than 2 to 3 percent.

Soils

> "The general cinder cone material exhibits relatively low bearing strength in its natural state. It is also highly susceptible to erosion by surface run-off. Surface erosion is presently very limited because of the low annual precipitation and the high permeability of the volcanic material. Permafrost is known to exist directly under the cone crater, but the lateral extent of the permafrost zone is not known... The results of recent research performed by Dr. A. Woodcock of the University of Hawaii indicate that the permafrost lense is only a few meters thick (Dames and Moore, 1973)."

Soil Conservation Service (SCS) has assigned a "land capability unit" rating of VIIIs which indicates that the soils of the project site have limitations that restrict their use for wildlife habitat and recreation. In addition, SCS recognizes that these cinderlands are suitable for use as construction material.

Drainage

Rain and melting snow water runoff presently occur in the downslope portions of the project site via existing ground contours and natural drainage patterns. As stated earlier, the project site is highly susceptible to erosion by surface run-off; however, surface erosion is limited because of the low annual precipitation of approximately 15 inches and the high permeability of the volcanic cinder material.

Access

Access to the project site from Hilo or Kona is via the Saddle Road, State Route 200, to Puu Huluhulu (figure 1). From this location, an existing

mauka access road continues past Humuula Sheep Station, through Hale Pohaku and on to the Summit. The existing access, which previously was a single-lane dirt road, is now being altered by construction of a two-lane paved roadway to Hale Pohaku.

From Hale Pohaku to the Summit, a proposed project (Related Projects and EIS Documents) change the existing one-lane dirt road by horizontal and vertical realignment of portions of the existing 6.5 mile road, surfacing of the roadway with additional crushed rock, as well as by paving of 0.2 mile of roadway up to the main observatory at the Summit. In conjunction with the 6.5 miles of roadway alterations, drainage facilities, roadway signing, and gates near the base of the Summit Cone would also be constructed.

Utilities

Power

Power generation to the Summit is supplied by one of three portable generators which are situated on a trailer adjacent to the main observatory. The primary generator has a power rating of 150 KW while two "standby" generators each have a rating of 250 KW. One of the two standby generators is generally used during the monthly maintenance of the primary and remaining "standby" generators.

A proposed project (Related Projects and EIS Documents), designed to provide power to the Summit, would consist of installing:

a. 69 KV overhead transmission lines from the existing 69 KV line at the Saddle Road to a 40-acre site at 8,500 feet which is also being proposed for the construction of a permanent mid-level facility.

b. Substation at the site of the proposed mid-level facility.

c. 12.47 KV overhead transmission lines from the proposed mid-level facility to the 12,950-foot elevation, and underground lines from there to the Summit. In this regard, construction of the 12.47 KV underground transmission ducts began on July 25, 1973 and is scheduled for completion in early 1974.

d. Overhead telephone lines from the connection to the existing lines at about one mile above the Saddle Road to the proposed mid-level facility.

Sewage and Solid Waste Disposal

Adjacent to the existing observatory is a cesspool which is the receiving facilities for sewage generated by the Observatory.

Solid waste material generated by personnel at the Observatory is collected and hauled to the solid waste dump site at Hale Pohaku for disposal.

Water

Water at the Summit is stored in an 8,000 gallon tank which is situated underground, approximately 50 feet south of the Observatory. The UH provides water to the Observatory by deliveries of approximately 500 to 1,000 gallons of water once every 20 days. Such deliveries are made in conjunction with 5,000 gallon deliveries to the temporary base camp at Hale Pohaku.

Existing Structures

The location and size of existing structures on the project site are illustrated in figure 2. All of these structures are owned and operated by the University of Hawaii, Institute for Astronomy. Within the project

site, there is a 24-inch planetary patrol scope, the main observatory which serves as the enclosure for the 88-inch telescope, as well as related support facilities. Adjacent to the project site is one other telescope--the 24-inch Air Force scope which is also owned by the UH.

On the southwest side of the main observatory (for the 88-inch telescope) is a trailer on which the three generators are stored, as well as a former power shed which is a semi-underground facility. The power shed is no longer used by UH; as a result, the UH permits the local ski patrol to use the structure for shelter.

Astronomical Observation Conditions

Introduction

This section of the report briefly attempts to describe the quality of Mauna Kea Summit as a site for optical and infrared observations. Each of the following subsections are excerpts from a technical description and analyses, by Morrison, Murphy, Cruikshank, Sinton and Martin, entitled "Evaluation of Mauna Kea, Hawaii, As an Observatory Site" (June, 1973).

Optical Observations

> "For optical astronomy, the most important qualities are frequency of clear weather, photometric quality, seeing, and sky brightness. At Mauna Kea, an average of 75% of the nights can be used for observing with 56% of photometric quality for six or more consecutive hours. The median seeing is 1 arc second or better at the 61-cm Planetary Patrol telescope and 1.5 arc second at the 2.24-m telescope, and the skies are very dark ($\simeq$23^{m}0 arc second^{-2} in the blue)."

Infrared Observations

"For the infrared astronomer, the low humidity and high altitude at Manua Kea result in higher transparency and lower sky temperature than at lower altitude sites. If an observer were given 30 nights a year for infrared work at Mauna Kea, he could expect 20 nights in which he could get good data, and 11 nights on which excellent conditions would prevail, with water vapor well under 1 mm precipitable, sky noise less than 1×10^{-7} W cm^{-2} $sterad^{-1}$ on the NASA-West-phal meter, 17- to 28-μm extinction less than 0^{m}4 air mass-1, and good transmission in the submillimeter."

Comparison With Other Observatory Sites

"Detailed comparison of Mauna Kea with other observatories is difficult. Even such basic parameters as number of photometric nights or median seeing conditions are rarely reported, and most available information is anecdotal.

"...based on some four years of observing experience (at Mauna Kea)...We conclude that Mauna Kea appears to be superior to any other northern-hemisphere site for optical astronomy and that it is the best site in the world that has been tested for infrared quality."

BIOLOGICAL CHARACTERISTICS

Vegetation

Above 9,850 ± foot (roughly 3000 m) elevation, there is little vegetation along the southern slope of Mauna Kea. As a result, the project site and general Summit Cone area is characterized by few forbs and grasses.

Mammals and Birds

Due to the limited amount of vegetation in the project site and the adjacent Summit area, few mammals or birds are seen in the vicinity of the Summit area. Mammals and birds which are infrequently seen include feral sheep or mouflon which are "chased" to higher elevations by hunters, as well as the chukar partridge which makes infrequent transitory flights in the Summit area.

The primary habitat for sheep is between 7,000 and 10,000 feet where sheep migrate vertically (up and down the mountain) and feed on mamani, puakeawe, as well as a variety of forbs and grasses. As a result, any movements by sheep in the Summit area are temporary.

The Chukar Partridge inhabits bare and rocky slopes at timberline and higher elevations.

> "Chukars appear to prefer green browse...On Hawaii....gosmore is favoured food with fruits and berries such as Ohelo and puakeawe being common (State Fish and Game Division, 1967)."

Even though vegetation is limited above 9,850 feet, the availability of some gosmore and lichen provides some "encouragement" for transitory movement by the Chukar Partridge in the Summit area.

CULTURAL CHARACTERISTICS

Land Use

Land Ownership

The project site is owned by the State of Hawaii and under the jurisdiction of the State Department of Land and Natural Resources. However, in November, 1967, the Board of Land and Natural Resources approved a 65-year (beginning 1 January 1968) lease (S-4191) to the UH, Institute for Astronomy for all lands (approximately) above the 12,000-foot elevation. The lease refers to these lands as the Mauna Kea Science Reserve which was established for the preservation of the area's qualifications for scientific research, as well as other activities compatible with the scientific programs.

Federal, State and County Land Use Designations

National Natural History and National Historic Landmarks

In December, 1972, Mauna Kea was officially declared a "National Natural History Landmark" by the U. S. Department of the Interior. Such a designation was based on the fact that Mauna Kea is the highest insular volcano in the world; Lake Waiau, at 13,020 feet, is the highest lake in the United States; evidence of glaciation during the Pleistocene Epoch is present above the 11,000-foot level, despite its tropical location; Mauna Kea is a scenic attraction as an example of shield volcanism in the Hawaiian Archipelago.

There are no archaeological sites within the project site; however, downslope from the Summit lies the Keanakakoi Adz Quarry (at the 12,400-foot elevation) which is approximately 2,000 feet west of the existing road to the Summit. The Quarry site is listed on the National Register of Historical Places as a National Historical Landmark.

Similar to other natural history and archaeological sites in Hawaii, man continues to restrict their preservation. For example, off-duty military personnel occasionally bring jeeps into the Summit area and drive them down the slopes of virtually undisturbed cinder cones in the Summit area. As stated earlier, these cones erupted over glacial ice during the late Pleistocene Epoch and are considered significant geologically. Another example of man's influence is the removal of artifacts and general disturbance of the ancient adz quarry by local residents.

State

Lands within the Mauna Kea Science Reserve are part of the Mauna Kea Forest Reserve. As a result, the project site is designated for "general conservation use" and is subject to DLNR Regulation No. 4. Under the present regulation, the present uses of the project site conform to the permitted uses of a General Use Conservation Subzone.

County

The Hawaii County General Plan designates the project site for "conservation" use. In conjunction with this designation, County

zoning ("open" designation) permits no structures except those related to recreational pursuits.

Hawaii County is also presently initiating an outdoor lighting ordinance which would attempt to preserve the quality of darkness at the Summit during nighttime hours when optical and infrared observations are made. The proposed ordinance, if enacted, would probably contain general requirements such as:

1. The installation of shielding on all outdoor lighting to minimize the amount of light shining upwards into the sky.

2. The filtration of all future outdoor lights, having more than 15 percent of the total emergent flux lying in the spectral region below 4,400 angstrom units. Such lights will be filtered with a filter whose transmission is less than 10 percent at any wave length less than 4,400 angstroms.

3. The prohibition of the following:

   The operation of searchlights for advertising purposes between 11 pm and sunrise;

   The illumination of outdoor public recreational facilities after 11 pm unless a specific recreational activity is already in progress;

   The outside illumination of any building by flood light above the horizontal between 11 pm and sunrise; and the

   The illumination of outdoor signs which require flood lighting above the horizontal between 11 pm and sunrise.

Uses of the Project Site

Institute for Astronomy

The project site is used almost entirely for astronomical purposes by UH and other visiting scientists. In addition,

some 10 to 15 persons (non-astronomers) per week visit the main observatory in order to see the 88-inch telescope and other related facilities

Ski Patrol

As stated earlier, members of the local Ski Patrol occasionally utilize the old power house as a shelter during their performance of voluntary work in the Summit area.

Recreational Uses of Mauna Kea

The remaining portions of the Mountain are used primarily for hunting within the Mauna Kea Game Management Area. However, local residents and tourists engage in a number of other recreational activities such as camping, hiking, picnicking, motorcycling, pleasure driving (by automobile), sightseeing and snow skiing.

Picnicking and other recreational activities (excluding hunting) are subject to the public's requirement of obtaining a "Mauna Kea Entry Permit". This permit authorizes a "permittee" to utilize the road between Hale Pohaku and the Mauna Kea Observatory Complex and to enter upon State lands within the Mauna Kea Forest Reserve. During FY 1971, "Mauna Kea Entry Permits" were issued to 5,073 adults and 2,458 accompanying children.

Development Trends on Mauna Kea

Astronomy

The extent to which Mauna Kea will be developed for astronomy

was recently discussed by Harland Cleveland in his article to The Sunday Star Bulletin & Advertiser (9 Dec 1973) which, in part, is as follows:

> "....the UH Institute for Astronomy has developed Mauna Kea as one of the world's prime sites for ground-based nighttime astronomy...Observations by this instrument (the existing 88-inch telescope completed in 1967) have helped to demonstrate the quality of the site. Now the French and Canadian governments have contracted with the UH to build a 150-inch telescope on the University site; the British government is negotiating for a possible observatory that would include one of the world's two largest telescopes (the other is being built in the Soviet Union); and the U.S. Government is interested in Mauna Kea as a probable site for the first major infrared telescope."

Recreation

The future development of Mauna Kea for most recreational activities seems dependent upon the development of the proposed Mauna Kea Observatory Access Road. Such a development would increase usage of the mountain for activities such as sightseeing, motorcycling, pleasure driving, and snow skiing by residents and tourists.

In contrast to these activities, future hunting activity is almost completely dependent upon game management practices of the State Fish and Game Division, as well as the related ecological balance between existing vegetation and game birds and mammals.

Aesthetics

During daylight hours, the existing main observatory can be seen approximately 200 days of the year from the residential areas of Hilo, south, to

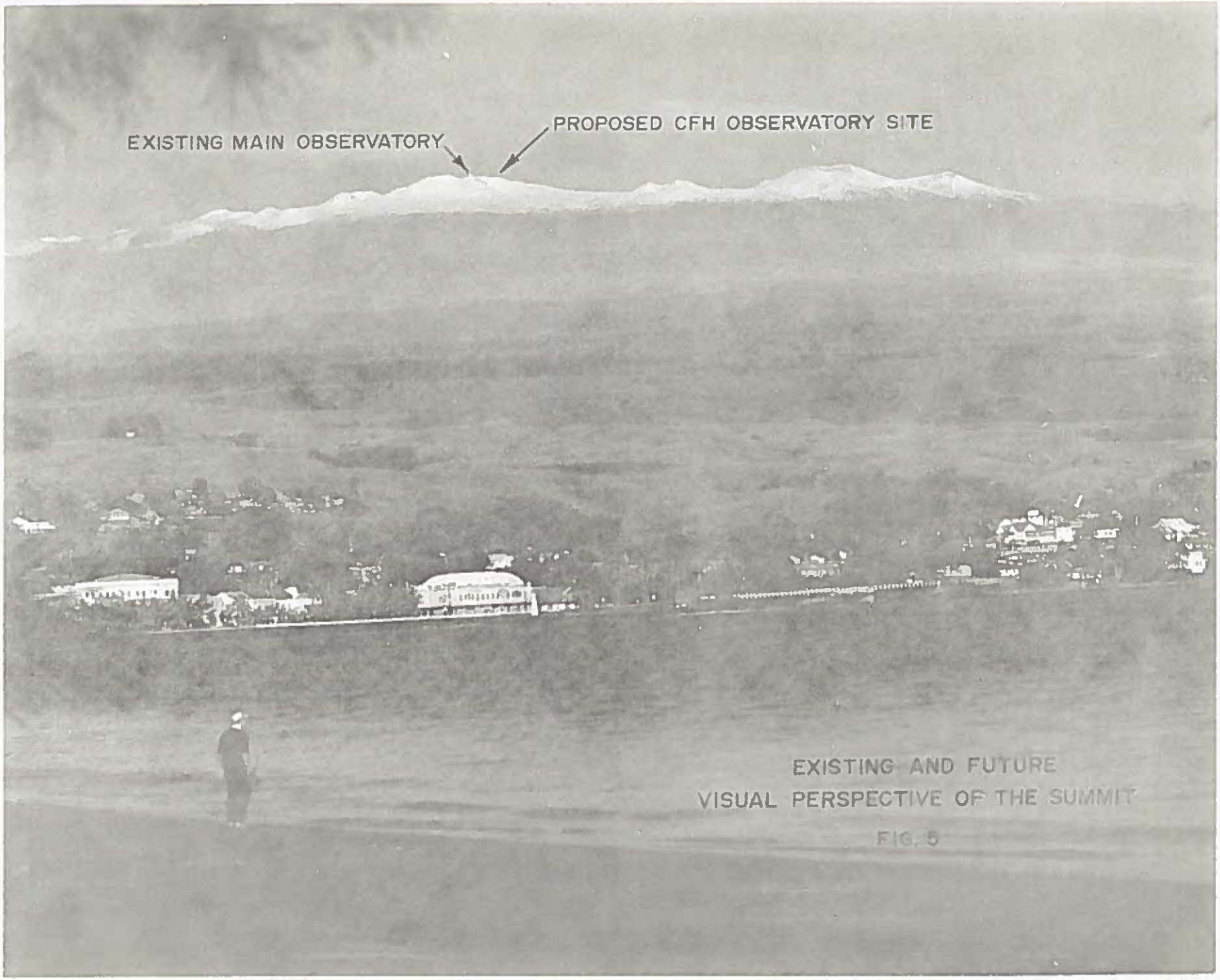
Glenwood, as well as from Waimea town which is situated some 50 miles west of the City of Hilo. Figure 5 illustrates the visual perspective of the Summit of Mauna Kea and the existing main observatory during winter months. During the non-winter months, the main observatory is more noticeable to the eye when normally there is no snow cover.

Social-Economic Characteristics

Provisional estimates of the total resident population by the U. S. Census and the State Department of Planning and Economic Development indicate that the resident population on Oahu increased from 630,528 to 678,124 residents (or 7.5 percent) from April 1, 1970 to July 1, 1973. During the same period, the resident population of Hawaii County increased 11.7 percent 63,468 to 70,872 residents.

In 1972, construction completed throughout the State totalled 714.3 million dollars and employed approximately 22,500 workers. For Hawaii County, total construction completed totalled 31.8 million dollars in 1971 (or almost 5 percent of the State's total construction) and employed approximately 1,820 workers.

The present UH Observatories on Mauna Kea employ 18 persons in Hawaii County who earn approximately $225,000 while 7 persons employed in Honolulu earn approximately $136,000. In addition, approximately $67,000 in other operating expenses are made by the Hilo office in Hawaii County while the Honolulu operations incure approximately $41,500 in operating expenses, as well as approximately $52,000 in indirect costs which support administrative functions in Honolulu.



EXISTING AND FUTURE
VISUAL PERSPECTIVE OF THE SUMMIT

FIG. 5

CHAPTER V

ENVIRONMENTAL IMPACT

INTRODUCTION

The proposed development program would cause effects upon topography, soils, sound levels, vegetation and land use regulations of the project site, as well as land use and economic trends within the tributary area. Other aspects of the project site and tributary area environments are not believed to be subject to any impact which would result from the proposed development program. Thus, only those aspects subject to some impact are discussed in the following paragraphs. Data providing the rationale for non-impact evaluation on other aspects of the project site and tributary area environments can be obtained upon request.

PHYSICAL CHARACTERISTICS

Topography

The equivalent of approximately one acre of land would be graded and/or excavated for the development of the observatory foundation, the underground support facility structures, an 18-foot wide access road from the existing main observatory to the proposed telescope site, as well as underground utility lines for power, water and sewage.

Fugitive Dust and Ground Vibrations

Fugitive dust and ground vibrations would be created by the proposed development program. Excessive amounts of fugitive dust could affect

the instrumentation of the existing three observatories on the Summit while excessive ground vibrations could disturb soil cementation and cause a vertical migration of ash particles. Disturbance of soil cementation and vertical migration of ash particles could further cause a reduction in bearing capacity and an increase in potential settlement (Dames and Moore, 1973). However, it is believed that the proposed precautions (see Project Description--Earthwork) to minimize both fugitive dust and ground vibrations would not cause damage to the instrumentation or foundations of the existing observatories.

Sound Levels

The proposed development program would create increased sound levels when construction workers and equipment would be present on the project site. On the average, it is believed that increased noise levels would not exceed 15 dbA over normal daytime sound levels, or approximately three times greater than present noise levels, during construction operations on the project site.

BIOLOGICAL CHARACTERISTICS

Vegetation/Bird and Mammal Ecology

As implied earlier, the project site is almost barren of vegetation except for a few forbs and grasses. Hence, no reduction in habitat for birds or mammals would result.

However, the importation of construction equipment into the project site could possibly cause the introduction of exotic plants in the area. Such a result would be in conflict with the stipulations of the UH lease

(S-4191) with DLNR which requires that no vegetation be planted within the Manua Kea Science Reserve without the approval of the Chairman of the Board of Land and Natural Resources.

CULTURAL CHARACTERISTICS

Land Use

Federal, State and County Land Use Designations

National Natural History and National Historic Landmarks

The National Natural History and the National Historic Landmarks within the tributary area would not be directly affected by the proposed development program; however, it is believed that they would be affected by the related Mauna Kea Observatory Access Road project. Increased usage of the Access Road would encourage more people to travel up the Mountain; and as a result, more people who would physically desecrate both the Adz Quarry sites and geologic features on Mauna Kea. The degree of desecration is impossible to quantify since National Landmarks are based on subjective value and, from a physical standpoint, little or no documentation is available concerning the present physical condition of the Adz Quarry sites and various geologic features on Mauna Kea. In fact, the physical coordinates of the Keanakakoi Adz Quarry have not yet been established by the National Park Service which originally initiated the designation of Historical Landmark status for this site.

However, it is further believed that desecration of these sites

will continue to increase with or without the Access Road, until the State Department of Land and Natural Resources and/or the U.S. Department of Interior can develop these sites for educational and recreational purposes. It is believed that such development would reduce desecration and encourage the public's preservation of the Adz Quarry sites and various geologic features on Mauna Kea.. :

State

The proposed revision of Regulation No. 4 (October, 1973) and associated land use designations would place the project site within a "Resource" conservation subzone. The revised Regulation, if adopted, would permit facilities and support facilities (under the auspices of public agencies), within a "Resource" subzone, which would be developed for the monitoring, observation and measurement of solar and atmospheric resources.

Since the project site has already been leased to UH, the Corporation would have to sub-lease a portion of the project site for its development. However, any sub-lease by UH would have to be approved by the Board of Land and Natural Resources.

County of Hawaii

Even though the project site is situated on State lands, all construction plans and specifications would have to conform to local building code requirements of Hawaii County.

Development Trends on Mauna Kea

In conjunction with four other projects related to the proposed telescope development, the proposed development program would encourage further development of the Summit area for astronomical purposes, as well as encourage recreational development along Mauna Kea's Southern slope. Astronomical development on the Summit would be encouraged by the presence of support facilities i.e. access and power, which would be required for the construction and operation of any future observatory. Increased demands for recreational facilities would stem primarily from greater accessibility to the Summit and southern slope of Mauna Kea. Such demands may include additional provisions for overnight camping, picnicking and skiing.

Aesthetics

The proposed development program would increase the present visual perspective of one observatory on Mauna Kea to two observatories in the residential areas of Waimea, Hilo, Keaau, Kurtistown, Mountain View, Glenwood and Volcano. In this regard, figure 5 depicts the view and location of the future observatory which would have the same color and vertical profile of the existing main observatory. It should be noted; however, that the location of the existing main observatory may "block" the view of the proposed observatory from Mountain View, Glenwood and Volcano.

Economic Impact

Of the $21,375,160 which would be spent jointly by CNRS and NRC over the 4-year construction program, approximately 4.5 million dollars would be generated into the State's economy. Utilizing "income coefficients"

developed by the State Department of Planning and Economic Development (DPED), the proposed development program would generate some $2,506,950 in direct income to the local building construction industry and approximately $1,505,700 in secondary income to the remainder of the Hawaiian economy. Further deliniation of direct and secondary income i.e. Honolulu and Hawaii Counties, cannot be estimated since the source of all labor and materials has not been determined at the time of this report. The remaining $16,875,160 of the $21,375,160 would be spent in France and Canada during the design and construction of the telescope and related instrumentation. For the purposes of this report, the economic impact of the income generated in these two Countries was not analyzed.

The primary economic impact of the proposed development program would result from the eventual operation of the proposed observatory by approximately 20 permanent personnel of the Corporation. Annual operating costs are estimated to be about $1,000,000. By utilization of the DPED "income coefficients" for "State and local government enterprises" and assuming that these "coefficients" would be somewhat indicative of the expenditures of the quasi-public CFHT Corporation in Hawaii County, it is believed that the operation of the proposed observatory would annually generate some $456,200 in direct income to other agencies i.e. local utilities, which support the operation of the observatory and approximately $364,100 in secondary income to the remaining Big Island economy.

Related to the impact of the proposed development program are the other four related projects (Related Projects and EIS Documents) which are all being subsidized by the State of Hawaii. The total construction value of these projects is roughly 4 million dollars which, if implemented, would

generate $2,228,400 in direct income to the State building construction industry and $1,336,000 in secondary income to the remaining Hawaiian economy.

CHAPTER VI

OTHER ENVIRONMENTAL CONSIDERATIONS

ADVERSE ENVIRONMENTAL EFFECTS

Adverse environmental effects resulting from the development program include the alteration of topography; fugitive dust and ground vibrations; increased sound levels; the potential introduction of exotic plants; and the increased demand for recreational facilities on Mauna Kea. Such effects are discussed more fully within the preceeding section regarding environmental impact.

ALTERNATIVES

One alternative is to forego development of the proposed observatory at the Summit, as well as the four other related projects. Such an alternative would result in the savings of approximately $2,228,000 to the State of Hawaii and a loss of approximately $1,844,200 which has already been spent by the State of Hawaii (as of 14 December 1973) for the planning and design of each of the projects, as well as the partial construction of the power line and access road to the Summit.

A second alternative is to temporarily forego development of the proposed observatory and the four other related projects until such time that a master plan has been developed for Mauna Kea. This alternative would cost the Canadian and French governments approximately 2.1 million additional dollars and the State of Hawaii an additional $400,000 for every year of delay. On the other hand, the implementation of this alternative would

provide DLNR with the opportunity of planning for the increasing use of the Mountain by the public and its relationship to game management policies, National Historic and Natural History Landmarks, as well as the rapidly changing floral community. However, it is believed that any such master planning would eventually conclude that astronomical observation facilities could only be developed at the Summit and that power and access to the Summit would be provided on the same, or a similar alignment to the existing access in order to minimize future environmental impact. Therefore, in terms of master planning for Mauna Kea, it appears that the location of a permanent mid-level facility could logically be the only variable involved in the development of astronomical observation facilities.

SHORT TERM/LONG TERM RELATIONSHIPS

Within the short term (the next 10 years), the CFH Telescope would be in operation and increasing international interest would be focused on astronomical observations on Mauna Kea. It is conceivable that the United States and British governments may each develop two additional telescopes on the Summit. During this period, the new access would also cause a substantial increase in recreational activity on Mauna Kea. With increased recreational demands, local politicians will promise new recreational facilities i.e. for picnicking, camping and hunting, for its constituents. However, the Department of Land and Natural Resources and other agencies will be hesitant to provide such facilities until it master plans the relationship of man to the Mauna Kea environment. Some examples might be the determination of game management policies which are consistent with goals for the declining Sophora parkland, or to what degree and what manner will man come in contact with geological features and ancient archaeological sites.

Within the long term (the next 20 years), several telescopes will be in operation on the summit of Mauna Kea. In terms of recreation, considerably more recreational facilities will be developed on the mountain to support a number of activities performed by an increasing number of residents and tourists. Such facilities will generally be in consonance with master planning for recreation, as well as game and forestry management.

IRREVERSIBLE COMMITMENTS

The commitment of resources required to accomplish the proposed development program would include labor and material used in construction, as well as the monetary resources required for governmental approval of the proposed project.

19 January, 1974.

APPENDIX A

TRIPARTITE AGREEMENT AMONG:

THE NATIONAL RESEARCH COUNCIL OF CANADA,
THE CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE OF FRANCE,
AND THE UNIVERSITY OF HAWAII

CONCERNING

THE CONSTRUCTION AND OPERATION OF
A LARGE OPTICAL TELESCOPE ON MAUNA KEA

Recognizing the increasing development of astronomical research and the quality and the quantity of related scientific work carried out in the universities and specialized research centres of Canada, France, and Hawaii,

Considering the need for instruments to be available for use by the astronomers of Canada, France and Hawaii,

Considering the desire of the astronomers of Canada, France and Hawaii to carry on cooperative programmes of research,

Considering the desirability of developing international cooperation in large-scale scientific undertakings,

- The National Research Council of Canada (NRC)
- The Centre National de la Recherche Scientifique (CNRS) and
- The University of Hawaii (UH)

hereinafter referred to as the Agencies, having obtained the approval as appropriate of their respective governments, that is those of Canada, of France, of the United States of America and of the State of Hawaii, agree:

I - GENERAL PROVISIONS

1. That the NRC, CNRS, and UH will establish under Hawaii law a Corporation to be named the Canada-Franco-Hawaii Telescope Corporation, to design, construct and operate on Mauna Kea, Hawaii, a large optical telescope of 3.6 meter aperture along with laboratories, equipment, and associated installations, which will remain the exclusive property of the Corporation during

the existence of the Corporation.

2. The Corporation will be directed by a Board of Directors assisted by a Scientific Advisory Council.

2-1 - the Board of Directors shall be composed of:

- 4 members appointed by NRC
- 4 members appointed by CNRS
- 2 members appointed by UH

The Board of Directors shall be responsible for coordination on technical and administrative problems, and, in particular, must ensure that the design and operation of the telescope and its ancillary installations will satisfy the needs of the astronomers.

It is responsible for the use of the funds of the Corporation.

Its decisions will be taken by majority vote, provided there is a quorum and that at least one of the directors named by each agency joins in that majority. If the need arises the Chairman may take action between meetings as specified in the bylaws.

2-2 - the Scientific Advisory Council shall be composed of:

- 4 members appointed by NRC
- 4 members appointed by CNRS
- 2 members appointed by UH

and up to four other members to be named by the Board of Directors.

It meets at least twice per year.

This Council shall be responsible for making recommendations to the Board of Directors and the Executive Director on scientific and technical matters relevant to the aims of the Corporation.

3. For the duration of the construction phase, the management of the telescope project is placed under the direction of a Project Officer and an Associate Project Officer appointed by the Board of Directors on the nomination of NRC and CNRS.

The Project Officer and the Associate Project Officer will be jointly responsible to the Board of Directors for carrying out the design and construction activities. In particular, they must ensure that the equipment provided satisfies the requirements for its intended use.

The Project Officer and the Associate Project Officer may attend meetings of the Scientific Advisory Council. On occasion the Council may deliberate without their presence, if it so wishes. Before these meetings the Project Officer will send to the Scientific Advisory Council a report on work in progress or completed within the scope of the project.

The responsibilities of the Project Officer and Associate Project Officer and the organization and working procedures of the Project Office are detailed in Annex A.

4. The powers necessary for the management of the Corporation shall be delegated to an Executive Director and to an Associate Executive Director appointed by the Board of Directors upon the proposal of NRC and CNRS following their consultation of UH.

The authority and the duties of the Executive Director and of the Associate Executive Director are defined in the bylaws.

5. During the construction phase and in any case as long as it deems it necessary, the Board of Directors may name the Project Officer, Executive Director of the Corporation, and the Associate Project Officer, Associate Executive Director.

6. All senior employees of the Corporation shall be appointed by the Board of Directors in such a manner as to ensure an appropriate division among NRC, CNRS and UH.

7. The Director of the Institute for Astronomy of UH has the authority to ensure that all persons on property over which the Institute has jurisdiction abide by the general rules and regulations of the Institute.

II - FINANCIAL PROVISIONS

8. That the NRC and the CNRS will provide to the Corporation work, components and sums necessary for the construction of the telescope, its basic instrumentation, its dome and associated buildings.

NRC and CNRS will equally share the cost and jointly assume responsibility for the design of the telescope. The total capital cost, including components and studies already in existence will be 91 million French francs (as estimated on February 1, 1973) providing the construction commences in 1973 and is completed by 1977.

The general technical characteristics of the project are given in Annex B.

As soon as it is formed the Corporation will take over the contractual obligations previously assumed by NRC and CNRS for this project. However, when those contractual obligations concern the construction of the telescope, its basic instrumentation, its dome and associated buildings, only NRC and CNRS may be held financially responsible.

That, in as equal a fashion as possible, maximum use will be made of French and Canadian industrial capacity in the design and construction of the telescope, its basic instrumentation, its dome and associated buildings, and in the production of high technology components.

9. The University of Hawaii will

9-1 - furnish a sub-lease at no cost to the Corporation until the year 2033 for part of the land UH now holds under Lease Number S4191 from the State of Hawaii, the boundaries of which are shown on the site plan, dated 15 December 1973, at Annex C. The University of Hawaii also agrees to seek from the State the renewal or extension of its Lease during the life of the Corporation and, if received, to renew or extend the Corporation's sub-lease for the life of the Lease or the life of the Corporation whichever is shorter.

9-2 - construct and maintain an access road - having characteristics consistent with the overall plan for the development of the Mauna Kea Observatory area-- to a boundary line of the sub-leased property.

9-3 - construct an electric power line to a central terminal near the Mauna Kea Observatory area, of approximately 750 KW capacity to meet the projected installations of the Corporation (approximately 350 KW) and the presently anticipated needs of the existing UH installations and to grant to the Corporation access to this power through an easement over UH leased land. The cost of connection from the telescope site to the central terminal, and of electric power, are to be paid by the Corporation.

9-4a - construct at a mid-level station two family dwellings with a total area of approximately 220 sq. m. for exclusive use by permanent personnel associated with the Corporation. In the same general area, UH will also construct an office and laboratory building. This structure is presently expected to contain 10 offices - of which 5 (containing approximately 70 sq. m.) will be made available to the Corporation. In addition, a data analysis laboratory of approximately 60 sq. m. and two darkrooms are contemplated, access to which will be accorded to the Corporation on an equitable basis between the UH and the Corporation.

These facilities will be maintained by UH. The Corporation will, however, be charged on an equitable basis for operating costs incurred by UH in providing such facilities.

b. undertake to provide at the same mid-level station, dormitory type living accommodations (including kitchen and dining facilities) sufficient to meet the combined needs of the University and the Corporation. The UH will assume responsibility for construction, subsequent operation and maintenance with the understanding that the pro rata cost of providing these accommodations, including amortization, shall be charged direct to the individual who uses them.

c. obtain for the Corporation, should the need arise, authority to construct on the mid-level area additional offices, laboratories and housing on condition that such construction be undertaken within five years from signature of this agreement, that financing be arranged by NRC and CNRS, and that the proposed style, materials, and location of such building be approved by the State and the University of Hawaii.

9-5 - furnish 75 sq. m. of office space to the Corporation, for its permanent staff, in the new buildings of the Institute for Astronomy on the Manoa campus. This space will be maintained by the UH and all operating costs will be charged to the Corporation on a basis of no profit to the UH.

9-6 - place at the disposition of visiting astronomers using the CFH Telescope, two offices in the Manoa campus building, and afford to them the same facilities as those available to the members of the staff of the Institute for Astronomy, on a basis of no profit to the UH.

9-7 - solicit maximum cooperation from the local authorities and users of the site in protecting the natural qualities of the site for astronomical observations.

10. Operating costs.

10-1 -. That after the completion of the construction phase, the Agencies will annually contribute funds to cover the expenses budgeted by the Corporation up to one million dollars US, as estimated on February 1, 1973, with appropriate provision for variations in the cost of living, in the proportion of NRC 42.5%, CNRS 42.5%, and UH 15%.

These funds will be assigned to cover necessary operating expenses of the Corporation (in particular, meetings of the Board of Directors and the Scientific Advisory Council, staffing and operating the telescope) and for developing further the instru-

mentation of the telescope.

Similar costs which will be incurred before the end of the construction phase, will be shared in the same proportions; however, in consideration of the other contributions by UH, no cash contributions will be required from UH before July 1, 1975.

The date on which the construction phase will be considered as completed will depend on the date set for commencement of the telescope's normal operation. This date of completion of the construction phase will be determined by the Board of Directors in agreement with each of the Agencies.

10-2 - NRC and CNRS will respectively support directly or through the Corporation Canadian and French staff working within the framework of the Project Office.

Other expenses of the Project Office will be shared equally by NRC and CNRS. With this aim in view on operational budget will be provided by NRC and CNRS to the Project Office through the Corporation upon the recommendation of the Board of Directors.

11. Personnel hired by the Corporation will be paid by the Corporation. The schedule of salaries will be that in use at the UH.

If the Corporation deems it necessary, the UH will assist the Corporation in arranging through an appropriate organization for payment of salaries and granting of social benefits to employees of the Corporation.

12. It is understood by the Agencies that the applicable laws of the State of Hawaii currently accord relief from state corporate, income, real estate and excise taxes to non-profit corporations registered exclusively in the State of Hawaii.

It is further understood by the Agencies that the non-profit Corporation referenced in this agreement will benefit from these facilities and that the UH will undertake to use its best efforts to ensure the continued availability of these benefits to the Corporation.

III - FINAL PROVISIONS

13. That in consideration of their respective contributions, the three Agencies will receive equitable interest in the Corporation as follows:

N.R.C.	42.5%
C.N.R.S.	42.5%
U.H.	15.0%

14. That their respective contributions entitle the Agencies to averaged observation time in the following proportions:

N.R.C.	42.5%
C.N.R.S.	42.5%
U.H.	15.0%

Only applications for observation time which are sponsored by a member of the Corporation shall be submitted to the Corporation for consideration.

Transfer by a member of the Corporation of part of its observation time to a third party can only take place with the unanimous agreement of the Directors present at the meeting when this proposal is discussed.

15. That should the need arise for the settlement of dispute concerning the interpretation or application of this agreement which cannot be resolved by the Agencies, such a dispute shall at the request of any Agency be submitted to a tribunal of arbitration.

Such a tribunal shall be constituted for each individual case as follows: each Agency shall appoint two members, and these six members shall jointly propose another member as their chairman, to be appointed jointly by CNRS, NRC and UH. Details of the procedure of arbitration are described below:

Procedure of Arbitration

All members of the tribunal shall be appointed within two months after any Agency has informed the other Agencies that it wishes to submit the dispute to a tribunal of arbitration.

If the two-month period specified above has not been observed, any agency may, in the absence of any other relevant agreement, invite the to make the appointments necessary to fill any positions vacant on the tribunal at the end of that period.

The tribunal shall determine the place or places where it shall sit, its own procedures and all other administrative matters. The decision of the tribunal shall be by majority vote.

The tribunal shall make its decision as promptly as possible and, in any case, no later than three months from the date of its establishment.

The tribunal shall transmit a certified copy of its findings including the decision and the reasons for it to each agency. Each Agency shall bear the costs for its own members on the tribunal of arbitration and of its representatives in the tribunal's proceedings. The costs of the chairman and the remaining costs shall be borne in equal parts by the Agencies unless the tribunal otherwise decides. The decision of the tribunal shall be final and binding.

16. That, after the completion of construction of the telescope and the laboratories, equipment and installations necessary for its operation and in any case not more than five years from the date of the signature of this agreement, authorized representatives of the Agencies shall meet to examine if it would be required to propose modifications to the text of this agreement. Thereafter such a revision will be possible every three years upon the express request of one of the Agencies.

17. That, the Agencies taking into account any recommendation of the Board of Directors, shall select the method of dissolution of the Corporation.

18. That, this agreement shall come into force when the authorized representatives of the three Agencies have duly signed the original texts of the agreement.

Signed in six copies, three in English and three in French, the texts in both languages having equal validity,

by _____ at _____ on _____

for the Centre National de la Recherche Scientifique

by _____ at _____ on _____

for the National Research Council of Canada

by _____ at _____ on _____

for the University of Hawaii

APPENDIX B

DEPARTMENT OF LAND AND NATURAL RESOURCES

MAUNA KEA ENTRY PERMIT AND PERMIT CONDITIONS

This permit authorizes the undersigned permittee to use the road between Hale Pohaku and the Mauna Kea Observatory Complex and to enter upon State lands within the Mauna Kea Forest Reserve for the purpose of _____

_____,

subject to the following conditions:

1. Only 4-wheel drive vehicles permitted.
2. Driving of vehicles shall be confined to designated roads provided for such use.
3. Parking on road prohibited except in designated areas.
4. Overnight camping is prohibited except in designated areas.
5. Entering the Mauna Kea Observatory Complex is prohibited without permission from the Observatory.
6. Littering is prohibited.
7. The permittee shall comply with all orders of the Board of Land and Natural Resources or its authorized representatives and any applicable Federal, State and County laws, ordinances, and rules and regulations.
8. The permittee shall read, study and obey instructions and other material contained in "Exhibit A" attached hereto and made a part hereof.

For and in consideration of the issuance of this permit, the undersigned permittee hereby waives any and all claims he may have against the State of Hawaii and its respective officers, agents and employees, and agrees to defend, hold harmless and indemnify the State of Hawaii and its respective officers, agents and employees, from any suits, actions and claims arising out of or in any way connected with the activities permitted under the permit.

Any violation of the terms and conditions of the permit, orders of the Board of Land and Natural Resources or its authorized representative and any applicable Federal, State and County laws, ordinances and rules and regulations shall constitute cause for revocation of this permit.

This permit is valid for the period from _____ _____

to _____ or until the area is closed by the Department of Land and Natural Resources.

BOARD OF LAND AND NATURAL RESOURCES

I understand and agree to conditions set forth above.

SUNAO KIDO, Chairman and Member

_____ _____

Permittee's Signature Date of Issue

EXHIBIT "A"

ROAD

The road from the Saddle Road to the Mauna Kea Observatory is unpaved, rough and narrow, with many sharp turns. Extreme caution must be exercised when driving on the road.

* Be on the lookout for washed away and slide areas.

* Do not operate a vehicle in excess of 15 miles per hour.

* Use headlights when fog sets in.

* Drive vehicle only on designated roads.

* Park vehicle only in designated areas.

* Only four-wheel drive vehicle above Hale Pohaku.

WEATHER

* Be prepared for sudden changes in weather conditions.

  Storms, high winds, fog, rain, hail, snow and freezing temperatures.

ALTITUDE

* 13,796 feet at the summit.

* Altitude Sickness.

  The effects of oxygen deficiency may cause headache, fatigue, shortness of breath, lassitude, rapid heart beat, nosebleed or nausea and vomiting. Any person suffering from heart, circulatory, blood or respiratory diseases should consult with his doctor before attempting to enter this area.

* Altitude may cause mechanical failures to motor vehicles. Carburetors adjusted for low altitudes will not function properly in high altitudes.

* Avoid running or extreme physical exertion, walk slowly.

* Use sun glasses and protective lotion.

MISCELLANEOUS

* There are NO water, food, fuel, restrooms, shelters, medical facilities, towing services, etc.

APPENDIX C

COMMENTS FROM GOVERNMENT AGENCIES

April 17, 1974

MEMORANDUM

TO: The Honorable Sunao Kido
Department of Land & Natural Resources

FROM: Richard E. Marland, Interim Director
Office of Environmental Quality Control /s/ Richard E. Marland

SUBJECT: Draft EIS for the CFHT Telescope and Observatory Facilities, Mauna Kea, Hawaii

This Office has reviewed the subject EIS and evaluated comments received from the following:

State Agencies:
- Agriculture (18 Mar 74)*
- Accounting & General Services (25 Feb 74)
- Transportation (11 Feb 74)*
- Planning & Economic Development (5 Mar 74)

Federal Agencies:
- Corps of Engineers, Honolulu District (1 Mar 74)
- U.S. Air Force, 15ABWG/DEEE (4 Mar 74)*

Hawaii County:
- Planning Department (22 Feb 74)*
- Public Works (28 Jan 74)*
- Parks & Recreation (27 Feb 74)*
- Water Supply (19 Feb 74)*

*indicates no comments/objection

Copies of these review comments were previously transmitted. Our review indicates the following major areas of concern.

Master Plan Development

The final EIS (fEIS) should include discussion of the most current proposal by the Institute for Astronomy to prepare a master plan for the Mauna Kea Science Reserve. The fEIS should also describe the concept of the Control Commission proposed by the Institute to manage the Reserve and to coordinate multi-agency interests on Mauna Kea. The fEIS should also discuss the means by which the CFHT telescope facilities were coordinated with other Institute projects. Finally, consultation with interested agencies should be discussed beyond a mere listing of agencies; what types of questions were asked of the agencies during consultation and what types of concerns and issues were raised by agencies? How were such concerns and issues handled?

Related Projects

The relationship of other individual projects to the CFHT telescope project should be stated in the fEIS. What is the timetable for development of all the various projects and how does development of the telescope fit into the overall schedule? The requirement for support facilities to service the telescope and associated personnel should be clearly outlined in the narrative of the fEIS. A brief description of the necessary base camp expansion would be appropriate. Also, the power and mid-level facilities required for the CFHT operation should be discussed; the extent to which the power and mid-level facilities will be committed to CFHT use should be the focus of such discussion.

CDUA Hearing

A hearing was held by the Board of Land & Natural Resources on April 11 in Waimea, Hawaii. Critical comments and opposing views presented at the hearing should be disclosed and discussed in the final EIS.

Technical Points

We recommend that the title be changed to simply read, "Environmental Impact Statement for the CFHT Telescope and Observatory Facilities, Mauna Kea, Hawaii". The terms assessment" and "preliminary draft" are confusing and may be misleading. Building plans appended to the CDUA should be included in the fEIS to provide the reader with a clear

description of the proposed facility. A typical cross section of the project site would also be helpful to the reader. The fEIS should include a map which illustrates: the location of the CFHT telescope in relation to all the other proposed projects -- including the NASA, UK, and MIT telescopes; the relative location of Lake Waiau and Keanakakoi Adz Quarry; the boundaries of the Historic and Natural History Landmarks; and natural drainage patterns. The Dames & Moore report which is referenced frequently in the text is not included in the Bibliography.

Lake Waiau

Given the information in the dEIS, it is difficult to assess how the CFHT facility will affect Lake Waiau. The relationship of the lake to the facility should be described in text as well as illustrated on a map. It is noted on page IV-3 that rain and melting snow water runoff "presently occur in the downslope portions of the project via existing ground contours and natural drainage patterns". The drainage patterns should be described in the fEIS, especially with respect to Lake Waiau. Mitigative measures to control fugitive dust include application of water or low-grade oil; road construction and operation will also involve small amounts of petroleum wastes; also, cesspool seepage will probably flow downhill from the summit. The fEIS should discuss the likelihood that such man-made pollutants may adversely affect the pristine character of Lake Waiau.

Vegetation

The section on "Vegetation" (page IV-8) should be expanded to more fully describe what is meant by "few forbs and grasses". Are these forbs and grasses unique in any way and do they represent an ecosystem not commonly found elsewhere in Hawaii? Were any experts consulted with regard to evaluating the research/educational value of the Mauna Kea vegetation? Was the Natural Area Reserves System Commission consulted?

Land Use Designations

The implications of Natural History and Historic Landmark designations should be discussed in terms of procedural requirements that must be met prior to construction. Also, the

statement that the County's "open" designation "....permits no structures except those related to recreational pursuits" (page IV-11) should be clarified. If this statement is true, can the telescope be built?

Recommendations

We recommend that: (1) written responses be sent to all commentors who provided substantive comments, including this office, indicating how specific concerns were considered, evaluated, and disposed; (2) review comments and your written responses be appended to the fEIS; and (3) copy of the final EIS be sent to each commentor for their information. We hope that our comments are useful in further evaluation of the proposed CFHT facilities.

cc: Dr. John Jeffries, UH/Institute for Astronomy
/Mr. Fred Zobrist, Neighbor Island Consultants

OFFICE OF ENVIRONMENTAL QUALITY CONTROL
OFFICE OF THE GOVERNOR
550 Halekauwila Street
Tani Office Building, Third Floor
Honolulu, Hawaii 96813

March 28, 1974

MEMORANDUM

TO: The Honorable Sunao Kido, DLNR
The Honorable KeNam Kim, DAGS

FROM: Richard E. Marland, Interim Director
Office of Environmental Quality Control

Richard E. Marland

SUBJECT: Draft Environmental Impact Statements for:
(1) Power to Summit, Mauna Kea Observatory (DAGS)
(2) Mauna Kea Observatory Mid-Elevation Facility (DAGS)
(3) Temporary Base Camp Expansion, Hale Pohaku, Mauna Kea (DLNR)
(4) Telescope and Observatory Facilities, Mauna Kea (DLNR)

To date we have received responses to the draft statements from the following agencies:

State Agencies:

Accounting and General Services (2/25/74)
Agriculture (3/18/74)*
Land and Natural Resources (2/19/74)
Transportation (2/11/74)
Planning & Economic Development (3/5/74) (5 memos)

Federal Agencies:

U. S. Army, Corps of Engineers (3/1/74)
Soil Conservation Service (3/1/74)*
U. S. Air Force, 15ABWG (PACAF)/DEEE (3/4/74)*

County of Hawaii:

Planning Department (2/22/74)*
Public Works (1/28/74)*
Parks and Recreation (2/27/74)*
Water Supply (2/19/74)*
*NOTE: No comments/objections

We are now evaluating the comments and the draft statements and anticipate that our recommendations will be ready very shortly. Meanwhile, please respond to comments received and advise this Office of your disposition of such comments.

Enclosures:

cc: Dr. John Jeffries, UH/Institute of Astronomy (w/o encl.)
✓Fred Zobrist, Neighbor Island Consultants (w/encl.)

JOHN A. BURNS
GOVERNOR

KENAM KIM
COMPTROLLER

STATE OF HAWAII
DEPARTMENT OF ACCOUNTING
AND GENERAL SERVICES
P. O. BOX 119
HONOLULU, HAWAII 96810

FEB 25 1974

Dr. Richard Marland
Interim Director
Office of Environmental
Quality Control
550 Halekauwila Street
Honolulu, Hawaii

Dear Dr. Marland:

Subject: Draft Environmental Impact Statements for:
(1) Power to Summit, Mauna Kea Observatory, Kaohe, Hawaii - DAGS
(2) Mauna Kea Observatory Mid-Elevation Facility - DAGS
(3) Temporary Base Camp Expansion, Hale Pohuku, Mauna Kea - DLNR
(4) Development of a Telescope and Observatory Facilities, Mauna Kea - DLNR

This is in response to your request for a simultaneous review and comments of the subject statements. The following are our comments:

Temporary Base Camp Expansion

There is no mention about the disposition of the temporary structures for the construction workers once the CFH observatory is completed. Since other observatories are anticipated to be constructed in the future, these temporary structures could be utilized again if CFH does not intend to convert it for their permanent use.

Development of a Telescope and Observatory Facilities

Page I-2, in the tabulated status of the project "Permanent Mid-Level Facility" the construction status, "Preliminary plans completed" should be changed to "Master planning in preparation".

If you have any questions, please advise.

Very truly yours,

KENAM KIM
State Comptroller

JOHN A. BURNS
GOVERNOR

FREDERICK C. ERSKINE
CHAIRMAN, BOARD OF AGRICULTURE

WILLIAM E. FERNANDES
DEPUTY TO THE CHAIRMAN

STATE OF HAWAII
DEPARTMENT OF AGRICULTURE
1428 SO. KING STREET
HONOLULU, HAWAII 96814

March 18, 1974

MEMORANDUM

TO: Dr. Richard E. Marland, Interim Director
Office of Environmental Quality Control

SUBJECT: Draft Environmental Impact Statements for:

1) Power to Summit, Mauna Kea Observatory Kaohe, Hawaii - Dept. of Accounting & General Services
2) Mauna Kea Observatory Mid-Elevation Facility - Dept. of Accounting & General Services
3) Temporary Base Camp Expansion, Hale Pohaku, Mauna Kea - Dept. of Land and Natural Resources
4) Development of a Telescope and Observatory Facilities, Mauna Kea - Dept. of Land and Natural Resources

The Department of Agriculture has reviewed these Environmental Impact Statements and finds no significant agricultural impact. The construction route will pass through a cattle grazing area. The density of cattle in this area is low and no impact is expected.

Thank you for the opportunity to comment on these matters.

Frederick C Erskine

FREDERICK C. ERSKINE
Chairman, Board of Agriculture

JOHN A. BURNS
GOVERNOR OF HAWAII

DIVISIONS:
CONVEYANCES
FISH AND GAME
FORESTRY
LAND MANAGEMENT
STATE PARKS
WATER AND LAND DEVELOPMENT

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
P. O. BOX 621
HONOLULU, HAWAII 96809

February 19, 1974

MEMORANDUM :

TO: Dr. R. E. Marland, Interim Director
OEQC

FROM: Sunao Kido, Chairman and Member
Board of Land and Natural Resources

SUBJECT: Comments on Environmental Assessment covering Proposed Temporary Base Camp Expansion, Hale Pohaku, Island of Hawaii.

We have reviewed the subject environmental assessment and feel that there are many details in the proposed operation that have not been covered.

We suggest that action be deferred on this project until the University of Hawaii and this department can further discuss overlapping responsibilities in the Mauna Kea area of Hawaii, and arrive at a workable solution for the compatible use of facilities and the surrounding lands.

BOARD OF LAND AND NATURAL RESOURCES

Sunao Kido

SUNAO KIDO
Chairman and Member

JOHN A. BURNS
GOVERNOR

E. ALVEY WRIGHT
DIRECTOR

LAWRENCE F. O. CHUN
DEPUTY DIRECTOR

MUNNY Y. M. LEE
DEPUTY DIRECTOR

DOUGLAS S. SAKAMOTO
DEPUTY DIRECTOR

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813

IN REPLY REFER TO:
ATP 8.2489

February 11, 1974

Dr. Richard E. Marland
Interim Director
Office of Environmental
Quality Control
550 Halekauwila St., Room 301
Honolulu, Hawaii 96813

Dear Dr. Marland:

Subject: Proposed Actions on Mauna Kea, Hawaii

We fully agree with your statement that all related projects should be considered together in order to identify and evaluate the overall, cumulative impact on the environment.

In the case of the Mauna Kea Summit area, there are at least three other major projects in the planning stage besides those listed above. These are the NASA infra-red observatory and observatory complexes proposed by the United Kingdom and the Massachusetts Institute of Technology. Obviously, the realization of these projects would have a tremendously increased impact on the fragile environment of Mauna Kea.

We will therefore withhold our review of the above four EIS's until, as you note, we are able to evaluate the total impact on the area.

Sincerely,

Douglas S. Sakamoto
for E. ALVEY WRIGHT
Director

STATE OF HAWAII

DEPARTMENT OF PLANNING AND ECONOMIC DEVELOPMENT

P. O. BOX 2359 • HONOLULU, HAWAII 96804

JOHN A. BURNS
Governor

SHELLEY M. MARK
Director

EDWARD J. GREANEY, JR.
Deputy Director

March 5, 1974

Ref. No. 0513

MEMORANDUM

TO: Dr. Richard E. Marland, Interim Director
Office of Environmental Quality Control

FROM: Shelley M. Mark, Director

SUBJECT: Draft EIS Statements for Mauna Kea Observatory Facilities

In terms of economic benefit and world prestige this project should be one of the most beneficial developments of Hawaii's R and D effort. In this regard, therefore, we believe the statements reviewed should have addressed the following points.

1. International attention has been focused on the summit of Mauna Kea because of certain natural attributes. It is, however, important to the State of Hawaii that support construction reflect the highest standards of site planning and design character. The four separate statements do not appear to show enough sensitivity toward this important aspect, except in such generalized phrases as: "The project will not adversely affect the present character of the neighborhood" and "The design will recognize public safety in all aspects and no compromises will be made." (From pages 4 and 5 of EIS for Power to Summit.)

2. The visual impact of an urban cluster imposed on the existing wilderness character of a completely undeveloped site should be specifically addressed.

3. A third issue which should have been investigated is the possible conflict due to the demand for both recreational and scientific use of the summit. The conditions under which these two uses might be mutually exclusive, as well as the controls which would enable them to co-exist, should have been explored.

STATE OF HAWAII

DEPARTMENT OF PLANNING AND ECONOMIC DEVELOPMENT

P. O. BOX 2359 • HONOLULU, HAWAII 96804

March 5, 1974

Ref. No. 0511

MEMORANDUM

TO: Dr. Richard E. Marland, Interim Director
Office of Environmental Quality Control

FROM: Shelley M. Mark, Director

SUBJECT: Draft EIS for Development of a Telescope and Observatory Facilities on Mauna Kea, Island of Hawaii

We have reviewed the subject draft and find it to be a generally adequate statement of the probable environmental impacts of the subject project. We feel, however, that some attention might be devoted to the possible impact this facility may have on existing recreational activities and uses of the area.

A related impact which should be addressed is the effect of additional vehicular traffic on the visual quality and environmental conditions vital to the sensitive, operational activities of this observatory.

These are the only comments we have at this time.

STATE OF HAWAII

DEPARTMENT OF PLANNING AND ECONOMIC DEVELOPMENT

P. O. BOX 2359 • HONOLULU, HAWAII 96804

March 5, 1974

Ref. No. 0509

MEMORANDUM

TO: Dr. Richard E. Marland, Interim Director
Office of Environmental Quality Control

FROM: Shelley M. Mark, Director

SUBJECT: Draft EIS for Mid-Elevation Facility, Mauna Kea Observatory, Island of Hawaii

We have made a preliminary review of the subject draft and feel that in consideration of the importance of this project to the image of Hawaii, inclusion of the following additional information and materials in the final EIS would be helpful in order to conduct a meaningful review.

1. A map showing the relationship of the proposed support community to Hale Pohaku, the Saddle Road, and the summit road.

2. A site plan, showing existing grades, vehicular and pedestrian circulation within the community, preliminary placement of the buildings and their relationship to each other on site.

3. Preliminary plans for support services and facilities, utilities and landscaping, if available.

For additional comments, please refer to our EIS responses on related Mauna Kea facilities.

STATE OF HAWAII

DEPARTMENT OF PLANNING AND ECONOMIC DEVELOPMENT

P. O. BOX 2359 • HONOLULU, HAWAII 96804

March 5, 1974

Ref. No. 0510

MEMORANDUM

TO: Dr. Richard E. Marland, Interim Director
Office of Environmental Quality Control

FROM: Shelley M. Mark, Director

SUBJECT: Draft EIS for Power to Summit, Mauna Kea Observatory, Island of Hawaii

We would like to offer the following suggestions relating to this particular draft statement.

The generalized statements in regard to "II Impact of Project," do not seem to relate to this particular project. A further in-depth discussion of the impact of the utility systems and an exposed substation on a wilderness area may be highly desirable in reviewing such a statement.

Under Part IV, Alternatives, an investigation of underground placement of wiring, or of ways to keep the installation as unobtrusive as possible might deserve some consideration.

We hope that these comments may be of help in preparing the final statement.

DEPARTMENT OF THE ARMY
HONOLULU DISTRICT, CORPS OF ENGINEERS
BUILDING 96, FORT ARMSTRONG
HONOLULU, HAWAII 96813

PODED-P

1 March 1974

Dr. Richard E. Marland, Interim Director
Office of Environmental Quality Control
State of Hawaii
550 Halekauwila Street, Room 301
Honolulu, Hawaii 96813

Dear Dr. Marland:

We have reviewed the four draft environmental impact statements for the proposed actions on Mauna Kea, Hawaii, and have the following comments:

a. Power to Summit. On page 3, the EIS indicates that underground transmission lines may be installed in the future. In the Alternatives section, a fuller discussion of underground transmission lines should be presented.

b. Mid-Elevation Facility. The sewage disposal system should be described in the final EIS.

c. Temporary Base Camp Expansion, Hale Pohaku. This EIS raises the possibility that "...increasing air pollution of the Hilo area will cast some doubt among scientists as to whether or not Mauna Kea can continue to be one of the world's primary observation sites (VI-2,3)." Given this anticipated problem, it is suggested that the final EIS discuss integrated and comprehensive planning measures being taken on the island of Hawaii to protect air quality.

d. Development of a Telescope and Observatory Facilities, Mauna Kea. The efforts of the city of Hilo to restrict night lighting is an example of coordinated planning which could be followed in other areas of concern such as air quality. These would give benefits not only to the scientific resources at Mauna Kea, but also to its National Natural History Landmark status.

Sincerely yours,

R. L. NICHOLS
Chief, Engineering Division

STATE OF HAWAII

DEPARTMENT OF PLANNING AND ECONOMIC DEVELOPMENT

P. O. BOX 2359 • HONOLULU, HAWAII 96804

March 5, 1974

Ref. No. 0512

MEMORANDUM

TO: Dr. Richard E. Marland, Interim Director
Office of Environmental Quality Control

FROM: Shelley M. Mark, Director

SUBJECT: Draft EIS for Temporary Base Camp Expansion, Hale Pohaku, Mauna Kea, Island of Hawaii

We have reviewed the subject draft and find that it is an adequate statement of the probable environmental impacts of the project. One question which may arise and which was not addressed, is the disposition planned for the "temporary" structures after activities are moved to the permanent support community.

For further comments, please refer to our memos on the Enviromental Impact Statements for the other Mauna Kea facilities.

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
440 Alexander Young Building, Honolulu HI 96813

March 1, 1974

Dr. Richard E. Marland
Office of Environmental
Quality Control
Room 301, Tani Office Bldg.
550 Halekauwila St.
Honolulu HI 96813

Dear Dr. Marland:

Re: Draft Environmental Impact Statement - Temporary Base Camp Expansion, Hale Pohaku, Mauna Kea

We have reviewed the above-mentioned draft and have no comments to offer.

Thank you for the opportunity to review this statement.

Sincerely,

Francis C. H. Lum

Francis C. H. Lum
State Conservationist

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS 15th AIR BASE WING (PACAF)
APO SAN FRANCISCO 96553

4 MAR 1974

REPLY TO ATTN OF: DEEE (Mr. Kimura, 4492158)

SUBJECT: Draft Environmental Impact Statement

TO: Office of Environmental Quality Control
Office of the Governor
550 Halekauwila Street
Tani Office Building, Third Floor
Honolulu, Hawaii 96813

1. Reference is made to your letter of 18 Jan 1974, subject as above.

2. This office has no comment to render relative to the draft environmental impact statements for the Mauna Kea Observatory projects.

ALLAN M. YAMADA
Asst Dep Comdr for Civil Engrg

COUNTY OF HAWAII

PLANNING DEPARTMENT

25 AUPUNI STREET • HILO, HAWAII 96720

SHUNICHI KIMURA
Mayor

RAYMOND H. SUEFUJI
Director

February 22, 1974

Dr. Richard E. Marland
Interim Director
Office of Environmental Quality Control
Tani Office Building, 3rd Floor
550 Halekauwila St.
Honolulu, Hawaii 96813

Re: Draft Environmental Impact Statement for:

1. Power to Summit, Mauna Kea Observatory, Kaohe, Hawaii;
2. Mauna Kea Observatory Mid-Elevation Facility;
3. Temporary Base Camp Expansion, Hale Pohaku, Mauna Kea;
4. Development of a Telescope and Observatory Facilities, Mauna Kea.

Thank you for the opportunity to review the subject draft EIS.

We are in support of the scientific endeavors on Mauna Kea. We further concur with the findings presented in the statements.

Sidney Fuke

RAYMOND H. SUEFUJI
Director

RN:VG:LR:mn

cc: Mayor
Public Works
DLNR

SHUNICHI KIMURA
MAYOR

EDWARD K. HARADA
CHIEF ENGINEER

BUREAUS AND DIVISIONS:
AUTOMOTIVE EQUIPMENT & MOTOR POOL
BUILDING CONSTRUCTION AND INSPECTIO
PLANS AND SURVEYS
ROAD CONSTRUCTION AND MAINTENANCE
SEWERS AND SANITATION
TRAFFIC SAFETY AND CONTROL

COUNTY OF HAWAII
DEPARTMENT OF PUBLIC WORKS
25 AUPUNI STREET
HILO, HAWAII 96720

January 28, 1974

Dr. Richard E. Marland
Interim Director
Office of Environmental Quality Control
Tani Office Building, 3rd Floor
550 Halekauwila Street
Honolulu, Hawaii 96813

SUBJECT: Draft Environmental Impact Statement for:

1. Power to Summit, Mauna Kea Observatory, Kaohe, Hawaii - Department of Accounting and General Services
2. Mauna Kea Observatory Mid-Elevation Facility - Department of Accounting and General Services
3. Temporary Base Camp Expansion, Hale Pohaku, Mauna Kea - Department of Land and Natural Resources
4. Development of a Telescope and Observatory Facilities, Mauna Kea - Department of Land and Natural Resources

Thank you for the opportunity to review the subject four draft copies of the E.I.S.

In view of the already established observatory for scientific research and the construction of the access road toward the observatory, we find that with due consideration given to ecology, the proposed projects are acceptable for providing facilities and service within economical means. During review of construction plan for approval further opportunity will be afforded to check requirements for construction approval.

Edward Harada

EDWARD HARADA
Chief Engineer

cc: Mayor
Planning Department

...ICHI ...URA
MAYOR

BRUCE C. McCALL
MANAGING DIRECTOR

ROBERT T. FUKUDA
DIRECTOR

DEPARTMENT OF PARKS & RECREATION

COUNTY OF HAWAII
HAWAII COUNTY BLDG.
25 AUPUNI STREET
HILO, HAWAII 96720

February 27, 1974

Dr. Richard E. Marland, Interim Director
Office of Environmental Quality Control
550 Halekauwila Street
Honolulu, Hawaii 96813

SUBJECT: Draft Environmental Impact Statements for:

1) Power to Summit, Mauna Kea Observatory

2) Mauna Kea Observatory Mid-Elevation Facility

3) Temporary Base Camp Expansion, Hale Pohaku

4) Telescope and Observatory Facilities - Mauna Kea

We have no comments on or objections to any of the above draft statements and we thank you for affording us the opportunity to review the materials.

ROBERT T. FUKUDA
Director

DEPARTMENT OF WATER SUPPLY • COUNTY OF HAWAI

P. O. BOX 1820 • HILO, HAWAII 96720 • 25 AUPUNI STREE

February 19, 1974

Dr. Richard Marland
Interim Director
Office of Environmental Quality Control
550 Halekauwila Street
Tani Office Building, 3rd Floor
Honolulu, HI 96813

Re: Draft Environmental Impact Statements for:
1) Power to Summit, Mauna Kea Observatory
2) Mauna Kea Observatory Mid-Elevation Facility
3) Temporary Base Camp Expansion, Halo Pohaku, Mauna Kea
4) Development of a Telescope and Observatory Facilities, Mauna Kea

We have no water system in this area. As stated in the report, water will have to be hauled in.

We do not foresee any adverse effects to our water system with the construction of this project.

Akira Fujimoto
Manager

WHS

APPENDIX D

RESPONSES TO COMMENTS FROM GOVERNMENTAL AGENCIES

Introduction

The following section summarizes all written comments and responses to concerns expressed by governmental agencies responding to the preliminary draft environmental impact statement for the proposed CFH Corporation telescope and observatory facilities at the summit of Mauna Kea.

Comments/Responses

Department of the Army, Corps of Engineers

Comment: The efforts of the City of Hilo to restrict night lighting is an example of coordinated planning which could be followed in other areas of concern such as air quality.

Response: It is believed that this comment stems from the reviewer's review of the EIS for the proposed temporary base camp at Hale Pohaku. The statement reports that "...increasing air pollution of the Hilo area will cast some doubt among scientists as to whether or not Mauna Kea can continue to be one of the world's primary observation sites (VI-2,3)." This statement is inaccurate as discussions with personnel of the Mauna Loa Observatory (subsequent to the publishing of the preliminary draft of the Temporary Base Camp EIS) indicate that increasing air pollution of Hilo's

lower inversion layer (up to approximately 6,000 to 6,500 feet) would most likely not affect the upper atmosphere at the summit of Mauna Kea.

State Department of Accounting and General Services

Comment: The tabulated construction status (p. I-2) of the permanent mid-level facility should be changed to "Master planning in preparation".

Response: Agreed.

State Department of Transportation

Comment: In the case of the Mauna Kea Summit area, there are at least three other major projects being proposed by NASA, the United Kingdom and the Massachusetts Institute of Technology. Obviously, the realization of these projects would have a tremendously increased impact on the fragile environment of Mauna Kea.

Response: Since the publishing of the preliminary environmental impact statements, the following additional data concerning other proposed projects on the summit of Mauna Kea has been received. The extent of impact resulting from each of these projects is not known without further study.

1.a. If funding can be obtained from within its own government, the United Kingdom (UK) would like to develop a 150-inch infrared telescope in the vicinity of the old

power shed (see figure 2). In this regard, preliminary design work is partially complete for this project. Should funds become available, the British would like to initially proceed with the preparation of an EIS in June or July, 1974. The present construction schedule shows that this telescope should be ready for observation in late 1977.

1.b. The United Kingdom is also considering the summit of Mauna Kea as a possible site for a northern hemisphere observatory. Should Mauna Kea be selected by the British and funds subsequently be appropriated by the same government, UK would make application to the State to construct a 60-, 100- and 180-inch telescope. Whether or not each of the three telescopes would be developed on a single site or three different sites has not been determined. At the time of this report, UK is presently studying several sites in the summit area. The British indicate that they hope to make a decision as to whether Mauna Kea should be the site for the UH Northern Hemisphere Observatory by October, 1974. If Mauna Kea is selected, UK astronomers would attempt to obtain development monies from their own government.

2. President Nixon's proposed FY 1975 budget contains a $6 million request for the construction and installation of

a three-master infrared scope on cinder cone adjacent to and northwest of the proposed CFH Telescope site. The telescope would be utilized by the National Aeronautic and Space Administration (NASA) and would be a data source for the Mariner program's Jupiter and Saturn missions which are scheduled to begin in 1977. At this time, NASA plans to proceed with the preparation of an EIS in May, 1974 and continue with complete construction unless funds are not appropriated.

3. The Massachusetts Institute of Technology (MIT) is considering Mauna Kea as a site for a 40- and 120-inch optical telescope. No site surveys have been undertaken by MIT; as a result, the possible location of these two proposed telescopes in unknown. Data concerning potential source of funds and/or construction schedule have also not been determined.

State Department of Planning and Economic Development

Comment: The visual impact of an urban cluster on the existing wilderness character of a completely undeveloped site should be specifically addressed.

Response: This subject is specifically addressed on p. V-5 of the Statement.

Comment: An issue which should have been investigated is the possible conflict due to the demand for both recreational and scientific use of the summit. The conditions under which these two uses might be mutually exclusive, as well as the controls which would enable them to co-exist, should have been explored.

Response: No conflict between scientific and recreational uses is foreseen as recreational opportunities in the summit area are limited to sightseeing and snow-related activities. Because of the high altitude environment and the existing road gradient, recreational demands for these activities, in the summit area, are not expected to increase appreciably.

One conflict which could result from the proposed CFHT project is the desecration of geologic features on Mauna Kea. This subject is discussed more fully on pp. V-3 to V-4.

Comment: Some attention might be devoted to the possible impact that the proposed facilities may have on existing recreational activities and uses of the area.

Response: In addition to the response to the preceeding comment, this subject is discussed more fully on pp. V-3 to V-5.

Comment: An impact which should be addressed is the effect of additional vehicular traffic on the visual quality and environmental conditions vital to the sensitive, operational activities of this observatory.

Response: Mauna Kea Observatory personnel indicate that, presently, the primary adverse effect from automobiles results from dust, rather than emissions such as carbon monoxide or nitrogen oxide. Increased vehicular traffic on the present dirt road would result in greater maintenance of the telescopes' mirror systems. For this reason, a paved access has been proposed for the immediate Summit area, as well as to the proposed CFH Telescope. Thus, the proposed paved access in the immediate Summit area would serve to minimize fugitive dust from future vehicular traffic.

In terms of fugitive dust and soil conditions of the Summit area, the greatest concern is for the construction period when heavier vehicular traffic and construction equipment will be utilized for development of the road and the observatory. Precautions during this period are discussed more fully on p. III-6 of the preliminary draft.

State Office of Environmental Quality Control

Comment: The final EIS should include a discussion of the most current proposal by the Institute for Astronomy to prepare a master plan for the Mauna Kea Science Reserve.

Response: The UH Physical Planning and Construction office will be sponsoring a master plan which will review all current and anticipated projects, land use concepts, utilities, traffic and pedestrian patterns, and the relationship between recreational and astronomical activities. The master plan will be administered by DAGS and will commence in late 1974.

In the interim, the UH will also provide OEQC with an overview of anticipated astronomical projects on Mauna Kea by May 31, 1974.

Comment: Describe the concept of the Control Commission, proposed by the Institute, which would manage the Reserve and coordinate multi-agency interests on Mauna Kea.

Response: In July, 1973, Dr. John T. Jeffries, Director of the UH Institute for Astronomy, made a presentation to the UH Board of Regents in which he proposed the establishment of a State Control Commission for Mauna Kea. The proposed Commission would be charged with the responsibility of formulating policy on questions of access, use, and general control of the Mauna Kea area above the 9,000-foot elevation. The Commission would reflect the interests

of both public and private groups such as DLNR, DPED, Hawaii County, Bishop Museum, Hawaii Ski Association, OEQC and UH, and be granted the authority to enforce its policy. However, at the time of this report, no formal action has been made by the Board of Regents, or the Governor, to establish such a Commission.

Comment: Discuss the means by which the CFHT telescope facilities were coordinated with other Institute projects.

Since UH is a part of CFHT Corporation, the Institute for Astronomy has provided the coordination of the CFHT project with other proposed projects for the summit of Mauna Kea. However, the indefinite status of other proposed projects has limited such coordination to providing flexibility in the design of support facilities, such as power and the permanent mid-level facility in order that future projects can be developed in the Summit area without considerable expense to the proposing private or public institution.

Comment: Consultation with interested agencies should be discussed beyond a mere listing of agencies.

Response: No specific concerns were obtained from these agencies as such consultation was performed for the purpose of obtaining data and informing the agency of the proposed project.

Comment: The relationship of other individual projects to the CFHT telescope project should be stated in the EIS. In this regard,

what is the timetable for development of all the various projects and how does development of the telescope fit into the overall schedule?

Response: The relationship of other individual projects is discussed on pp. I-2, III-1 and Appendix A. The estimated schedule of these projects, the CFHT project, and proposed future summit projects are illustrated in figure D-1.

Comment: The requirement for support facilities to service the telescope and associated personnel should be clearly outlined in the narrative of the final EIS.

Response: Support facilities being planned within the telescope structure include shops, laboratories, storage, electrical and mechanical equipment operating areas, lounge and sleeping areas, library, office and visitors areas. Underground support facilities discussed on p. III-4 of the draft EIS are now planned to include only transformers, pumps and compressors, pipe lines, electrical service ducts, water storage, and septic tank. The workshop, laboratories, an emergency generator and other accessory facilities would be housed inside the dome.

Additional support facilities would be provided at the permanent mid-level facility.

Also a permanent staff of approximately 20 personnel would operate and maintain the telescope (p. V-6). Their homes would be made in

the surrounding communities except as provided for at the mid-level facility (see following comment and response).

Comment: To what extent will the power and mid-level facilities be committed to CFHT use?

Response: As indicated in Appendix A, the Corporation would utilize 350 KW of the 750 KW capacity power line to the Summit. The remaining 400 KW capacity would meet the anticipated needs of the existing UH installations.

At the permanent mid-level facility, the Corporation would have the exclusive use of 2 family dwellings with a total area of 220 square meters and 5 office spaces containing a total of 70 square meters. In addition, access to a data analysis laboratory of approximately 60 square meters and two darkrooms would be accorded to the Corporation on an equitable basis.

Comment: Critical comments and opposing views presented at the hearing should be disclosed and discussed in the final EIS.

Response: Mrs. Mae Mull, a Volcano resident, opposed the proposed development and indicated that recreational activities, bird and mammal habitat and astronomical activities should be master planned and the extent of Summit development decided upon. In general, she also indicated that the telescope development would adversely affect recreational use, the bird and mammal habitat and visual perspective of Mauna Kea. Other de-emphasized comments made by Mrs. Mull can be obtained from tape recordings made by the Board of Land and Natural Resources.

Comments by Mrs. Mull indicate her concern, but unfamiliarity, toward the ecology of the Mauna Kea environment. Most all of her comments were very specifically addressed in the Summit EIS (pp. IV-8, IV-11 to IV-14, figure 5, V-2 to V-3), however, she reports she was unable to receive a copy of the EIS.

Her concern toward master planning and the ultimate development of the Summit are discussed more fully in the first response to a related comment by OEQC. The alternate of master planning is discussed on VI-1 and VI-2.

Comment: Building plans appended to the CDUA should be included in the final EIS to provide the reader with a clear description of the proposed facility. A typical cross section of the project site would also be helpful to the reader. In addition, the EIS should include a map depicting the location of all other proposed projects i.e. NASA, UK and MIT telescopes, Lake Waiau, Keanakakoi Adz Quarry, the boundaries of the Historic and Natural History Landmarks, and natural drainage patterns.

Response: Building plans are illustrated in figures C-IIa to C-IIe.

A cross section of the proposed observatory site is not available. However, it should be noted that grades above the 13,725-foot elevation are not greater than 2 percent.

Figure C-III shows the proposed location for NASA's proposed National Infrared Telescope and the United Kingdom's proposed 150-inch infrared telescope, Lake Waiau and the Keanakakoi Adz Quarry.

The United Kingdom is also considering the summit of Mauna Kea as a possible site for a northern hemisphere observatory. Should Mauna Kea be selected by the British and funds subsequently be appropriated by the same government, UK would make application to the State to construct a 60-, 100- and 180-inch telescope. Whether or not each of the three telescopes would be developed on a single site or three different sites has not been determined. At the time of this report, UK is presently studying several sites in the summit area. The British indicate that they hope to make a decision as to whether Mauna Kea should be the site for the UH Northern Hemisphere Observatory by October, 1974. If Mauna Kea is selected, UK astronomers would attempt to obtain development monies from their own government.

In regards to the Massachusetts Institute of Technology (MIT) consideration of a telescope on the Summit of Mauna Kea, no field surveys or related site selection have been made at the time of this report. MIT has also given no indication as to when a decision might be reached concerning this potential project.

As stated on p. IV-16, Keanakakoi Adz Quarry is situated near the 12,400-foot elevation and is approximately 2,000 feet west of the existing road to the Summit. Even though the Quarry is listed on the National Register of Historic Places, no boundaries have been established by the Department of the Interior (p. V-3).

The boundary of the 83,900-acre National Historic Landmark is the same as the boundary of the Mauna Kea Forest Reserve located 25 miles west-northwest of the City of Hilo.

Natural drainage patterns of the project site are generally indicated by the 25-foot contours shown in figure 2.

Comment: The relationship of Lake Waiau to the proposed facility should be described and illustrated on a map. It is noted on p. IV-3 that rain and melting snow water runoff "presently occur in the downslope portions of the project via existing ground contours and natural drainage patterns". The drainage patterns should be described in the final EIS, especially with respect to Lake Waiau. Mitigative measures to control fugitive dust include application of water or low-grade oil; road construction and operation will also involve small amounts of petroleum wastes; and, cesspool seepage will probably flow downhill from the summit. The final EIS should discuss the likelihood that such man-made pollutants may adversely affect the pristine character of Lake Waiau.

Response: As shown in figure C-III, Lake Waiau is approximately 1-1/4 miles southwest of the project site. Rain and melting snow water runoff occurring in the downslope portions of the project site do not flow into the vicinity of Lake Waiau because of the nature of existing contours, low annual precipitation, and high soil permeability. For these reasons, mitigative measures to con-

trol fugitive dust during construction and any potential cesspool seepage would also not affect Lake Waiau.

Comment: The section on "Vegetation" (p. IV-8) should be expanded to more fully describe what is meant by "few forbs and grasses". Are these forbs and grasses unique in any way and do they represent an ecosystem not commonly found elsewhere in Hawaii? Were any experts consulted with regard to evaluating the research/educational value of the Mauna Kea vegetation? Was the Natural Area Reserves System Commission consulted?

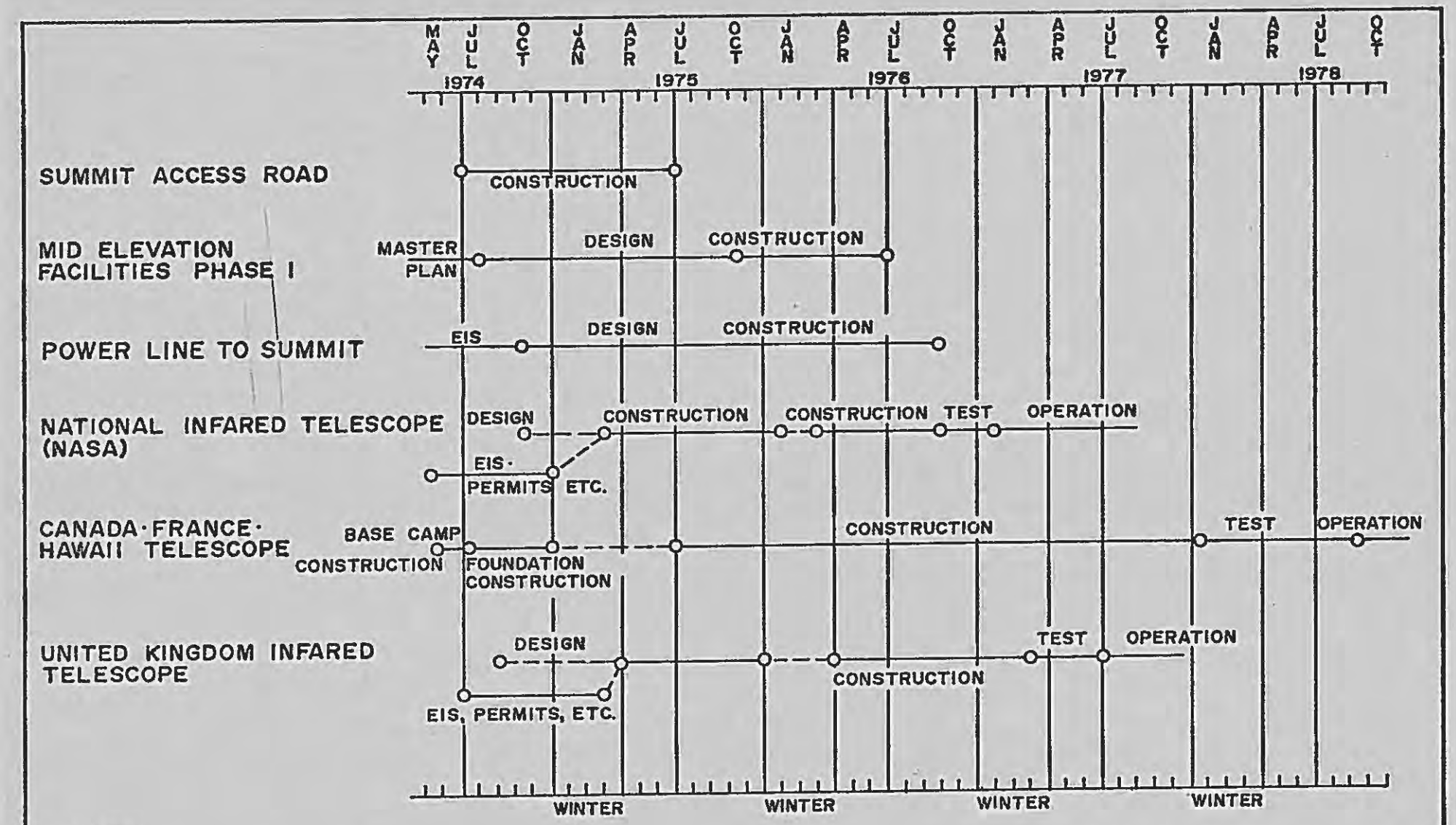
Response: A very general reconnaisance of the project site on November 25, 1973 by Mr. Rick Warshauer, a local botanist, indicates that the project site is characterized by a very sparse growth of several types of forbs and grasses. Without any individual floral specie identification, it appears that all forbs and grasses on the project site are exotic and were probably introduced by machinery and equipment during construction of the UH 88-inch telescope. The Natural Area Reserves System Commission was only consulted about vegetation below the 10,000-foot elevation.

Comment: The implications of Natural History and Historic Landmark designations should be discussed in terms of procedural requirements that must be met prior to construction. Also, the statement that the County's "open" designation "...permits no structures except those related to recreational pursuits" (p. IV-11) should be clarified. If this statement is true, can the

telescope be built?

Response: No private agency is subject to procedural requirements under the Federal legislation establishing National Natural History and Historic Landmark designations. However, governmental agencies such as the Department of Interior and the State Department of Land and Natural Resources may utilize such legislation to delay a proposed project and/or to request the director of the Department of the Interior to render a decision regarding the project.

The telescope can be built on the project site as the County of Hawaii has no jurisdiction as to whether or not a structure can be built on State conservation lands. Its review consists only of recommendations to the Board of Land and Natural Resources regarding land use and its approval/disapproval of any structure in terms of its conformance to local building codes.

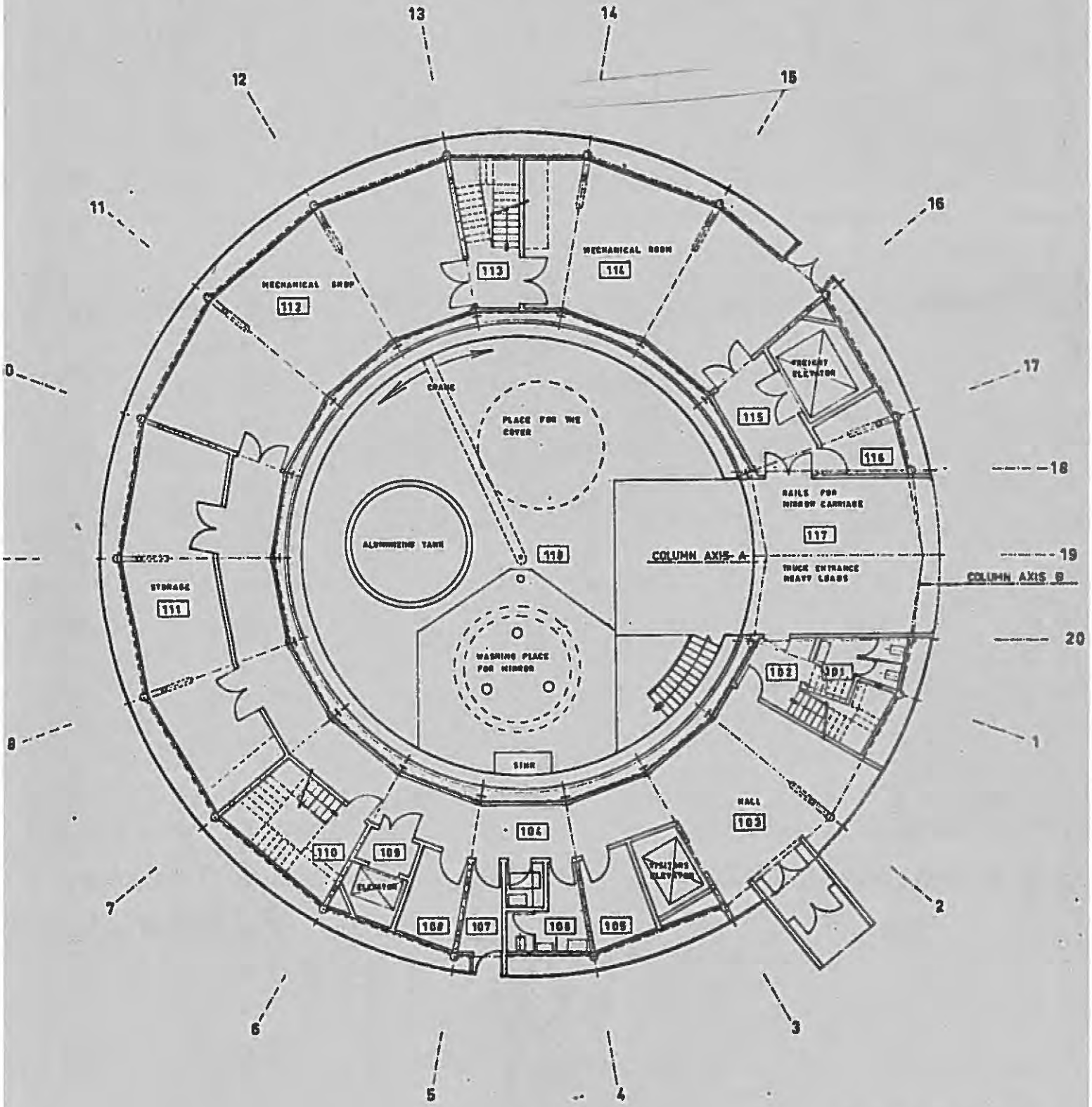


NOTE:
SCHEDULE BASED ON INFORMATION AVAILABLE. APRIL 1974

PLANNED MAUNA KEA TELESCOPES AND RELATED FACILITIES

FIG. D-1

N.I.C.



PLAN GROUND LEVEL

FIGURE D—11a

SCALE: 1/16" = 1'—0"

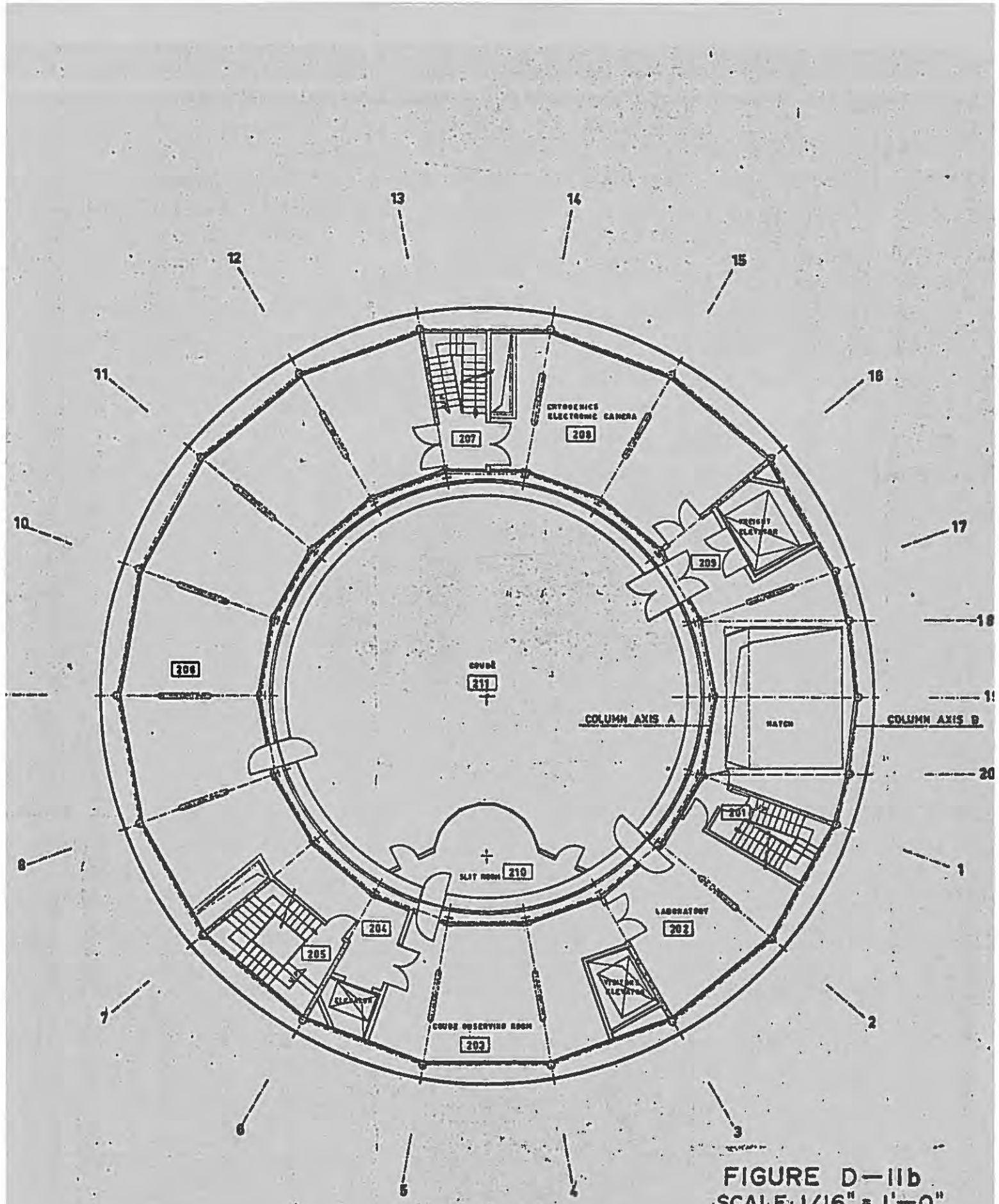


FIGURE D—11b
SCALE: 1/16" = 1'—0"

PLAN 2nd LEVEL

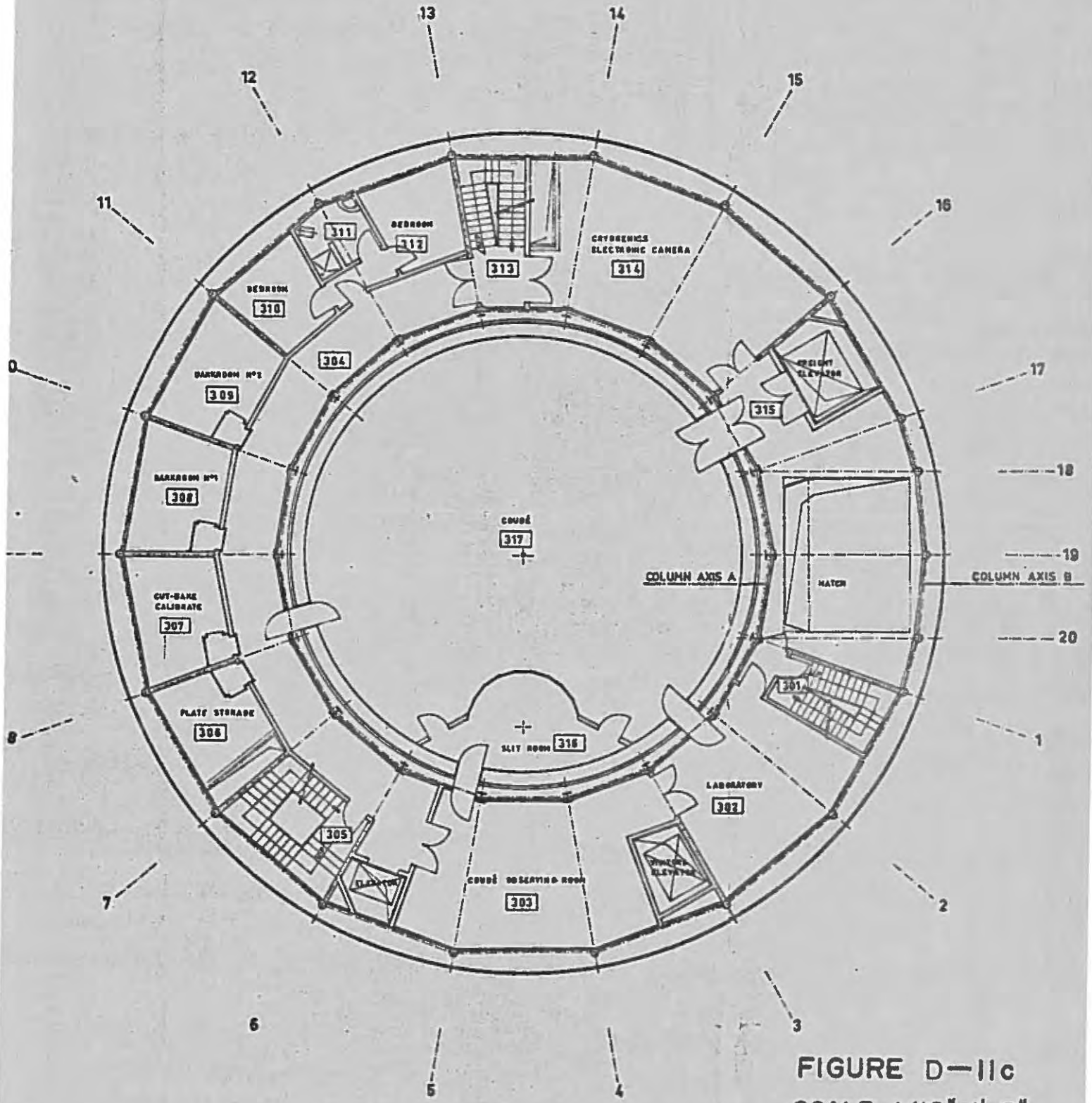


FIGURE D—11c

SCALE: 1/16"=1'-0"

PLAN 3rd LEVEL

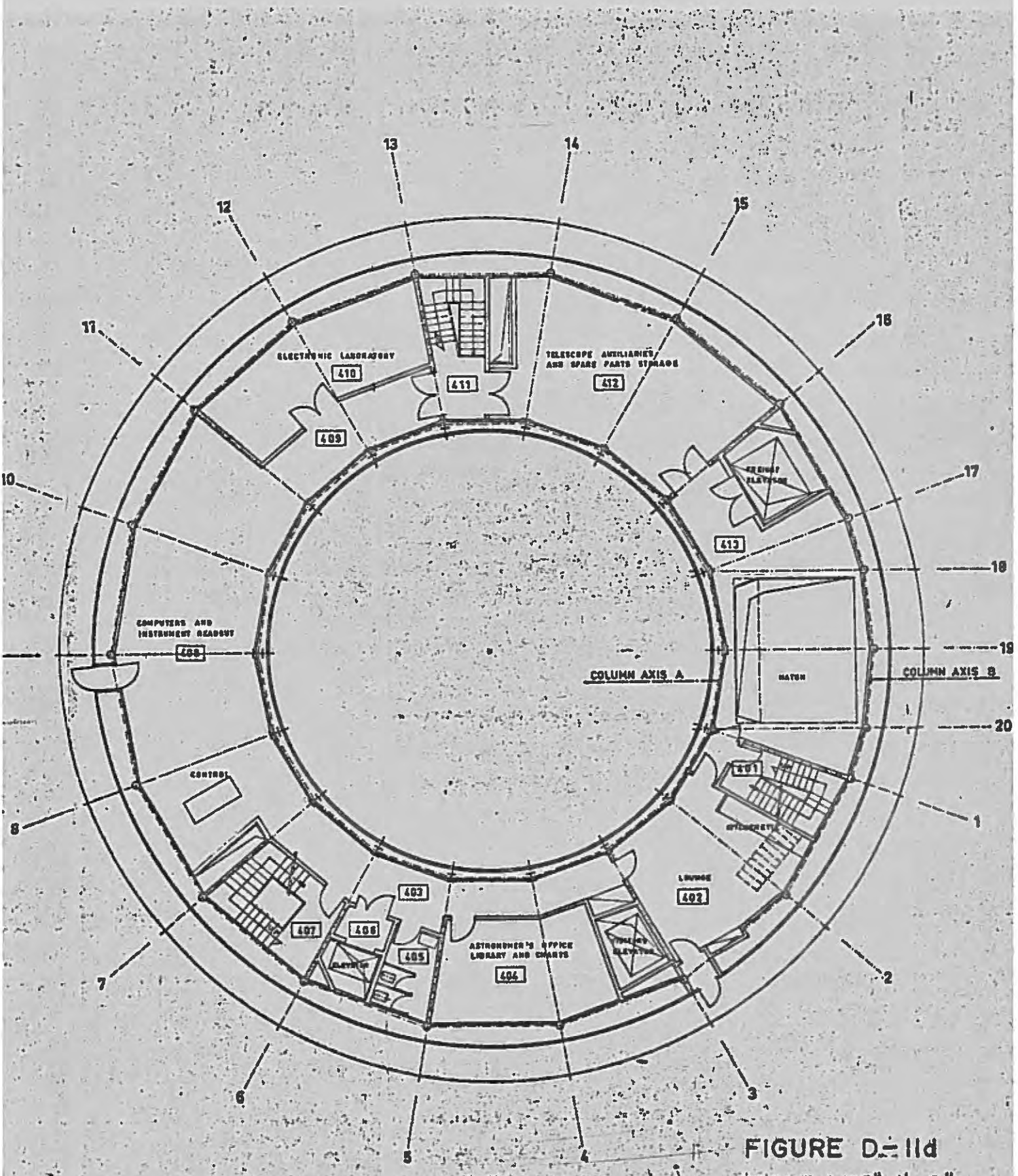
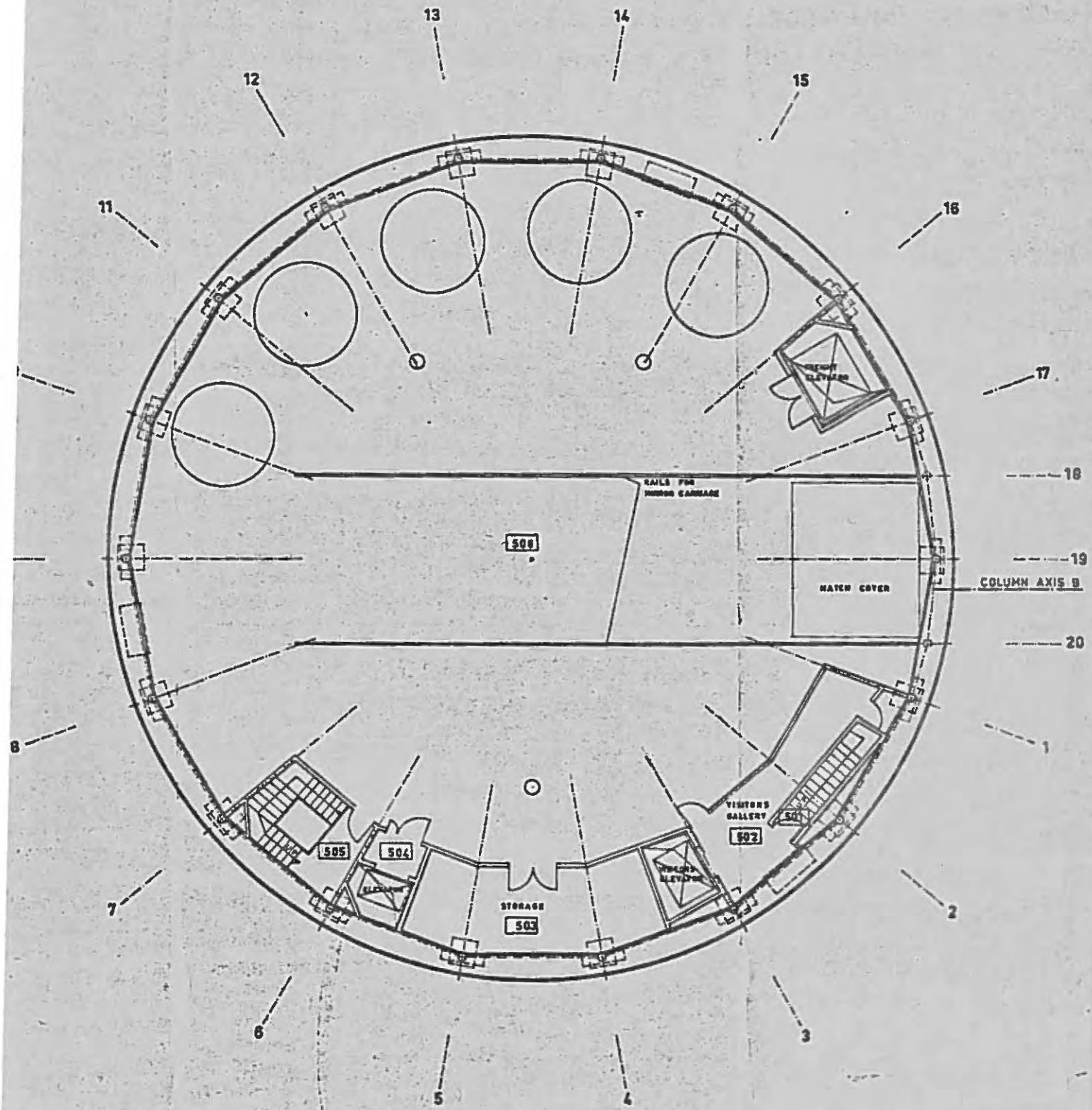


FIGURE D-11d

SCALE: 1/16"=1'-0"

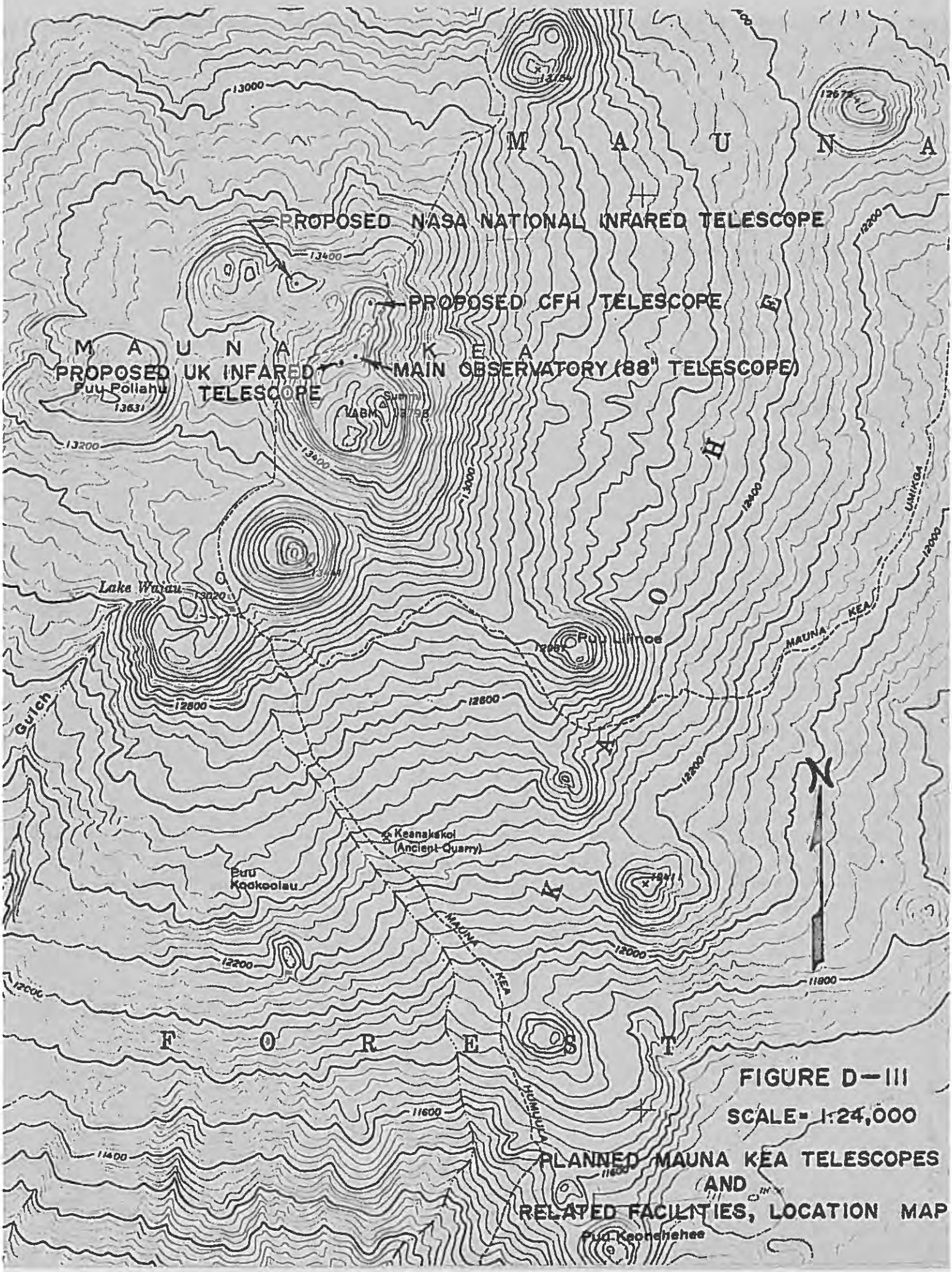
PLAN 4th LEVEL



PLAN OBSERVATION LEVEL

FIGURE D—11e

SCALE: 1/16" = 1'—0"


M A U N A
PROPOSED NASA NATIONAL INFARED TELESCOPE
PROPOSED CFH TELESCOPE
M A U N A K E A
PROPOSED UK INFARED TELESCOPE
MAIN OBSERVATORY (88" TELESCOPE)
Puu Poliahu
13631
Summit
ABM
13796
Lake Waiau
13020
Puu Lilinoe
12967
Keanakakoi
(Ancient Quarry)
Puu
Kookoolau
13184
MAUNA KEA
HUMUULA
Puu Keonehehee
F O R E S T
N
13000
13400
13200
12800
12600
12400
12200
12000
11800
11600
11400
FIGURE D—III
SCALE- 1:24,000
PLANNED MAUNA KEA TELESCOPES
AND
RELATED FACILITIES, LOCATION MAP

BIBLIOGRAPHY

GENERAL

Instruction Manual for Developing and Processing Draft Environmental Impact Statements, State Office of Environmental Quality Control, Final Draft, October, 1972.

Preliminary Draft Environmental Impact Statement -- Mauna Kea Observatory Access Road, Phase I, State Highways Division, July, 1973.

Draft Environmental Impact Statement -- Mauna Kea Observatory Access Road, Phase II, State Highways Division, August 23, 1971.

Preliminary Draft Environmental Impact Statement -- The Proposed Mauna Kea Observatory Mid Elevation Facility, Department of Accounting and General Services, November, 1973.

Preliminary Draft Environmental Impact Statement -- Power to Summit Mauna Kea Observatory, Kaohe, Hawaii, Department of Accounting and General Services, July, 1973.

An Assessment of Environmental Impact Resulting From Proposed Temporary Base Camp Expansion, Hale Pohaku (Mauna Kea), Hawaii, Canada-France-Hawaii Telescope Corporation, December, 1973.

PHYSICAL CHARACTERISTICS

Volcanoes In the Sea, Macdonald and Abbott, University of Hawaii Press, 1971.

"Stratigraphy and Chronology of Late Quaternary Tephra along the South Rift Zone of Mauna Kea Volcano, Hawaii", Stephen C. Porter, Geological Society of American Bulletin, Vo. 84, p. 1923-1940, June, 1973.

"General Features and Glacial Ecology of Mauna Kea, Hawaii", Gregory and Wentworth, Geological Society of American Bulletin, Vol. 48, p. 1719-1742, December, 1937.

Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii, U. S. Soil Conservation Service and University of Hawaii Agricultural Experiment Station.

An Inventory of Basic Water Resources Data: Island of Hawaii, State of Hawaii, Division of Water and Land Development, Report R34, February, 1970.

"Evaluation of Mauna Kea, Hawaii, as an Observatory Site", Morrison, Murphy, Cruikshank, Sinton and Martin, Publications of the Astronomical Society of the Pacific, Vol. 85, No. 505, June, 1973.

"Foundation Investigation, Proposed 3.6 Meter Telescope, Mauna Kea, Hawaii, Hawaii, for the Institut National D'Astronomie et de Geophysique", Dames & Moore, March 26, 1973.

BIOLOGICAL CHARACTERISTICS

Hawaiian Birdlife, Andrew J. Berger, University Press of Hawaii, 1972.

Game Birds in Hawaii, Schwartz and Schwartz, Territory of Hawaii, Board of Agriculture and Forestry, 1949.

Mammals in Hawaii, P. Q. Tomich, Bishop Museum Special Publication No. 57, Bishop Museum Press, 1969.

"Regulation 3" of the State Division of Fish and Game, October 12, 1973.

"Regulation 23" of the State Division of Fish and Game, April 27, 1973.

"Hunting in Hawaii", State of Hawaii, State Division of Fish and Game, 1967.

CULTURAL CHARACTERISTICS

Personal communication dated 7 December 1973 from Yosihiko Sinoto, Chairman, Department of Anthropology, Bishop Museum, Honolulu.

"Interior Secretary Morton Names Pacific Volcanic Sites As New Natural Landmarks", U. S. Department of Interior News Release, December 28, 1972.

The General Plan, County of Hawaii, Ordinance No. 439, December 15, 1971.

"UH Best at Doing What Comes Naturally", Harland Cleveland, The Sunday Star Bulletin & Advertiser, pg. A-21, December 9, 1973.

Construction in Hawaii, 1973, Bank of Hawaii, May, 1973.

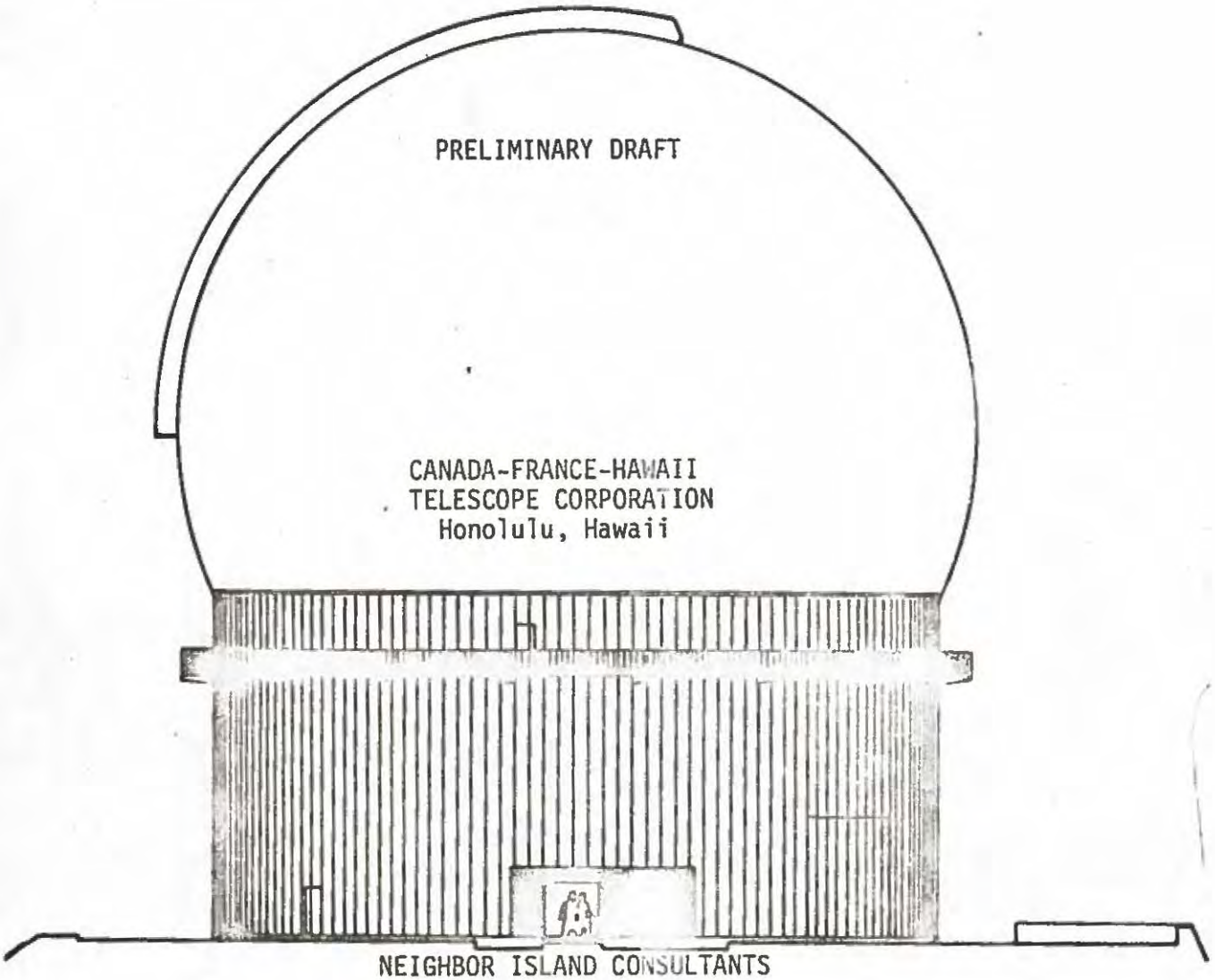
Hawaii '73, Annual Economic Review, Bank of Hawaii, August, 1973.

State of Hawaii Data Book, 1972 Statistical Abstract, Department of Planning and Economic Development State of Hawaii, July, 1972.

Interindustry Study of the Hawaiian Economy, State of Hawaii, Department of Planning and Economic Development, 1972.

AN ASSESSMENT OF ENVIRONMENTAL IMPACT RESULTING FROM THE DEVELOPMENT OF A TELESCOPE AND OBSERVATORY FACILITIES

MAUNA KEA (SUMMIT), HAWAII



PRELIMINARY DRAFT

CANADA-FRANCE-HAWAII
TELESCOPE CORPORATION
Honolulu, Hawaii

NEIGHBOR ISLAND CONSULTANTS

190 Keawe Street
Hilo, Hawaii 96720
Phone: (808) 935-6654

December, 1973

1/31/74

No adverse effects on birds or other endemic animals.

CJ Berger

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

LIST OF FIGURES

CHAPTER I

INTRODUCTION

STUDY PURPOSE

The purpose of this environmental impact statement is to provide all concerned parties with:

A description of selected aspects of the Mauna Kea Summit environment.

An analysis of environmental impact resulting from proposed developments at the Summit of Mauna Kea in the near and distant future.

A determination of the type and amount of irretrievable resources required to accomplish the proposed development program.

An analysis of alternative actions which could be implemented to accomplish the goals and objectives of the proposed development program.

A document which has been prepared in accordance with the Governor's Executive Order of August 23, 1971 and the State Office of Environmental Quality Control Manual for the Preparation and Processing of Environmental Impact Statements (Final Draft, October 4, 1972).

SCOPE OF STUDY

The project site at the Summit of Mauna Kea has been limited to the area depicted in figure 2 while the greater tributary area (figure 1) includes the remaining environment of Mauna Kea, as well as the population and economy of Hawaii County. The discussion of physical and biological characteristics is generally within the context of the project site; however, the analysis of cultural characteristics primarily considers the tributary area with a lesser discussion of the project site.

RELATED PROJECT AND EIS DOCUMENTS

The proposed development program is directly related to four other proposed projects on Mauna Kea which include the construction of the Mauna Kea Observatory Access Road, the installation of electrical power to the summit of Mauna Kea, the proposed development of a permanent mid-level facility, as well as the proposed expansion of the temporary base camp at Hale Pohaku. In coordination with the State Office of Environmental Quality Control (OEQC), the University of Hawaii (UH) and the State Department of Accounting and General Services (DAGS) are jointly preparing individual environmental impact statements (EIS) for each of the four related projects. The present status of each project and its related EIS is as follows:

Project	EIS Status	Construction Status
Mauna Kea Observatory Access Road (from Saddle Road to Hale Pohaku)	EIS approved	Near completion
(from Hale Pohaku to Summit)	Draft submitted to OEQC for review and circulation	Final plans and specifications completed
Power to Summit	Draft submitted to OEQC for review and circulation	Conduit laid by Mauna Kea Electric from Summit to one-mile below
Permanent Mid-Level Facility	Draft submitted to OEQC for review and circulation	Awaiting EIS approval--Preliminary plans completed
Hale Pohaku Base Camp Expansion	Draft submitted to OEQC for review and circulation	Awaiting EIS approval--Preliminary plans completed
New Observatory Development	Draft submitted to OEQC for review and circulation	Awaiting EIS approval--Preliminary plans in preparation for foundation

LIST OF CONTRIBUTORS

Neighbor Island Consultants

James Pedersen

Environmental Planner

Robert Page

Civil Engineer

Fred Zobrist

Engineer-Economist

Leonard Ah Sing

Graphics and Report Production

COORDINATION WITH OTHERS

Data and analyses required for the preparation of this report resulted in the coordination of the proposed project with each of the following agencies:

Federal

Department of Interior, National Park Service, Honolulu
Department of Agriculture, Soil Conservation Service, Hilo
Department of Agriculture, Forest Service Institute of Pacific Islands Forestry, Honolulu
Department of Commerce, National Oceanic Atmospheric Administration, National Weather Service, Honolulu

State

University of Hawaii, Institute for Astronomy, Hilo and Honolulu
University of Hawaii, Office of Physical Planning & Construction, Honolulu
Department of Health, Research Unit, Honokaa
University of Hawaii, Institute of Geophysics, Honolulu
Department of Land and Natural Resources, Division of Fish and Game, Hilo and Honolulu
Department of Land and Natural Resources, Division of Parks, Hilo
Department of Land and Natural Resources, Division of Land Management, Hilo and Honolulu
Department of Land and Natural Resources, Division of Forestry, Hilo
Office of Environmental Quality Control, Honolulu
Department of Accounting and General Services, Honolulu

County of Hawaii

Department of Planning, Hilo

Private

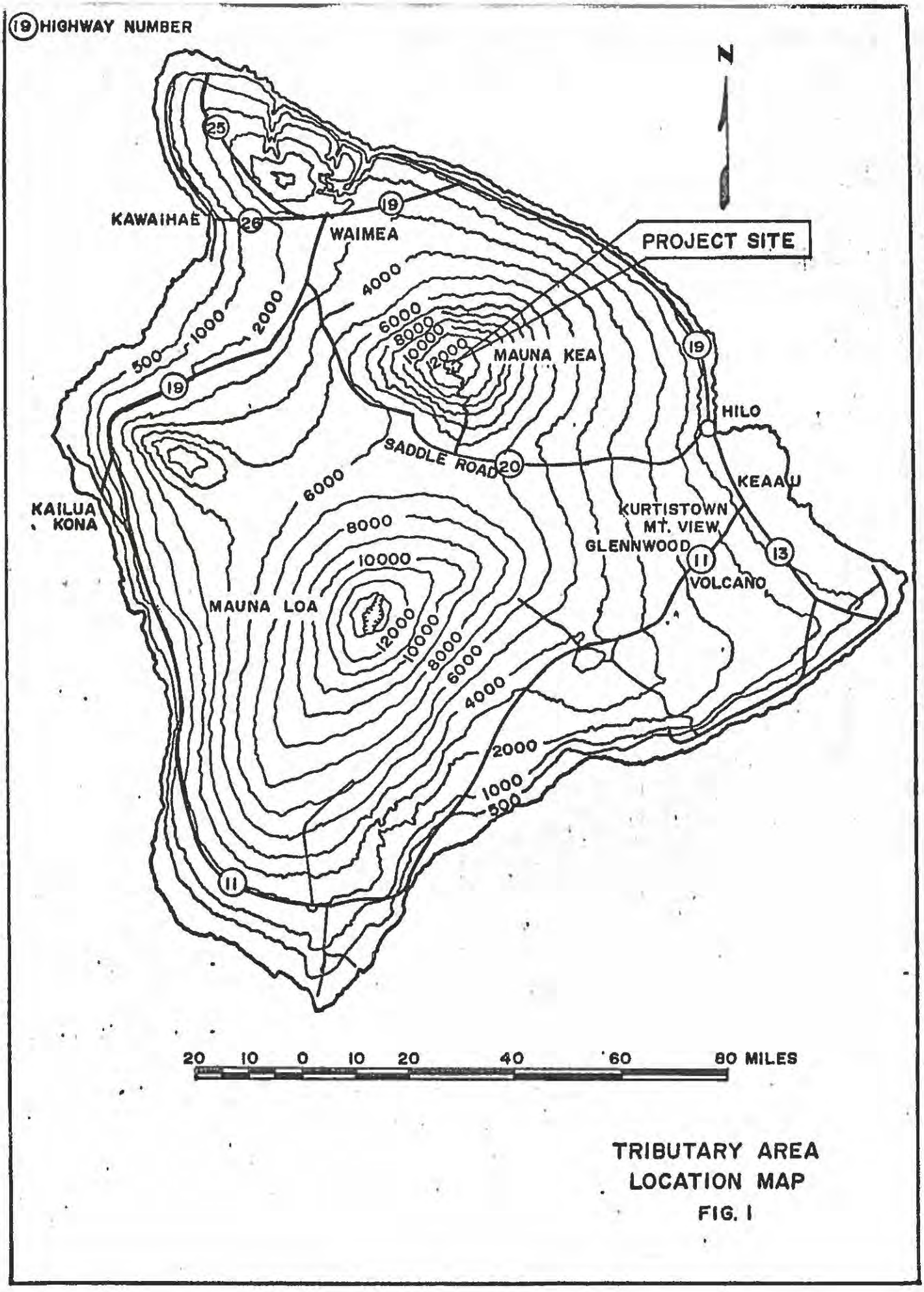
Institut National d'Astronomie et de Geophysique, Paris, France

Mr. Stephen C. Porter, University of Canterbury, Department of Geology, Christchurch, New Zealand

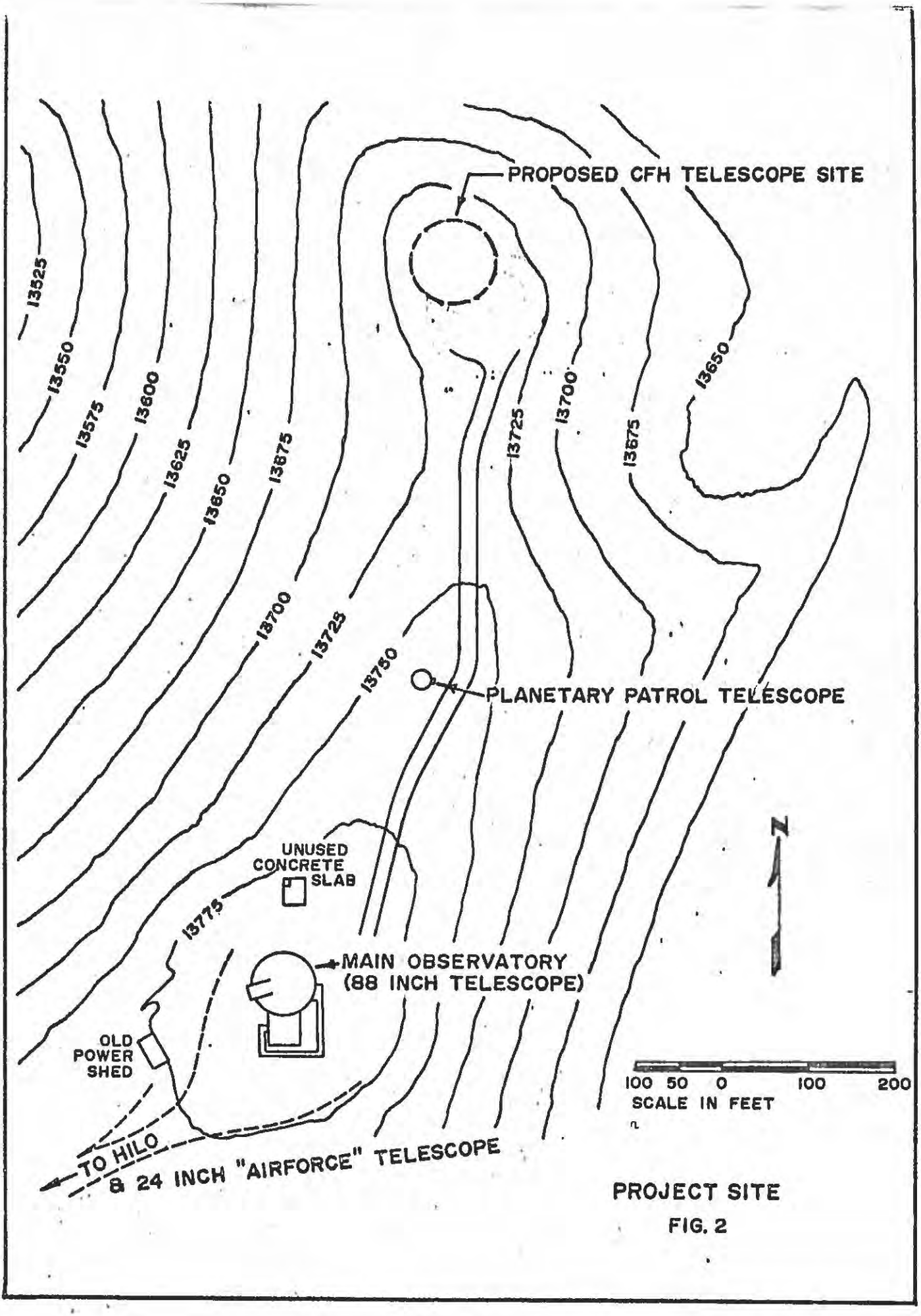
Mrs. Violet Hansen, Field Associate, Bishop Museum, Volcano

Mr. Yosihiko Sinoto, Department of Anthropology, Bishop Museum, Honolulu

Mr. Glen Mitchell, Hilo



TRIBUTARY AREA
LOCATION MAP
FIG. 1



PROJECT SITE

FIG. 2

CHAPTER II

OBJECTIVES OF THE DEVELOPMENT PROGRAM

The purpose of the proposed development program is to accomplish each of the following objectives:

To construct and operate a large optical telescope of 3.6 m (142 inches) aperture, in conjunction with laboratories, equipment and associated installations, on the Summit of Mauna Kea;

To minimize ground vibrations generated by construction equipment and other vehicular traffic during construction of the observatory;

To minimize fugitive dust during excavation and grading for the proposed facilities.

CHAPTER III

PROJECT DESCRIPTION

PROJECT ORIGIN

For the past several years, the Centre National de la Recherche Scientifique (CNRS) of France, the National Research Council (NRC) of Canada, and the University of Hawaii (UH) have considered the joint design, construction and operation of a large optical telescope on the Summit of Mauna Kea. At the time of this report, a preliminary "tripartite agreement" has been drafted which outlines the organization of a proposed, joint Hawaii corporation to be named the Canada-France-Hawaii Telescope Corporation (Appendix A) and the obligations of each of these three agnecies.

DEVELOPMENT COSTS/SOURCE OF FUNDS

Under the "tripartite agreement", the CNRS and the NRC would provide the proposed Corporation with the work, components and sums necessary for the construction of the telescope, its basic instrumentation, its dome and associated buildings. In this regard, the CNRS and the NRC would provide all funds necessary for the design and construction of the proposed, expanded base camp facilities at Hale Pohaku. The estimated telescope and related observatory construction cost of $21,375,160 as well as an estimated $100,000 cost for expansion of the existing temporary base camp facilities, would be shared equally by CNRS and NRC.

Even though the University of Hawaii would not be providing funds for development of the base camp expansion, its proposed obligation of approxi-

mately $4,072,200 to the overall observatory development would include its:

Maintenance of existing and expanded temporary accomodations at Hale Pohaku base camp to meet the present anticipated needs of a minimum of transient and permanent personnel associated with the Corporation;

However, the Corporation would be charged on an equitable basis for operating costs incurred by UH in providing services and facilities to the Corporation; Sub-lease of part of the land which UH now holds under Lease Number S-4191 from the State of Hawaii until the year 2033;

Construction and maintenance of an access road to a boundary line of the sub-leased property;

Installation of an electric power line of 750 KW capacity to a central terminal near the Mauna Kea Observatory Area and granting of access to the Corporation through an easement over UH leased land. The cost of connection from the telescope site to the central terminal, and of electric power, are to be paid by the Corporation;

Construction of a permanent mid-level station with accomodations to meet the anticipated need of a minimum of transient and permanent personnel associated with the Corporation. In the same general area, UH would also construct offices, laboratories and other related facilities. This entire station would be maintained by UH; however, the Corporation would be charged on an equitable basis for operating costs incurred by UH in providing all such services and facilities to the Corporation;

Furnishing of 750 square feet of office space to the Corporation in the new buildings of the Institute for Astronomy on the Mauka Manoa Campus. The area would be maintained by UH; however, any operating costs incurred in providing such space would be charged to the Corporation on an equitable basis;

Providing access to visiting astronomers to the same facilities as those available to the members of the staff of the Institute for Astronomy of the State of Hawaii; as well as the

Solicitation of maximum cooperation from local authorities in protect-in the natural qualities of the site for astronomical observations.

In consideration of their respective contributions totalling $25,547,360 the three agencies would receive equitable interest in the Corporation as follows:

CNRS 42.5%
NRC 42.5%
UH 15.0%

DEVELOPMENT PROPOSAL

General

The proposed development program would consist of the construction of a large optical telescope of 3.6 m aperture (141.2 inches), in conjunction with laboratoties, a workshop and other facilities required for the operation and maintenance of the telescope; The proposed telescope development would be a four year construction program which will consist of the placing of the observatory foundation and piers in 1974; construction of the cylinder in 1975; construction of the hemisphere in 1976; and the installation of the telescope in 1977. Each of these aspects is generally depicted in figure 3.

Optical Parameters

The telescope would have a primary mirror of CERVIT material of outside diameter 3.60 metre and would have a focal length corresponding to an aperture ratio of approximately 3.8, and the figure of the primary mirror will be parabolic.

The telescope would have several secondary mirrors, the largest of which would give an effective aperture ratio of approximately 8.0 at the Cassegrain focus. Other secondary mirrors would provide coude foci and an infra-red Cassegrain focus. Other Cassegrain mirrors may be added later.

Mechanical Description

The mounting will be of the "horse-shoe" type, similar to the well-known Palomar 200" telescope which is of proven design and very suitable to low

latitudes. However, modern developments such as upper-end exchanges and computer controlled devices will be included.

Enclosure

The telescope would be enclosed in a metallic dome and supported on a suitable pillar which will also support the coude spectrograph. The proposed dome, approximately 105 feet (32 meters) in diameter, would be founded on eight individual footings joined together by the beams while the telescope itself would be mounted on a concrete pier with an isolated foundation. Both the metallic dome structure footings and the concrete pier would be buried at least one meter below the immediate surrounding grade (Dames and Moore, 1973).

Underground Support Facilities

The workshop, laboratories, water tank, an emergency generator, pumps, compressors and other accessory facilities would be housed in small underground buildings near the dome. Their precise location has not been decided upon at the time of this report. Such buildings would be supported on shallow spread footings established on the natural, untreated soil or on compacted fill. The design bearing pressures for these structures would not exceed seven metric tons per square meter. The concrete footings and other concrete members of the underground support facility structures would be reinforced with steel to prevent cracking after settlement (Dames and Moore, 1973).

Utilities

All utility lines for power, water and sewage would be installed underground. The precise location of the utility lines has not been decided upon at the time of this report.

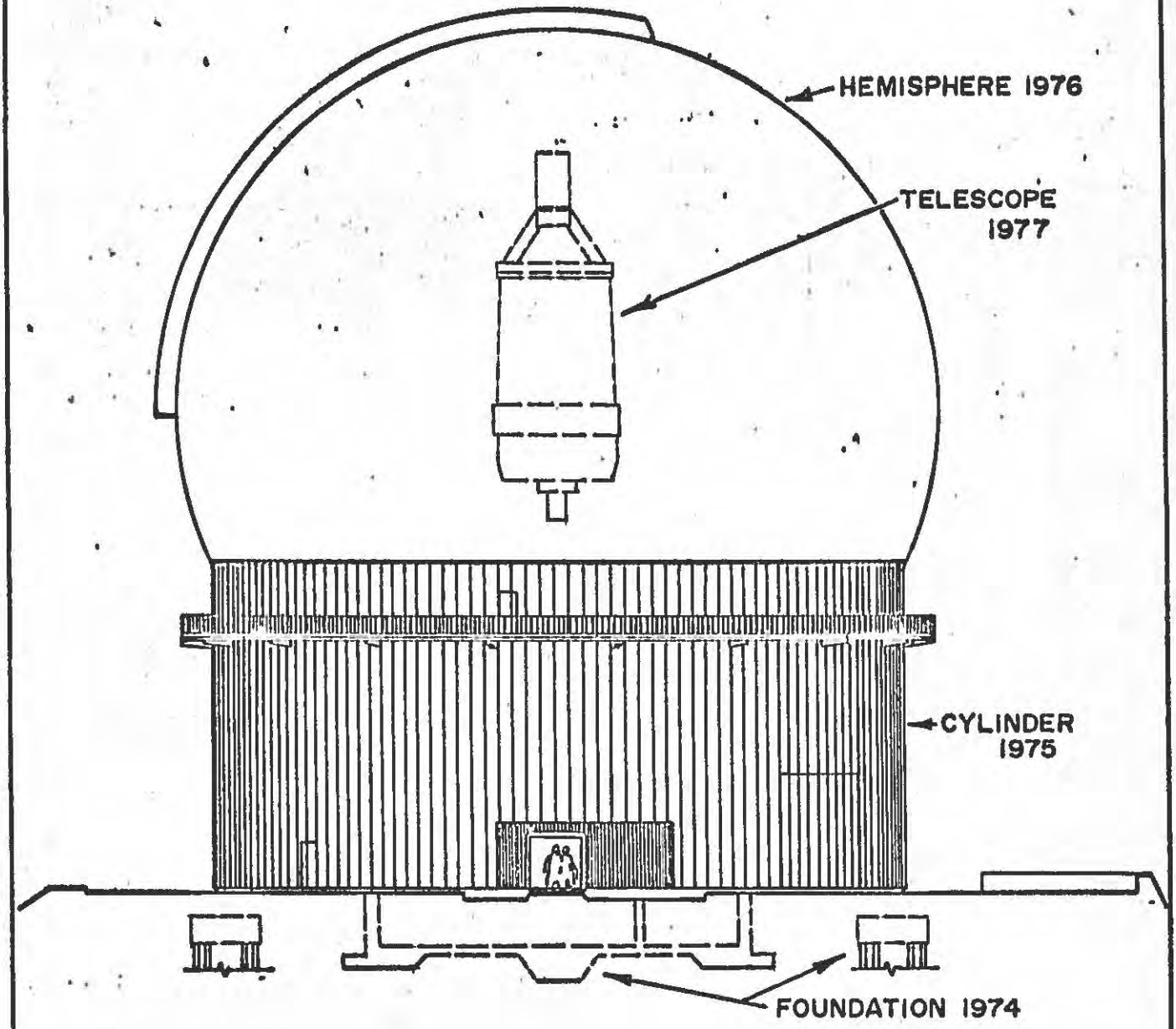
Earthwork

A graded area of about 60 x 80 meters would be prepared at the proposed location of telescope structure (figure 4). The final grade surrounding the planned facilities would be designed to direct surface run-off away from the foundation area. Drainage facilities would be provided in the general project area to dispose of concentrated surface run-off that might otherwise cause erosion of the ground surface. Both cut and fill embankments would be constructed with maximum slopes of 1.5 horizontal to 1 vertical, 1 horizontal to 1.5 vertical if they are fortified with additives or a surface treatment such as soil cement. Embankments constructed from fill would be carefully keyed into the underlying, natural soil. Compaction would be performed under the technical supervision of a qualified soils engineer (Dames and Moore, 1973).

Temporary excavations in the general cinder cone material would stand unsupported with vertical cuts although minor sloughing would occur almost immediately and large slides would occur if the unsupported excavations were disturbed by ground vibration of the magnitude caused by heavy vehicular traffic within the general construction area. For safety reasons, shoring would be provided in all major excavations i.e. underground support facility structures, with depths of more than 1.5 meters.

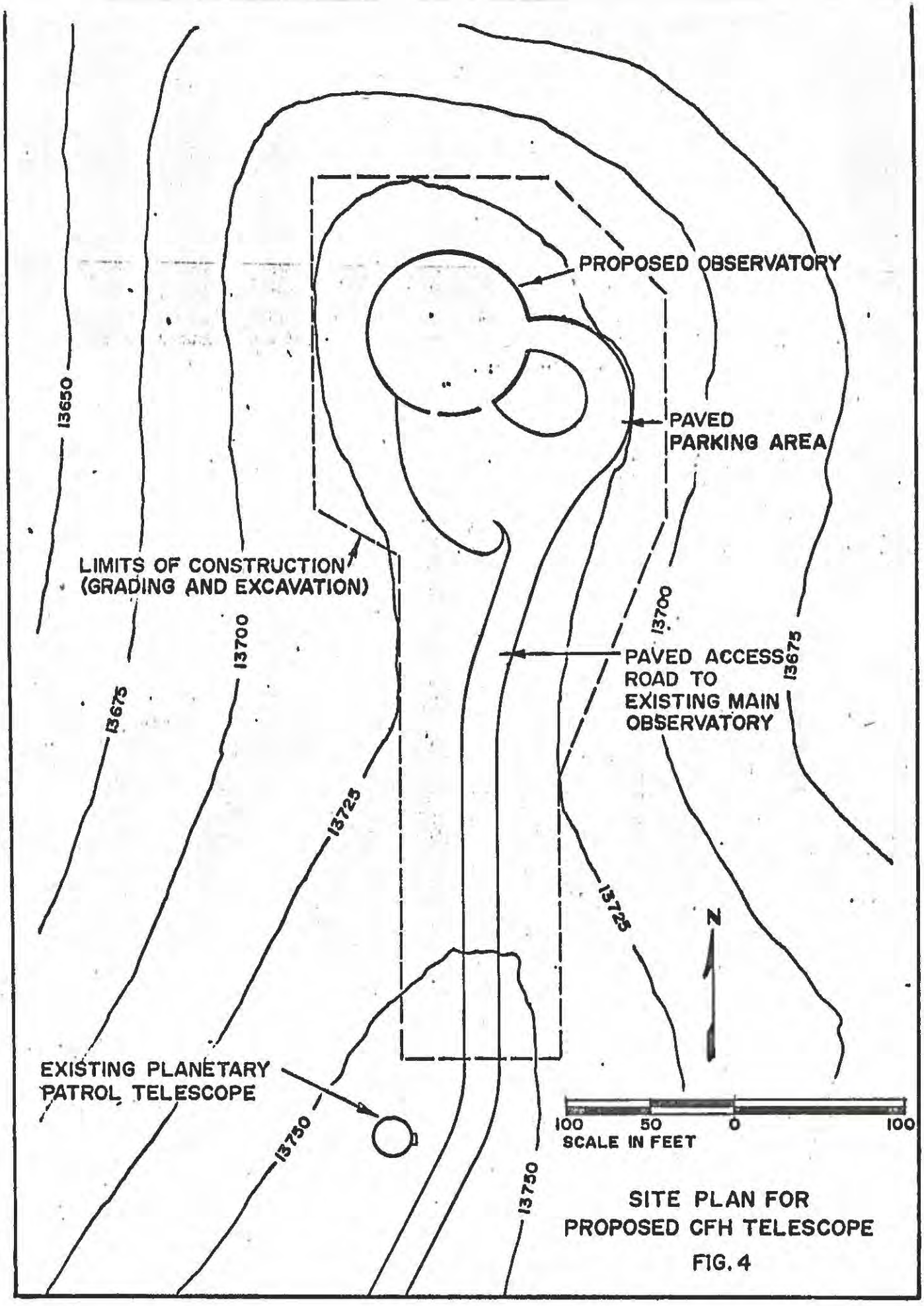
Because of the close proximity of the proposed construction site to the existing UH observatory, fugitive dust would have to be minimized. Fugitive dust would be partially controlled by sprinkling the construction site with heavy applications of water or low grade fuel oil while earthwork is in progress. In this regard, a substantial amount of liquid would have to be imported to the Summit for this purpose. In addition, construction work schedules would be coordinated with activities at the UH Observatory in order to avoid any possibility of damaging instrumentation of the existing observatories.

Blasting or heavy pounding of the subsoil would be avoided to prevent possible damage to the soil structure under the nearby existing observatory. Ground vibrations generated by accessory equipment would be reduced by isolating the equipment as far as practical from the planned facilities while ground vibrations, induced by vehicular traffic in the immediate vicinity of the proposed telescope site, would be minimized by the proposed paving of an 18-foot wide roadway from the main observatory to the site of the proposed observatory.



PROPOSED DEVELOPMENT PROGRAM
CONSTRUCTION SCHEDULE

FIG. 3



SITE PLAN FOR PROPOSED CFH TELESCOPE

FIG. 4

CHAPTER IV

DESCRIPTION OF THE ENVIRONMENT

PHYSICAL CHARACTERISTICS

Location

The project site is situated on the Summit of Mauna Kea and is accessible via the Saddle Road from either Hilo or Kona.

Geology

> "Mauna Kea volcano (4,206 m) on the Island of Hawaii erupted intermittently during late Pleistocene glacial ages, as shown by lava flows and pyroclastic sediments intercalated between four recognized sheets of glacial drift on the upper slopes of the mountain. Certain flows lying within the limits of the outermost drift sheet display a variety of features indicating eruptions through an ice cap (Porter, 1973)."

Since the cinder cones and lava flows on the mountain top erupted beneath ice, these natural features will probably be of continuing interest to geologists and volcanologists concerned with Hawaiian rocks and volcanic history.

Within the project site,

> "The summit cone consists essentially of volcanic ash and cinders except for intermittent zones of cementation and localized inclusions of spatter lava (tephra). There is no evidence of any cavities or faults in the cinder cone structure (Dames and Moore, 1973)."

Climate

Table 1 summarizes average daily temperature extremes and median nighttime wind velocities which characterize the Summit throughout the year.

Such data indicate that the mean temperature at the Summit is usually at, or a few degrees above, freezing ($0^{o}C$) while winds generally blow from the east at 10 to 15 mph. Data obtained by Morrison, Murphy et al also indicate that diurnal temperatures do not vary more than $1^{o}C$ between sunset and sunrise.

Most of the precipitation (approximately 15 inches annually) at the Summit is in the form of freezing fog or snow which can fall during any month of the year. However, only between December and March is the accumulation of ice and/or snow more than transitory (Morrison, Murphy et al, 1973).

TABLE 1

AVERAGE DAILY TEMPERATURE AND NIGHTTIME WIND VELOCITIES
MAUNA KEA SUMMIT

Month	T_{max}(° C) (1965-69)	T_{min}(° C) (1965-69)	Nighttime Wind Speed (mph) (1965-69)
Jan	3	-4	11
Feb	3	-4	20
Mar	5	-1	17
Apr	5	-3	24
May	5	-1	17
Jun	10	0	15
Jul	10	0	15
Aug	11	-1	13
Sep	11	+1	13
Oct	10	0	15
Nov	6	-3	13
Dec	3	-4	19

Source: Morrison, Murphy et al, 1973.

Topography

Elevations on the entire project site vary from 0 to over 57 percent. Steeper elevations are encountered downslope of the immediate and existing observatory site, as well as the area downslope of the proposed observatory

platform. In the immediate vicinity of both the existing and proposed observatory, elevations are not greater than 2 to 3 percent.

Soils

> "The general cinder cone material exhibits relatively low bearing strength in its natural state. It is also highly susceptible to erosion by surface run-off. Surface erosion is presently very limited because of the low annual precipitation and the high permeability of the volcanic material. Permafrost is known to exist directly under the cone crater, but the lateral extent of the permafrost zone is not known... The results of recent research performed by Dr. A. Woodcock of the University of Hawaii indicate that the permafrost lense is only a few meters thick (Dames and Moore, 1973)."

Soil Conservation Service (SCS) has assigned a "land capability unit" rating of VIIIs which indicates that the soils of the project site have limitations that restrict their use for wildlife habitat and recreation. In addition, SCS recognizes that these cinderlands are suitable for use as construction material.

Drainage

Rain and melting snow water runoff presently occur in the downslope portions of the project site via existing ground contours and natural drainage patterns. As stated earlier, the project site is highly susceptible to erosion by surface run-off; however, surface erosion is limited because of the low annual precipitation of approximately 15 inches and the high permeability of the volcanic cinder material.

Access

Access to the project site from Hilo or Kona is via the Saddle Road, State Route 200, to Puu Huluhulu (figure 1). From this location, an existing

mauka access road continues past Humuula Sheep Station, through Hale Pohaku and on to the Summit. The existing access, which previously was a single-lane dirt road, is now being altered by construction of a two-lane paved roadway to Hale Pohaku.

From Hale Pohaku to the Summit, a proposed project (Related Projects and EIS Documents) change the existing one-lane dirt road by horizontal and vertical realignment of portions of the existing 6.5 mile road, surfacing of the roadway with additional crushed rock, as well as by paving of 0.2 mile of roadway up to the main observatory at the Summit. In conjunction with the 6.5 miles of roadway alterations, drainage facilities, roadway signing, and gates near the base of the Summit Cone would also be constructed.

Utilities

Power

Power generation to the Summit is supplied by one of three portable generators which are situated on a trailer adjacent to the main observatory. The primary generator has a power rating of 150 KW while two "standby" generators each have a rating of 250 KW. One of the two standby generators is generally used during the monthly maintenance of the primary and remaining "standby" generators.

A proposed project (Related Projects and EIS Documents), designed to provide power to the Summit, would consist of installing:

a. 69 KV overhead transmission lines from the existing 69 KV line at the Saddle Road to a 40-acre site at 8,500 feet which is also being proposed for the construction of a permanent mid-level facility.

b. Substation at the site of the proposed mid-level facility.

c. 12.47 KV overhead transmission lines from the proposed mid-level facility to the 12,950-foot elevation, and underground lines from there to the Summit. In this regard, construction of the 12.47 KV underground transmission ducts began on July 25, 1973 and is scheduled for completion in early 1974.

d. Overhead telephone lines from the connection to the existing lines at about one mile above the Saddle Road to the proposed mid-level facility.

Sewage and Solid Waste Disposal

Adjacent to the existing observatory is a cesspool which is the receiving facilities for sewage generated by the Observatory.

Solid waste material generated by personnel at the Observatory is collected and hauled to the solid waste dump site at Hale Pohaku for disposal.

Water

Water at the Summit is stored in an 8,000 gallon tank which is situated underground, approximately 50 feet south of the Observatory. The UH provides water to the Observatory by deliveries of approximately 500 to 1,000 gallons of water once every 20 days. Such deliveries are made in conjunction with 5,000 gallon deliveries to the temporary base camp at Hale Pohaku.

Existing Structures

The location and size of existing structures on the project site are illustrated in figure 2. All of these structures are owned and operated by the University of Hawaii, Institute for Astronomy. Within the project

site, there is a 24-inch planetary patrol scope, the main observatory which serves as the enclosure for the 88-inch telescope, as well as related support facilities. Adjacent to the project site is one other telescope--the 24-inch Air Force scope which is also owned by the UH.

On the southwest side of the main observatory (for the 88-inch telescope) is a trailer on which the three generators are stored, as well as a former power shed which is a semi-underground facility. The power shed is no longer used by UH; as a result, the UH permits the local ski patrol to use the structure for shelter.

Astronomical Observation Conditions

Introduction

This section of the report briefly attempts to describe the quality of Mauna Kea Summit as a site for optical and infrared observations. Each of the following subsections are excerpts from a technical description and analyses, by Morrison, Murphy, Cruikshank, Sinton and Martin, entitled "Evaluation of Mauna Kea, Hawaii, As an Observatory Site" (June, 1973).

Optical Observations

> "For optical astronomy, the most important qualities are frequency of clear weather, photometric quality, seeing, and sky brightness. At Mauna Kea, an average of 75% of the nights can be used for observing with 56% of photometric quality for six or more consecutive hours. The median seeing is 1 arc second or better at the 61-cm Planetary Patrol telescope and 1.5 arc second at the 2.24-m telescope, and the skies are very dark ($\simeq$23^{m}0 arc second^{-2} in the blue)."

Infrared Observations

"For the infrared astronomer, the low humidity and high altitude at Manua Kea result in higher transparency and lower sky temperature than at lower altitude sites. If an observer were given 30 nights a year for infrared work at Mauna Kea, he could expect 20 nights in which he could get good data, and 11 nights on which excellent conditions would prevail, with water vapor well under 1 mm precipitable, sky noise less than 1×10^{-7} W cm^{-2} $sterad^{-1}$ on the NASA-West-phal meter, 17- to 28-μm extinction less than 0^m4 air $mass^{-1}$, and good transmission in the submillimeter."

Comparison With Other Observatory Sites

"Detailed comparison of Mauna Kea with other observatories is difficult. Even such basic parameters as number of photometric nights or median seeing conditions are rarely reported, and most available information is anecdotal.

"...based on some four years of observing experience (at Mauna Kea)...We conclude that Mauna Kea appears to be superior to any other northern-hemisphere site for optical astronomy and that it is the best site in the world that has been tested for infrared quality."

BIOLOGICAL CHARACTERISTICS

Vegetation

Above 9,850 ± foot (roughly 3000 m) elevation, there is little vegetation along the southern slope of Mauna Kea. As a result, the project site and general Summit Cone area is characterized by few forbs and grasses.

Mammals and Birds

Due to the limited amount of vegetation in the project site and the adjacent Summit area, few mammals or birds are seen in the vicinity of the Summit area. Mammals and birds which are infrequently seen include feral sheep or mouflon which are "chased" to higher elevations by hunters, as well as the chukar partridge which makes infrequent transitory flights in the Summit area.

The primary habitat for sheep is between 7,000 and 10,000 feet where sheep migrate vertically (up and down the mountain) and feed on mamani, puakeawe, as well as a variety of forbs and grasses. As a result, any movements by sheep in the Summit area are temporary.

The Chukar Partridge inhabits bare and rocky slopes at timberline and higher elevations.

> "Chukars appear to prefer green browse...On Hawaii....gosmore is favoured food with fruits and berries such as Ohelo and puakeawe being common (State Fish and Game Division, 1967)."

Even though vegetation is limited above 9,850 feet, the availability of some gosmore and lichen provides some "encouragement" for transitory movement by the Chukar Partridge in the Summit area.

CULTURAL CHARACTERISTICS

Land Use

Land Ownership

The project site is owned by the State of Hawaii and under the jurisdiction of the State Department of Land and Natural Resources. However, in November, 1967, the Board of Land and Natural Resources approved a 65-year (beginning 1 January 1968) lease (S-4191) to the UH, Institute for Astronomy for all lands (approximately) above the 12,000-foot elevation. The lease refers to these lands as the Mauna Kea Science Reserve which was established for the preservation of the area's qualifications for scientific research, as well as other activities compatible with the scientific programs.

Federal, State and County Land Use Designations

National Natural History and National Historic Landmarks

In December, 1972, Mauna Kea was officially declared a "National Natural History Landmark" by the U. S. Department of the Interior. Such a designation was based on the fact that Mauna Kea is the highest insular volcano in the world; Lake Waiau, at 13,020 feet, is the highest lake in the United States; evidence of glaciation during the Pleistocene Epoch is present above the 11,000-foot level, despite its tropical location; Mauna Kea is a scenic attraction as an example of shield volcanism in the Hawaiian Archipelago.

There are no archaeological sites within the project site; however, downslope from the Summit lies the Keanakakoi Adz Quarry (at the 12,400-foot elevation) which is approximately 2,000 feet west of the existing road to the Summit. The Quarry site is listed on the National Register of Historical Places as a National Historical Landmark.

Similar to other natural history and archaeological sites in Hawaii, man continues to restrict their preservation. For example, off-duty military personnel occasionally bring jeeps into the Summit area and drive them down the slopes of virtually undisturbed cinder cones in the Summit area. As stated earlier, these cones erupted over glacial ice during the late Pleistocene Epoch and are considered significant geologically. Another example of man's influence is the removal of artifacts and general disturbance of the ancient adz quarry by local residents.

State

Lands within the Mauna Kea Science Reserve are part of the Mauna Kea Forest Reserve. As a result, the project site is designated for "general conservation use" and is subject to DLNR Regulation No. 4. Under the present regulation, the present uses of the project site conform to the permitted uses of a General Use Conservation Subzone.

County

The Hawaii County General Plan designates the project site for "conservation" use. In conjunction with this designation, County

zoning ("open" designation) permits no structures except those related to recreational pursuits.

Hawaii County is also presently initiating an outdoor lighting ordinance which would attempt to preserve the quality of darkness at the Summit during nighttime hours when optical and infrared observations are made. The proposed ordinance, if enacted, would probably contain general requirements such as:

1. The installation of shielding on all outdoor lighting to minimize the amount of light shining upwards into the sky.

2. The filtration of all future outdoor lights, having more than 15 percent of the total emergent flux lying in the spectral region below 4,400 angstrom units. Such lights will be filtered with a filter whose transmission is less than 10 percent at any wave length less than 4,400 angstroms.

3. The prohibition of the following:

   The operation of searchlights for advertising purposes between 11 pm and sunrise;

   The illumination of outdoor public recreational facilities after 11 pm unless a specific recreational activity is already in progress;

   The outside illumination of any building by flood light above the horizontal between 11 pm and sunrise; and the

   The illumination of outdoor signs which require flood lighting above the horizontal between 11 pm and sunrise.

Uses of the Project Site

Institute for Astronomy

The project site is used almost entirely for astrpnomical purposes by UH and other visiting scientists. In addition,

some 10 to 15 persons (non-astronomers) per week visit the main observatory in order to see the 88-inch telescope and other related facilities

Ski Patrol

As stated earlier, members of the local Ski Patrol occasionally utilize the old power house as a shelter during their performance of voluntary work in the Summit area.

Recreational Uses of Mauna Kea

The remaining portions of the Mountain are used primarily for hunting within the Mauna Kea Game Management Area. However, local residents and tourists engage in a number of other recreational activities such as camping, hiking, picnicking, motorcycling, pleasure driving (by automobile), sightseeing and snow skiing.

Picnicking and other recreational activities (excluding hunting) are subject to the public's requirement of obtaining a "Mauna Kea Entry Permit". This permit authorizes a "permittee" to utilize the road between Hale Pohaku and the Mauna Kea Observatory Complex and to enter upon State lands within the Mauna Kea Forest Reserve. During FY 1971, "Mauna Kea Entry Permits" were issued to 5,073 adults and 2,458 accompanying children.

Development Trends on Mauna Kea

Astronomy

The extent to which Mauna Kea will be developed for astronomy

was recently discussed by Harland Cleveland in his article to The Sunday Star Bulletin & Advertiser (9 Dec 1973) which, in part, is as follows:

> "....the UH Institute for Astronomy has developed Mauna Kea as one of the world's prime sites for ground-based nighttime astronomy...Observations by this instrument (the existing 88-inch telescope completed in 1967) have helped to demonstrate the quality of the site. Now the French and Canadian governments have contracted with the UH to build a 150-inch telescope on the University site; the British government is negotiating for a possible observatory that would include one of the world's two largest telescopes (the other is being built in the Soviet Union); and the U.S. Government is interested in Mauna Kea as a probable site for the first major infrared telescope."

Recreation

The future development of Mauna Kea for most recreational activities seems dependent upon the development of the proposed Mauna Kea Observatory Access Road. Such a development would increase usage of the mountain for activities such as sightseeing, motorcycling, pleasure driving, and snow skiing by residents and tourists.

In contrast to these activities, future hunting activity is almost completely dependent upon game management practices of the State Fish and Game Division, as well as the related ecological balance between existing vegetation and game birds and mammals.

Aesthetics

During daylight hours, the existing main observatory can be seen approximately 200 days of the year from the residential areas of Hilo, south, to

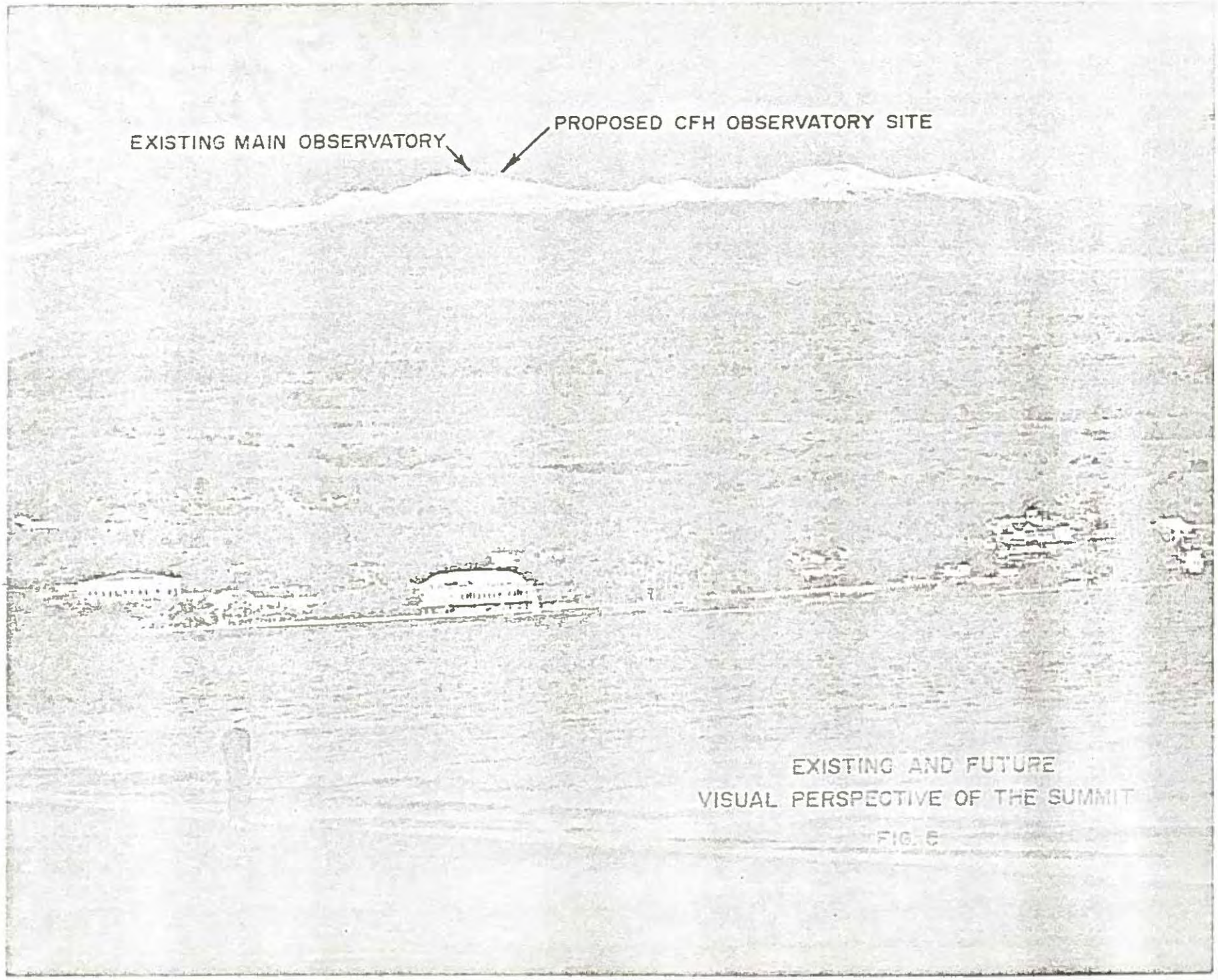
Glenwood, as well as from Waimea town which is situated some 50 miles west of the City of Hilo. Figure 5 illustrates the visual perspective of the Summit of Mauna Kea and the existing main observatory during winter months. During the non-winter months, the main observatory is more noticeable to the eye when normally there is no snow cover.

Social-Economic Characteristics

Provisional estimates of the total resident population by the U. S. Census and the State Department of Planning and Economic Development indicate that the resident population on Oahu increased from 630,528 to 678,124 residents (or 7.5 percent) from April 1, 1970 to July 1, 1973. During the same period, the resident population of Hawaii County increased 11.7 percent 63,468 to 70,872 residents.

In 1972, construction completed throughout the State totalled 714.3 million dollars and employed approximately 22,500 workers. For Hawaii County, total construction completed totalled 31.8 million dollars in 1971 (or almost 5 percent of the State's total construction) and employed approximately 1,820 workers.

The present UH Observatories on Mauna Kea employ 18 persons in Hawaii County who earn approximately $225,000 while 7 persons employed in Honolulu earn approximately $136,000. In addition, approximately $67,000 in other operating expenses are made by the Hilo office in Hawaii County while the Honolulu operations incure approximately $41,500 in operating expenses, as well as approximately $52,000 in indirect costs which support administrative functions in Honolulu.



EXISTING AND FUTURE
VISUAL PERSPECTIVE OF THE SUMMIT

FIG. 6

CHAPTER V

ENVIRONMENTAL IMPACT

INTRODUCTION

The proposed development program would cause effects upon topography, soils, sound levels, vegetation and land use regulations of the project site, as well as land use and economic trends within the tributary area. Other aspects of the project site and tributary area environments are not believed to be subject to any impact which would result from the proposed development program. Thus, only those aspects subject to some impact are discussed in the following paragraphs. Data providing the rationale for non-impact evaluation on other aspects of the project site and tributary area environments can be obtained upon request.

PHYSICAL CHARACTERISTICS

Topography

The equivalent of approximately one acre of land would be graded and/or excavated for the development of the observatory foundation, the underground support facility structures, an 18-foot wide access road from the existing main observatory to the proposed telescope site, as well as underground utility lines for power, water and sewage.

Fugitive Dust and Ground Vibrations

Fugitive dust and ground vibrations would be created by the proposed development program. Excessive amounts of fugitive dust could affect

the instrumentation of the existing three observatories on the Summit while excessive ground vibrations could disturb soil cementation and cause a vertical migration of ash particles. Disturbance of soil cementation and vertical migration of ash particles could further cause a reduction in bearing capacity and an increase in potential settlement (Dames and Moore, 1973). However, it is believed that the proposed precautions (see Project Description--Earthwork) to minimize both fugitive dust and ground vibrations would not cause damage to the instrumentation or foundations of the existing observatories.

Sound Levels

The proposed development program would create increased sound levels when construction workers and equipment would be present on the project site. On the average, it is believed that increased noise levels would not exceed 15 dbA over normal daytime sound levels, or approximately three times greater than present noise levels, during construction operations on the project site.

BIOLOGICAL CHARACTERISTICS

Vegetation/Bird and Mammal Ecology

As implied earlier, the project site is almost barren of vegetation except for a few forbs and grasses. Hence, no reduction in habitat for birds or mammals would result.

However, the importation of construction equipment into the project site could possibly cause the introduction of exotic plants in the area. Such a result would be in conflict with the stipulations of the UH lease

(S-4191) with DLNR which requires that no vegetation be planted within the Manua Kea Science Reserve without the approval of the Chairman of the Board of Land and Natural Resources.

CULTURAL CHARACTERISTICS

Land Use

Federal, State and County Land Use Designations

National Natural History and National Historic Landmarks

The National Natural History and the National Historic Landmarks within the tributary area would not be directly affected by the proposed development program; however, it is believed that they would be affected by the related Mauna Kea Observatory Access Road project. Increased usage of the Access Road would encourage more people to travel up the Mountain; and as a result, more people who would physically desecrate both the Adz Quarry sites and geologic features on Mauna Kea. The degree of desecration is impossible to quantify since National Landmarks are based on subjective value and, from a physical standpoint, little or no documentation is available concerning the present physical condition of the Adz Quarry sites and various geologic features on Mauna Kea. In fact, the physical coordinates of the Keanakakoi Adz Quarry have not yet been established by the National Park Service which originally initiated the designation of Historical Landmark status for this site.

However, it is further believed that desecration of these sites

will continue to increase with or without the Access Road, until the State Department of Land and Natural Resources and/or the U.S. Department of Interior can develop these sites for educational and recreational purposes. It is believed that such development would reduce desecration and encourage the public's preservation of the Adz Quarry sites and various geologic features on Mauna Kea.

State

The proposed revision of Regulation No. 4 (October, 1973) and associated land use designations would place the project site within a "Resource" conservation subzone. The revised Regulation, if adopted, would permit facilities and support facilities (under the auspices of public agencies), within a "Resource" subzone, which would be developed for the monitoring, observation and measurement of solar and atmospheric resources.

Since the project site has already been leased to UH, the Corporation would have to sub-lease a portion of the project site for its development. However, any sub-lease by UH would have to be approved by the Board of Land and Natural Resources.

County of Hawaii

Even though the project site is situated on State lands, all construction plans and specifications would have to conform to local building code requirements of Hawaii County.

Development Trends on Mauna Kea

In conjunction with four other projects related to the proposed telescope development, the proposed development program would encourage further development of the Summit area for astronomical purposes, as well as encourage recreational development along Mauna Kea's Southern slope. Astronomical development on the Summit would be encouraged by the presence of support facilities i.e. access and power, which would be required for the construction and operation of any future observatory. Increased demands for recreational facilities would stem primarily from greater accessibility to the Summit and southern slope of Mauna Kea. Such demands may include additional provisions for overnight camping, picnicking and skiing.

Aesthetics

The proposed development program would increase the present visual perspective of one observatory on Mauna Kea to two observatories in the residential areas of Waimea, Hilo, Keaau, Kurtistown, Mountain View, Glenwood and Volcano. In this regard, figure 5 depicts the view and location of the future observatory which would have the same color and vertical profile of the existing main observatory. It should be noted; however, that the location of the existing main observatory may "block" the view of the proposed observatory from Mountain View, Glenwood and Volcano.

Economic Impact

Of the $21,375,160 which would be spent jointly by CNRS and NRC over the 4-year construction program, approximately 4.5 million dollars would be generated into the State's economy. Utilizing "income coefficients"

developed by the State Department of Planning and Economic Development (DPED), the proposed development program would generate some $2,506,950 in direct income to the local building construction industry and approximately $1,505,700 in secondary income to the remainder of the Hawaiian economy. Further deliniation of direct and secondary income i.e. Honolulu and Hawaii Counties, cannot be estimated since the source of all labor and materials has not been determined at the time of this report. The remaining $16,875,160 of the $21,375,160 would be spent in France and Canada during the design and construction of the telescope and related instrumentation. For the purposes of this report, the economic impact of the income generated in these two Countries was not analyzed.

The primary economic impact of the proposed development program would result from the eventual operation of the proposed observatory by approximately 20 permanent personnel of the Corporation. Annual operating costs are estimated to be about $1,000,000. By utilization of the DPED "income coefficients" for "State and local government enterprises" and assuming that these "coefficients" would be somewhat indicative of the expenditures of the quasi-public CFHT Corporation in Hawaii County, it is believed that the operation of the proposed observatory would annually generate some $456,200 in direct income to other agencies i.e. local utilities, which support the operation of the observatory and approximately $364,100 in secondary income to the remaining Big Island economy.

Related to the impact of the proposed development program are the other four related projects (Related Projects and EIS Documents) which are all being subsidized by the State of Hawaii. The total construction value of these projects is roughly 4 million dollars which, if implemented, would

generate $2,228,400 in direct income to the State building construction industry and $1,336,000 in secondary income to the remaining Hawaiian economy.

CHAPTER VI

OTHER ENVIRONMENTAL CONSIDERATIONS

ADVERSE ENVIRONMENTAL EFFECTS

Adverse environmental effects resulting from the development program include the alteration of topography; fugitive dust and ground vibrations; increased sound levels; the potential introduction of exotic plants; and the increased demand for recreational facilities on Mauna Kea. Such effects are discussed more fully within the preceeding section regarding environmental impact.

ALTERNATIVES

One alternative is to forego development of the proposed observatory at the Summit, as well as the four other related projects. Such an alternative would result in the savings of approximately $2,228,000 to the State of Hawaii and a loss of approximately $1,844,200 which has already been spent by the State of Hawaii (as of 14 December 1973) for the planning and design of each of the projects, as well as the partial construction of the power line and access road to the Summit.

A second alternative is to temporarily forego development of the proposed observatory and the four other related projects until such time that a master plan has been developed for Mauna Kea. This alternative would cost the Canadian and French governments approximately 2.1 million additional dollars and the State of Hawaii an additional $400,000 for every year of delay. On the other hand, the implementation of this alternative would

provide DLNR with the opportunity of planning for the increasing use of the Mountain by the public and its relationship to game management policies, National Historic and Natural History Landmarks, as well as the rapidly changing floral community. However, it is believed that any such master planning would eventually conclude that astronomical observation facilities could only be developed at the Summit and that power and access to the Summit would be provided on the same, or a similar alignment to the existing access in order to minimize future environmental impact. Therefore, in terms of master planning for Mauna Kea, it appears that the location of a permanent mid-level facility could logically be the only variable involved in the development of astronomical observation facilities.

SHORT TERM/LONG TERM RELATIONSHIPS

Within the short term (the next 10 years), the CFH Telescope would be in operation and increasing international interest would be focused on astronomical observations on Mauna Kea. It is conceivable that the United States and British governments may each develop two additional telescopes on the Summit. During this period, the new access would also cause a substantial increase in recreational activity on Mauna Kea. With increased recreational demands, local politicians will promise new recreational facilities i.e. for picnicking, camping and hunting, for its constituents. However, the Department of Land and Natural Resources and other agencies will be hesitant to provide such facilities until it master plans the relationship of man to the Mauna Kea environment. Some examples might be the determination of game management policies which are consistent with goals for the declining Sophora parkland, or to what degree and what manner will man come in contact with geological features and ancient archaeological sites.

Within the long term (the next 20 years), several telescopes will be in operation on the summit of Mauna Kea. In terms of recreation, considerably more recreational facilities will be developed on the mountain to support a number of activities performed by an increasing number of residents and tourists. Such facilities will generally be in consonance with master planning for recreation, as well as game and forestry management.

IRREVERSIBLE COMMITMENTS

The commitment of resources required to accomplish the proposed development program would include labor and material used in construction, as well as the monetary resources required for governmental approval of the proposed project.

APPENDIX A

PRELIMINARY (AS OF 26 SEPTEMBER 1973)

TRIPARTITE AGREEMENT AMONG:

THE NATIONAL RESEARCH COUNCIL OF CANADA, THE CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE OF FRANCE, AND THE UNIVERSITY OF HAWAII

CONCERNING

THE CONSTRUCTION AND OPERATION OF A LARGE OPTICAL TELESCOPE ON MAUNA KEA

Recognizing the increasing development of astronomical research and the quality and the quantity of related scientific work carried out in the universities and specialized research centres of Canada, France, and Hawaii;

Considering the need for instruments to be available for use by the astronomers of Canada, France and Hawaii;

Considering the desire of the astronomers of Canada, France and Hawaii to carry on cooperative programmes of research;

Considering the desirability of developing international cooperation in large-scale scientific undertakings;

The Centre National de la Recherche Scientifique (CNRS) of France, the National Research Council (NRC) of Canada, and the University of Hawaii (UH), hereinafter referred to as the Agencies, having obtained the approval as appropriate of their respective governments, that is those of France, of Canada, of the United States of America and of the State of Hawaii, agree:

OBLIGATIONS OF THE AGENCIES

1. That the CNRS, NRC, and UH will establish under Hawaii law a corporation to be named the Canada-France-Hawaii Telescope Corporation, to design, construct and operate on Mauna Kea, Hawaii, a large optical telescope of 3.6 m aperture along with laboratories, equipment, and associated installations, which will remain the exclusive property of the Corporation during the existence of the Corporation. The Corporation will be directed by a Board of Directors assisted by a Scientific Advisory Council.

2. That the Corporation shall have:

(i) A Board of Directors composed of:

. 4 representatives of CNRS

. 4 representatives of NRC

. 2 representatives of UH

to be appointed by their respective Agencies.

The Board of Directors shall be responsible for coordination on technical and administrative problems, and, in particular, must ensure that the design of the telescope and its ancillary installations will satisfy the needs of the astronomers. It is also responsible for financial control of the business of the Corporation. Its decisions will be taken by majority vote, simple or other, as provided in its bylaws, provided that at least one of the directors named by each agency joins in that majority.

(ii) A Scientific Advisory Council composed of:

. 4 representatives of CNRS

. 4 representatives of NRC

. 2 representatives of UH

and up to four others to be named by the Board of Directors.

This Council shall be responsible for making recommendations to the Board of Directors on all scientific and technical matters.

(iii) For the duration of the construction phase, a Project Officer and an Associate Project Officer to be named by the Agencies on the recommendation of the Board of Directors. The Project Officer and the Associate Project Officer will be jointly responsible to the Board of Directors for carrying out the design and construction activities. In particular, they must ensure that the equipment provided satisfies the requirements for its intended use.

(iv) After the construction phase a staff headed by an Executive Director and an Associate Executive Director, proposed by NRC and CNRS and appointed by the Board of Directors. The authority and the duties of the Executive Director will be determined by the Board of Directors. All senior employees of the Corporation shall be appointed in such a manner as to ensure an appropriate division among NRC, CNRS and UH as determined by the Board of Directors.

3. That the CNRS and the NRC will provide to the Corporation work, components and sums necessary for the construction of the telescope, its basic instrumentation, its dome and associated buildings, the technical characteristics of which are attached as Appendix A. The detailed technical specifications will be the subject of agreement between the CNRS and the NRC. NRC and CNRS will equally share the cost and jointly assume responsibility for the design of the telescope. The total capital cost, including components and studies already in existence will be 91 million French francs, as estimated on February 1, 1973, providing the construction commences in 1973 and is completed by 1977. It is understood that the Corporation will take over the contractual obligations assumed by NRC and CNRS for this project during the period preceding the establishment of the Corporation. It is further understood that the UH shall be held harmless by NRC and CNRS for assumption of such contractual obligations during the whole of the construction period.

4. That during the construction phase as defined in paragraph 11, the operating cost for the Project Office, and its personnel will be shared equally by the NRC and the CNRS, within limits to be determined by mutual agreement between the NRC and the CNRS.

5. That, in as equal a fashion as possible, maximum use will be made of French and Canadian industrial capacity in the design and construction of the telescope, its basic instrumentation, its dome and associated buildings, and in the production of high technology components.

6. That the UH will

i) Furnish a sub-lease to the Corporation until 2033 for part of the land UH now holds under Lease Number S4191 from the State of Hawaii, sufficient to meet the present needs of the Corporation at the telescope site and ensure renewal or extension of the lease for the life of the Corporation. (Approximate boundaries of the land to be sub-leased are shown in Appendix B.)

ii) Construct and maintain an access road--having characteristics consistent with the overall plan for the development of the Mauna Kea Observatory area--to a boundary line of the sub-leased property.

iii) Construct an electric power line to a central terminal near the Mauna Kea Observatory area, of approximately 750 KW capacity to meet the presently anticipated needs of the existing UH installations and the projected installations of the Corporation; and to grant to the Corporation access to this power through an easement over UH leased land. The cost of connection from the telescope site to the central terminal, and of electric power, are to be paid by the Corporation.

iv) Construct at a mid-level station, accommodations to meet the presently anticipated needs of a minimum of transient and permanent personnel associated with the Corporation. In the same general area, UH will also construct offices, laboratories, and other related facilities, of which square feet will be made available to the Corporation on a priority basis. This entire mid-level station will be maintained by UH. The Corporation will, however, be charged on an equitable basis for operating costs incurred by UH in providing all such services and facilities to the Corporation; except that the cost of providing accommodations will be charged direct to the individual who uses them.

v) Furnish to the Corporation space in the new buildings of the Institute for Astronomy on the Mauka Manoa campus, of which square feet will be available to the Corporation on a priority basis. The area will be maintained by UH, and any operating costs incurred in providing such space will be charged to the Corporation on an equitable basis.

vi) Give access to visiting astronomers to the same facilities as those available to the members of the staff of the Institute for Astronomy of the State of Hawaii.

vii) Solicit maximum cooperation from the local authorities in protecting the natural qualities of the site for astronomical observations.

7. That in consideration of their respective contributions, the three Agencies will receive equitable interest in the Corporation as follows:

CNRS	42.5%
NRC	42.5%
UH	15.0%

OBSERVING TIME

8. That their respective contributions entitle the Agencies to averaged observation time in the following proportions:

CNRS	42.5%
NRC	42.5%
UH	15.0%

PERSONNEL

9. That the Executive Director and the Associate Executive Director of the telescope will be proposed by NRC and CNRS, and will be appointed by the Board of Directors. The authority and the duties of the Executive Director will be determined by the Board of Directors.

OBSERVANCE OF RULES

10. The Director of the Institute for Astronomy has the authority to ensure that all persons on property over which the Institute has jurisdiction abide by the general rules and regulations of the Institute.

OPERATING COSTS

11. That after the completion of the construction phase, the Agencies will annually contribute funds to cover the expenses budgeted by the Corporation up to one million dollars US, as estimated on February 1, 1973, with appropriate provision for variation in the cost of living, in the proportion of CNRS 42.5

percent, NRC 42.5 percent, and UH 15 percent. These funds will be assigned to cover necessary expenses for meetings of the Board of Directors and the Scientific Advisory Council, staffing and operating the telescope, and for developing further its instrumentation. Before the end of the construction phase, some similar costs may be incurred, and these costs will be shared in the same proportions; however, in consideration of the other contributions by UH, no cash contributions will be required from UH before July 1, 1975. The date on which the construction phase will be considered as completed will depend on the date set for commencement of the telescope's normal operation. This date of completion of the construction phase will be determined by the Board of Directors in agreement with each of the Agencies.

HAWAII STATE TAXES

12. It is understood by the Agencies that the applicable laws of the State of Hawaii currently accord relief from state corporate, income, real estate and excise taxes to non-profit corporations registered in the State of Hawaii and organized exclusively for scientific and/or educational purposes. It is further understood by the Agencies that the non-profit corporation referenced in this agreement will benefit from these facilities and that the UH will undertake to use its best efforts to ensure the continued availability of these benefits to the Corporation.

DISPUTES

13. That in order to ensure the availability, should the need arise, of a system for the settlement of dispute concerning the interpretation or application of this agreement which cannot be resolved by the Agencies, such a dispute shall at the request of any Agency be submitted to a tribunal of arbitration.

Such a tribunal shall be constituted for each individual case as follows: each Agency shall appoint two members, and these six members shall jointly propose another member as their chairman, to be appointed jointly by CNRS, NRC and UH. Details of the procedure of arbitration are described below:

Procedure of Arbitration

All members of the tribunal shall be appointed within two months after any Agency has informed the other Agencies that it wishes to submit the dispute to a tribunal of arbitration.

If the two-month period specified above has not been observed, any agency may, in the absence of any other relevant agreement, invite the President of the International Court of Justice to make the appointments necessary to fill any positions vacant on the tribunal at the end of that period.

The tribunal shall determine the place or places where it shall sit, its own procedures and all other administrative matters. The decision of the tribunal shall be by majority vote.

The tribunal shall make its decision as promptly as possible and, in any case, no later than three months from the date of its establishment.

The tribunal shall transmit a certified copy of its findings including the decision and the reasons for it to each agency. Each Agency shall bear the costs for its own members on the tribunal of arbitration and of its representatives in the tribunal's proceedings. The costs of the chairman and the remaining costs shall be borne in equal parts by the Agencies unless the tribunal otherwise decides. The decision of the tribunal shall be final and binding.

REVISION

14. That, after the completion of construction of the telescope and the laboratories, equipment and installations necessary for its operation and in any case not more than five years from the date of the signature of this agreement and every five years thereafter authorized representatives of the Agencies shall meet in Hawaii or such other place as may be mutually agreed upon to examine if it would be required to propose modifications to the text of this agreement.

Signed at_____

in six copies, three in English and three in French, the texts in both languages having equal validity,

by_____

for the Centre National de la Recherche Scientifique

by_____

for the National Research Council of Canada

by_____

for the University of Hawaii

DEPARTMENT OF LAND AND NATURAL RESOURCES

MAUNA KEA ENTRY PERMIT AND PERMIT CONDITIONS

This permit authorizes the undersigned permittee to use the road between Hale Pohaku and the Mauna Kea Observatory Complex and to enter upon State lands within the Mauna Kea Forest Reserve for the purpose of _____

_____,

subject to the following conditions:

1. Only 4-wheel drive vehicles permitted.
2. Driving of vehicles shall be confined to designated roads provided for such use.
3. Parking on road prohibited except in designated areas.
4. Overnight camping is prohibited except in designated areas.
5. Entering the Mauna Kea Observatory Complex is prohibited without permission from the Observatory.
6. Littering is prohibited.
7. The permittee shall comply with all orders of the Board of Land and Natural Resources or its authorized representatives and any applicable Federal, State and County laws, ordinances, and rules and regulations.
8. The permittee shall <u>read</u>, <u>study</u> and <u>obey</u> instructions and other material contained in "Exhibit A" attached hereto and made a part hereof.

For and in consideration of the issuance of this permit, the undersigned permittee hereby waives any and all claims he may have against the State of Hawaii and its respective officers, agents and employees, and agrees to defend, hold harmless and indemnify the State of Hawaii and its respective officers, agents and employees, from any suits, actions and claims arising out of or in any way connected with the activities permitted under the permit.

Any violation of the terms and conditions of the permit, orders of the Board of Land and Natural Resources or its authorized representative and any applicable Federal, State and County laws, ordinances and rules and regulations shall constitute cause for revocation of this permit.

This permit is valid for the period from _____ _____

to _____ or until the area is closed by the Department of Land and Natural Resources.

BOARD OF LAND AND NATURAL RESOURCES

Sunao Kido

SUNAO KIDO, Chairman and Member

I understand and agree to conditions set forth above.

_____
Permittee's Signature

_____
Date of Issue

APPENDIX B

EXHIBIT "A"

ROAD

The road from the Saddle Road to the Mauna Kea Observatory is unpaved, rough and narrow, with many sharp turns. Extreme caution must be exercised when driving on the road.

* Be on the lookout for washed away and slide areas.

* Do not operate a vehicle in excess of 15 miles per hour.

* Use headlights when fog sets in.

* Drive vehicle only on designated roads.

* Park vehicle only in designated areas.

* Only four-wheel drive vehicle above Hale Pohaku.

WEATHER

* Be prepared for sudden changes in weather conditions.

  Storms, high winds, fog, rain, hail, snow and freezing temperatures.

ALTITUDE

* 13,796 feet at the summit.

* Altitude Sickness.

  The effects of oxygen deficiency may cause headache, fatigue, shortness of breath, lassitude, rapid heart beat, nosebleed or nausea and vomiting. Any person suffering from heart, circulatory, blood or respiratory diseases should consult with his doctor before attempting to enter this area.

* Altitude may cause mechanical failures to motor vehicles. Carburetors adjusted for low altitudes will not function properly in high altitudes.

* Avoid running or extreme physical exertion, walk slowly.

* Use sun glasses and protective lotion.

MISCELLANEOUS

* There are NO water, food, fuel, restrooms, shelters, medical facilities, towing services, etc.

BIBLIOGRAPHY

GENERAL

Instruction Manual for Developing and Processing Draft Environmental Impact Statements, State Office of Environmental Quality Control, Final Draft, October, 1972.

Preliminary Draft Environmental Impact Statement -- Mauna Kea Observatory Access Road, Phase I, State Highways Division, July, 1973.

Draft Environmental Impact Statement -- Mauna Kea Observatory Access Road, Phase II, State Highways Division, August 23, 1971.

Preliminary Draft Environmental Impact Statement -- The Proposed Mauna Kea Observatory Mid Elevation Facility, Department of Accounting and General Services, November, 1973.

Preliminary Draft Environmental Impact Statement -- Power to Summit Mauna Kea Observatory, Kaohe, Hawaii, Department of Accounting and General Services, July, 1973.

An Assessment of Environmental Impact Resulting From Proposed Temporary Base Camp Expansion, Hale Pohaku (Mauna Kea), Hawaii, Canada-France-Hawaii Telescope Corporation, December, 1973.

PHYSICAL CHARACTERISTICS

Volcanoes In the Sea, Macdonald and Abbott, University of Hawaii Press, 1971.

"Stratigraphy and Chronology of Late Quaternary Tephra along the South Rift Zone of Mauna Kea Volcano, Hawaii", Stephen C. Porter, Geological Society of American Bulletin, Vo. 84, p. 1923-1940, June, 1973.

"General Features and Glacial Ecology of Mauna Kea, Hawaii", Gregory and Wentworth, Geological Society of American Bulletin, Vol. 48, p. 1719-1742, December, 1937.

Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii, U. S. Soil Conservation Service and University of Hawaii Agricultural Experiment Station.

An Inventory of Basic Water Resources Data: Island of Hawaii, State of Hawaii, Division of Water and Land Development, Report R34, February, 1970.

"Evaluation of Mauna Kea, Hawaii, as an Observatory Site", Morrison, Murphy, Cruikshank, Sinton and Martin, Publications of the Astronomical Society of the Pacific, Vol. 85, No. 505, June, 1973.

BIOLOGICAL CHARACTERISTICS

Hawaiian Birdlife, Andrew J. Berger, University Press of Hawaii, 1972.

Game Birds In Hawaii, Schwartz and Schwartz, Territory of Hawaii, Board of Agriculture and Forestry, 1949.

Mammals in Hawaii, P. Q. Tomich, Bishop Museum Special Publication No. 57, Bishop Museum Press, 1969.

"Regulation 3" of the State Division of Fish and Game, October 12, 1973.

"Regulation 23" of the State Division of Fish and Game, April 27, 1973.

"Hunting in Hawaii", State of Hawaii, State Division of Fish and Game, 1967.

CULTURAL CHARACTERISTICS

Personal communication dated 7 December 1973 from Yosihiko Sinoto, Chairman, Department of Anthropology, Bishop Museum, Honolulu.

"Interior Secretary Morton Names Pacific Volcanic Sites As New Natural Landmarks", U.S. Department of Interior News Release, December 28, 1972.

The General Plan, County of Hawaii, Ordinance No. 439, December 15, 1971.

"UH Best at Doing What Comes Naturally", Harland Cleveland, The Sunday Star Bulletin & Advertiser, pg. A-21, December 9, 1973.

Construction in Hawaii, 1973, Bank of Hawaii, May, 1973.

Hawaii '73, Annual Economic Review, Bank of Hawaii, August, 1973.

State of Hawaii Data Book, 1972 Statistical Abstract, Department of Planning and Economic Development State of Hawaii, July, 1972.

Interindustry Study of the Hawaiian Economy, State of Hawaii, Department of Planning and Economic Development, 1972.