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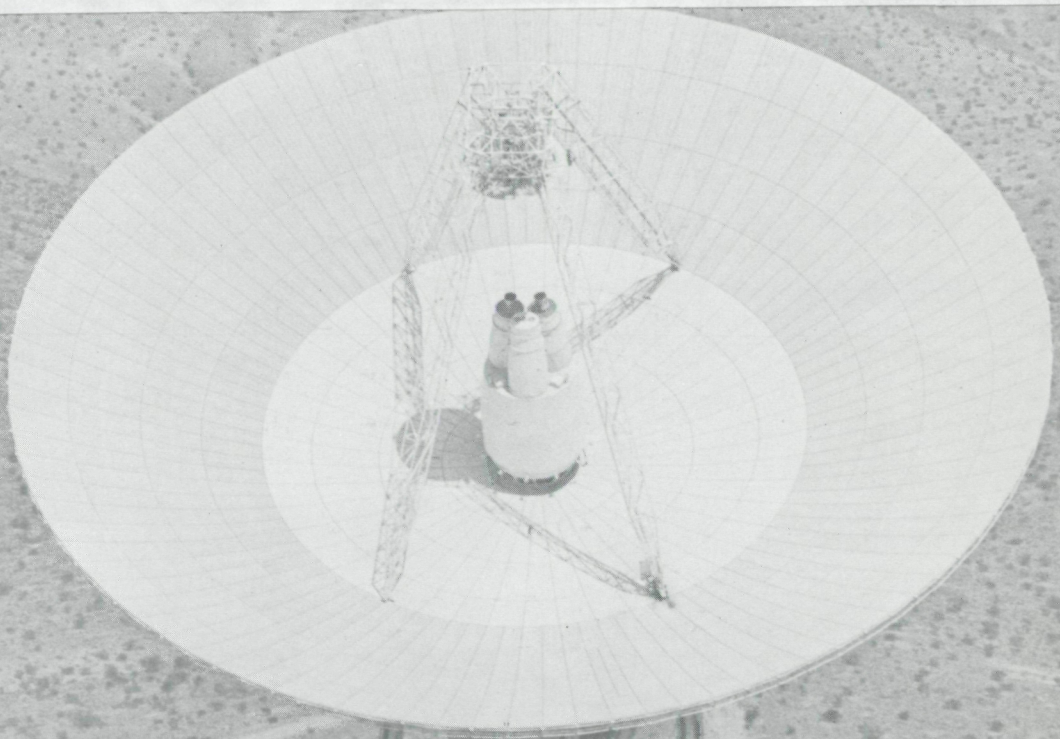
June 15, 1988

Environmental Projects: Volume 6

Environmental Assessment: New 34-Meter Antenna at Venus Site



Goldstone Deep Space Communications Complex

JPL
Jet Propulsion Laboratory
California Institute of Technology

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The work described in this publication was carried out under the direction of the Jet Propulsion Laboratory, California Institute of Technology, and was supported by the National Aeronautics and Space Administration.

ABSTRACT

The Goldstone Deep Space Communications Complex (GDSCC), located in the Mojave Desert about 45 miles north of Barstow, California, and about 150 miles northeast of Pasadena, is part of the National Aeronautics and Space Administration's (NASA's) Deep Space Network, one of the world's largest and most sensitive scientific telecommunications and radio navigation networks. The Goldstone Complex is managed, technically directed, and operated for NASA by the Jet Propulsion Laboratory (JPL) of the California Institute of Technology in Pasadena, California. A detailed description of the GDSCC is presented in Section II of this report.

The GDSCC includes five distinct operational areas named Echo Site, Venus Site, Mars Site, Apollo Site, and Mojave Base Site. Within each site is a Deep Space Station (DSS) that consists of a large parabolic dish antenna and its support facilities.

At present, the Venus Station, known as DSS-13, has a 26-meter (85 ft) antenna. In conjunction with NASA, JPL is proposing to replace this antenna with a new 34-meter (111.5 ft) antenna.

The proposed construction of this new antenna at the Venus Site required an Environmental Assessment (EA) document that would record the existing environmental conditions at the Venus Site, that would analyze the environmental effects that possibly could be expected from the construction, installation and operation of the new proposed antenna, and that would recommend measures taken to mitigate any possibly deleterious environmental effects. M. B. Gilbert Associates (MBGA), Long Beach, California, was retained by JPL, under Contract No. 957925-71070, to prepare the EA document.

This present report is an expanded JPL-version of the EA document submitted to JPL by MBGA on February 15, 1988. The conclusion of the MBGA-prepared environmental assessment is that there would be no significant adverse effects on the environment due to the construction, installation and operation of the new 34-meter antenna at the Venus Site.

GLOSSARY

AICP	American Institute of Certified Planners
BLM	Bureau of Land Management
CDFG	California Department of Fish and Game
CEQ	(Federal) Council on Environmental Quality
CFR	Code of Federal Regulations
CNDDB	California Natural Diversity Data Base
CNPS	California Native Plant Society
DSCC	Deep Space Communications Complex
DSN	Deep Space Network
DSS	Deep Space Station
EA	Environmental Assessment
EIS	Environmental Impact Statement
FAA	Federal Aviation Administration
FEMA	Federal Emergency Management Agency
FONSI	Finding of No Significant Impact
FWS	U.S. Fish and Wildlife Service (see USFWS)
GDSCC	Goldstone Deep Space Communications Complex
JPL	Jet Propulsion Laboratory
MBGA	M.B. Gilbert Associates
MSL	Mean Sea Level
NAS	National Audubon Society
NASA	National Aeronautics and Space Administration
NEPA	National Environmental Policy Act
NOAA	National Oceanic and Atmospheric Administration
NTC	National Training Center (U.S. Army)
RCN	Rural Conservation

SEDAB	Southeast Desert Air Basin
USC	United States Code
USFWS	U.S. Fish and Wildlife Service (see FWS)

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SECTION I

INTRODUCTION

The Goldstone Deep Space Communications Complex (GDSCC), located in the Mojave Desert about 45 miles north of Barstow, California, and about 150 miles northeast of Pasadena, is part of the National Aeronautics and Space Administration's (NASA's) Deep Space Network, one of the world's largest and most sensitive scientific telecommunications and radio navigation networks. The Goldstone Complex is managed, technically directed, and operated for NASA by the Jet Propulsion Laboratory (JPL) of the California Institute of Technology in Pasadena, California. A detailed description of the GDSCC is presented in Section II of this report.

The GDSCC includes five distinct operational areas named Echo Site, Venus Site, Mars Site, Apollo Site, and Mojave Base Site. Within each site is a Deep Space Station (DSS) that consists of a large parabolic dish antenna and its support facilities.

A. PROPOSED CONSTRUCTION OF A NEW 34-METER ANTENNA AT THE VENUS SITE

At present, the Venus Station, known as DSS-13, has a 26-meter (85 ft) antenna. In conjunction with NASA, JPL is proposing to replace this antenna with a new 34-meter (111.5 ft) antenna. The reasons for construction of the new antenna are to create an advanced facility to improve:

(1) Antenna pointing

(2) Spacecraft tracking

(3) Spacecraft navigation

(4) Antenna microwave optics

(5) Transmission capability

(6) Reception capability

(7 The return of scientific data

The technology developed from the implementation of the proposed Venus antenna would be of use to the existing Deep Space Network (DSN) antennas located not only at the GDSCC but also at other Deep Space Communications Complex (DSCC) facilities in Spain and Australia.

B. DESCRIPTION OF THE PROPOSED 34-METER ANTENNA AT THE VENUS SITE

The proposed antenna, to be located at the existing Venus Site, would be a high-performance, 34-meter wheel-and-track type, azimuth-elevation antenna located approximately 200 feet south of the existing 26-meter antenna. The

proposed project includes construction and installation of the antenna structure, a below-grade foundation and equipment enclosure, mechanical drive and controls, optical elements, and may include a minor ancillary support building. The proposed Venus Station antenna is similar in size and structure to the 34-meter Uranus antenna located at the Mars Station, in the northern portion of the GDSCC (see Figure 11).

C. REQUIREMENT OF AN ENVIRONMENTAL ASSESSMENT

The proposed construction of this new antenna at the Venus Site required an Environmental Assessment (EA) Document that would record the existing environmental conditions at the Venus Site, that would analyze the environmental effects that possibly could be expected from the construction, installation and operation of the new proposed antenna, and that would recommend measures that could be taken to mitigate any possibly deleterious environmental effects.

The need for an Environmental Assessment Document had its origin in 1978, when the Federal Council on Environmental Quality (CEQ) issued regulations under 40 CFR Parts 1500 - 1508 to implement the procedural requirements of the National Environmental Policy Act (NEPA). Following this action, the National Aeronautics and Space Administration (NASA) procedures to implement NEPA were published in 14 CFR Subparts 1261.1 and 1261.3. The NASA procedures now have been incorporated in the NASA Directives System as NMI 8800.7.

Thus, NASA installations planning qualifying projects must prepare an Environmental Assessment Document (14 CFR 1216.304). As defined in 40 CFR Subpart 1508.9 (Preparation of Environmental Assessments), the purpose of the Environmental Assessment is to provide sufficient evidence and analysis to permit the determination whether to prepare an Environmental Impact Statement (EIS) or a Finding Of No Significant Impact (FONSI).

The EA report must be completed and a decision made as to whether or not an Environmental Impact Statement is required before a decision can be made to begin detailed project definition and planning (NASA, 1980). Evaluation of environmental impacts, therefore, must commence at the onset of project conception. In addition to assessing the probable impacts resulting from the proposed project, the EA must provide an evaluation of alternatives to the proposed project, including the alternative of "no action." While there is no requirement to select the alternative having the least environmental impact, the rationale for selecting the favored alternative must be provided.

M. B. Gilbert Associates (MBGA), Long Beach, California, was retained by JPL, under Contract No. 957925-71070, to prepare this EA document according to Section 102 of the National Environmental Policy Act (42 United States Code, USC 4321); Council on Environmental Quality Regulations for Implementing the National Environmental Policy Act (40 CFR Code of Federal Regulations, 1500-1508); NASA Policy on Environmental Control (14 CFR 1216.1); NASA Procedures for Implementing the National Environmental Policy Act (14 CFR 1216.3); and NASA Handbook 8800.11. MBGA submitted its prepared EA Document to JPL on February 15, 1988. The MBGA document serves as the Environmental Assessment for the 34-meter antenna proposed to be constructed at the Venus Site at the GDSCC.

This present report is an expanded JPL-version of the EA document submitted to JPL by MBGA. The conclusion of the MBGA-prepared Environmental Assessment is that there would be no significant adverse effects on the GDSCC environment due to the construction, installation and operation of the new 34-meter antenna at the Venus Site.

D. SUMMARY OF THE ENVIRONMENTAL ASSESSMENT

The environmental consequences of the proposed construction of a new 34-meter antenna at the Venus Site are minimal. The construction and operation of the proposed antenna will not result in any significant impacts to the natural environment (geology, seismic conditions, soils, water resources, floodplains, biotic resources, and air quality). Similarly, there are minimal human environmental impacts (socioeconomics, traffic and circulation, noise, cultural resources, solid and hazardous waste, toxic substances and pesticides, and aesthetic), because the proposed antenna is replacing an existing antenna operation. The only potential area of concern is high-power radio transmission and its effects on surrounding land uses and aircraft operations. NASA/JPL has yet to evaluate restrictions of antenna operation imposed by neighboring Fort Irwin and the Federal Aviation Administration (FAA). Furthermore, a Safety Review of New Operations must be completed before a final decision can be rendered on health and safety impacts from planned high-power radio transmissions.

E. CONCLUSIONS OF THE ENVIRONMENTAL ASSESSMENT

The Environmental Assessment (EA), concerning the construction and operation of a new 34-meter antenna proposed to be located at the Venus Site at the GDSCC, has analyzed and focused upon many areas of possible environmental concern.

Key issues associated with potential impacts were identified during preliminary discussions with NASA, JPL, Fort Irwin and Goldstone contractor personnel. The conclusion of the EA analysis is that the proposed action would cause no significant adverse impacts to the natural or human environment provided that NASA/JPL can provide evidence that operations will not result in emissions of radiation exceeding safety standards established by NASA/JPL, and will not produce interferences with Fort Irwin and FAA operations. Upon determination that these standards and conditions will not be exceeded or violated, a Finding of No Significant Impact (FONSI) would be appropriate in accordance with NASA procedures in 40 CFR 1216.306(b).

SECTION II

THE GOLDSTONE DEEP SPACE COMMUNICATIONS COMPLEX (GDSCC)

A. LOCATION OF THE GDSCC

The Goldstone Deep Space Communications Complex (GDSCC) is located in southern California in a natural, bowl-shaped depression in the Mojave Desert, in San Bernardino County about 40 miles north of Barstow, California, and about 170 miles northeast of Pasadena, California, where the Jet Propulsion Laboratory (JPL) is located.

As indicated in Section I, the GDSCC is part of the National Aeronautics and Space Administrations's (NASA) Deep Space Network (DSN), one of the world's largest and most sensitive scientific telecommunications and radio navigation networks. The Goldstone Complex is managed, technically directed, and operated for NASA by the Jet Propulsion Laboratory of the California Institute of Technology in Pasadena, California.

The 52-square-mile Goldstone Complex lies within the western part of the Fort Irwin Military Reservation (Figure 1). A Use Permit for the use of the land was granted to NASA by the U.S. Army. The Complex is bordered by the Fort Irwin Military Reservation on the north, east and southeast, the China Lake U.S. Naval Weapons Center on the northwest, and state and Federal lands managed by the U.S. Bureau of Land Management (BLM) on the south.

B. FUNCTIONS OF THE GDSCC

After the Space Act of 1958 had accelerated U.S. plans and programs for space exploration, JPL initiated construction work at Goldstone to build the first tracking station of what is now known as the Deep Space Network (DSN). The primary purpose of the DSN is to support the tracking of both manned and unmanned spacecraft missions and to provide instrumentation for radio and radar astronomy in the exploration of the solar system and the universe.

As indicated above, in addition to its participation in numerous scientific explorations, Goldstone performs the following functions in support of DSN operations:

(1) Tracking: Locating the spacecraft, measuring its distance, velocity and position, and following its course.

(2) Data Acquisition: Gathering information coming in from the spacecraft.

(3) Command: Sending of instructions from the ground that guide the spacecraft in its flight to the target. Commands also tell the spacecraft when to perform required operations, including the switching on and off of instruments for performance of the mission's scientific experiments.

Goldstone also is a research and development center to extend the communication range and to increase the data acquisition capabilities of the DSN. It serves as a proving ground for new operational techniques. Prototypes

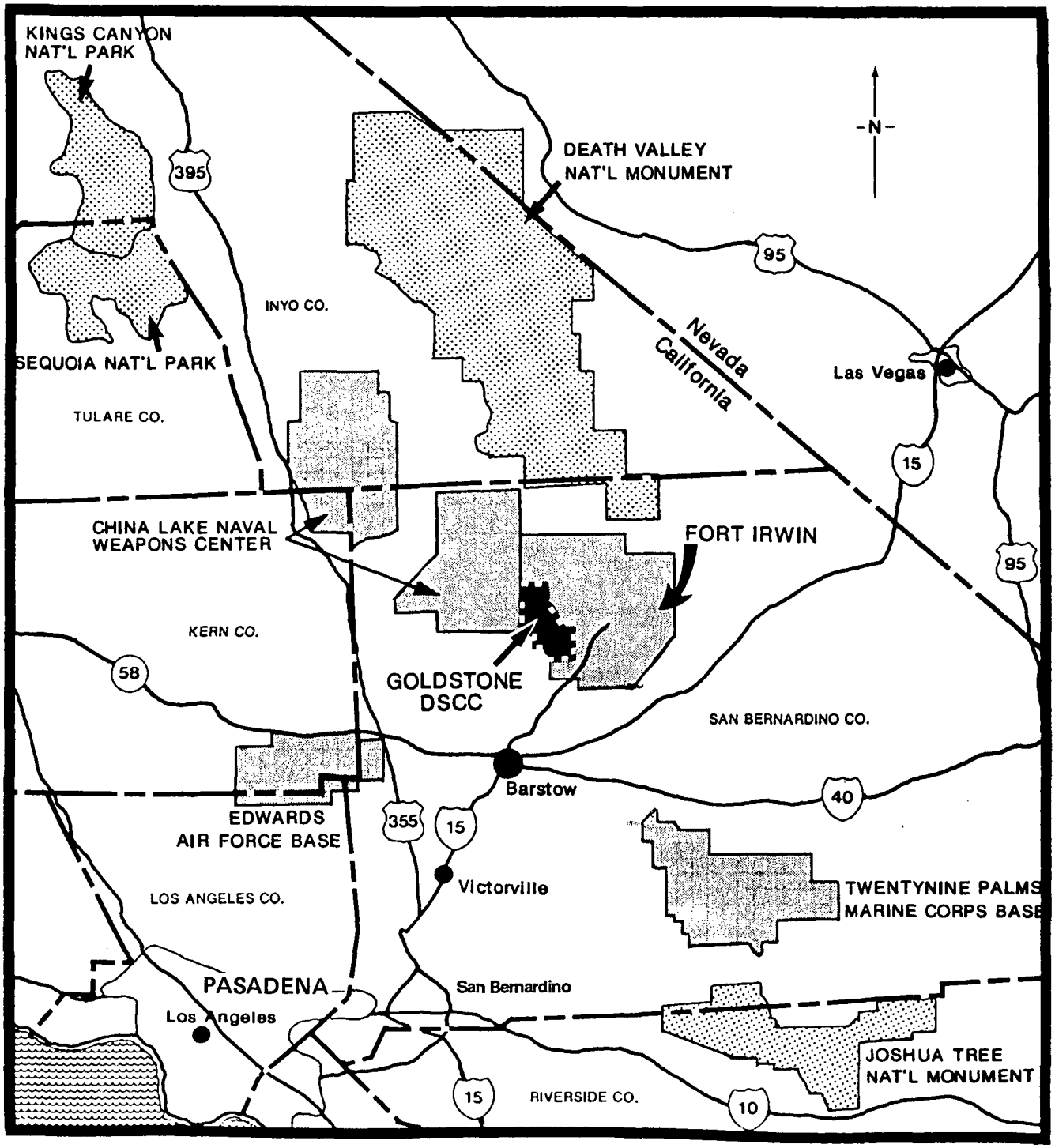


Figure 1. Geographic Relationship of the Goldstone Deep Space Communications Complex to JPL in Pasadena

of all new equipment are thoroughly tested at Goldstone before they are duplicated for installation at overseas stations (see Section II, C below).

C. FACILITIES AT THE GDSCC

The GDSCC is a self-sufficient, working community with its own roads, airstrip, cafeteria, electrical power, and telephone systems and is equipped to conduct all necessary maintenance, repairs, and domestic support services. Facilities at the GDSCC include about 100 buildings and structures that were constructed during a 30-year period from the 1950s through the 1980s. The construction of additional buildings and structures continues today as the GDSCC increases its activities and operations.

Goldstone is one of three Deep Space Communications Complexes (DSCCs) operated by NASA/JPL that are located on three continents: at Goldstone in Southern California's Mojave Desert; in Spain, near Madrid; and at Tidbinbilla, in Australia, near Canberra. Because these three DSCCs are approximately 120 degrees apart in longitude, a spacecraft always is in view of one of the DSCCs as the Earth rotates on its axis (Figure 2).

Activities at the GDSCC operate in support of six, large, parabolic dish antennas, at sites called Deep Space Stations (DSSs): four DSSs are operational, one is devoted to research and development (R&D) activities, and one has been deactivated. There also are four, similar, operational DSSs in Spain and in Australia. Thus, the NASA DSN consists of a worldwide network of 12 operational DSSs. One of the six parabolic dish antennas at Goldstone is operated by the National Oceanic and Atmospheric Administration (NOAA).

Total facilities at the GDSCC (Figure 3) include the six large, parabolic dish antennas, an airport, a microwave test facility, miscellaneous support buildings, and a remote support facility in Barstow located about 45 miles southwest of the GDSCC. The GDSCC support staff consists of 246 personnel on site and 55 personnel located at the Barstow facility. Table 1 summarizes the major facilities, buildings (number and square footage), and antennas (construction date and size). Three sites within the GDSCC have antennas (referred to as stations) devoted to NASA operations (Echo Site, Mars Site, and Apollo Site). Two other sites have antennas devoted to research and development: (Venus, operated by the GDSCC, and Mojave, operated by the National Oceanic and Atmospheric Administration). A 26-meter (85 foot) antenna, located at the Pioneer Site was deactivated in 1981. In 1985, the Pioneer antenna was designated a National Historic Landmark by the U.S. Department of Interior and the Pioneer Site was returned to the U.S. Army. Each of the Goldstone sites is briefly described below.

D. ANTENNA STATIONS AT THE GDSCC

1. Echo Site (DSS-12)

The Echo Site, as the administration center and operations headquarters of the GDSCC, is the most extensively developed site on the complex. It has one 34-meter antenna and 24 support buildings having a combined area of 86,622 ft^2 (SF). Support buildings include administration and engineering offices, cafeteria and dormitory facilities, transportation

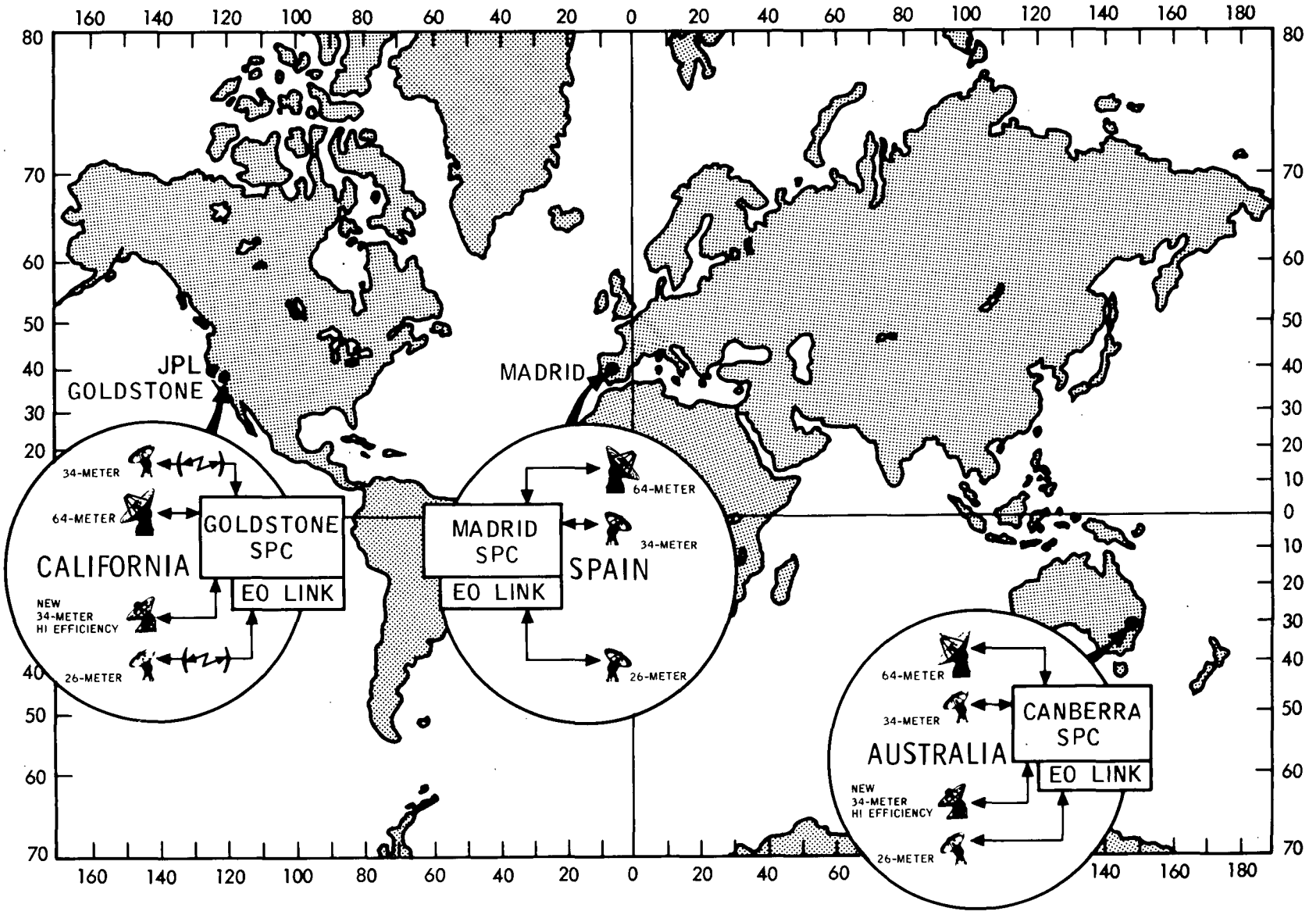


Figure 2. The Three-Continent NASA Deep Space Network as it Existed in 1987

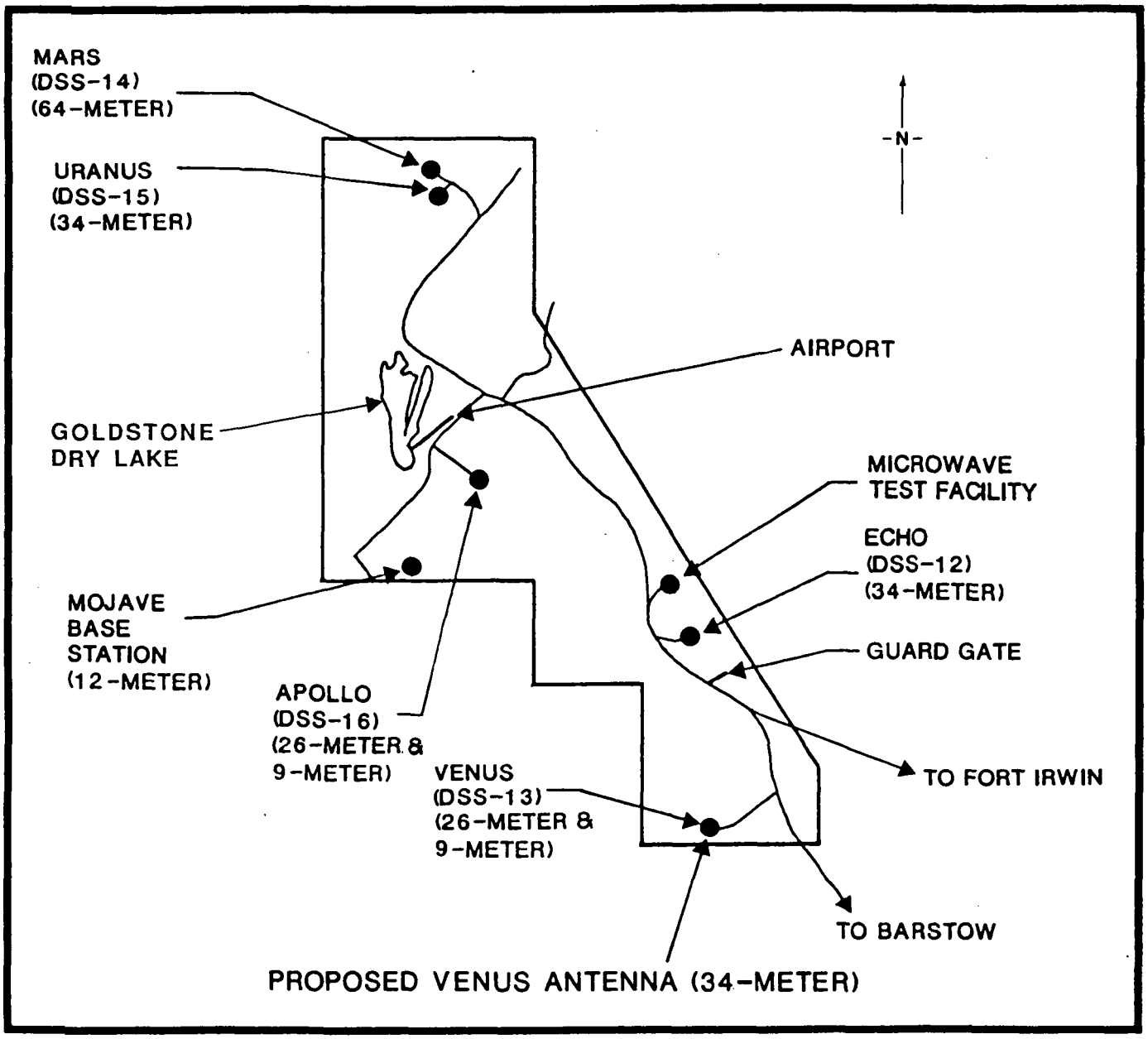


Figure 3. Schematic Map of the Goldstone DSCC Showing Locations of the Six NASA Deep Space Stations (DSSs)

Table 1. Major Facilities at the GDSCC

Site	Station Number	Buildings		Antennas	
		Number	SF (ft^2)	Date of Construction	Size (Meters)
Echo Site	DSS-12	24	86,662	1961[a]	34
Venus Site	DSS-13	12	12,502	1962[b]	26 9
Mars Site	DSS-14 DSS-15	11	36,834	1966 1984	64 34
Apollo Site	DSS-16	23	43,985	1965[c]	26 9
Mojave Site		5	11,850	1964	12[d]
Airport[e]		2	710	1963/1970	--
Microwave Test Facility	MTF	1	2,880	1963	--
Miscellaneous	--	3	1,430	--	--
Barstow Facility[f]		1	28,343	--	--

[a]Original antenna, built in 1959, was moved to Venus Site in 1962. A new 26-meter antenna, built in 1961, was extended to 34 meters in 1978.

[b]Antenna was constructed at Echo Site in 1959 and moved to the Venus Site in 1962.

[c]Antenna originally was constructed for the NASA Goddard Space Tracking and Data Network. JPL/GDSCC/DSN operation of the antenna began in October 1984.

[d]This antenna is operated by the National Oceanic and Atmospheric Administration (NOAA).

[e]The airport is located at the Goldstone Dry Lake.

[f]This site, a leased facility, is located in Barstow, California about 45 miles southwest of the GDSCC.

Source: Directory of Goldstone DSCC Buildings and Supporting Facilities (Gold Book, Document 890-165, JPL internal document), Jet Propulsion Laboratory and National Aeronautics and Space Administration, December 1, 1985.

and maintenance facilities, storage areas, and warehouses. Echo Station originally was built in 1959 as a 26-meter (85 foot) antenna. The antenna was first used in 1960 in support of the Echo Project, an experiment to transmit voice communications coast-to-coast by bouncing radio signals off the reflective Mylar surface of a passive balloon-type satellite. In 1962, this original 26-meter antenna was moved to the Venus Site. In anticipation of this move, a newer 26-meter antenna had been built at the Echo Site in 1961. In 1978, this antenna was enlarged to 34 meters (111.5 ft).

2. Venus Site (DSS-13)

The Venus Site consists of a 26-meter (85 ft) antenna, a 9-meter (29.5 ft) antenna, and 11 buildings having a combined area of 12,502 SF. The support buildings provide space for operations control, laboratories, offices, security, workshops, warehouses, and mechanical equipment. The 26-meter antenna, which was originally located at Echo Site, was moved to the Venus Site in 1962. The antenna was used for a radar astronomy study of the planet Venus. Currently, its primary function is research and development and performance and reliability testing of high power radio-frequency transmitters and new systems and equipment prior to their introduction into the Deep Space Network. A new 34-meter (111.5 ft) antenna has been proposed to replace the 26-meter antenna. An Environmental Assessment concerning this new antenna is the subject of this present report.

3. Mars Site (DSS-14 and DSS-15)

The Mars Site consists of 2 antennas and 13 buildings with a combined area of 36,834 SF. The support buildings provide facilities for operations control, offices, training, mechanical equipment, storage, and security.

The Mars Station Antenna (DSS-14), at 64-meters (210 ft) in diameter, is one of the larger antennas of its kind in the world (see Front Cover). The antenna, which was constructed in 1966, is 6.5 times more powerful and sensitive than a 26-meter antenna, extending the range of deep space communications by 2.5 times. It can maintain communications with spacecraft even to the edge of the solar system. Standing more than 234 ft high, this antenna is one of the most striking features in the geographic area. Currently under construction is the extension of the 64-meter parabolic dish to 70 meters to be ready for the Voyager 2 spacecraft's encounter with the planet Neptune in August 1989.

The Uranus Station Antenna (DSS-15) is a 34-meter, high efficiency (HEF) antenna, located approximately 1,600 ft southeast of the Mars Station Antenna. Built in 1984, this latest antenna-addition at the GDSCC first was used to support the encounter of the Voyager 2 spacecraft with the planet Uranus in January 1986. The new, proposed 34-meter antenna to be constructed at the Venus Site is similar in size and structure to this Uranus antenna.

4. Apollo Site (DSS-16)

The Apollo Site has a 26-meter (85-ft) antenna, a 9-meter (29.5 ft) antenna, and 18 buildings having a combined area of 43,985 SF. The buildings provide space for operations, equipment, storage, and warehousing. The 26-meter antenna originally was constructed in 1965 by the NASA Goddard Space Tracking and Data Network to support the manned Apollo missions to the moon. Operation of this antenna under the JPL/GDSCC/DSN began in October 1984. Both the 26-meter and the 9-meter antennas now are used to support the missions of the Space Shuttle (STS) and satellites in both low and high Earth orbits.

5. Mojave Base Site (NOAA Antenna)

The Mojave Base Site has five buildings with a combined area of 11,850 SF. At one time, these buildings provided support facilities for operations, equipment, and maintenance. Except for the NOAA operations buildings, however, these buildings now are not in use.

The Mojave Base Station Antenna is a 12-meter (40-ft) antenna operated by NOAA. The antenna is involved in several programs including monitoring of shifts in the Earth's plates, monitoring weather changes, and retrieving information from very low orbiting Earth satellites.

E. SUPPORT FACILITIES AT THE GDSCC

1. Goldstone Dry Lake Airport

The airport consists of an approximately 6,000 ft by 100 ft paved runway. There are two buildings at the airport site, both of which are presently not in use. An open hangar is used to provide shelter for a single aircraft. For its personnel, NASA operates three scheduled shuttle flights per week to the GDSCC that originate from the Burbank-Glendale-Pasadena Airport. In addition, the Goldstone airport is used infrequently by administrative Army flights. Both NASA and the U.S. Army use propeller-driven aircraft.

2. Microwave Test Facility and Fire Training Area

The Microwave Test Facility (MTF) and Fire-Training Area consists of a single building of 2,880 SF along with areas identified for fire fighting. The MTF is used for research and development testing of antenna equipment. Fire training includes procedures for the quenching of fires.

3. Miscellaneous Buildings in the GDSCC Area

Three buildings and structures at the GDSCC that fall into this category include the main gatehouse, pump house, and radio spectrum monitor. Total area of these three buildings/structures is 1,430 SF.

4. Off-Site Facility at Barstow, California

In addition to the above-mentioned on-site facilities, the GDSCC leases an office and warehouse support facility in the nearby city of Barstow. The facility is a single story, 28,343 SF structure located at 850 Main Street.

F. NON-STRUCTURAL SUPPORT FACILITIES AT THE GDSCC

1. Transportation Network

The major roadways in the area are shown in Figure 4. The only surface public transportation route to the GDSCC is by the Fort Irwin Road that leads to Fort Irwin. The NASA Road cutoff from Fort Irwin Road leads into the GDSCC. NASA Road merges with Goldstone Road, which is the only north-south paved access road within the complex. Both NASA and Goldstone Roads are paved two-lane roads and are maintained by the Ft. Irwin Post Engineer. Two-lane paved access roads also lead to each of the sites and major facilities.

2. Utilities and Services

The Southern California Edison Company provides electricity for the Goldstone Complex. The GDSCC provides its own backup diesel-engine generators for operations during emergencies and to ensure continuity of electrical service for prescheduled periods of time. Gasoline, diesel oil, and hydraulic oil are stored in underground storage tanks. Water is supplied by Fort Irwin from groundwater basin wells. Sanitary sewage is discharged through septic tank systems to a leaching field. The Echo and Mars Sites also discharge wastewater to evaporation ponds.

G. WASTE-MANAGEMENT FACILITIES AT THE GDSCC

At the Echo Site, the GDSCC operates its own 6-acre, Class III solid-waste landfill. This facility, soon to be expanded to 20 acres, accepts only non-hazardous, solid wastes.

Most of a small quantity of hazardous waste, generated at the GDSCC each year, is sent to off-site commercial facilities for reclamation and eventual reuse. The remainder is transported to off-site commercial treatment or disposal facilities within 90 days of generation. The GDSCC maintains several properly managed waste-accumulation points, but operates no facilities requiring a hazardous waste permit. In accordance with its environmental management program, the GDSCC conducts all of its waste-management operations in strict compliance with environmental regulations, in a manner consistent with protection of human health and the environment.

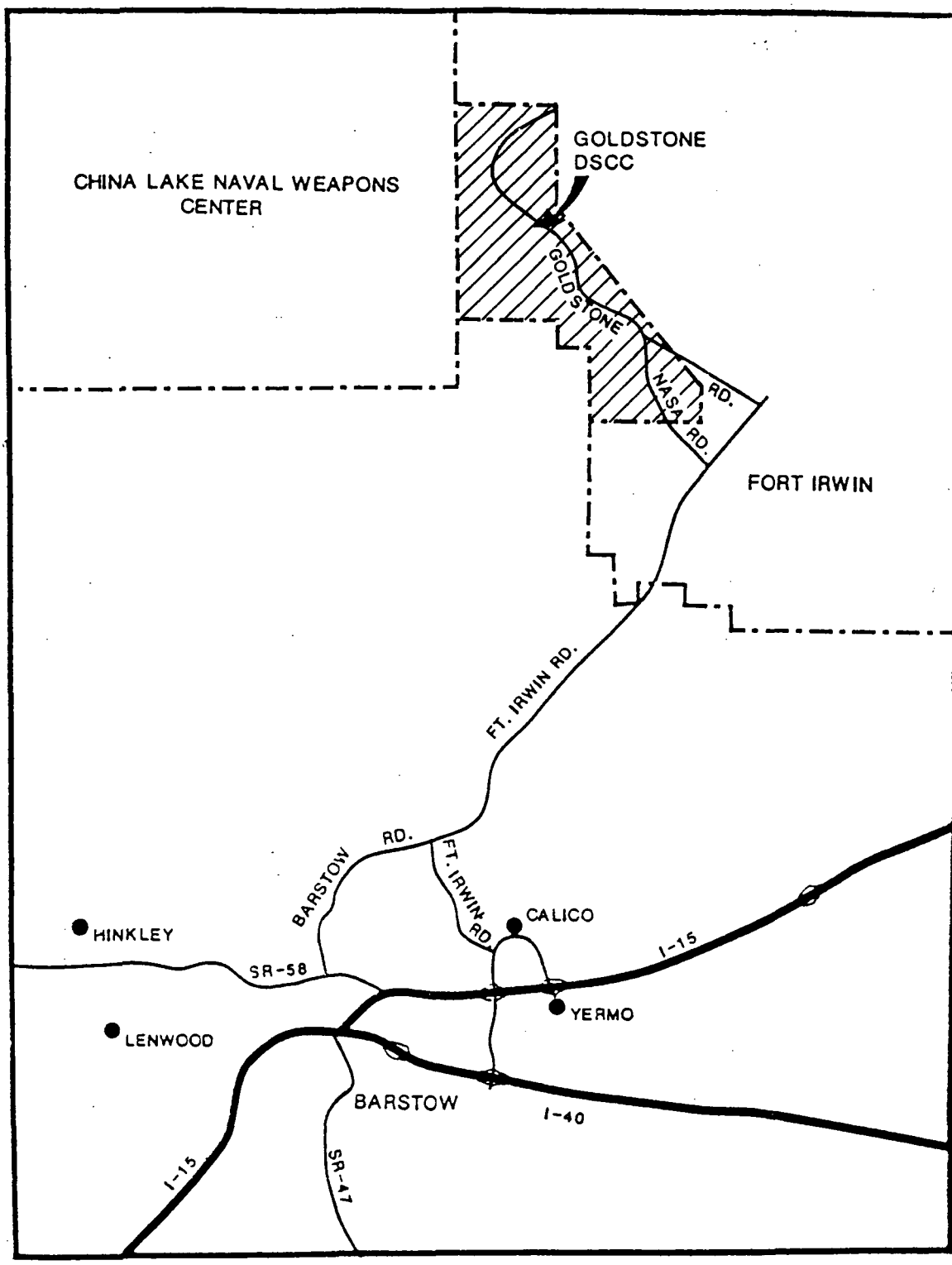


Figure 4. Major Roads Leading to and at the Goldstone DSCC

H. OPERATIONAL RELATIONSHIPS BETWEEN THE GDSCC AND FORT IRWIN

Because the GDSCC is located within the Fort Irwin property, the two installations potentially can affect each other's roles and missions. Fort Irwin is a U.S. Army installation serving as the U.S. Army National Training Center (NTC). The remote desert environment allows military task forces to practice large-scale training maneuvers that could affect natural, historic, and cultural resources at the GDSCC. This especially is true when the maneuvers involve the movement of heavy equipment (tanks, large trucks) within the GDSCC. Most maneuvers occur at the eastern border of the GDSCC and every effort is made by both the GDSCC and Ft. Irwin personnel to avoid the use of sensitive areas for such maneuvers.

I. NATURAL ENVIRONMENTAL ASPECTS OF THE GDSCC

1. Geology

The GDSCC is located in a naturally-occurring bowl-shaped depression bounded on three sides by geological faults. The Garlock Fault lies to the north, while the Blackwater and Calico Faults lie, respectively, to the west and south. The GDSCC is bounded on the east by the Tiefort Mountains. Each antenna site at the GDSCC is located on natural alluvial material, ranging in thickness from 15 feet at the Venus Site to more than 70 feet at the Echo Site. The alluvium is derived from the surrounding hills.

2. Hydrology

Groundwater in the Goldstone area is generally confined and is found at depths ranging from 170 ft near the Minitrack Site to approximately 1,000 ft below the Echo Site. Chemical analyses of the groundwater have yielded total dissolved solids (TDS) values in excess of 1,000 ppm indicating the groundwater is brackish. The Goldstone Complex currently obtains potable water from a group of wells located at Fort Irwin, approximately ten miles to the southeast.

3. Climatic Conditions

The GDSCC lies within the U.S. Naval Weather Service's Southwest Desert, Climatic Area A. Mean annual temperatures for the area range from 50° to 80°F. Temperatures can climb as high as 114°F during the summer months, and drop as low as 11°F during the winter months. Mean annual precipitation for the area is approximately 2.5 inches with most precipitation falling between November and February.

SECTION III

PURPOSE OF AND NEED FOR CONSTRUCTION OF A NEW 34-METER ANTENNA AT THE VENUS SITE OF THE GDSCC

The Jet Propulsion Laboratory (JPL), in conjunction with the National Aeronautics and Space Administration (NASA), proposes to construct a 34-meter, beam waveguide antenna at the Venus Site, Goldstone Deep Space Communications Complex (GDSCC) Goldstone, California. See Figures 1 and 3 for regional and vicinity maps.

A. PURPOSE OF THE CONSTRUCTION OF THE NEW 34-METER ANTENNA

The purpose of the construction of the new antenna is to further develop deep space communications knowledge by constructing an antenna that would increase scientific data returns, improve antenna microwave optics, improve performance of transmitting and receiving capability, and improve antenna pointing, spacecraft tracking, and spacecraft navigation. The technology developed from implementing the proposed Venus antenna would be utilized by the existing Deep Space Network (DSN) antennas located at the GDSCC and eventually by other Deep Space Communications Complex (DSCC) facilities in Spain and Australia. The proposed antenna-upgrading would improve the efficiency of existing DSN equipment and allow for the execution of projects not currently possible using existing technology.

B. NEED FOR THE CONSTRUCTION OF THE NEW 34-METER ANTENNA

The GDSCC is the largest of three DSN complexes located on three continents. As part of the NASA Deep Space Network, these three complexes represent one of the world's largest and most sensitive scientific telecommunications and radio navigation networks. The major purpose of expanding deep space communications technology is to support the tracking of manned and unmanned spacecraft missions and to provide means for radio and radar astronomy to explore the solar system and universe.

There are six antenna stations at the GDSCC. The antennas were built between 1961 and 1985, with three built before 1965. As a result, the technology utilized in the early antennas is relatively outdated. Several technological advances have occurred recently that make possible the proposed new Venus antenna as a prototype of future antennas that would permit advanced deep space communications capabilities.

Construction of the proposed new antenna at the Venus Site at the GDSCC is necessary because the required concentration of resources and capable personnel is available only at the GDSCC.

SECTION IV

CONSTRUCTION OF THE PROPOSED NEW ANTENNA AT THE VENUS SITE AND A CONSIDERATION OF ALTERNATIVE ACTIONS

A. DESCRIPTION OF THE PROPOSED CONSTRUCTION

The proposed Venus Station antenna is located at the southern end of the GDSCC within the Fort Irwin National Training Center in San Bernardino County, California (Figures 1 and 3). The GDSCC is approximately 45 miles north of Barstow, California in the Mojave Desert. The complex covers 52 square miles and consists primarily of hilly topography with a desert scrub habitat. Access to the proposed antenna site is via NASA Road and Venus Road.

The proposed antenna would be located at the Venus Site and would replace an existing 26-meter antenna that had been built at the Echo Site in 1959 and moved to the Venus Site in 1962. The existing Venus Site facilities comprise 11 buildings, along with a small 9-meter research and development antenna, and the 26-meter Deep Space Station-13 antenna. The existing on-site structures provide for operations control, laboratories, offices, security, workshops, warehouses, and mechanical equipment. The existing 26-meter antenna originally was developed for a radar astronomy study of the planet Venus. Currently, its primary function is for research and development, and performance and reliability testing of new systems and equipment for the DSN. See Figure 5 for the existing Venus Site plan and Figures 6 and 7 for photographs of the 26-meter antenna.

The Venus site is located within a natural topographical bowl on ground that slopes to the east at an approximate 4 percent decline. The existing 26-meter antenna is located toward the western end of the Venus site and is supported by offices, workshops and other facilities located on Venus Road. The existing Venus Deep Space Station-13 antenna is on a concrete foundation adjacent to the hydromechanical building/pump room, transmitter building, and equipment room. The control building, laboratory and office building, security building, and 9-meter antenna are located toward the eastern end of the Venus Site (see Figure 5 for structure locations). The uses of the existing buildings at the Venus Site and their associated areas (in square feet) are provided in Table 2. Twelve employees presently support the existing Venus antenna and facilities.

Electrical power for existing Venus Site operations is provided by the Southern California Edison Company, while on-site generators at the site provide for a limited amount of backup power. A cable tray, which follows the south side of Venus Road, provides an interface between the Venus Deep Space Station-13 antenna and the facilities toward the eastern end of the Venus Site.

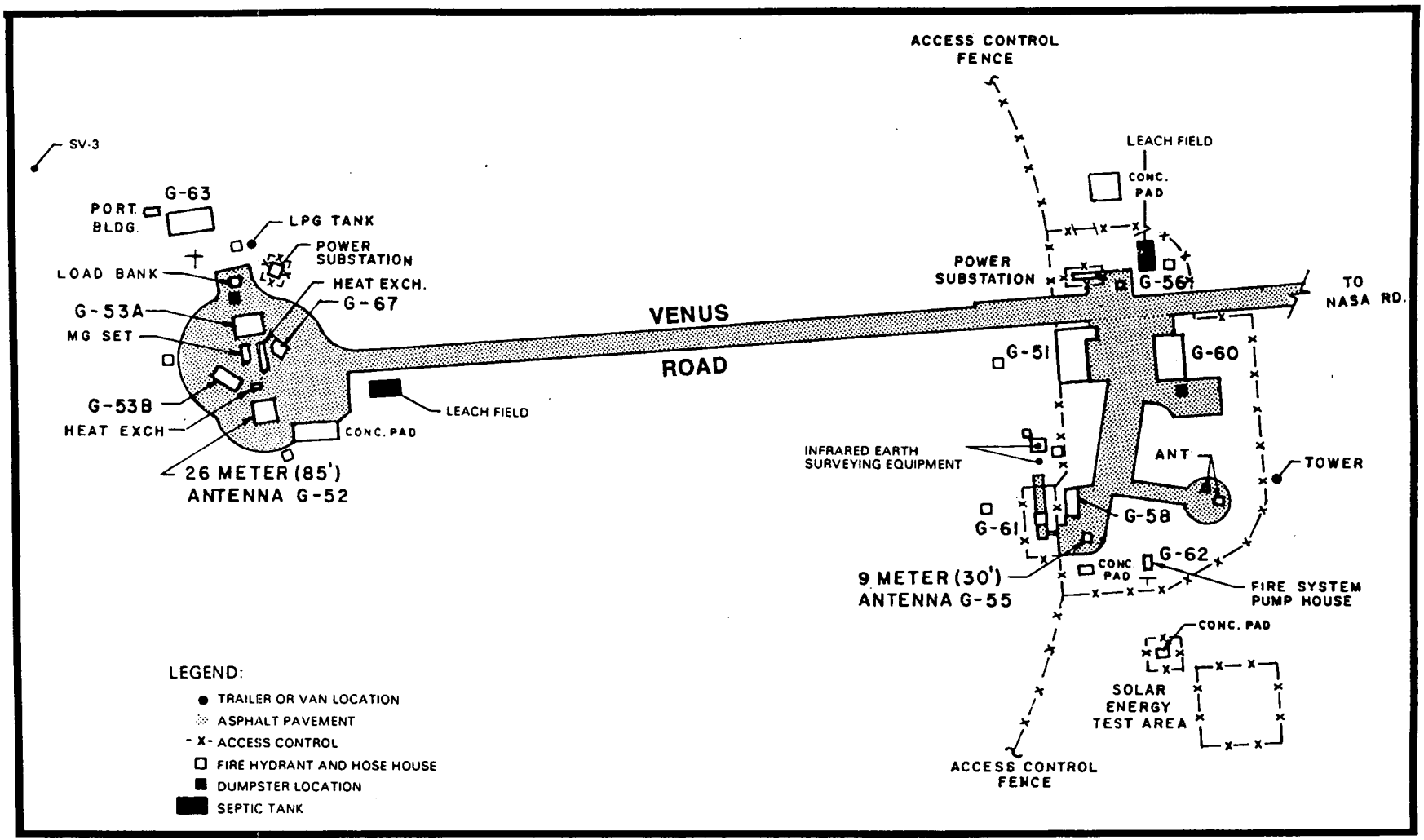


Figure 5. Venus Site: Existing Site Plan

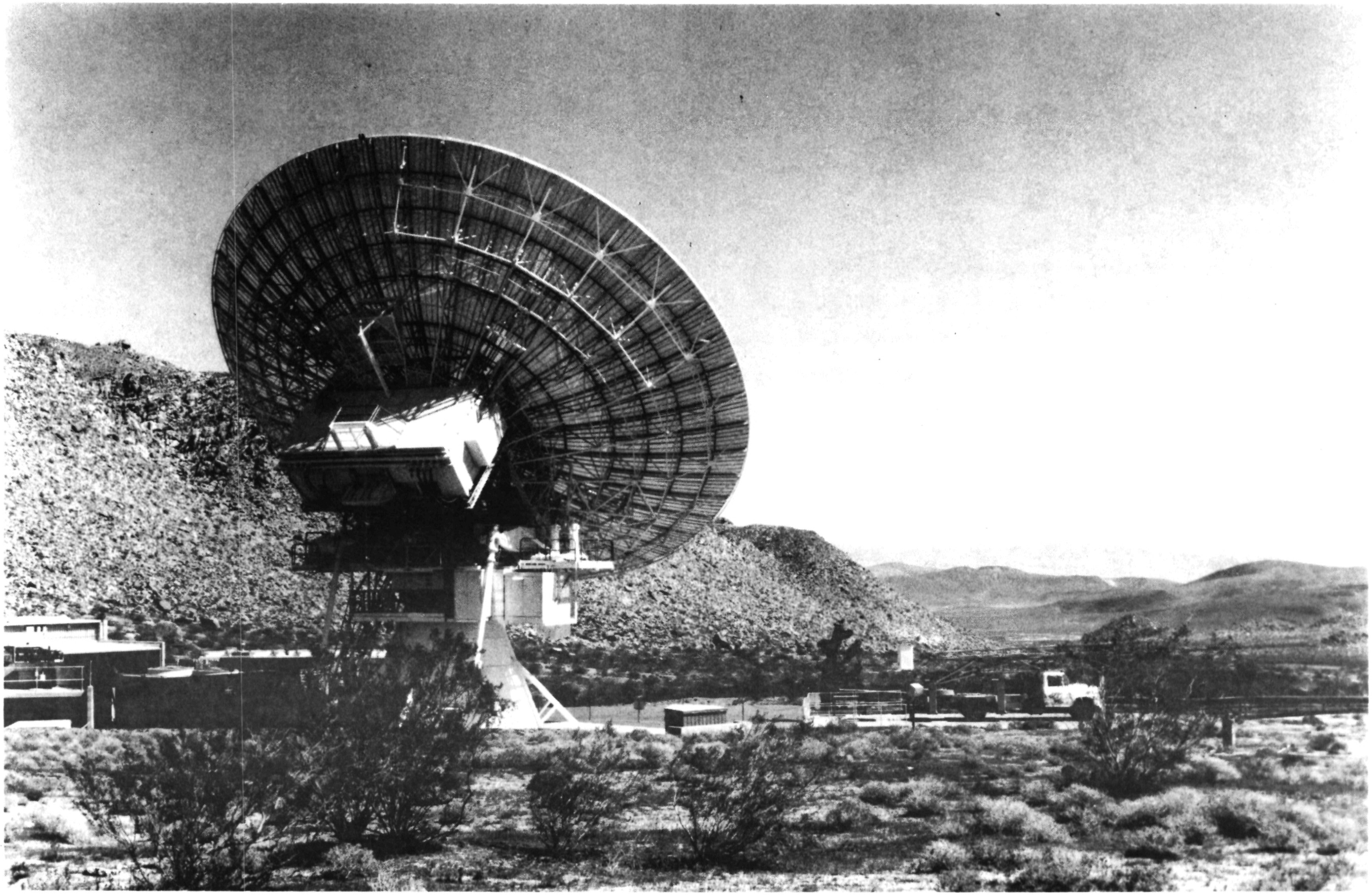


Figure 6. Looking Northeast from Existing 26-Meter Antenna at the Venus Site. See Figure 8. Photo Location A for Specific Location

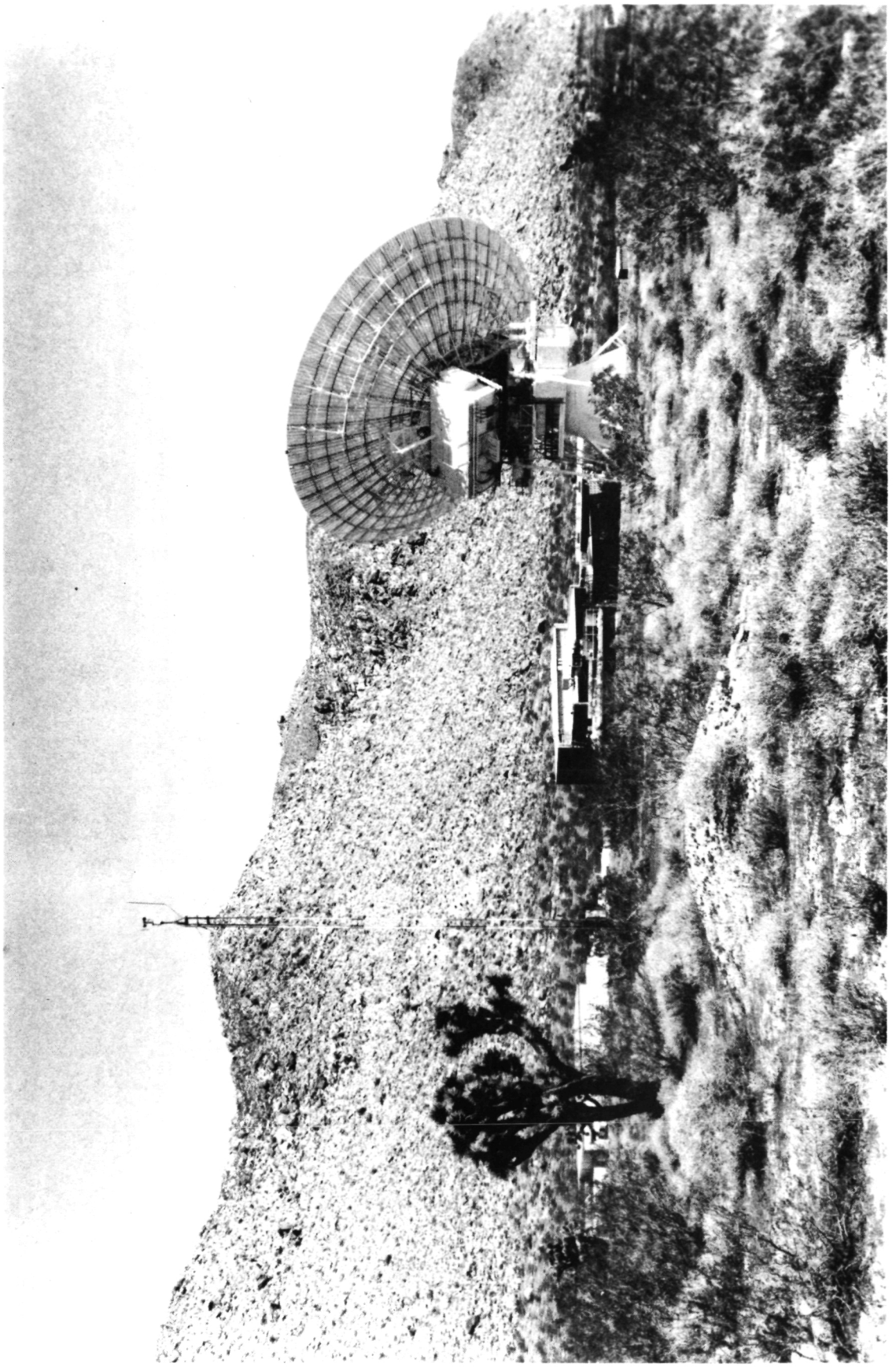


Figure 7. View to Northeast, with Proposed Site for New 34-Meter Antenna in Foreground. See Figure 8, Photo Location B for Specific Location

Table 2. Existing Structures at the Venus Site at the GDSCC

Building Number	Description of Structure	Square Feet
G-51	Operations Control	2,960
G-52	26m Antenna (85 feet)	---
G-53A	Transmitter	1,912
G-53B	Hydromechanical Building for 85-foot antenna	944
G-54	Collimation Tower	---
G-55	9m Antenna (30 feet)	169
G-56	Security	100
G-57	Collimation Tower	96
G-58	Hydromechanical Building and Transmitter for 30-foot antenna	960
G-60	Laboratory and Office	2,520
G-61	100-kW Transmitter	400
G-62	Fire Line Pump House	360
G-63	Workshop and Warehouse	1,800
G-67	Distilled Water Building	281

[1]Structure numbers correlate with Figure 5.
Source: Directory of Goldstone Buildings and Facilities. (Gold Book, Document Number 890-165, JPL internal document, December 1985).

The proposed Venus Station antenna is a high-performance, 34-meter, wheel-and-track type, azimuth-elevation antenna located approximately 200 feet south of the existing 26-meter antenna (see Figures 8 through 10 for the proposed site plan of the new Venus Station antenna, the antenna's general configuration, and photograph of the proposed antenna location). The proposed project includes construction and installation of the antenna structure, a below-grade foundation and equipment enclosure, the mechanical drive and controls, and the optical elements and ancillary support buildings. The proposed Venus Station antenna would be similar in size and structure to the 34-meter Uranus antenna located at Deep Space Station-15 in the northern portion of the GDSCC (see Figure 11).

The new high-performance 34-meter antenna would have a new configuration that would allow effective technology transfer to the operational DSN. It would provide a means for the demonstration of high-reliability cryogenics for improved frequency and timing technology, and for increased efficiency of radio frequency transmitting and receiving equipment and techniques. Developments from this antenna would result in increased capability for data return, more precise tracking, navigation and control, and improvements in associated sciences for the DSN. This antenna also would provide emergency high-power transmitter backup communications for Deep Space Station-14 for use in commanding spacecraft for navigational and operational maneuvers (TIW Systems, Inc., 1986).

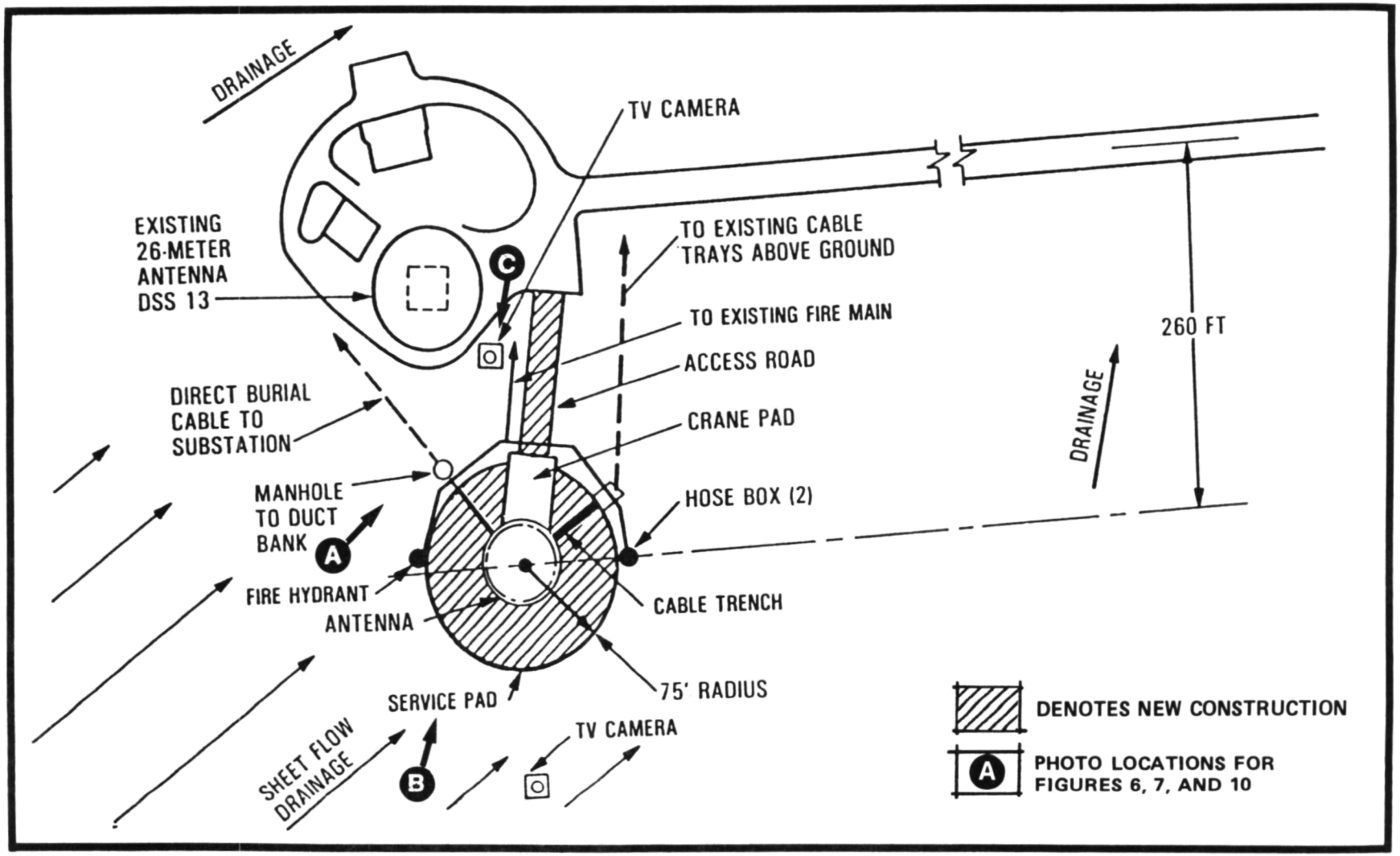


Figure 8. Venus Site: Site Plan for Proposed New 34-Meter Antenna

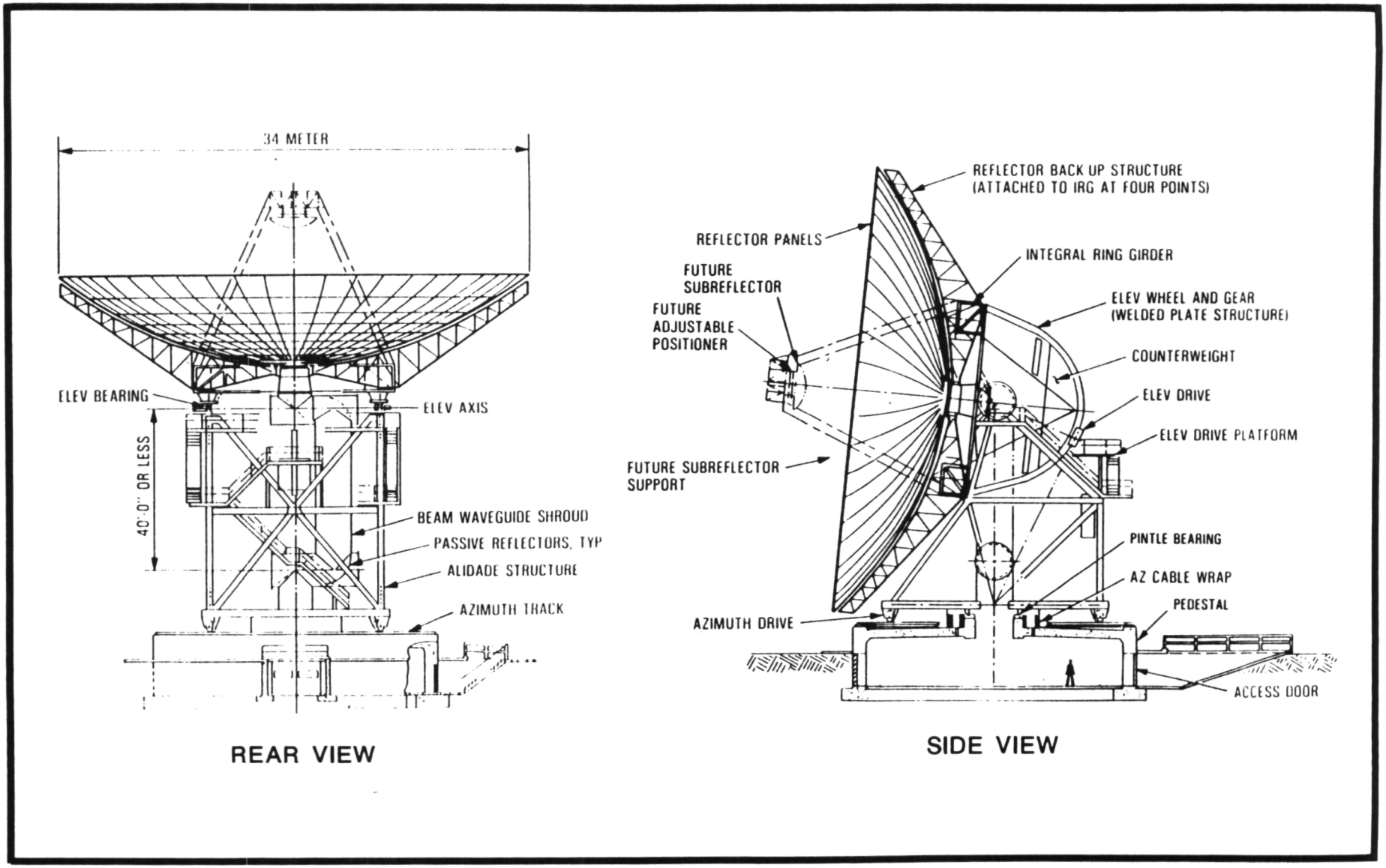


Figure 9. Artist's Drawing of the Proposed New 34-Meter Antenna at the Venus Site

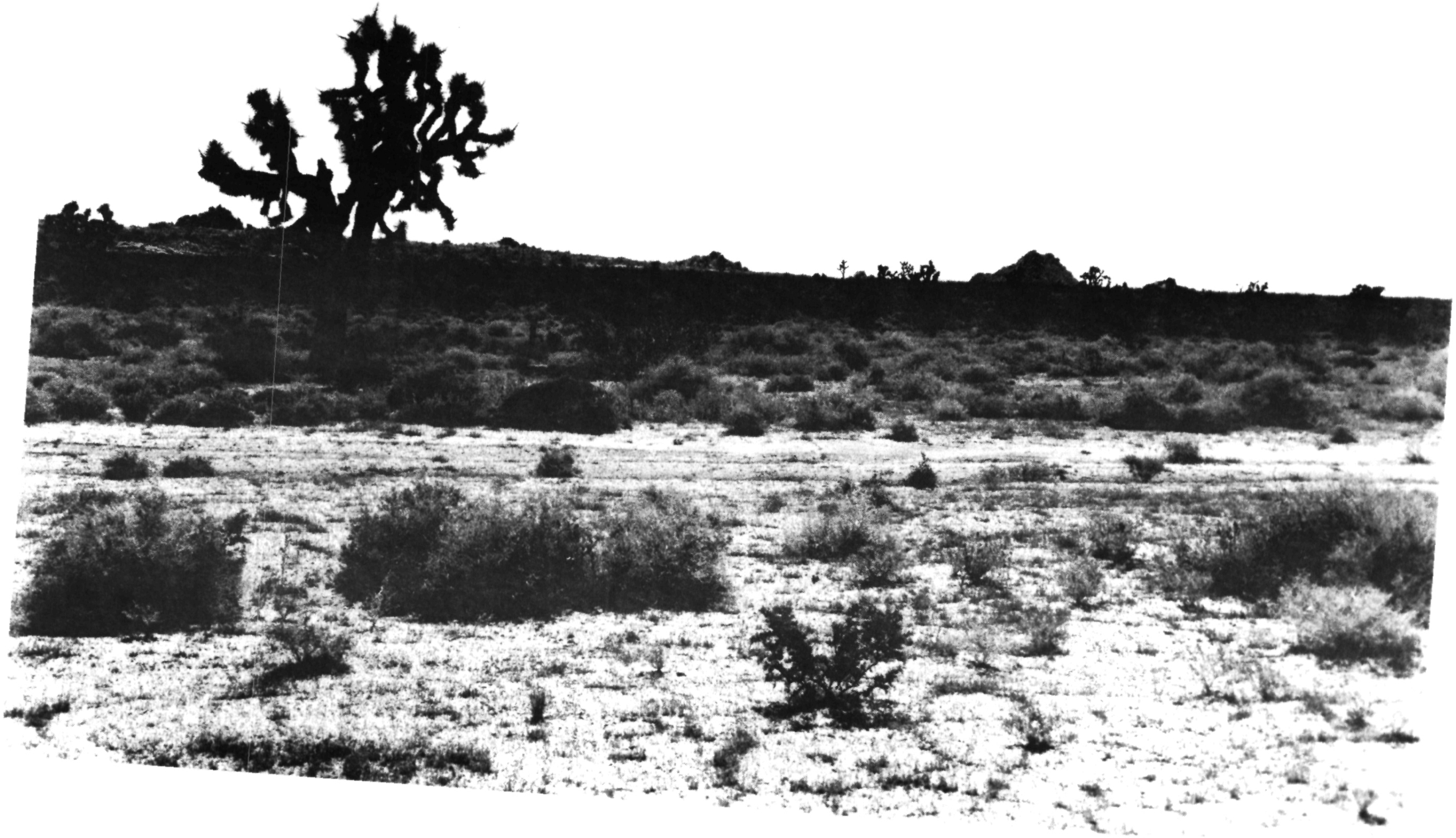


Figure 10. Looking Southwest from the Existing 26-Meter Antenna at the Venus Site. See Figure 8, Photo Location C for Specific Location

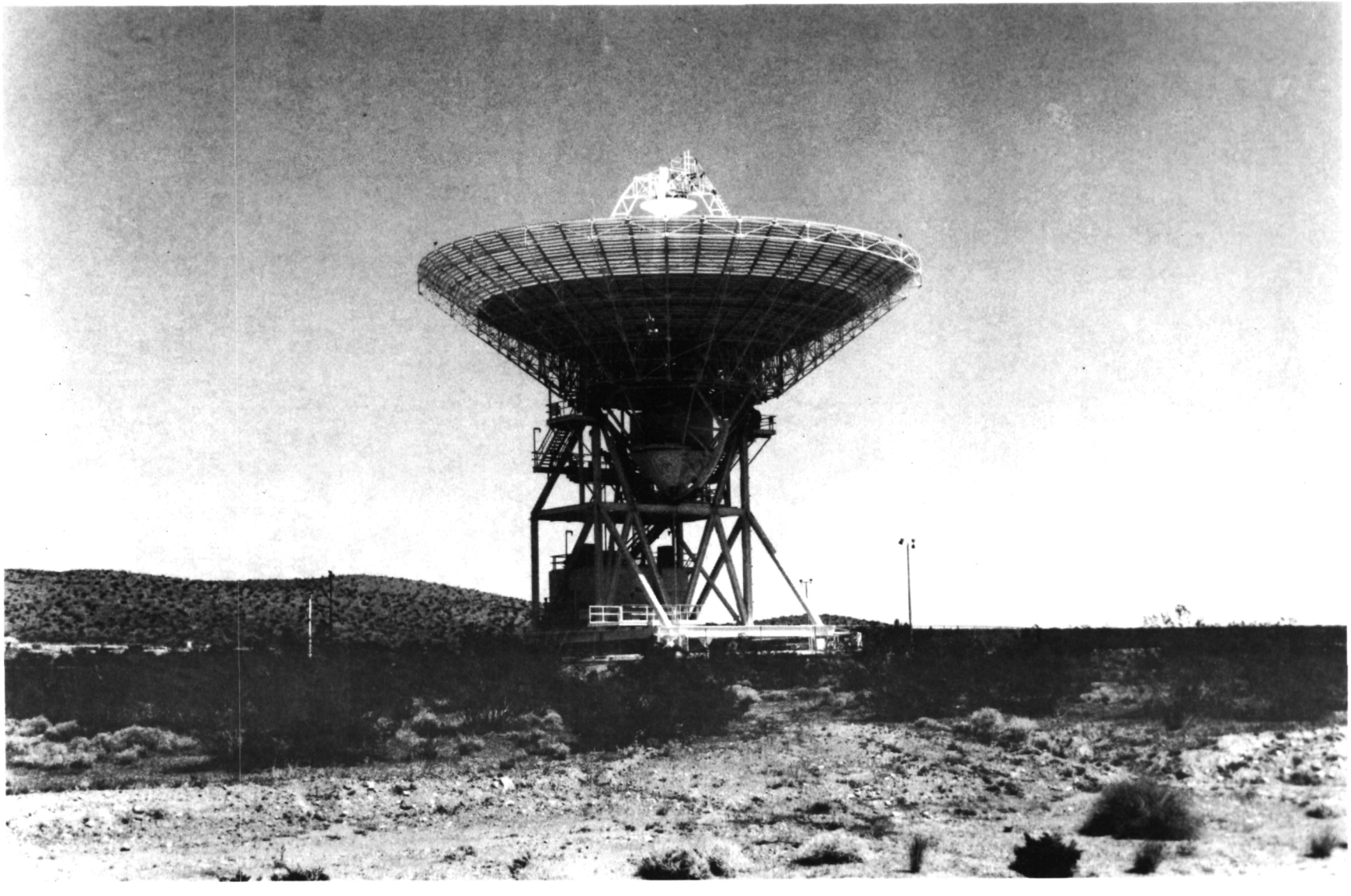


Figure 11. Photo of Existing 34-Meter Antenna (Uranus Station) at the Mars Site. Antenna is Similar to Antenna Proposed for the Venus Site

The proposed 34-meter antenna at the Venus Station would be supported by the 12 employees presently operating the existing Deep Space Station-13 facilities. Technical descriptions of the proposed Venus Station antenna and associated components may be found in the Advanced Engineering Study Report for Design and Construction of a Beam Waveguide 34-Meter X-Band AZ-EL Antenna (TIW Systems, Inc., 1986).

B. ALTERNATIVES TO CONSTRUCTION OF THE NEW 34-METER ANTENNA AT THE VENUS SITE AT THE GDSCC

A number of alternatives to the proposed Venus Station 34-meter antenna were considered as part of this environmental assessment.

1. Alternative One: Non-Construction of the 34-Meter Antenna

Discussion of the alternative involving not constructing the new antenna is required under the National Environmental Policy Act (NEPA). No action would mean the GDSCC would remain as it presently exists, with five NASA/JPL antenna stations and the existing National Oceanic and Atmospheric Administration antenna. The existing 26-meter Venus Deep Space Station-13 antenna would remain and not be replaced. This would preclude the opportunity to greatly improve upon deep space communications technology and to transfer information derived from the proposed 34-meter antenna prototype technology to other DSN antennas in the world-wide NASA Deep Space Network.

With respect to environmental considerations, the No-Action alternative would not require physical alteration to the Venus Site. Thus, removal of animal and plant habitats and construction-related effects associated with the proposed action would not occur. Yet, in spite of the minimal impact of these construction-related issues, their avoidance by the No Action alternative does not present a substantial environmental advantage.

The No-Action alternative would not eliminate the concern regarding antenna operating constraints, since the proposed antenna is replacing an existing antenna which also operates under constraints. While operating conditions would be different for the existing and proposed antennas, there are standard safety practices in place to minimize radiation hazards. Thus the No-Action alternative would not provide a substantial environmental advantage.

The primary disadvantage of the No-Action alternative is the loss of opportunity to greatly improve NASA deep-space communications technology world-wide and provide a means to advance specific scientific knowledge to a level not possible with the existing technology.

2. Alternative Two: Relocation of the 34-Meter Antenna within the Venus Site

One potential alternative to the proposed project would be to locate the new 34-meter antenna 200 to 300 feet west of the existing antenna instead of to the south as proposed. This is the only potentially viable alternative at the Venus Site because of the proximity of hills to the north, the potential

floodplain further to the south, and the existing infrastructure and buildings to the east. The proposed minor ancillary support building, discussed under Section I B, could be constructed in the same general location. The operational constraints at the alternative location to the west would be essentially the same as for the presently proposed antenna location. The environmental effects of the antenna at this alternative location would be similar to the proposed site, except that the storm flow from a small sandy wash approximately 100 ft west of the presently proposed site would have to be controlled and a 200-to-300-ft extension of the access road also would be necessary.

With respect to environmental considerations, the move of the proposed antenna to a different location within the Venus Site would not result in benefits to the environment. The topography, geology, biology, and visual setting of other sites in the immediate vicinity of the Venus Site would be similar to the proposed location. Because of the presence of washes near the Venus Site, certain options for antenna siting could encroach into storm flow areas, causing a potentially adverse drainage impact and possible flood hazard. Other environmental impact issues associated with the antenna's operation would be similar regardless of its location within the Venus Site.

3. Alternative Three: Relocation of the 34-Meter Antenna Within the GDSCC but at a Site Other Than the Venus Site

Relocation of the proposed new antenna project to a site at the GDSCC other than the Venus Site would require performing the necessary soils and geologic investigations and the identification of operational limitations at each candidate site. In 1973, JPL investigated three candidate locations (Pioneer, Echo, and Venus Sites) for construction of a 64-meter antenna (Pacific Engineering Soils, Inc., 1973). The Pioneer Site no longer is an option since it has been turned over to the Army. The Echo Site was determined to be usable based on foundation conditions and geologic environment, but less desirable than the Venus Site because of transmission constraints imposed by local topography. Other sites would most likely be unsuitable candidates because the orientation of these sites would severely restrict antenna operations.

Relocation of the proposed Venus antenna also would require the construction of an infrastructure at the alternative site and reconstructing all existing support facilities presently on site at Venus. It also would involve the preparation of environmental impact statements. Congressional approval for a major increase in funding would need to be obtained, undoubtedly resulting in a delay in project construction and operation of several years.

With respect to environmental considerations, the environmental impacts from locating the proposed project at the Venus Site would be minimal. Thus, there is little to gain by relocating the project at another site within the GDSCC. There are no known sensitive environmental conditions at other GDSCC antenna sites that would preclude relocation of the antenna. To add the Venus antenna, however, there would be a need for reconstructing much of the infrastructure at other sites. The additional construction necessary for the relocated infrastructure would be an environmental disadvantage as compared to the proposed site.

4. Alternative Four: Relocation of the 34-Meter Antenna at a Site other than the GDSCC

Locating the proposed antenna outside the GDSCC is a possible alternative to the proposed Venus Site. Although this alternative would require the relocation of the entire complex along with the Venus antenna, this concept has been considered by NASA/JPL in the past. Likely locations for a new complex similar in size and function to the GDSCC include sites within Arizona and New Mexico. Minimum requirements would include locating a substantial area of undeveloped land within the critical tracking range that is geographically compatible with DSN operations in Spain and Australia.

Relocating the new antenna off-site is not the preferred alternative because of environmental concerns, excessive relocation costs, years of delays in project implementation incurred while seeking the necessary Congressional approval, and time incurred to redevelop a base of operating and maintenance capabilities.

With respect to environmental considerations, the relocation of the antenna project to an off-site location (e.g., Arizona, New Mexico), cannot be characterized sufficiently to provide a detailed environmental review. Moving the project to a distant location, however, likely involves substantial additional construction activity, compared to the action now proposed to build the new 34-meter antenna at the Venus Site.

5. Preferred Alternative: Construction of the 34-Meter Antenna at the Venus Site

Location of the proposed antenna at Venus Site is the preferred alternative since it will not result in significant environmental impacts, will result in the shortest implementation schedule, is the most economical of the alternatives, and is anticipated to provide the United States with a much needed improved deep-space communications technology.

SECTION V

ENVIRONMENTAL FACTORS AT THE GDSCC THAT MUST BE ASSESSED IN THE PROPOSED CONSTRUCTION AND OPERATION OF A NEW 34-METER ANTENNA AT THE VENUS SITE

A. GEOLOGICAL SETTING

The GDSCC is located in the north central section of the Mojave Desert Province, a wedge-shaped, down-faulted, block that is bounded by mountain ranges to the north-northwest and south-southwest (Sharp, 1972). The structure and topography of the Province are largely fault controlled (Norris and Webb, 1976). The Mojave Desert is bounded on the south-southwest by the San Andreas Fault, which is the principal fault of a northwesterly trending shear zone at least 600 miles in length with 350 miles of right-lateral displacement. The Garlock Fault trends to the northwest and has left-lateral displacement.

Typically, the Mojave Desert Province is characterized by broad, flat plains with occasional low (1,000 to 2,000-ft high) mountains. The Goldstone area, situated within one of these low mountain areas, trends in the northwest-southeast direction (parallel to the regional structural trend). Elevations in the Goldstone area range from 2,895 to 4,491 ft above Mean Sea Level (MSL). GDSCC lies within a 70-square mile internal drainage area that includes Goldstone Lake, the largest of several dry lakes in the area. The elevation of Goldstone Lake is 3,021 ft above MSL (Kieffer, 1961).

B. CLIMATIC CONDITIONS

The climate at the GDSCC is arid with characteristic wide ranges in daily and seasonal temperatures, as well as high variability of precipitation. Average annual rainfall is approximately 5.5 in. Recorded annual precipitation ranges from a low of 0.5 to a high of 15 in. Precipitation is typified by shortlived, high-intensity storms that may produce local flash floods. More than one-half of the average annual precipitation has been known to fall in a three day period, during which peak rainfall may be as high as two inches in one hour (Kieffer, 1961).

C. SEISMOLOGY

The Mojave Block is broken by several major vertical to near-vertical shear faults. The primary fault system in the GDSCC area trends northwest, from the southern boundary of the facility to the the southern tip of Goldstone Lake. This fault system follows the regional structural trend that is characteristic of that portion of the Mojave Desert Province south of the GDSCC, which roughly parallels the San Andreas Fault zone. The Goldstone area is located in a transition zone between the northwest-trending area to the south, and an east-west-trending structural area to the north that roughly parallels the Garlock fault. Minor faults in the Goldstone area trend in nearly all directions, the main directions being west, northwest, and north. The general relationships between the two structural systems enclosing the Goldstone area

are not known, but both systems are active, and neither predominates over the other. The closest fault to the project site, a north-south directional fault, is located approximately 1.25 miles east of the proposed Venus antenna.

The GDSCC, including the Venus Site, is located within an area that has recently been reclassified from Zone 3 to Zone 4, seismic risk (Uniform Building Code, 1985, International Conference of Building Officials, Earthquake Regulations, Chapter 23). Zone 4 is defined as a zone susceptible to damage corresponding to a Modified Mercalli Scale Intensity VIII or greater earthquake. (The Mercalli Scale is an arbitrary scale of earthquake intensity, ranging from I for an earthquake detectable only with instruments, to XII for an earthquake resulting in total destruction).

In 1973, a shallow seismic refraction survey conducted by Pacific Soils Engineering, Inc. defined the subsurface structure of the Venus Site. Structure in the area does not appear to be controlled by faulting. It was determined, however, that the Venus Site would be exposed to considerable seismic shaking and a potential for structural damage to occur at the site from a major earthquake. The extent of impact would be a function of soil composition, design of the structures, and their joint response to seismic shaking. Based on the findings of this study, however, the Venus Site is in an area of acceptable seismic risk as long as the seismic considerations are incorporated into the design and construction of the proposed antenna.

D. LITHOLOGY

Table 3 describes a generalized stratigraphic sequence of the Mojave Desert Province in the Goldstone area, giving maximum thickness of each of the units and a brief lithologic description. It should be noted that this is a generalized sequence and that at any given site some of the units may or may not be present or may or may not be present in the given thickness. The general stratigraphic data in Table 3 were constructed from information obtained from Kieffer (1961).

E. GEOLOGICAL HISTORY OF THE GDSCC AREA

The following is a brief summary of geologic events that have occurred in the Goldstone area (Kieffer, 1961):

(1) The Granitic Complex crystallized during Precambrian or early Paleozoic time. These rocks underwent metamorphic recrystallization, and were later intruded (cut into) by granitic (pegmatite) dikes (thin injections of molten rock).

(2) Sediments of the Rustic Formation were deposited and metamorphosed (recrystallized) during Late Paleozoic time.

(3) Magma (molten rock) of the Jack Spring Quartz Monzonite intruded the existing older rocks probably during Cretaceous time.

(4) Uplift and erosion of the area occurred and most Paleozoic and Precambrian rocks were eroded away.

Table 3. Generalized Strategraphic Sequence in the Goldstone Area (after Kieffer, 1961)

Series	Stratigraphic Unit	Maximum Thickness (ft)	Description
Quaternary (Pleistocene)[a]	Gravel Deposit	300+	Composed of cobbles and boulders of volcanic rocks; occurs in extreme northern part of area; alluvial fan deposit, has been uplifted, moderately cemented in a caliche matrix.
Quaternary (Pleistocene)[a]	Basalt Flow	b	Vesicular olivine basalt; resistant to erosion, caps several ridges, dips gently north; offset by faults only in the southeast part of area.
Quaternary to Tertiary	Conglomeratic Sandstone	b	Overlies andesite southeast of Pink Canyon.
Quaternary to Tertiary	Black Glass Dikes	c	General trend N70E, intrude andesite flows only; assumed they occurred near end of andesite extrusion.
Tertiary	Andesite Flows	1000+	Thick sequence of lava flows; composed of andesite, hornblende andesite, and porphyritic plagioclase; flowed from several volcanic vents, very resistant.
Tertiary	Andesite Breccia	600+ (with Tuff)	Angular blocks of volcanic rock, set in a matrix of volcanic ash; coarse grained with large clasts, resistant to erosion; common cap rock.

Table 3. Generalized Strategraphic Sequence in the Goldstone Area (after Kieffer, 1961) (Continued)

Series	Stratigraphic Unit	Maximum Thickness (ft)	Description
Tertiary	Andesite Tuff	600+ (with Breccia)	Volcanic ash; well bedded, soft, and nonresistant to erosion.
Cretaceous	Jack Spring Quartz Monzonite[c]		Quartz monzonite pluton that extends over 85 square miles; has an orthogonal fracture system, parallel jointing, very solid and homogeneous.
Paleozoic	Rustic Formation	b	Limestones and metamorphic rocks derived from fine-grained sediments; foliated, very hard, and moderately fractured, containing several quartz veins with gold and tungsten.
Paleozoic to Precambrian	Granitic Complex	c	Metamorphic and intrusive granitic rocks; schists and gneisses, highly shattered, low resistance to erosion.

[a] This unit is apparently of Pleistocene age, but its exact age has not been confirmed.
[b] Thickness was undocumented in the available source literature.
[c] Thickness cannot be determined for this type of rock body.

(5) A broad basin formed in Tertiary (probably Miocene) time. Volcanic fragments composed of andesite tuffs and breccias erupted as ash and covered the basin floor with a deposit 600 ft thick. Up to 1,000 ft of andesite lava flows originating from several volcanic vents covered the ash. Black glass dikes intruded the andesite flows.

(6) Conglomeratic sandstone was deposited atop the andesite lava beds in places.

(7) The region was uplifted and extensively faulted in Late Tertiary and Quaternary time.

(8) Lava composed of olivine basalt partially covered the region. Since deposition, the basalt has been tilted slightly to the north and extensively faulted in the southern part of the region.

(9) Quaternary alluvial deposits include the following: dry lake bed sediments; low lying sand and gravel alluvium in the main valleys; gravel and boulder alluvial fans and debris slope deposits; unconsolidated sand, gravel and boulders in stream channels; and windblown sand. Alluvium is 500 to 1,000 ft thick.

F. TYPES OF SOILS AT THE GDSCC

The following three soil types predominate at the GDSCC:

(1) Silty, sandy gravel derived from granitic rocks,

(2) Silty gravel derived from decomposing volcanic rocks,

(3) Very rocky soils derived from older, dissected alluvial deposits and terrace gravels.

Both the volcanic and granitic soils have medium to low permeability.

Desert pavement (a residual layer of large soil particles left on the ground surface after the finer particles have been carried off by wind and water), has developed over virtually all soil surfaces. This layer is made up of lag gravels that protect the surface against further erosion. These gravels are often coated with oxides of iron and manganese, known as desert varnish, that give the surface a shiny appearance.

In July, 1973, a geological, geophysical, and foundation-engineering survey of the Venus Site was conducted to determine the feasibility of constructing a 64-meter antenna (Pacific Soils Engineering, Inc., 1973). The study concluded that good foundation support exists at the Venus Site, with bedrock within reach (approximately 20 feet below the surface) of the pedestal and instrument tower foundations for the subject design. In addition, JPL has studied the foundation designs of existing structures similar to the one proposed for the Venus Site, that were located at the GDSCC Mars Site and at sites in Spain and Australia. Based on these studies, soils at the Venus Site are suitable for construction of the proposed 34-meter diameter antenna.

G. WATER RESOURCES AND FLOODPLAINS

1. Water Resources

There are no permanent streams at the GDSCC. Surface water flow occurs only after intense rainfall periods, and the water quickly infiltrates into the dry desert soils or evaporates. During heavy rainfall, water reaches Goldstone Lake, which becomes inundated for short periods. This intermittent water supply is inappropriate for domestic and other planned uses due to its high levels of suspended and dissolved solids and very short-term availability. The entire Mojave River Basin (which includes the GDSCC), draws its water supply from the Mojave River groundwater basin, which in turn is recharged by only two sources: rainfall and the Mojave River (Department of the Army, 1979). The GDSCC receives potable water from a group of six wells located within the vicinity of Fort Irwin. These wells draw from the Bicycle Lake groundwater basin and from the Irwin groundwater basin. About 1,000,000 to 2,000,000 gallons of water are pumped monthly from Fort Irwin to the GDSCC.

2. Floodplains

The Federal Emergency Management Agency (FEMA) has not mapped floodplains for the Fort Irwin Reservation, including the GDSCC. Ninety percent of the area in the southeast desert of California, however, is classified as Zone D, in accordance with FEMA definitions (A. Russell 1987). Therefore, the GDSCC is most likely to be classified as Zone D, an area of undetermined but possible flood hazard. Two washes (intermittent stream beds) are located near the existing Venus Station: a large wash several hundred feet to the north, and a much smaller wash located approximately 100 feet to the west. Flooding, however, has not been experienced in the vicinity of the existing antenna. The site proposed for the new antenna, which would be immediately south of the existing Venus antenna, similarly has not experienced any previous flooding problems.

H. BIOTIC RESOURCES, ENDANGERED SPECIES, AND WETLANDS

1. Biotic Resources

The biotic composition at the site of the proposed new Venus Station 34-meter antenna was determined from information compiled through field reconnaissance, supplemented by information obtained from the existing literature. The site was surveyed in May 1987 by 4-wheel drive vehicle and on foot by the MBGA project team. Weather at the time of the survey was warm, with temperatures ranging from 80°F to 85°F, occasional thunderstorms, and moderately strong winds.

The physical nature of the proposed antenna site permitted a direct systematic examination of all terrain within its confines. Floral constituents encountered were recorded in terms of relative abundance and habitat type. Faunal constituents were determined through the use of field identification, combined with documented habitat preferences of regional wildlife species that, whether or not detected during the survey, are thought

to include the site within their range. The overall biotic composition of the site was derived from this information.

2. Vegetation

The vegetation of the project site is typical of the mid-elevation Mojave Desert. Two dominant plant communities that are present on or immediately adjacent to the proposed project site are the heat-tolerant, perennial shrubs known as creosote bush scrub and desert wash scrub.

A total of 32 plant species representing 18 families was recorded during the site survey. A survey conducted during the height of the spring flowering season would likely disclose as much as a 10 to 15 percent greater diversity due to the presence of annual herbs. Of the recorded species, three (nine percent) are not native. A list of all plant species recorded during the survey is available from the GDSCC. The floral composition of each plant community on the site is described as follows:

a. Creosote Bush Scrub. The creosote bush scrub found on the project site represents, for the most part, an example of the most common plant community of the Mojave Desert. The dominant plant species is creosote bush (Larrea tridentata), which is usually widely and regularly spaced with burro-weed (Ambrosia dumosa) scattered in the interstices. Plant cover is typically as low as 10-20 percent in this community.

On the proposed project site, portions of which have been slightly to moderately disturbed, creosote bush and burro-weed are interspersed with goldenhead (Acamptopappus sphaerocephalus), cheese-bush (Hymenoclea salsola), brittle-bush (Encelia farinosa), little-leaved ratany (Krameria parvifolia), Anderson thornbush (Lycium andersonii), and thamnosma (Thamnosma montana). Several Joshua trees (Yucca brevifolia) also are located within the immediate project vicinity.

In the spring of each year, the interstices of the creosote bush scrub community may display diverse assemblages of annual plant species. Although the spring of 1987 was not conducive for growth of annuals due to sparse winter rainfall, and the time of the survey did not coincide with the peak of spring-flowering, a few annual species were still in evidence on the site. These included the desert dandelion (Malacothrix glabrata), tessellate fiddleneck (Amsinckia tessellata) and cryptantha (Cryptantha sp.). The dried remains of several introduced annual species, including red-stemmed filaree (Erodium cicutarium), red brome (Bromus rubens), and Arabian schismus (Schismus arabicus), also were in evidence.

b. Desert Wash Scrub. Localized variations in substrate or topography within the creosote bush scrub community can give rise to marked changes in species composition. Such is the case with sandy washes, where the association of plants supported by the sandy substrate is sufficiently distinct from that of the creosote bush scrub to warrant independent designation. The plant association seen in these sandy washes commonly is

termed "desert wash scrub". Plant diversity in these washes is often greater than in the creosote bush scrub community; creosote typically remains present, but is usually not dominant. The sandy soil of these washes tends to store the limited runoff generated from rainfall events, providing a relatively mesic (moderately moist) environment that is critical to the desert ecosystem. Though the desert wash scrub community is often common with the creosote bush scrub community, its comparatively limited ground coverage results in little effect on the predominant visual uniformity of the creosote bush scrub community.

A small sandy wash runs roughly north-south about 100 feet west of the proposed project site. The dominant desert wash scrub species present are similar to those of the creosote bush scrub. Diversity is higher, however, including such perennial species as Nevada ephedra (Ephedra nevadensis), beavertail cactus (Opuntia basilaris), winter fat (Ceratoides lantana), bladder sage (Salazaria mexicana) and California buckwheat (Eriogonum fasciculatum). Several specimens of Mojave indigo bush (Psorothamnus arborescens) also were present. Although low in numbers, the annual species present in the wash at the time of survey, included pebble pincushion (Chaenactis carphoclinia), desert aster (Machaeranthera tortifolia), small wreathplant (Stephanomeria exigua) and brown-eyed evening primrose (Camissonia claviformis). A percentage of this increased diversity may be due to the undisturbed nature of the wash relative to the higher ground.

3. Wildlife

Based upon both field observations and literature searches, the varieties of wildlife expected or observed to regularly occur in the habitats of the projected project site, are described below. A complete list of expected and observed fauna is available from the GDSCC.

a. Amphibians and Reptiles. No amphibians are expected, or have been observed due to the absence of surface water at the proposed project site or in its vicinity. A variety of lizards and snakes are expected to occur in the project vicinity. Common lizards include the western whiptail (Cnemidophorus tigris), zebra-tailed lizard (Callisaurus draconoides), and side-blotched lizard (Uta stansburiana). Other reptile species found with some frequency throughout the creosote bush scrub community are desert iguana (Dipsosaurus dorsalis), common leopard lizard (Gambelia wislizenii), coachwhip (Masticophis flagellum), gopher snake (Pituophis melanoleucus), and sidewinder (Crotalus cerastes).

The desert tortoise (Gopherus agassizi), a state-listed threatened species, is known to occur on the GDSCC (Kirtland, 1987). No sign (tracks or burrows) of this species was observed, however, during the May 1987 survey of the Venus Site.

b. Birds. A number of bird species are expected to breed in the creosote bush scrub community within the vicinity of the proposed project. These include the black-throated sparrow (Amphispiza bilineata), Say's phoebe (Sayornis saya), Le Conte's thrasher (Toxostoma lecontei), mourning dove

(Zenaida macroura), loggerhead shrike (Lanius ludovicianus), and horned lark (Eremophila alpestris). No breeding activity was observed, however, on the proposed project site.

Four species of raptors (birds of prey) may breed in the vicinity of the proposed project site, and may utilize the site for forage. Common barn owls (Tyto alba) nest in the crevices and caves found in butte faces and canyons. Red-tailed hawks (Buteo jamaicensis), which are more frequent in winter, may breed locally. Prairie falcons (Falco mexicanus) are an uncommon breeding resident in the area, nesting primarily on steep cliff faces, which are more frequent in the northern portion of the GDSCC. Golden eagles (Aquila chrysaetos) may also inhabit the area.

c. Mammals. Small mammals, most of them nocturnal, are common in the Mojave Desert. The long-tailed pocket mouse (Perognathus formosa), canyon mouse (Peromyscus crinitus), and desert wood rat (Neotoma lepida) are expected in the vicinity of the proposed project. In the sandy wash, the little pocket mouse (Perognathus longimembris) is an expected resident. Merriam's kangaroo rats (Dipodomys merriami) are likely the most abundant and widespread small mammal within the project area. Black-tailed jackrabbits (Lepus californicus) and desert cottontails (Sylvilagus audubonii) are also common throughout the area. Predators expected in the proposed project area include the coyote (Canis latrans), kit fox (Vulpes macrotis), ringtail (Bassariscus astutus), and bobcat (Felix rufus).

4. Impacts upon the Biotic Resources of the Proposed Project Site and their Mitigations

Impacts to the biotic resources of the proposed project site and its vicinity are expected to be minimal due to the small size of the area to be altered by the proposed project and its proximity to existing roads. Project implementation may result in the removal of one mature Joshua tree, which may be too large to be transplanted, and one to several individual Mojave indigo bushes. Wildlife, for the most part in the form of small rodents, would be permanently displaced from the area of construction, and population numbers would likely continue to be lower in the immediate vicinity of the project. This decline in rodent numbers may have a minor effect on predators presently foraging in the area. None of these biological impacts would be significant.

During construction of the new 34-meter antenna, efforts should be made to disturb as small an area of vegetation as possible. The desert flora recovers very slowly, and unnecessary clearing will be visible for many decades. No fill or construction debris should be placed in the adjacent wash.

5. Endangered Species

Several species present in the vicinity of the proposed project have been given special recognition by Federal, state, or local resource-conservation agencies and organizations due to declining, limited, or

threatened populations, resulting in most cases from habitat reduction. Sources used for determination of sensitive biological resources are as follows:

(1) Wildlife: U.S. Fish and Wildlife Service (FWS) (1986), California Natural Diversity Data Base (CNDDB) (1987), California Department of Fish and Game (CDFG) (1980, 1986), Remsen (1978), National Audubon Society (NAS) (Tate and Tate 1986), and Bureau of Land Management (BLM) (1980).

(2) Plants: FWS (1986), CDFG (1985), CNDDB (1987), and Smith and York (1984).

Species considered sensitive in other parts of their range but not in the California deserts are not included in this discussion. No Federally-listed threatened or endangered species were located on the proposed site, nor are any expected to occur. Of the nine plant, one reptile, three bird, and one mammal species listed by one or more of the above agencies as rare, or of limited distribution, only one, the Mojave indigo bush, was located during the recent survey (Tables 4 and 5). This plant is listed by the California Native Plant Society (CNPS) as being of limited distribution, but not presently considered rare or threatened.

No significant impacts to sensitive, rare, threatened, or endangered plant or animal species are expected to result from project implementation. One to several Mojave indigo bushes may be removed as a result of project implementation. The loss of these few individual plants, however, is not considered significant. There will be no effects to Federally-protected rare, threatened, or endangered species.

6. Wetlands

No wetlands in the form of springs, seeps, or streams are found in the vicinity of the proposed project. No playas (dry lakes) or areas where standing water may accumulate during or after a storm are evident on or in the immediate vicinity of the project site. The small and large washes, described earlier in this section, are two washes near the proposed site. Both of these washes show evidence of recent water movement. No vegetation associated with a relatively sustained water supply, such as mesquite (Prosopis spp.) or desert willow (Chilopsis linearis) were found, however, in these washes, indicating that water movement and storage in the washes are highly ephemeral.

No direct impacts to the nearby washes are expected to result from implementation of the project. During construction, however, no activities should be allowed within the area of the wash whereby a storm could cause debris to be deposited in the wash. As these conditions will not be allowed, no impacts to wetlands are anticipated during construction of the new 34-meter antenna.

Table 4. Sensitive Plant Species that Potentially Could Occur at the GDSCC

Species	Status[a] FWS	CNPS	Habitat
Androstephium breviflorum Small-flowered androstephium	--	2[b]	Gravelly to rocky soils below 7,000 ft
Astragalus jaegerianus[c] Jaeger's locoweed	C2[d]	1B[e]	Sandy to gravelly soils below 4,000 ft
Chorizanthe spinosa Mojave spiny-herb	C2	4[f]	Same
Cymopterus deserticolus Desert cymopterus	C2	1B	Same
Dudleya saxosa ssp. saxosa Panamint dudleya	C2	4	Same
Eriophyllum mohavense Mohave eriophyllum	C2	1B	Same
Linanthus arenicola Sand linanthus	C3c[g]	2	Deep sandy soils
Psorothamnus arborescens Mojave indigo bush var. arborescens (Dalea a.)[c]	C3c	4	Same
Sclerocactus polyancistrus Mojave fish-hook cactus	C2	4	Rocky soils

[a] Listing agencies/organizations:
FWS: U.S. Fish and Wildlife Service (USFWS, 1986).
CNPS: California Native Plant Society.
Note: The California Fish and Game Department has no listing for this area.

[b] Rare or endangered in California, but more common elsewhere.

[c] This species is located on the proposed project site.

[d] Federal Category 2 candidate in which a decline of the species is suspected. Insufficient data exist, however, to support a proposed listing.

[e] Considered rare and endangered throughout its range.

[f] Species has limited distribution.

[g] Species is too widespread to warrant listing.

Table 5. Sensitive Wildlife Species Known from the Vicinity of the GDSCC[a]

Species	Status[b] FWS	CDF	GPS	NAS	Habitat
Gopherus agassizii Desert tortoise	C1[c]	--	S[d]	--	Creosote bush scrub
Aquila chrysaetos Golden Eagle	--	SC3[e]	PS[f]	--	Nests in cliffs forages over creosote bush scrub
Falco mexicanus Prairie falcon	--	SC3	--	--	Same
Athene cunicularia Burrowing Owl	--	SC2[g]	--	2[h]	Nests in banks of washes and road cuts
Spermophilus mohavensis Mojave ground squirrel	--	T[i]	--	--	Creosote bush scrub

[a] None of the listed species actually were identified at the project site during the MBGA survey.
[b] Listing agencies:
FWS: U.S. Fish and Wildlife Service (USFWS, 1986).
CDFG: California Department of Fish and Game (CDFG 1980, 1985, 1986).
BLM: Bureau of Land Management (BLM, 1980).
NAS: National Audubon Society (NAS, 1986).
[c] Federal Category 1 candidate in which sufficient data exist to propose species for listing as threatened or endangered.
[d] BLM considers this species to be sensitive due to small population size, limited distribution, or threat from human activities.
[e] State Species of Special Concern, List 3: species not in immediate danger of expiration. Small population sizes, however, warrant observation.
[f] BLM-proposed sensitive species, pending the accumulation of sufficient data to support concern.
[g] State Species of Special Concern, List 2: Species warrants active monitoring due to population decline.
[h] NAS second priority species: Special concern due to observed decline in population.
[i] State-listed as threatened.

I. AIR RESOURCES

1. Meteorology

Climatic conditions at the GDSCC are those typical of high desert. Summers are hot and arid while winters are relatively cool with little precipitation and frequent strong westerly winds. Occasionally there are summer showers and thunderstorms that result in flash flooding. During the winter months, strong winds may occur often accompanied by local dust storms.

2. Air Quality

The project site is located in the Southeast Desert Air Basin (SEDAB), an area that complies with environmental limits for all primary air pollutants except ozone. Air pollutant emissions from the GDSCC are primarily from use of fuel tanks, a spray booth and degreaser, generators, and wipe-solvents.

The proposed project would increase present building square footage by about 82 SF, which will not substantially increase fuel consumption for heating purposes. Additionally, two motors would be replaced with smaller motors (a planned reduction of 65 HP), and there are no plans to increase fuel consumption for other purposes or to add new equipment that would increase the present level of emissions. Thus, it is not anticipated that the proposed project would result in any significant impact on basin air quality from stationary sources.

There will be no substantial increase in mobile-source emissions as a result of the proposed project, since daily vehicle usage is not anticipated to significantly increase as compared to current usage.

Emissions generated during site preparation and construction of the proposed antenna and support structures would be primarily from exhaust emissions from construction equipment and fugitive dust generated as a result of soil movement. These emissions would be of short-term duration, and, for the most part would be confined to the Venus Site, resulting in an insignificant impact on local air quality.

J. HUMAN ENVIRONMENT

1. Land Use and Socioeconomics

The GDSCC is located within the Fort Irwin Military Reservation, a U.S. Army installation under the control of the U.S. Armed Forces. The GDSCC is an extremely low-density development for a 52-square-mile complex. Because of its mission, the GDSCC is highly sensitive to physical and electromagnetic interference and thus requires large surrounding areas with minimal activity and development.

With Fort Irwin bordering the GDSCC on the north, east, and southeast, the potential for incompatible activities and actions exists unless both facilities operate in a cooperative manner. Of primary concern are the 20 to

25 "critical" and 35-40 "semi-critical" days per year when GDSCC transmissions require absolute freedom from physical and electromagnetic interference. While critical-day activities have not been violated up to this time, this is still an area of concern. Memoranda of understanding have been signed addressing the responsibilities of both Fort Irwin and the GDSCC.

The GDSCC, including the Venus site, is designated as Rural Conservation (RCN) in the County of San Bernardino General Plan (San Bernardino County, 1986). The RCN designation permits a variety of low intensity land uses such as agricultural croplands, mining areas, national forest, wilderness, and residential units on minimum lot sizes of 40 acres. The area is zoned DL-40, restricting subdivisions to no less than 40 acres. The proposed 34-meter antenna at the Venus Site is included in the GDSCC development plans. The proposed antenna project is consistent with the County's General Plan.

The proposed 34-meter antenna would also be compatible with existing uses at the GDSCC and would complement and support the existing Deep Space Network. The antenna would be constructed over an 18-month time period. The existing 26-meter antenna would be dismantled and removed from GDSCC within approximately one year from completion of the 34-meter antenna.

The existing Venus Station has 12 full-time employees who exclusively support operation of the existing Venus 26-meter antenna. The proposed 34-meter antenna and associated facilities would also require 12 employees, shifting the existing employees' workspace south by 200 feet. No new employees would be required for the proposed project. Therefore, no long term socioeconomic impact from the proposed project on GDSCC or regional demographics is expected.

2. Vehicular Traffic and Circulation

Vehicular access to the Venus Site at the GDSCC is provided via Venus Road. Venus Road is an east-west road intersecting NASA Road and traversing westerly approximately 1.5 miles to DSS-13. Venus Road is a two-lane road that goes through DSS-13 and terminates at the existing 26-meter antenna.

The employment level at the Venus Site will remain the same when the 34-meter antenna is placed in operation. No increases to local vehicular traffic, therefore, would result from the proposed project. The proposed antenna would be located approximately adjacent to the existing antenna, and thus would only require construction of about 100 feet of additional access road.

Some temporary construction traffic would occur. The small number of trips, relatively short duration of construction activity, and low level of roadway usage would preclude any significant impacts to local roadways.

3. Noise

The GDSCC noise environment is typical of quiet desert locations. The sparsely developed complex and restricted airspace, which are required to

minimize interference with communications, serve to promote a quiet environment.

Noise sources originating from the GDSCC include minor, intermittent surface traffic, occasional aircraft operations, and activities at other remote GDSCC operating sites. Surface traffic, and its associated noise impact, is relatively low with a total staff of only about 217 people at the GDSCC. Air traffic at the airport at Goldstone Dry Lake is limited to propeller-driven aircraft. Flights include three scheduled NASA flights per week and infrequent flights of military administrative personnel. Mechanical equipment in use at the GDSCC also contributes to the overall noise environment. Even the loudest of generators, pumps and other types of mechanical equipment present at any particular site produces a highly localized noise impact, however, that does not extend more than a few hundred feet from its source.

Off-site noise sources include some minimal occasional disturbance by Fort Irwin military training exercises and military aircraft sonic booms. Since antenna operations are restricted during hours when troop maneuvers and military aircraft have scheduled operations, these noise sources should not have an adverse impact on the various NASA missions.

Over the short term, noise impacts at the proposed project site would involve additional construction traffic noise and noise from site preparation (earth moving and excavation), materials handling, fabrication, and erection of facilities. Since the project location is in a remote area with no noise-sensitive land uses within miles, however, short-term noise impacts are expected to be insignificant. Long-term noise generation can be expected from the antenna mechanical system, engineering shop activities, heating/ventilation systems, generators, and motor vehicles. Since the proposed project is replacing existing comparable facilities and a staff of approximately the same size, no significant change to the existing noise environment is expected.

4. Cultural Resources

An abundance of archaeologic and historic resources exists in the Mojave Desert, and especially within the boundary of Fort Irwin and the GDSCC. Since access to these installations is controlled, only a few archaeologic sites have been discovered and recorded. Fort Irwin has employed a resident archaeologist who has documented areas of archaeologic, prehistoric, and historic interest as well as fossil areas within the Fort Irwin and GDSCC boundaries. A large area within the GDSCC has been designated as an area of archaeologic and historic interest. This site is located in the northern portion of the GDSCC, in and around Goldstone Lake, approximately 8 miles northwest of the Venus Site. Areas with surface scatter and evidence of historic battle have been located approximately three miles north of the Venus Site. The Fort Irwin archaeologist has recently conducted a survey of the Venus Site and has found no archaeologic or historic resources to exist at the site.

5. Radio Interference, Electromagnetic Radiation, and Microwaves

The GDSCC operates several large, high-powered, microwave, ground transmitters used in deep space communications. These transmitters are capable of transmitting radiation ranging in frequency from 10 megahertz to 100 gigahertz. Transmission in this frequency range produces radiation potentially hazardous to persons working nearby. The power density in the direct beam may cause severe biological damage. The energy density in the feeding system is considered potentially lethal. Currently, DSS-14 (Mars Station) is the only GDSCC antenna station that radiates high-power on a routine basis.

The Jet Propulsion Laboratory (JPL) has issued Safety Practice Bulletin 12-4-6 that sets standards for safely operating antennae during transmissions. The bulletin addresses exposure hazards, exposure limits, and procedures for ensuring that all safety precautions are taken prior to and during a transmission event. In addition, the bulletin contains a requirement that JPL Form 0284-S, A Safety Review of New Operations, be completed prior to modification of an existing antenna or construction of a new radio frequency transmitter. This bulletin is included in this Environmental Assessment Document as Appendix C. Although this review has not as yet been conducted for the proposed antenna, it will be required prior to construction and will ensure that the facility meets safety standards.

High-power microwave transmissions also can generate effects at greater distances, potentially exposing aircraft to radiation. In accordance with standard practice, procedures will be established with neighboring military installations and the Federal Aviation Administration (FAA) to prevent exposure of aircraft to radiation levels greater than 10 mW/cm. These procedures include restricting the permissible angles of radiation and avoidance of the supersonic corridor, establishing a pre-arranged schedule for transmissions, and providing airspace avoidance contour plots to cognizant external agencies. By following prescribed policies and procedures for existing antenna, the GDSCC has maintained a record of safe transmissions since it began operations in 1981.

During the project-planning phase for the proposed 34-meter Venus antenna, specific requirements will be negotiated and coordinated with nearby military installations and the FAA. It is anticipated that these requirements for operation of the proposed antenna will be much more restrictive than those already in place for the Mars antenna, since the Venus Site has limited GDSCC airspace except to the north and northeast. Transmissions to the southeast, south, and west would likely be restricted because of the potential effect upon existing military supersonic air corridors, and would be restricted to the east and southeast because of potential impact to FAA commercial air corridors. Restrictions for the proposed Venus antenna would include a limit of 25 degrees elevation, +/-25 degrees declination, and no radiation from 180 - 300 azimuth from 0600 - 1800 hours local time weekdays. Present plans are for high-power transmission to commence in about 1992 concurrent with the 400 kW Ka band installation (See Appendix D: Interoffice Memorandum, BAG 87-VENUSHP, July 30, 1987).

Two radiation issues remain unresolved at this time. These include:

(1) Uncertainties regarding high power transmission and its effect on surrounding land uses and aircraft operations.

(2) Lack of information on health and safety impacts from planned high power transmissions and from more frequent ("routine") transmissions.

Both matters will be resolved prior to final project approval, through the standard procedures of negotiation of transmission restrictions with the military and FAA and completion of the required safety review.

6. Solid and Hazardous Waste, Toxic Substances, and Pesticides

a. Solid Wastes: Goldstone operates one 10-acre, Class III solid waste landfill. The landfill, which is located at the Echo Site, is properly permitted and has a projected remaining life of five years. Only non-putrescible, non-liquid solid wastes are accepted for burial. Adverse impacts from solid waste generation are not anticipated as a result of the proposed project because:

(1) Additional staff will not be required to operate the proposed antenna.

(2) Operation of the proposed antenna will not result in generation of quantities of solid waste that are greater than quantities generated by the existing antenna.

(3) Types of solid waste generated are not expected to change from those generated at the present time.

b. Toxic Substances and Hazardous Wastes: The GDSCC does not store or use large quantities of toxic or hazardous substances. The substances used in greatest quantities are fuels and oils. Purchase of drummed liquids is kept to a minimum. The GDSCC operates one main drum storage area at the Apollo site. This facility consists of drums stored on locked, metal, dispensing racks situated on a concrete pad. The facility is properly equipped with warning signs, fire extinguishers, and materials for spill cleanup. Small quantities of containerized substances are stored throughout the complex in a manner consistent with procedures established by the GDSCC Environmental Office. Storage locations are inspected on a routine basis. Typically, only the quantity of material needed to support operations is distributed for storage at each workplace.

Bulk products (primarily fuels and oils) are stored in permitted underground tanks in conformance with prevailing underground tank regulations. There currently are 15 underground tanks in use for storage of bulk fuels and oils at the GDSCC. Underground tanks are monitored daily for leakage.

Hazardous waste generated at the GDSCC is collected in drums at designated accumulation points throughout the complex. Accumulation points are maintained in conformance with procedures established by the GDSCC Environmental Office, and are inspected on a routine basis. Waste is transported from each accumulation point to a central staging facility located at the Echo Site. At this facility, all hazardous waste containers are readied for off-site transport to a commercial, permitted Hazardous Waste Management Facility for either treatment, recycle, or disposal, as appropriate. GDSCC policy requires minimizing waste generation and supports detoxification, reclamation, and reuse of wastes as compared to their disposal.

Materials to be stored at the Venus Site to support the proposed operations are not expected to be substantially different in quantity or type from what is stored to support current operations. The waste-generation rate presently is very low (primarily oily waste), and also is not expected to substantially differ if this proposed antenna project is implemented. Furthermore, the GDSCC has an active environmental program that includes routine monitoring of hazardous materials and waste management practices at each antenna station by the GDSCC Environmental Coordinator. Consequently, no adverse hazardous substances impacts are anticipated.

c. Pesticides: The GDSCC does not directly purchase, store, or use pesticides. All pesticide application is by a licensed contract firm that brings spray applicators containing pre-mixed pesticide to the Complex, applies the pesticide under the direction of the Complex's Environmental Officer, and leaves the premises with all remaining product and spent canisters. Virtually all pesticide application is to the interior of buildings. In the event that it is necessary to spray outside areas prior to initiating new construction, Natural Resource Management personnel from Fort Irwin or from the private sector are consulted to ensure that spraying will not impact environmental resources.

d. Summary of Hazardous Materials Use, Generation of Solid and Hazardous Wastes, and the Use of Pesticides at the Proposed New 34-Meter Antenna at the Venus Site: The proposed Venus antenna project would not require expansion over the current level of operations or an increase in manpower. It is not, therefore, anticipated that hazardous materials use, solid waste generation, or hazardous waste generation would increase significantly as a result of implementation of the proposed project. Pesticide use inside of buildings may increase slightly because of the proposed increase in building space (about 82 SF of additional working space will be added). This slight increase in pesticide use would not create conditions which are radically different from existing conditions at the Venus Site.

7. Health and Safety

The 34-meter antenna design is required to meet the health and safety standards of prevailing health and safety codes.

According to the Advanced Engineering Study Report for Design and Construction of a Beam Waveguide 34-Meter X-Band AZ-EL Antenna, prepared by TIW Systems, 1986, safety provisions would be provided at the proposed antenna site. At a minimum, provisions would include the following:

(1) Lighting: Incandescent lighting would be provided to give a minimum of five foot-candles in all work areas. Battery-powered emergency lights would also be provided wherever frequent maintenance and service is required.

(2) Grounding: The antenna would be grounded and would have lightning protection. All grounding and bonding shall conform to prevailing codes and good engineering practice.

(3) Travel Limits: Redundant antenna travel limits would be supplied at both limits of travel on each axis. Azimuth bumper contact switches also would be provided on the azimuth access stairway structure to prevent damage in periphery around the antenna at ground level. Emergency stop switches would be installed at the following locations:

(a) Elevation Drives

(b) Antenna Access Stairway

(c) Each Azimuth Drive Wheel

(d) Reflector Surface

(e) Provisions for Future Lower Quadripod Leg.

No project-related health and safety impacts are anticipated with implementation of the above and other essential safety measures. A review of safety issues specific to operation of the proposed antenna should, however, be initiated prior to project approval.

8. Aesthetics

Typical views at the Venus Site can be seen in Figures 6, 7 and 10 in Section IV. The proposed project site is approximately 1.5 miles west of NASA Road and thus is not clearly visible to vehicle occupants traveling to the main work area of the Echo Station. The existing antenna and the location of the proposed antenna are within a natural topographic bowl and thus are shielded from distant viewpoints. Although the proposed antenna facility will be approximately 30 feet taller than the existing Venus 26-meter antenna, no residential, commercial or public uses are located near the site. Therefore, the proposed antenna is not expected to have an effect on area aesthetics.

SECTION VI

CONCLUSIONS OF THE ENVIRONMENTAL ASSESSMENT CONCERNING THE CONSTRUCTION AND OPERATION OF A NEW 34-METER ANTENNA PROPOSED FOR THE VENUS SITE AT THE GDSCC

The Environmental Assessment (EA) for the proposed 34-meter antenna to be constructed at the Venus Site has examined the full range of potential environmental impacts that may result from implementation of this project. The conclusion of this EA is that the proposed antenna and its operation would not result in significant adverse impacts to the physical or human environment. It will, however, be necessary to manage electromagnetic transmissions from the antenna in such a manner as to ensure safe operation, in accordance with existing JPL standard procedures and external interface agreements.

Thus, in accordance with the National Environmental Policy Act (NEPA), the Council on Environmental Quality implementing regulations, and the NASA implementing provisions, the proposed project is eligible for a Finding of No Significant Impact (FONSI).

SECTION VII

CERTIFICATION

I hereby certify that all work performed by M. B. Gilbert Associates, Long Beach, California, in its environmental assessment of the construction and operation of a new 34-meter antenna proposed for the Venus Site at the Goldstone Complex of the Ft. Irwin Military Reservation, San Bernardino County, California, as described in this report, was performed in compliance with Federal, state, and local regulations, and in accordance with good engineering and investigative practice.

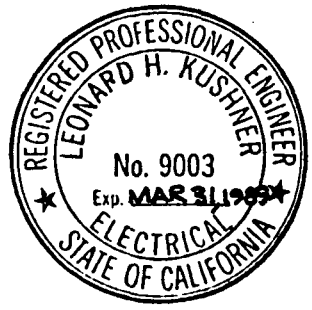
Leonard H. Kushner
Registered Professional Engineer

Signature Leonard H Kushner

Date Signed: June 15, 1988

Registration No. E9003, Electrical — State: California
SF1086, Safety — California

Stamp/Seal



APPENDIX A

INDIVIDUALS AND AGENCIES CONSULTED IN PREPARATION OF THE ENVIRONMENTAL ASSESSMENT

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APPENDIX B

ENVIRONMENTAL ASSESSMENT: BIBLIOGRAPHY

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ENVIRONMENTAL ASSESSMENT: BIBLIOGRAPHY

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APPENDIX C

JET PROPULSION LABORATORY SAFETY PRACTICE BULLETIN 12-4-6,
EFFECTIVE DATE: JUNE 15, 1978

I. GENERAL

A. Microwave transmitters have extensive application in industry and in the home. They are used for: curing certain adhesives, ionizing gases, treating physical ailments, detecting optically invisible objects, cooking, spacecraft communications, etc.

B. Potential dangers are associated with microwave transmitter operations. High-powered ground transmitters used in spacecraft communications are potentially hazardous to persons working nearby. The power density in the direct beam may cause severe biological damage, and the energy density in the feeding system is considered potentially lethal.

C. Any known accidental exposure must be reported immediately to the First Aid Office.

D. For the purpose of this Safety Practice, the microwave frequency spectrum extends from 10 megahertz to 100 gigahertz.

II. HAZARDS

A. Radio frequency radiation heat affects specific parts of the human body. At a particular frequency, the amount of radiation heating is determined by the power density of the field and duration of exposure. The absorbed energy results in heating the body tissue which induces a temperature rise capable of producing biological damage, while no pain is experienced.

B. Users of radio frequency/microwave transmitters are required to be thoroughly familiar with associated hazards and the safety precautions to be taken. Biological damage occurring to the body, without physical warning, must always be kept in mind.

C. Looking into or standing in front of an antenna, waveguide horn, or open waveguide, while the transmitter is on, is extremely dangerous and can cause biological damage.

III. EXPOSURE LIMITS

A. The power density must not exceed one milliwatt per centimeter squared (1 mw/cm^2) in areas where employees are working eight hours a day or forty hours a week.

B. In areas where the power density exceeds 1 mw/cm^2, but is not more than 10 mw/cm^2, employees are restricted to working for no longer than one hour in any twenty-four hour period.

IV. PROCEDURE

A. All radio frequency/microwave transmitter operation areas must be posted with the necessary warning signs and devices.

B. A Safety Review of New Operation, JPL Form 0284-S, must be completed when a new radio frequency transmitter is installed for operation or an existing one is modified.

C. If at the time of initial operation the calculated power density exceeds 1 mw/cm^2 at 1 meter, a survey must be made of the electromagnetic radiation density. The antenna must be rotated, leaving the survey meter stationary while the side lobes are checked. A copy of this survey report must be sent to the Safety Office.

D. Klystrons and magnetrons are to be monitored for X-rays.

E. Certain pulse and transmit/receive tubes contain small amounts of radioactive material and must be handled carefully if broken.

F. The types of waveguide fill gases should be checked to see if a hazard would be created during arcing or accidental release.

G. High-voltage leads must be properly contained to ensure that they cannot come into direct contact (accidentally) with persons in the area.

H. High-voltage capacitors must be enclosed or covered to prevent accidental contact by persons in the area. They must also be provided with an automatic bleed-off system, to prevent the retention of a charge after the equipment is shut off.

I. Combustible materials may not be kept in areas where electrical or radio frequency arcing can occur.

J. Concentrated microwave beams must never be pointed or aimed where flashbulbs, squibs, or other types of electronic explosive devices are in use.

V. MEDICAL REQUIREMENTS

A. The Laboratory requires that persons, working in areas where exposure to radio frequency energy of 1 mw/cm^2 could occur, have an eye examination when the work assignment is made, and annually thereafter, as long as assigned to this type of work.

B. Annual eye-examinations are required of persons working on radio frequency/microwave systems where the total average output power of the transmitter exceeds 500 watts including:

1. Large, microwave tracking antennas during transmission.

2. Antenna testing ranges.

3. Laboratories where transmitters of this output power are being used.

NOTE: Should a break in the waveguide occur with systems of this power level, the resulting leakage could cause damage to the eyes.

Charles H. Terhune, Jr.
Deputy Director

OFFICE OF PRIMARY RESPONSIBILITY

Assistant Laboratory Director for Administrative Divisions

SUPERSEDES

Safety Practice 12-4-6, Microwave Transmitters, dated May 13, 1976.

JPL OPERATIONAL SAFETY REVIEW

NO.

TO Cognizant Section Manager — DATE

FROM Cognizant Engineer — EXT. — SECTION

PROGRAM

☐ R/AD ☐ FLIGHT PROJECT ☐ CIVIL PROGRAMS ☐ DEFENSE PROGRAMS ☐ OTHER

LOCATION

☐ JPL ☐ DSN BLDG. _____ OPERATION STARTING DATE _____

☐ TM ☐ EF ☐ OTHER ROOM _____ OPERATION COMPLETION DATE _____

☐ PRE-OPERATIONAL REVIEW ☐ OPERATIONAL REVIEW ☐ ANNUAL REVIEW

NAME OF OPERATION OR PROJECT

NAMES OF QUALIFIED PERSONNEL ASSIGNED TO THE OPERATION

DESCRIPTION OF OPERATION (NUMBER OF RUNS, DURATION OF RUNS, ETC.) Attach block diagrams, layout, etc., if needed for clarity.

OPERATION ☐ ATTENDED ☐ UNATTENDED WHEN

EMERGENCY NOTIFICATION: NAME _____ PHONE _____ ALTERNATE _____ PHONE _____

WILL THIS OPERATION REQUIRE USE OF THE BUDDY SYSTEM OR OTHER SURVEILLANCE (T.V., AUDIO, ETC.)

☐ NO ☐ YES, TYPE _____

IS ADEQUATE WRITTEN INFORMATION (JPL) AVAILABLE TO ASSIST IN SAFELY CARRYING OUT THIS OPERATION

☐ YES ☐ ADDITIONAL INFORMATION REQUIRED AND WILL BE AVAILABLE PRIOR TO OPERATION

LIST HAZARDOUS MATERIALS, PRESSURE, TEMPERATURES, POWER, VOLTAGES, FREQUENCIES, ETC. TO BE USED

MATERIAL – POWER – ETC.	PRESSURE – VOLTAGE – ETC.	TEMPERATURE – FREQUENCY – ETC.	QUANTITY		HAZARD *
			AT SITE	IN RIG	

HAZARD TYPE *
1-TOXIC 2-CORROSIVE 3-EXPLOSIVE 4-PYROPHORIC 5-RADIATION 6-ACOUSTIC 7-ELECTRICAL 8-FIRE 9-SUFFOCATION 10-PRESSURE 11-LASER 12-ENERGY SOURCES 13-CONTAMINATION 14-

LIST DISCHARGE PRODUCTS AND WASTE FROM OPERATION (FOR BOTH NORMAL AND ABNORMAL CONDITIONS)

MATERIAL	QUANTITY	CONDITION	MEANS OF DISPOSAL	DISCHARGE PRODUCTS
		NORMAL		
		ABNORMAL		
		NORMAL		
		ABNORMAL		
		NORMAL		
		ABNORMAL		

LIST PERSONNEL SAFETY EQUIPMENT REQUIRED FOR THIS OPERATION

LIST OF DOCUMENTS, BY TITLE, THAT PERTAIN TO THIS OPERATION

JPL 0284-S R 3/86

JPL TEST PREPARATION CHECK LIST

YES	NO	N/A	
			PERSONNEL SAFETY
☐	☐	☐	1. Location of personnel during test and in adjacent areas is safe.
☐	☐	☐	2. Provisions exist to avoid unsafe contamination of materials (spills, hypergolic, catalyst, etc.)
☐	☐	☐	3. Emergency procedures exist for protecting personnel in case of fire, spill, explosion, etc.
☐	☐	☐	4. Pertinent personnel protection exist (protective clothing, breathing apparatus, eye and ear protection, medical check, first aid, etc.)
☐	☐	☐	5. Shielding against high frequency or particle radiation, splash, blast exposure, heat, cold, etc., is provided.
☐	☐	☐	6. Additional training is required for this test.
			TEST OPERATION
☐	☐	☐	7. Operating procedure has been prepared. Existing procedure reviewed/revised.
☐	☐	☐	8. Operating procedure has been reviewed with operating personnel.
☐	☐	☐	9. "Fail safe" means exist in case of power, pressure, combustion or personnel failure.
☐	☐	☐	10. Protective means exist in case of over-temperature, over-pressure, over-speed, explosion, fire, etc.
☐	☐	☐	11. Provisions in case of failure of vessel or system from evacuation or pressure are provided (drains, deluge, ventilation, etc.)
☐	☐	☐	12. Electrical and/or static grounding and bonding is adequate (electrical equipment, test systems, work bench, drums, building grounds, etc.)
☐	☐	☐	13. Live parts are suitably guarded (electrical, belts, vent/burst pipes, bldg. sprinklers).
☐	☐	☐	14. Provisions exist for purging of equipment or area after test (water, nitrogen, freon, etc.)
			TEST FACILITY
☐	☐	☐	15. Sprinklers and/or other fire extinguishing equipment installed and operating.
☐	☐	☐	16. Fire protection valves, detection, and warning devices or switches sealed in operating position.
☐	☐	☐	17. Equipment for detection and monitoring of hazardous conditions installed and operating (radiation, toxicity, insufficient oxygen).
☐	☐	☐	18. Pressure vessel is certified. Pressure Vessel number: _____.
☐	☐	☐	19. Protection from ignition sources (space heaters, automatic electrical, contamination, etc.) exists.
☐	☐	☐	20. Warning system installed and operational (horn, lights, observer, personnel barriers, signs indicating presence of hazards, etc.)
☐	☐	☐	21. Adequate work area around equipment and electric power panels (aisles, exits, doors, etc.)
☐	☐	☐	22. Adequate ventilation (windows, doors, fans, exhaust systems) provided.
			ADDITIONAL ITEMS
		☐	Brain Tickler: Consider pressure relief devices, vents, moving equipment, automatic equipment, storage, instrumentation, transportation, sample analysis, material compatibility, proof testing, clean equipment, lifting, tripping hazards, etc.

23. _____

24. _____

CC: Cognizant Engineer
Division Safety Coordinator
Safety Office
Supervisor

_____
Cognizant Engineer

_____
Group Supervisor

_____
Section Safety Coordinator

REVERSE SIDE JPL 0284-S R 3/86

APPENDIX D

HIGH-POWER RADIATION CONCERNS FOR THE NEW DSS-13 34-METER ANTENNA: INTEROFFICE MEMORANDUM BAG 87-VENUSHP, JULY 30, 1987

JET PROPULSION LABORATORY

INTEROFFICE MEMORANDUM

BAG 87-VENUSHP

July 30, 1987

TO: L. Kushner

FROM: Goldstone Radio Spectrum and Airspace Coordinator - B. Gaudian BG

SUBJECT: HIGH POWER RADIATION CONCERNS FOR THE NEW DSS-13 34 METER ANTENNA

In response to the Environmental Assessment document for the planned new 34 meter antenna for DSS-13 there are environmental considerations to be resolved in the area of high power radiation outside of Goldstone airspace, before high power radiation can take place from that location.

Currently DSS-14 is the only Goldstone station that radiates high power on a routine basis for planetary radar and on occasion for spacecraft support. Procedures have been established with the military neighbors and the FAA to prevent exposure of aircraft to radiation levels greater than 10 mw/cm2. The procedures require advance scheduling and require that we do not impact military activities on a repeated basis.

The basic requirements for DSS-14 high power radiation are:

1. No radiation below 15 degrees elevation angle.
2. No radiation outside of +/-25 degrees declination.
3. 4 weeks advance notice on radiation of more than 2 days/week.
4. A minimum of 72 hours notice on late changes.
5. All radiation requests require airspace avoidance contour plots to provide the avoidance information to external agencies.
6. Avoid the supersonic corridor and coordinate its use on a case by case basis.

If future planning includes DSS-13 for planetary radar and spacecraft uplink support then a similar set of requirements would have to be negotiated and coordinated, but would most likely be much more restrictive because DSS-13 has almost no Goldstone airspace except north and northeast. The major impacts would be that DSS-13 transmissions to the southeast, south and west would be restricted because of impact to existing military supersonic air corridors and to the east and southeast because of impact to FAA commercial air carriers.

The current limit of 15 degrees elevation for DSS-14 and the +/- 25 degree declination restrictions maintain the radiated beam pointing within the military R2508 complex and minimal coordination is required for the FAA for commercial aircraft. A like restriction for DSS-13 would be a limit of 25 degrees for elevation, +/-25 degrees declination and no radiation from 180-300 azimuth from 0600-1800 local time weekdays.

Some of these concerns were discussed with J. Smith, Manager of 420 TDA PLANNING, on July 30, 1987. He indicated there are no plans for a high power transmitter at DSS-13 until the 400 Kw Ka band installation in about 1992 and TDA Planning will consider the potential for conflict and restrictions to high power radiation from the Venus Site.

Distribution: R. J. Amorose
L. E. Butcher
D. W. Johnston
A. Price
J. G. Smith
Max Wyatt

APPENDIX E

ARCHAEOLOGICAL APPROVAL OF THE NEW VENUS 34-METER ANTENNA: INTEROFFICE MEMORANDUM ENVOK34M.NTC, DECEMBER 18, 1987

JET PROPULSION LABORATORY INTEROFFICE MEMORANDUM

ENVOK34M.NTC

December 18, 1987

TO: DISTRIBUTION

FROM: B. A. Gaudian BG.

SUBJECT: Environmental and archaeological approval of new Venus 34M antenna

Attached is the environmental and archaeological compliance approval from Ft. Irwin for the new 34M antenna at the Venus site.

cc: H. Alderson
R. J. Amorose
L. E. Butcher
G. Kroll
J. E. Mcpartland
A. L. Price
F. Stoller

DISPOSITION FORM

For use of this form, see AR 340-15; the proponent agency is TAGO.

REFERENCE OR OFFICE SYMBOL	SUBJECT
- Goldstone	Construction of a new 34 meter antenna at the Goldstone Venus Site.

TO	FROM	DATE	CMT 1
Director, DEH Ft. Irwin ATTN: W. Cassidy	Goldstone B. A. Gaudian	11/20/87	

1. Goldstone requests EHE archaeological and environmental compliance approval for the construction of a new 34 meter antenna at the Venus Site. The new antenna will be located approximately 200 ft. Southeast of the existing Venus antenna and construction is planned for March 1989.

   The antenna location and environmental concerns are addressed in the attached material.

   Action on this requirement is needed by January 20, 1988.

cc: H. Alderson
L. E. Butcher
J. E. McPartland
A. L. Price

AFZJ-EHE-S (JPL - Goldstone/11-20-87)
SUBJECT: Construction of a new 34 meter antenna at the Goldstone Venus Site

TO Goldstone FROM Staff Archaeologist DATE 10 Dec 87 CMT 2
ATTN: B.A. Gaudian W.L. Cassidy

1. An archaeological and environmental compliance field reconnaissance was conducted on 8 Dec 87.

2. The project as proposed will not adversely affect any observed environmental factors.

3. I am in agreement with the Finding of No Significant Impact (FONSI) as stated in the Environmental Assessment prepared for NASA/JPL.

Walter L. Cassidy
WALTER L. CASSIDY
Staff Archaeologist

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16. Abstract

The Goldstone Deep Space Communications Complex (GDSCC), located in the Mojave Desert about 45 miles north of Barstow, California, and about 150 miles northeast of Pasadena, is part of the National Aeronautics and Space Administration's (NASA's) Deep Space Network, one of the world's largest and most sensitive scientific telecommunications and radio navigation networks.

The GDSCC includes five distinct operational areas named Echo Site, Venus Site, Mars Site, Apollo Site, and Mojave Base Site. Within each site is a Deep Space Station (DSS) that consists of a large parabolic dish antenna and its support facilities.

At present, the Venus Station, known as DSS-13, has a 26-meter (85 ft) antenna. In conjunction with NASA, JPL is proposing to replace this antenna with a new 34-meter (111.5 ft) antenna.

The proposed construction of this new antenna at the Venus Site required an Environmental Assessment (EA) document that would record the existing environmental conditions at the Venus Site, that would analyze the environmental effects that possibly could be expected from the construction, installation and operation of the new proposed antenna, and that would recommend measures taken to mitigate any possibly deleterious environmental effects.

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