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Environmental Projects: Volume 5

Part One: Study of Subsurface Contamination

Part Two: Guide to Implement Environmental Compliance Programs

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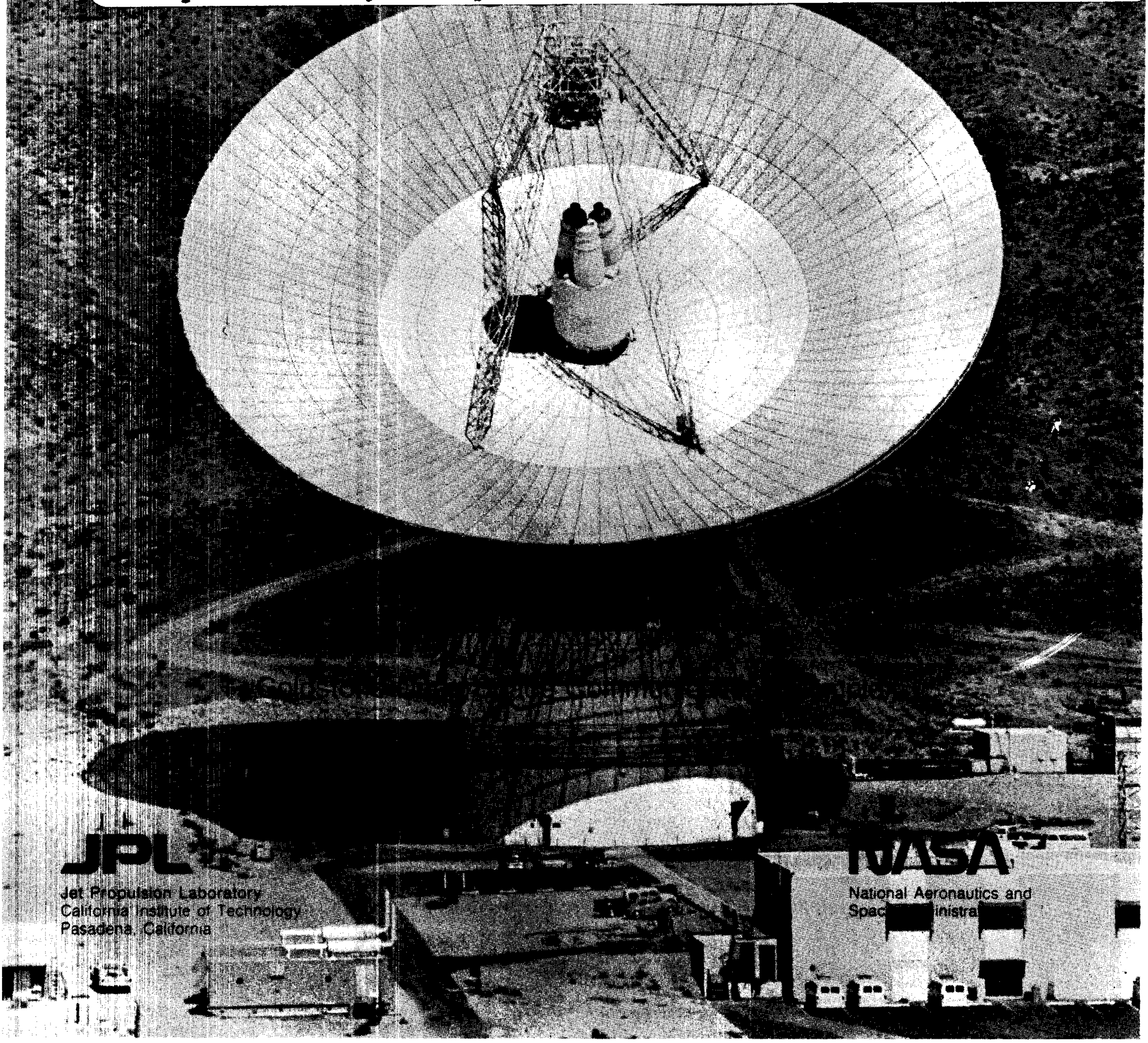

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Environmental Projects: Volume 5

Part One: Study of Subsurface Contamination

Part Two: Guide to Implement Environmental Compliance Programs

Goldstone Deep Space Communications Complex

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

National Aeronautics and
Space Administration

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.

Part One:
Study of Subsurface Contamination at the Goldstone Deep Space Communications Complex (GDSCC)

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16. Abstract

In support of the national goal of the preservation of the environment and the protection of human health and safety, the National Aeronautics and Space Administration, the Jet Propulsion Laboratory, and the Goldstone Deep Space Communications Complex have adopted a position that their operating installations shall maintain a high level of compliance in regard to regulations on environmental hazards. An investigation carried out by Engineering-Science, Inc. focused on possible underground contamination that may have resulted from any leaks and/or spills from storage facilities at the Goldstone Communications Complex. It also involved the cleanup of a non-hazardous waste dumpsite at the Mojave Base Site at the Goldstone Complex. The report also includes details of the management duties and responsibilities needed to maintain compliance with environmental laws and regulations.

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ABSTRACT

PART ONE

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.

Activities at the GDSCC are carried out in support of six large parabolic dish antennas. These activities may give rise to environmental hazards: use of hazardous chemicals, asbestos, and underground storage tanks as well as the generation of hazardous wastes. Federal, state, and local laws governing the management of hazardous substances, asbestos, and underground storage tanks have become so complex there is a need to devise specific programs to comply with the many regulations that implement these laws.

In support of the national goal of the preservation of the environment and the protection of human health and safety, NASA, JPL and the GDSCC have adopted a position that their operating installations shall maintain a high level of compliance with these laws.

Thus, Engineering-Science, Inc. (E-S), Pasadena, California, was retained by JPL to carry out an investigation of any possible underground contamination by hazardous materials that may have resulted from any leaks and/or spills from hazardous-waste storage facilities at the GDSCC. The study also involved the cleanup of a non-hazardous waste dumpsite at the Mojave Base Site.

In addition, E-S prepared a Preliminary Engineering Report that deals with the repair of the embankments of the operating sewage evaporation ponds at both the Echo and Mars Sites, and the proper environmental closure of the abandoned sewage treatment plant and abandoned sewage evaporation pond at the Mojave Base Site at the GDSCC.

Part One of this report essentially is a JPL-version of the two reports compiled and submitted by E-S that deal with the above E-S work concerning subsurface contamination and sewage evaporation ponds at the GDSCC.

GLOSSARY

PART ONE

A&E	Architectural and Engineering
BLM	U.S. Bureau of Land Management
CAC	California Administrative Code
CFR	Code of Federal Regulations
DEHS	Department of Environmental Health Services (San Bernardino County)
DSCC	Deep Space Communications Complex
DSN	Deep Space Network
DSS	Deep Space Station
EPA	Environmental Protection Agency
E-S	Engineering-Science, Inc.
GDSCC	Goldstone Deep Space Communications Complex
HEF	High-Efficiency (Antenna)
HNu	Trade name for a photoionization meter used for monitoring volatile organic materials
JPL	Jet Propulsion Laboratory
KES	Kern Environmental Services
LRWQCB	Lahontan Regional Water Quality Control Board
MTF	Microwave Test Facility
NASA	National Aeronautics and Space Administration
ND	Not Detected
NOAA	National Oceanic and Atmospheric Administration
NTC	National Training Center (U.S. Army)
O&M	Operations and Maintenance
PCB	Polychlorinated Biphenyl
PER	Preliminary Engineering Report

ppm	parts per million
PR	Percentage Recovery
R&D	Research and Development
RPD	Relative Percentage Difference
SA	Spike Added (Sample for analysis)
SBC	San Bernardino County
SR	Sample Result
SSR	Spiked Sample Result
STS	Space Transportation System (Space Shuttle)
TDA	Office of Telecommunications and Data Acquisition (JPL)
TDS	Total Dissolved Solids
TPH	Total Petroleum Hydrocarbons
TTLC	Total Threshold Limit Concentration
UST	Underground Storage Tank

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SECTION I

INTRODUCTION

A. BACKGROUND

The Goldstone Deep Space Communications Complex (GDSCC) is part of the National Aeronautics and Space Administration'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 (JPL) of the California Institute of Technology in Pasadena, California. 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.

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 overall NASA DSN consists of a worldwide network of 12 operational DSSs. A seventh parabolic dish antenna at Goldstone is operated by the National Oceanic and Atmospheric Administration (NOAA). A more detailed description of the GDSCC is presented in Section II.

B. POTENTIAL ENVIRONMENTAL HAZARDS AT THE GDSCC

Operation and maintenance (O&M) of the various sites at the GDSCC result in the use of hazardous chemical substances and the generation of hazardous wastes. It was reported in 1985 that 20 tons of hazardous wastes were generated at the GDSCC including waste oils, cleaning solvents, antifreeze, acids and bases, spent batteries, paints, and thinners. A large portion of these was transported off-site for recycling. The remainder went off-site to permitted hazardous waste disposal facilities. The GDSCC also operates an on-site, Class III solid waste landfill. This facility is permitted to receive non-hazardous solid waste generated at the GDSCC including garbage, grass and tree clippings, construction debris, and paper materials.

Large quantities of various hazardous materials commonly have been used at NASA facilities. It now is accepted that these hazardous materials pose a significant health hazard. As a result of these findings, many NASA facilities have implemented extensive hazardous materials abatement programs as a preventive measure.

One of the NASA facilities involved in programs to abate hazardous materials is the Goldstone Deep Space Communications Complex (GDSCC). Federal, state, and local laws governing the management of hazardous materials have become so complex that a need has been created to structure programs to comply with the many regulations implementing these laws. NASA, JPL, and the GDSCC, in supporting the national goal of preserving the environment and protecting human health and safety, have adopted a position that operating installations shall maintain a high level of compliance with these laws based on a policy of prevention rather than reaction. Under supervision of JPL's Office of Telecommunications and Data Acquisition (TDA), efforts have been initiated to develop and implement programs that focus on various environmental issues including both the subsurface contamination by hazardous materials and the proper maintenance of sewage evaporation ponds.

C. REPORTS CONCERNING ENVIRONMENTAL COMPLIANCE PROGRAMS AT THE GDSCC

As a result of these TDA environmental compliance programs at the GDSCC, the following four reports have been issued to date:

1. Polychlorinated Biphenyl (PCB) Abatement Program, Final Report, JPL 87-4, Environmental Projects: Volume 1, March 15, 1987.

2. Underground Storage Tanks Compliance Program, JPL 87-4, Environmental Projects: Volume 2, June 15, 1987.

3. Environmental Compliance Audit, Final Report, JPL 87-4, Environmental Projects: Volume 3, September 15, 1987.

4. Asbestos Survey, JPL 87-4, Environmental Projects: Volume 4, February 1, 1988.

This present report, (Environmental Projects: Volume 5), consists of the following two parts:

1. Part One: Study of Subsurface Contamination

This part of the report documents the existing conditions, analyzes the environmental effects, and presents mitigation measures for suspected underground contamination resulting from leakage and spillage from hazardous waste storage facilities at the GDSCC. This part of the report also addresses the cleanup of a non-hazardous waste-disposal area.

The need for these actions is in accordance with the National Environmental Policy Act (42 USC); NASA Policy on Environmental Control (14 Code of Federal Regulations (CFR) 1216.1); NASA Procedures for Implementing the National Environmental Policy Act (14 CFR 1216.3); NASA Handbook 8800; Protection of the Environment (40 CFR 260-265); California Administrative Code (CAC) Title 22, and the San Bernardino County Regulations.

In addition, this part of the report contains portions of a Preliminary Engineering Report (PER) prepared for JPL by Engineering-Science, Inc. (E-S), Pasadena, California (Contract No. 957982), that documents the existing conditions, analyzes the environmental effects, and presents alternative mitigation measures and costs, for the repair/closure of sewage evaporation ponds at the GDSCC.

The PER specifically deals with the preliminary engineering aspects involved in the repair of interior embankments and berms of four presently used evaporation ponds and the closure of a fifth pond that now is unused and abandoned.

The need for these actions is in accordance with CAC Title 22 and the Lahontan Regional Water Quality Control Board (LRWQCB) Order 6-85-7.

2. Part Two: Guide to Implement Environmental Compliance Programs

Although this part of the report describes the specific duties and responsibilities of an Operations and Maintenance (O&M) Contractor at the Goldstone Deep Space Communications Complex (GDSCC), the described duties and responsibilities also are applicable to the O&M Contractors at other facilities of similar size and function.

The comprehensive duties and responsibilities described in this part of the report range from the monitoring and abatement of hazardous and solid wastes, through the management of pesticides, to the environmental training of a Complex's personnel.

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 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.

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). In support of DSN operations, Goldstone performs the following functions:

(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

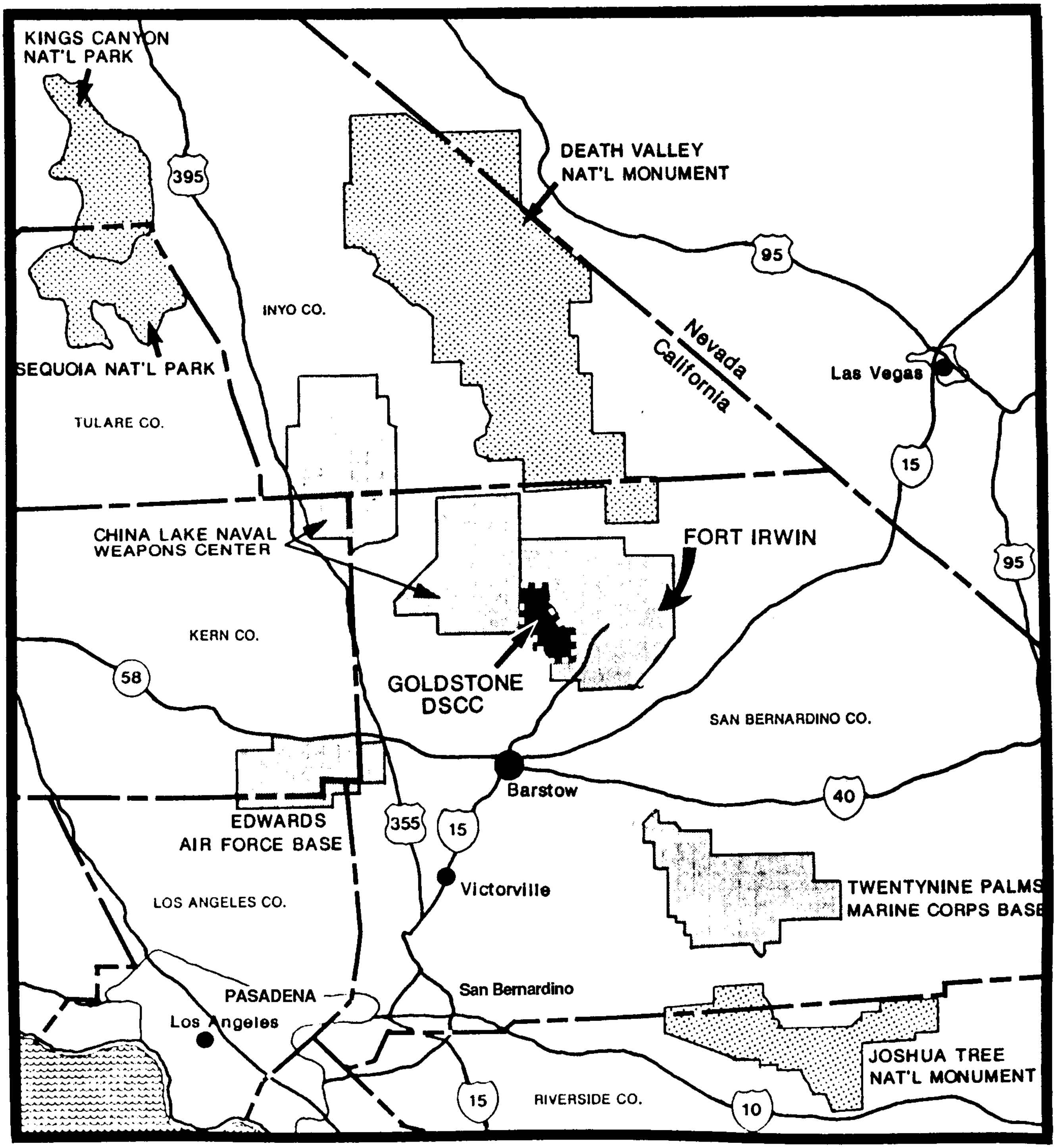

Figure 1. Geographic Relationship of the Goldstone Deep Space Communications Complex to JPL in Pasadena

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. A seventh parabolic dish antenna 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. The GDSCC support staff consists of 246 personnel onsite 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

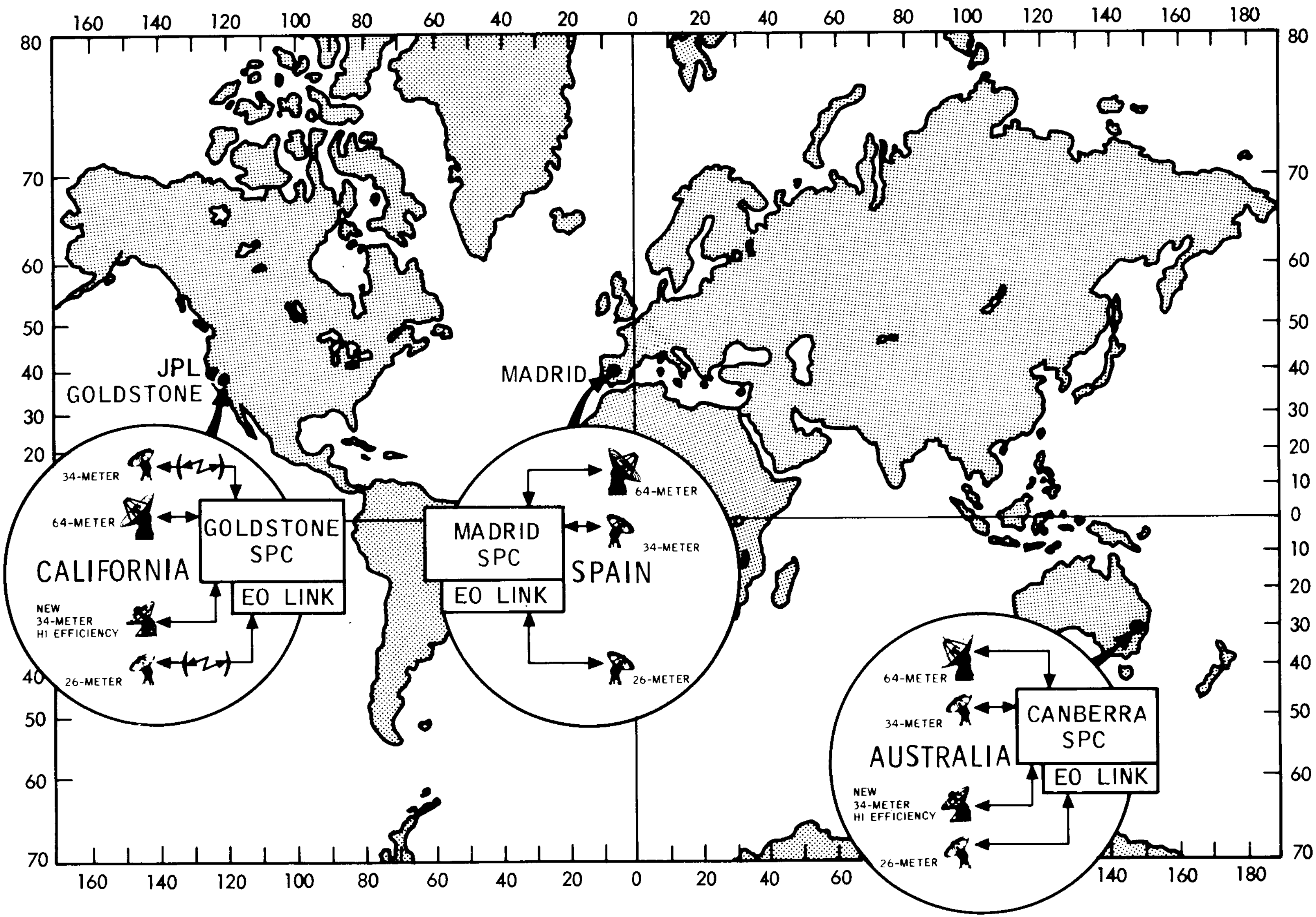

Figure 2. The Three-Continent NASA Deep Space Network as it Existed in 1988

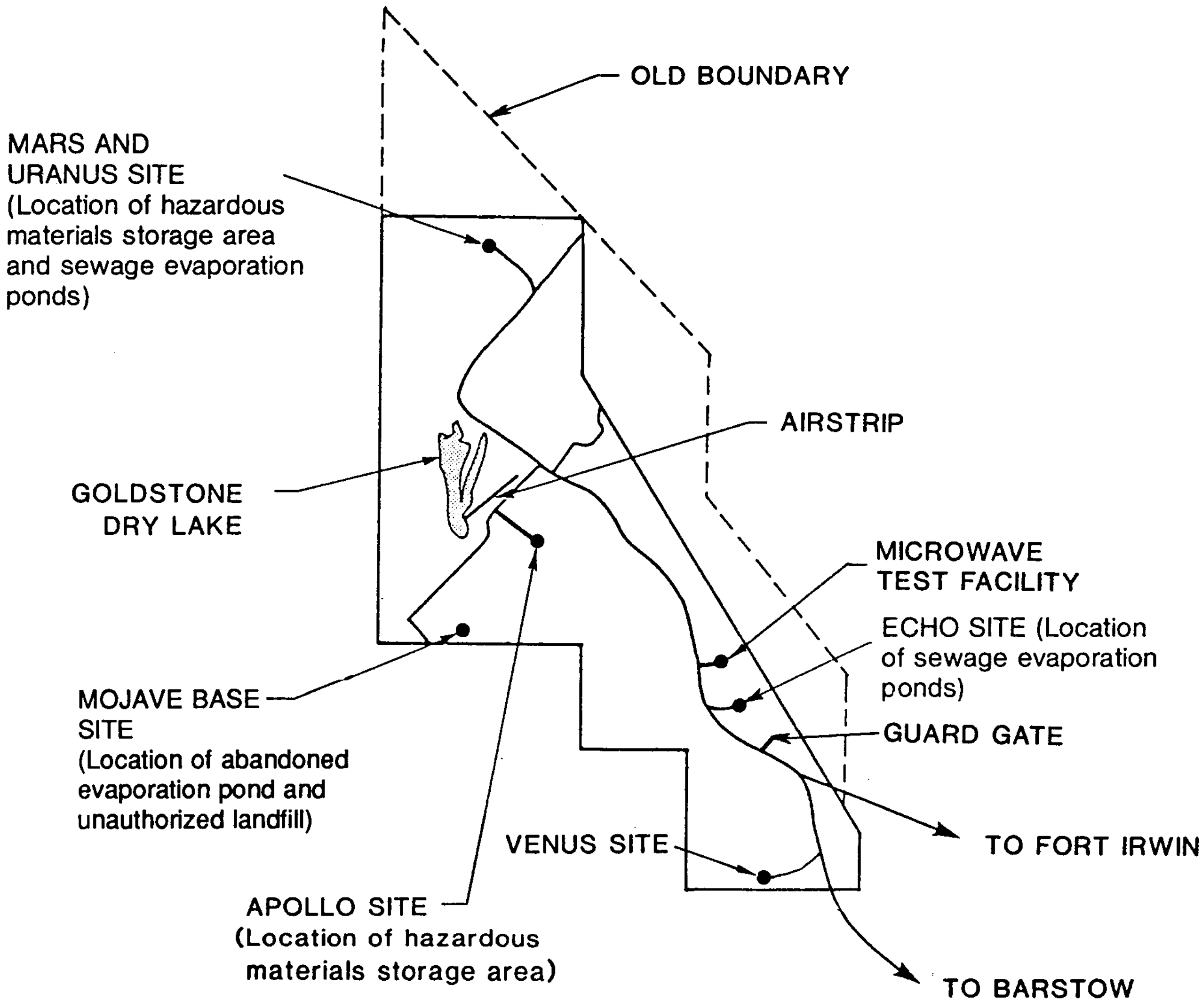

Figure 3. Schematic Map of the Goldstone DSCC Showing Locations of the Six NASA Deep Space Stations (DSSs)

Table 1. Major Facilities at the GDSCC

Site	Station Number	Buildings: Number	Buildings: SF (ft^2)	Antennas: Date of Construction	Antennas: 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), 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 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 very 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.

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.

4. Apollo Site (DSS-16)

The Apollo Site has a 26-meter (85-ft) antenna and 18 buildings having a combined area of 43,985 SF. The buildings provide space for operations, equipment, storage, and warehousing. The antenna was originally constructed in 1965 by the NASA Goddard Space Tracking and Data Network to support the manned Apollo missions to the moon. Operation of the antenna under the JPL/GDSCC/DSN began in October 1984. The antenna now is 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 scheduled shuttle flights 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 abovementioned onsite 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 to septic tank systems constructed at each site. The Echo and Mars Sites also discharge waste water to small 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.

H. OPERATIONAL RELATIONSHIPS BETWEEN THE GDSCC AND FORT IRWIN

Because the GDSCC is contained within Fort Irwin, 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

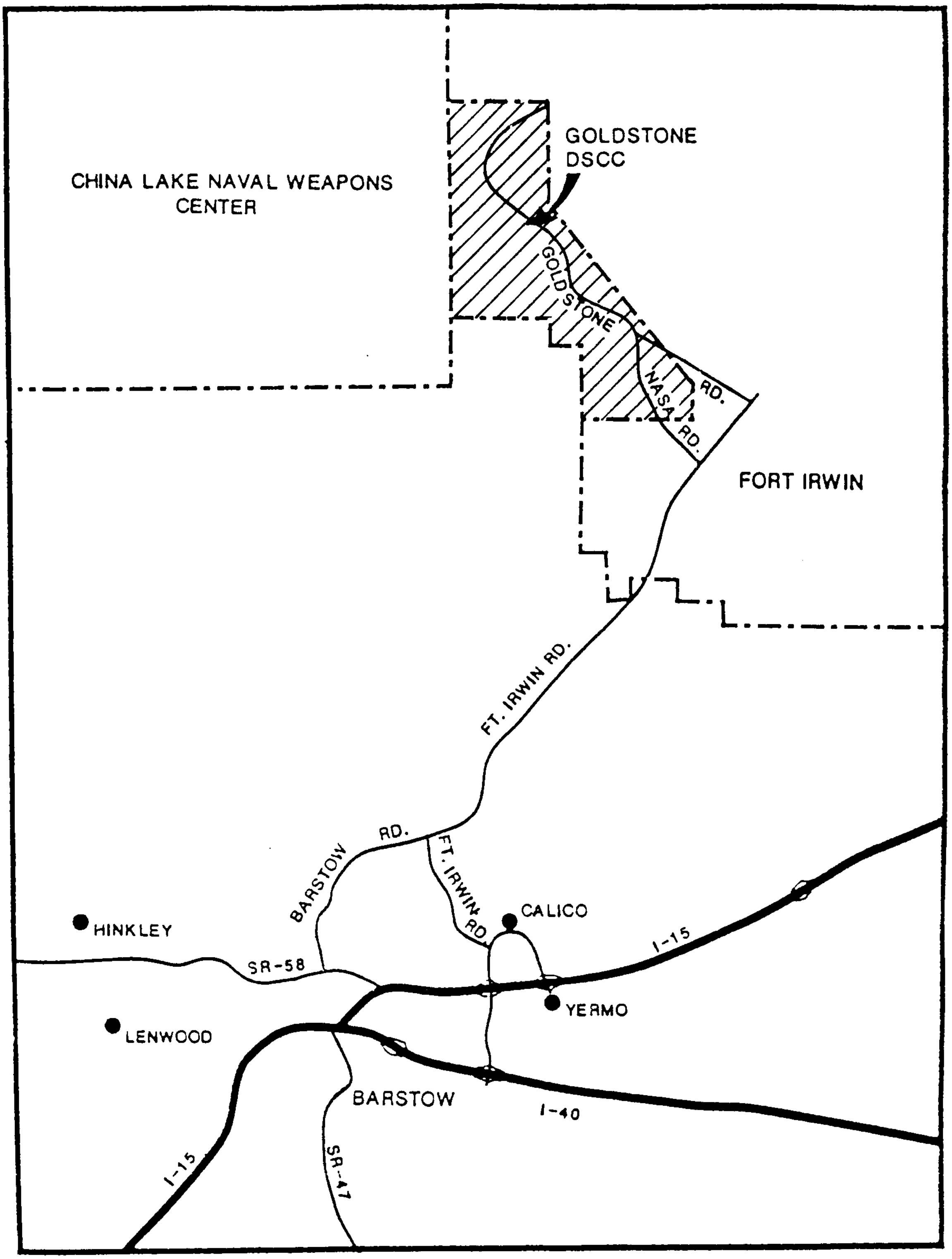

Figure 4. Major Roads Leading to and at the Goldstone DSCC

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 GDFSCC 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

STUDY OF SUBSURFACE CONTAMINATION AT THE GDSCC

A. PURPOSE AND SCOPE OF THE STUDY

Engineering-Science, Inc. (E-S), Pasadena, California, was contracted by JPL to carry out studies of both subsurface contamination and the repair/closure of sewage evaporation ponds at the GDSCC. This present document essentially is an expanded JPL-version involving the combination and integration of the two field survey reports (PE039.01 and PE039.05) compiled and submitted by E-S in December 1987.

The objectives of the subsurface contamination investigation were:

1. To determine the presence of surface and/or subsurface contamination at suspected spill and waste disposal sites.

2. To determine the potential for migration in the various environmental media of any contaminants discovered.

3. To identify potential environmental consequences and health risks of any migrating contaminants based on State or Federal standards and guidelines for those contaminants.

4. If contamination is present, to recommend corrective measures to be taken to bring any deficiencies into compliance with applicable NASA and EPA regulations.

5. To report on JPL's past activities for compliance with the underground storage tanks requirements of San Bernardino County (SBC).

6. To assess the effects of the current NASA/JPL Goldstone operations on the subsurface environment.

To meet the objectives of the project, E-S personnel carried out both a records search to review existing available data, and made reconnaissance field trips to the GDSCC sites under investigation. Soil samples were collected from borings and trenches at the sites for chemical analysis. The results of this field investigation, along with recommendations for future work, are provided in this report. This present document includes the contents of both the subsurface contamination report (PE039.01) and the sewage evaporation ponds report (PE039.05) submitted by E-S to JPL in December 1987.

B. DURATION OF THE SUBSURFACE CONTAMINATION STUDY

Personnel of Engineering-Science, Inc. made several reconnaissance trips to the Goldstone Deep Space Communications Complex (GDSCC) to review the GDSCC facilities and environmental resources. On-site field work was conducted on August 4, 5 and 6, 1987, and the necessary laboratory analytical work was completed August 30, 1987.

C. SITES INVESTIGATED AT THE GDSCC FOR SUBSURFACE CONTAMINATION

Three sites at the Goldstone Complex, Mars, Apollo, and Mojave, were identified as having areas of potential subsurface contamination. Locations of these sites are shown in Figure 3. Individual site descriptions are presented in Section IV. In addition, the sewage evaporation ponds at three sites, Echo, Mars, and Mojave, were examined.

D. STUDY OF SEWAGE EVAPORATION PONDS

As part of the subsurface contamination study, the objectives of this investigation of sewage evaporation ponds were to determine alternative methods of repair of operational ponds and to close the abandoned pond at the Mojave Base Site.

Because the linings of the clay embankments of the evaporation ponds at the Echo and Mars Site have been eroded by wind, precipitation and wave action, the embankments no longer are protected by a water-impervious barrier.

If this situation is not remedied, the damage to the existing pond liners will continue and sewage effluent may seep into the unprotected soil. It is even possible that over an extended period of time, the embankments may erode enough to allow the septic tank effluent to escape the pond not only by seepage, but also by flowing directly through breaches in the failed embankment.

One of the sewage evaporation ponds at the GDSCC (Mojave Base Site) has not been used for 8 years and has been abandoned. It remains an illegally closed facility at the GDSCC if it not closed properly. This unused pond, therefore, must be closed in accordance with both State and Federal laws that deal with the security of abandoned facilities.

SECTION IV

FIELD PROGRAM TO INVESTIGATE SUBSURFACE CONTAMINATION AT THE GDSCC

A. PURPOSE OF THE FIELD INVESTIGATION OF SUBSURFACE CONTAMINATION

The purpose of the field investigation program at the GDSCC was the collection of soil samples from the three sites suspected of having environmental contamination either because of spills or because of waste-disposal practices in the past. Data obtained in the field program were used to determine the presence of contamination at the Mars, Apollo, and Mojave Base Sites and the potential for migration of the contaminants from these sites. This section discusses the procedures and the methodology used in the field investigation program.

B. SOIL BORING AND SAMPLING PROCEDURES

Soil borings were drilled with a CME-75 hollow-stem auger drill rig (Figure 5) or hand-augered. In some areas, where the drill auger was refused because of rocky soil, small pits were dug by hand. Rig-drilled borings were drilled by the hollow-stem auger method that uses a stainless steel split-spoon sampler to obtain samples. The split-spoon was fitted with California brass-ring samplers driven ahead of the bit through the center (hollow-stem) of the auger into undisturbed soil. Soil samples for chemical analysis were collected from various depths down to 15 feet. Soils were classified visually with respect to type, grain size, mineralogy (when pertinent), color, moisture content, and odor. The presence of organic vapors was monitored during drilling operations using an HNu photoionization meter (Figure 6)*, and the HNu readings were recorded in the boring logs. Additional notes or problems encountered were recorded in the field notebook (see Appendix F).

In one area (the Mojave sewage evaporation pond) a boring was drilled manually using a hand auger. Soil samples for chemical analysis were collected from depths down to five feet.

Cross-contamination was prevented between sampling locations as well as between individual samples. The drill rig was cleaned with high-pressure steam prior to its initial use at the GDSCC. Drill bits, augers, drill rods, split-spoon samplers, California brass-ring samplers, and other down-hole equipment were decontaminated prior to each use. The decontamination procedure consisted of steam and detergent cleaning, a tap water rinse, a methanol rinse, and a distilled water rinse, followed by air drying (Figures 7 and 8).

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*The HNu photoionization meter is a device to detect both the presence and amount of volatile organic materials including petroleum hydrocarbons. It is equipped with a small air pump to draw vapors past the sensor. It is useful both as a screening device (to see whether petroleum hydrocarbons are present) and as a measuring device (to indicate how much of the organic volatiles are present). The latter value can indicate to the HNu operator whether protective measures should be taken by personnel in the area.

Figure 5. Typical Drilling Operation for Soil Samples with CME-75 Hollow-Stem Auger Drill

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Figure 6. HNu Photoionization Meter "Sniffing" for Volatile Organic Materials at the Hazardous-Materials Storage Area at the Mars Site

Figure 7. Cleaning and Decontamination of Soil-Sample Tubes Prior to Use

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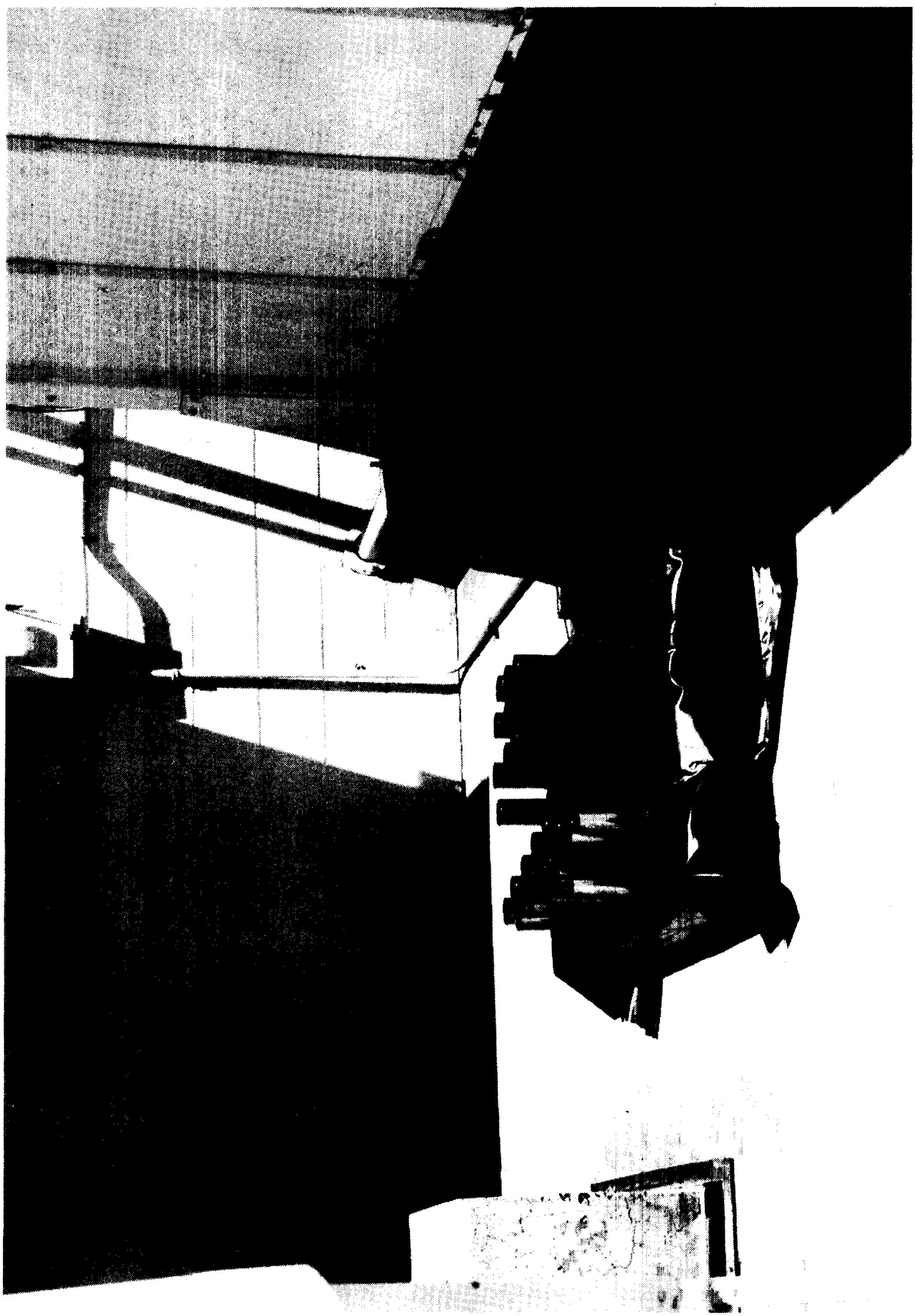


Figure 8. Cleaned and Decontaminated Soil-Sample Tubes Stored and Ready for Use

C. SOIL-TRENCHING AND SAMPLING PROCEDURES

Trenches were dug and sampled using a backhoe equipped with a hydraulic push for sampling. The hydraulic push, located on the arm of the backhoe just above the bucket, operates horizontally. The sampler was fitted with California brass-ring samplers and was driven into soil at the sides of the trenches. Soil samples for chemical analyses were collected from various depths down to seven feet. The presence of organic vapors was monitored during trenching operations using an HNu photoionization meter. HNu readings and additional notes or problems encountered were recorded in the field notebook.

The backhoe bucket and sampling equipment were decontaminated prior to each use in a fashion similar to that employed for the drill rig (Figure 9).

D. SOIL-SAMPLE NUMBERING SYSTEM

Each individual soil sample was assigned a unique sample identifier. The same identifier was used in the drilling logs, and on bottle labels, chain-of-custody forms, and laboratory reports for samples that were chemically analyzed. Each sample identifier consists of four groups of letters and/or numbers separated by hyphens, as described below:

(1) Project identification: The abbreviation JPL identifies this project as that of the Jet Propulsion Laboratory.

(2) Site Identification: Letter codes (described below) identified the sites from which samples were collected.

ID Code	Site Description
MARS	Mars Site
A	Apollo Site
MD	Mojave Base Site, dumpsite
ML	Mojave Base Site, lagoon (sewage evaporation pond)

(3) Sample Location Identification: A letter prefix and a number identified the sampling location within each site.

(4) Sample Depth Identification: A number identified the depth in the soil from which a sample was collected.

For example, a sample identified as JPL-MARS-B1-5 indicates this is a Jet Propulsion Laboratory sample from the Mars Site, Soil Boring #1, and collected from a depth of 5 ft.

Figure 9. Cleaning and Decontamination of Backhoe Bucket and California Brass-Ring Soil-Sample Tubes Prior to Use

E. SAMPLE HANDLING, PACKAGING AND DELIVERY

All equipment used in the collection of soil samples was decontaminated prior to each use. The sampling equipment was washed with biodegradeable soap and water, rinsed with tap water, methanol, and distilled water, followed by air drying.

Soil samples obtained from the borings or the hydraulic push on the backhoe were collected using California brass-ring samplers. The two soil samples collected from hand-augered boring were transferred directly from the barrel of the auger into California brass-ring samplers. Soil samples sent for chemical analysis were left in the brass rings. These were wrapped tightly with aluminum foil, the ends capped with plastic caps, and the caps taped in place. Each sample then was labeled. Labels were prepared using waterproof markers and included the sample identification number, the date and time of collection, initials of the person performing the sampling, and a list of the analyses to be performed. Samples then were put into plastic bags, the bags sealed to prevent cross-contamination, and then placed on ice in coolers.

A chain-of-custody form containing the following information was completed and sealed in a waterproof bag and placed inside each cooler:

(1) Project identification.

(2) Signature of person who collected the samples.

(3) Sample identifiers (for all samples in the cooler).

(4) Date and time of sample collection.

(5) Number of individual containers for each sample.

(6) Required analytical methods for each sample.

The coolers were hand-delivered to the Brown & Caldwell Laboratory (Pasadena) by E-S personnel.

F. CHEMICAL ANALYTICAL METHODS AND PROCEDURES

The soil samples were analyzed for selected parameters using standard, published procedures. The substances to be analyzed for, the analytical methods used, and the laboratory detection limits are presented in Table 2. Detailed results of the chemical analyses of the soils from the Mars, Apollo and Mojave Sites are described in Section V.

G. SITE-SPECIFIC SOIL-BORING AND SAMPLING ACTIVITIES

A summary of the site-specific field investigations is presented in Table 3. Activities at individual sites are described below.

Table 2. Parameters, Analytical Methods and Detection Limits in the Analysis of Soil Samples from the GDSCC

Analytical Parameter	Method Citation[a]	Detection Limit (µg/g)[c]
Halogenated Volatile Organics	SW 8010	0.3
Aromatic Volatile Organics	SW 8020	0.3
Total Petroleum Hydrocarbons	SW 3550 + EPA 418.1[b]	10
Priority Pollutant Metals		
Antimony	SW 6010	8
Arsenic	SW 7060	0.3
Beryllium	SW 6010	0.2
Cadmium	SW 6010	0.5
Chromium (total)	SW 6010	1
Copper	SW 6010	0.5
Lead	SW 6010	5
Mercury	SW 7471	0.4
Nickel	SW 6010	1
Selenium	SW 7740	0.4
Silver	SW 6010	0.2
Thallium	SW 6010	5
Zinc	SW 6010	0.8

[a] Test Methods for Evaluating Solid Waste - Physical Chemical Methods, SW-846, 2nd Edition, U.S. EPA, 1982.

[b] Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020, U.S. EPA, March 1983.

[c] Micrograms per gram (wet weight basis).

Table 3. Summary of the Program for the Field Investigation of Subsurface Contamination at the GDSCC (by Sites)

Site Name	Description	Field Activities	Laboratory Analyses
Mars	Hazardous Materials and Waste Storage	Hand dug (4) 1-1/2 ft pits Collected 8 soil samples for analysis.	Total petroleum hydrocarbons. Halogenated volatile organics and aromatic volatile organics for 4 samples.
Apollo	Hazardous Materials and Waste Storage	Drilled (1) 8-1/2 ft boring (2) 10 ft borings (1) 12 ft boring (3) 15 ft borings Collected 12 soil samples for analysis.	Total petroleum hydrocarbons. Halogenated volatile organics and aromatic volatile organics for 7 samples.
Mojave Base	Abandoned Sewage Evaporation Pond	Hand augered (1) 5 ft boring Collected 2 soil samples for analysis.	Priority pollutant metals. Halogenated volatile organics and aromatic volatile organics for 1 sample.
	Abandoned Dumpsite	Backhoed (4) 7-1/2 ft deep pits (1) 8-1/2 ft deep pit (2) 2 to 3 ft deep pits Collected 15 soil samples for analysis.	Priority pollutant metals. Halogenated volatile organics and aromatic volatile organics for 7 samples. Total petroleum hydrocarbons for 5 samples.

H. CONFIGURATION AND USE OF SEWAGE EVAPORATION PONDS

In addition to the subsurface contamination study, the sewage evaporation ponds at the GDSCC were examined.

1. General

Location of on-site evaporation ponds at three facilities at the GDSCC (Echo, Mars, and Mojave Base Sites) are shown in Figure 10. While the Mojave Base Site has a single, unused pond, the Echo and Mars sites have functioning evaporation ponds constructed in pairs (Figure 11). The ponds are designed to receive and evaporate effluent from upstream septic tank systems. The normal mode of effluent input and distribution is as follows:

a. All wastewaters flow from the buildings through pipelines to the septic tanks.

b. Effluent from the septic tanks is split so that some flow is directed to the leach lines. This provides sufficient moisture to allow the soil to function as grounding fields. The major portion of the flow is discharged to the evaporation ponds.

c. All flow directed from the septic tank system to the ponds is to one evaporation pond for an extended period of time. Flow is then directed from the septic tank system to the second pond. The pond not in use is allowed to evaporate until it is dry.

d. Septic tanks are pumped as necessary by a contractor and the waste is transported to an approved, licensed landfill for disposal.

2. Construction of Sewage Evaporation Ponds

The sewage evaporation ponds were constructed in the late 1950s and early 1960s by removing the native desert soils and piling the spoil around the excavation to form embankments that vary from 2 to 6 ft above the overall grade elevation of the site. The interior slopes then were lined with a two-foot layer of clay material obtained within the GDSCC.

I. DESCRIPTION OF SUBSURFACE CONTAMINATION INVESTIGATION AND EXAMINATION OF SEWAGE EVAPORATION PONDS AT THE GDSCC

Details of both the subsurface contamination investigation and the examination of sewage evaporation ponds at the GDSCC are described in the following pages. Detailed results of the chemical analyses of the soils dug up from the Mars, Apollo and Mojave Sites are described in Section V.

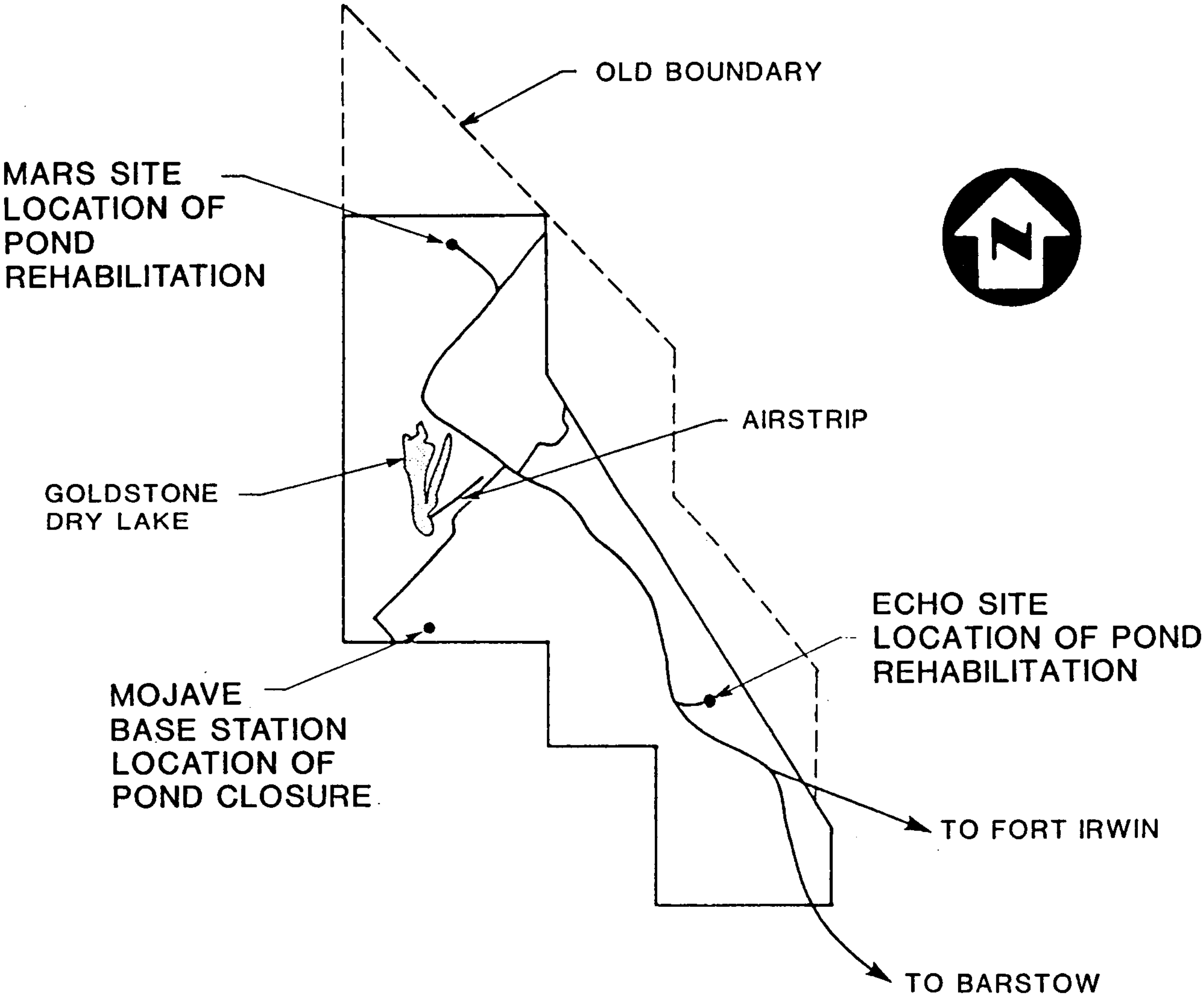
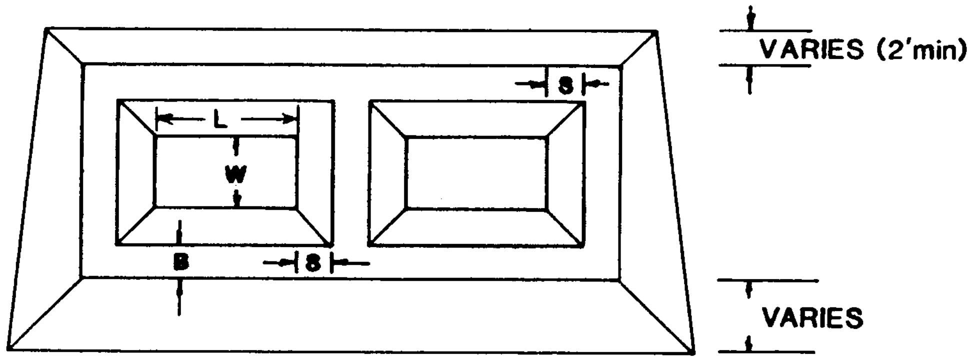


Figure 10. Schematic Map of the GDSCC Showing Site-Locations of the Three Sewage Evaporation Ponds



	ECHO	MARS
"L"	182'	110'
"W"	72'	40'
"S"	12'	12'
"B"	8'	8'

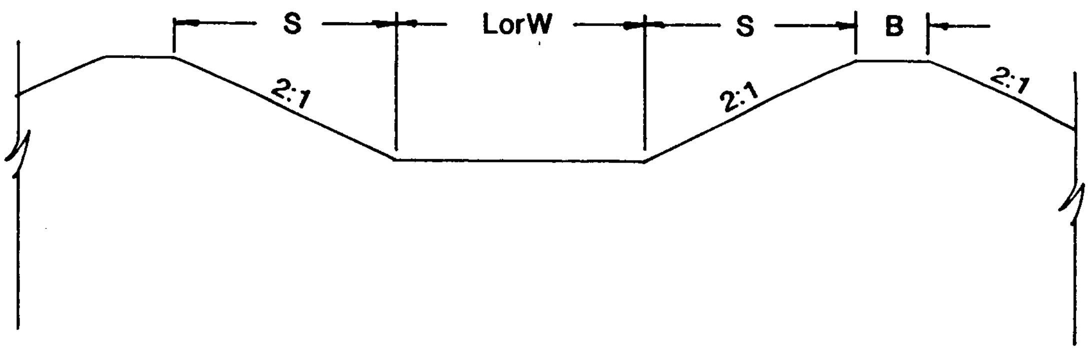
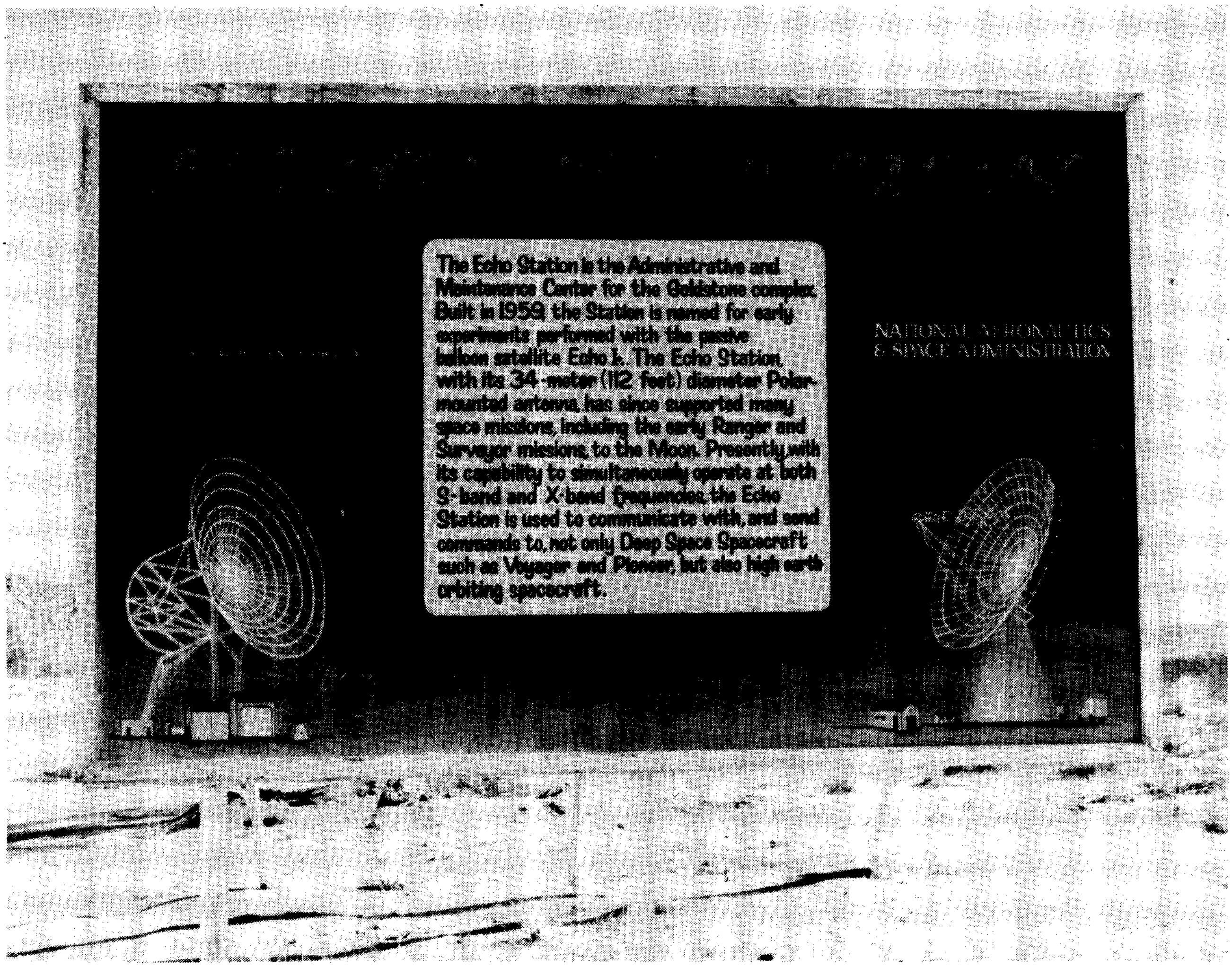


Figure 11. Plan for Pairs of Sewage Evaporation Ponds at the Echo and Mars Sites

Investigations of Subsurface Contamination and Sewage Evaporation Ponds Performed at Four of the Sites at the Goldstone Deep Space Communications Complex

ECHO STATION
DSS 12



Originally built in 1959, the 26-meter (85 ft) antenna first was used in 1960 in support of the Echo Project, an experiment to transmit voice communications Coast-to-coast by bouncing radio signals off the surface of a passive ballon-type satellite. In 1978, the antenna was extended to 34-meters (111.5 ft).

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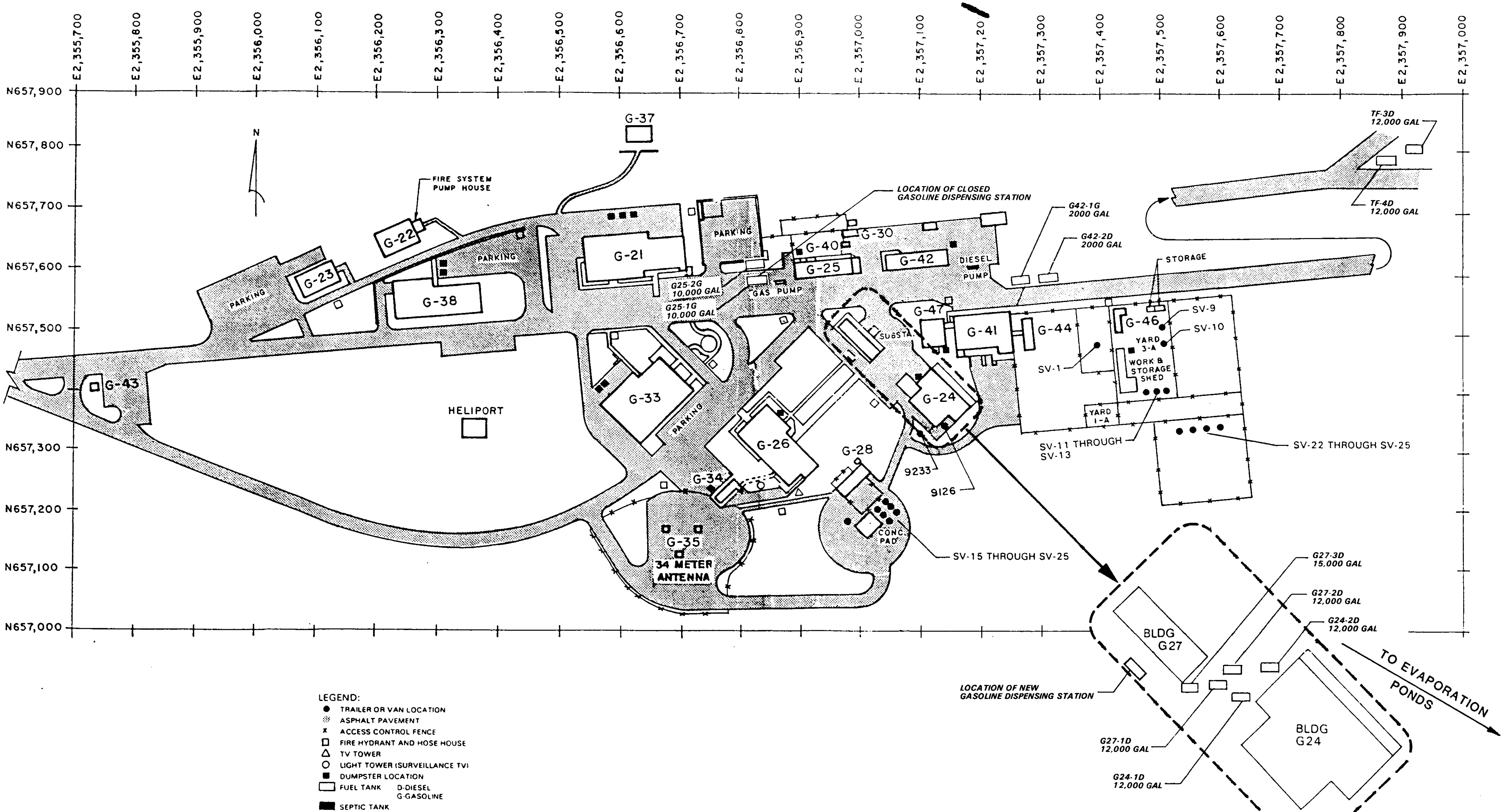

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Figure 12. Echo Site: Plot Plan.

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J. ECHO SITE (DSS 12)

1. Sewage Evaporation Ponds

Two sewage evaporation ponds at the Echo Site were examined.

The ponds at the Echo site, located approximately 1400 ft southeast of the main building cluster (Figure 12), are configured end-to-end, separated by a common embankment, and are oriented north to south (Figure 13). Each pond has an area of approximately 19,800 square ft and an operating volume of 61,000 cubic ft. With the average number of persons working at Echo Station at 110 persons per day, the average daily flow to the ponds is approximately 1,200 gallons per day.

Typical views of the sewage evaporation ponds at both the Echo and Mars Sites are depicted in Figure 14. All the interior embankments of the two evaporation ponds at the Echo Site (and the Mars Site) have been heavily eroded. Figures 15, 16, 17, 18 and 19 vividly depict the degree of erosion that has occurred. In some areas, no evidence exists of the original embankment lining. Rain runoff, flowing over the embankment into the pond, has caused erosion of the clay liner. Once the protective liner had been penetrated, the soil of the embankment constantly was saturated by the pond's contained effluent. As the level of effluent varied, wind-generated waves lapped at the embankment, causing the remaining liner material to slough off. Other factors that contribute to the degradation of the lining are weed growth (root penetration) along the water line, and rodent activity (digging or burrowing) on the top and sides of the embankments.

2. Proposed Repair of the Embankment Lining

a. <u>Alternatives Considered</u>

(1) Repair of the eroded clay material lining with additional local clay material.

(2) Relining the eroded embankment lining with a high-density plastic sheeting.

(3) Relining the eroded embankment with a bentonite/soil mixture.

(4) Relining the eroded embankment with soil cement.

(5) Relining the eroded embankment with Gunite.

(6) Relining the eroded embankment with a fabric-formed concrete lining.

b. <u>Recommended Method of Repair of Embankment Linings</u>

Relining of the embankments with either clay or high density polyethylene sheeting was ruled out due to their relatively short useful life of less than 20 years.

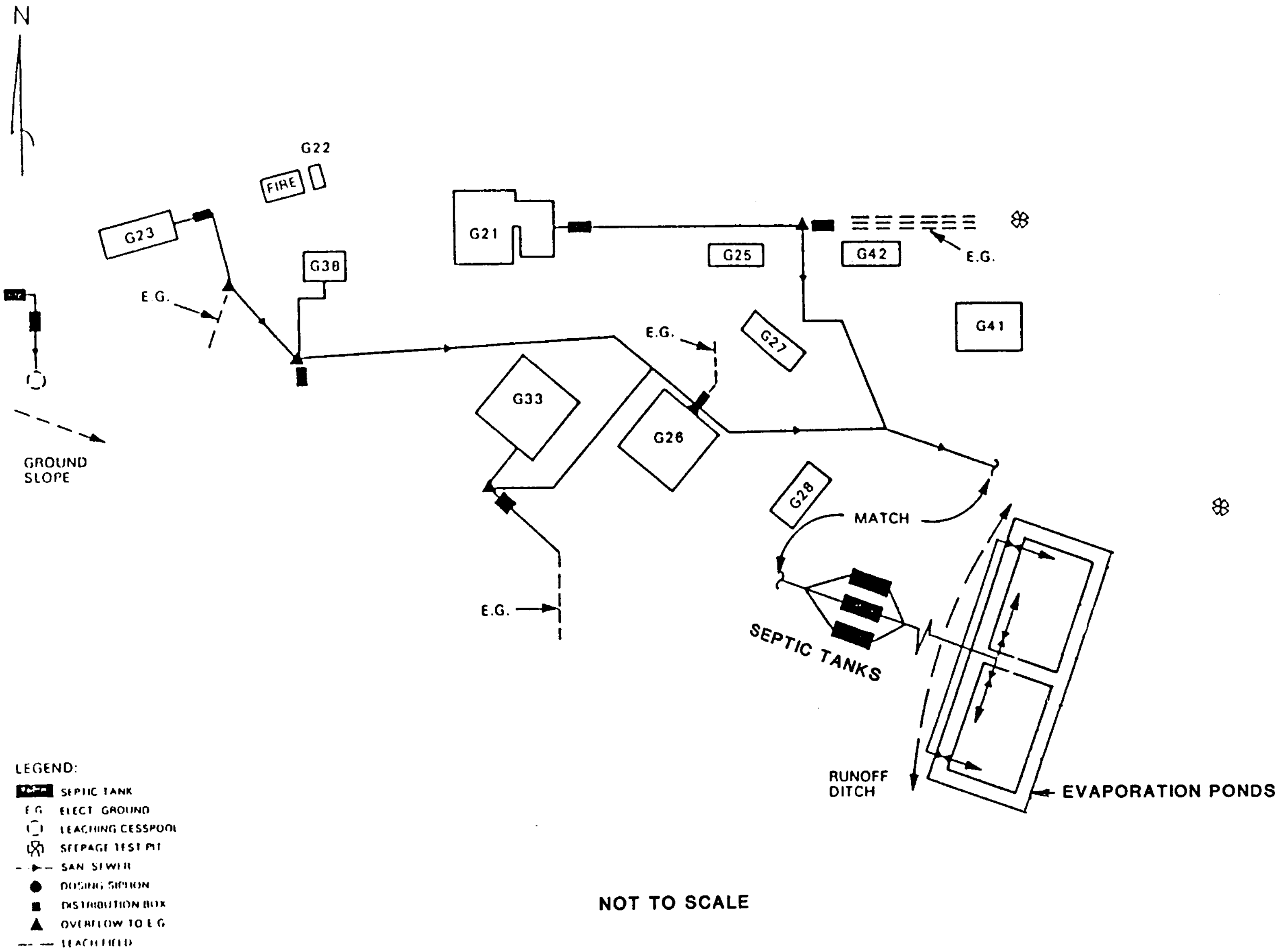

Figure 13. Echo Site: Schematic of Sewage System

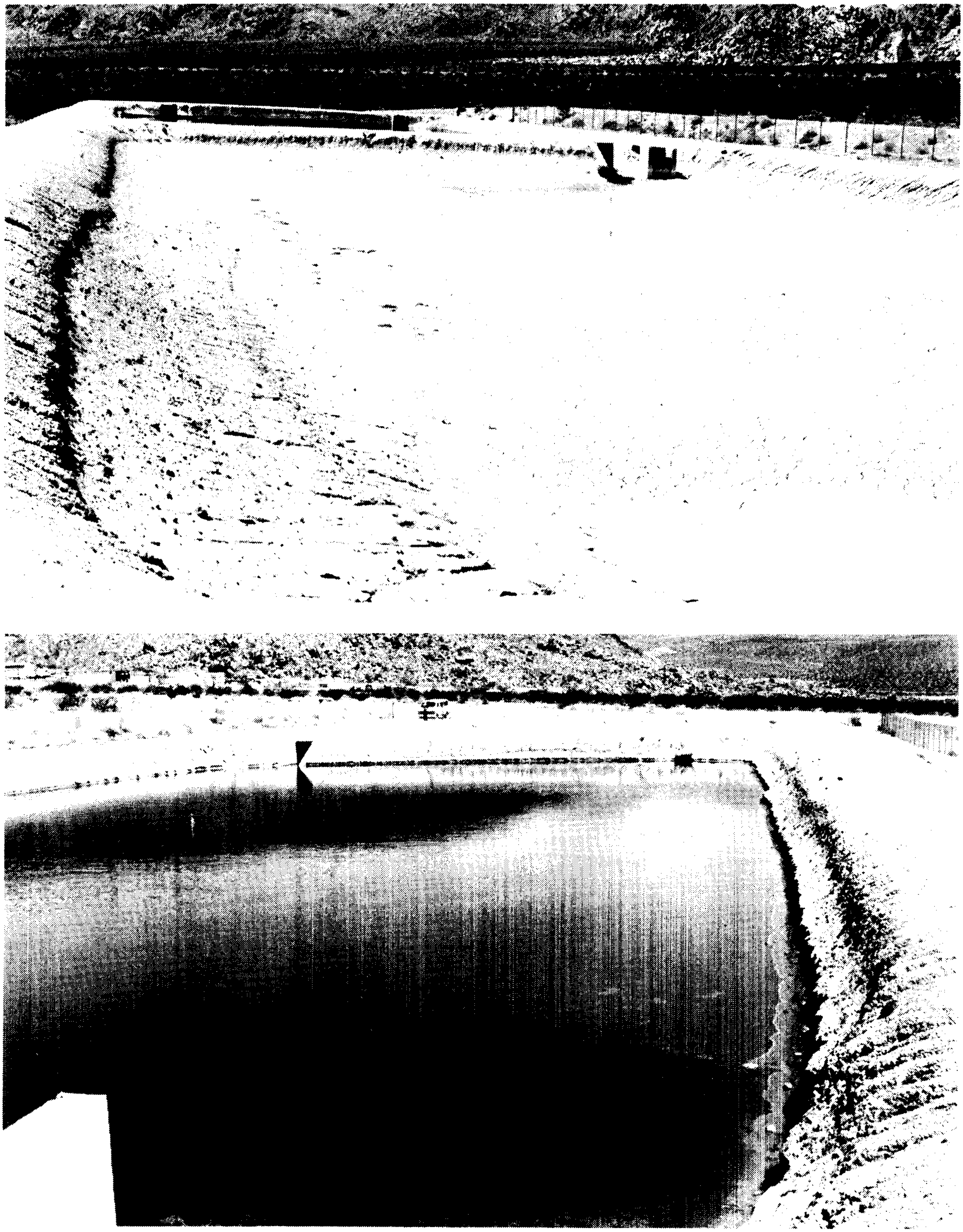

Figure 14. Typical Views of Sewage Evaporation Ponds at both Echo and Mars Sites

Figure 15. Typical Erosion at Shoreline at a Sewage Evaporation Pond

Figure 16. Typical Erosion of Embankment at a Sewage Evaporation Pond

Figure 17. Typical Erosion of an Embankment at a Sewage Evaporation Pond

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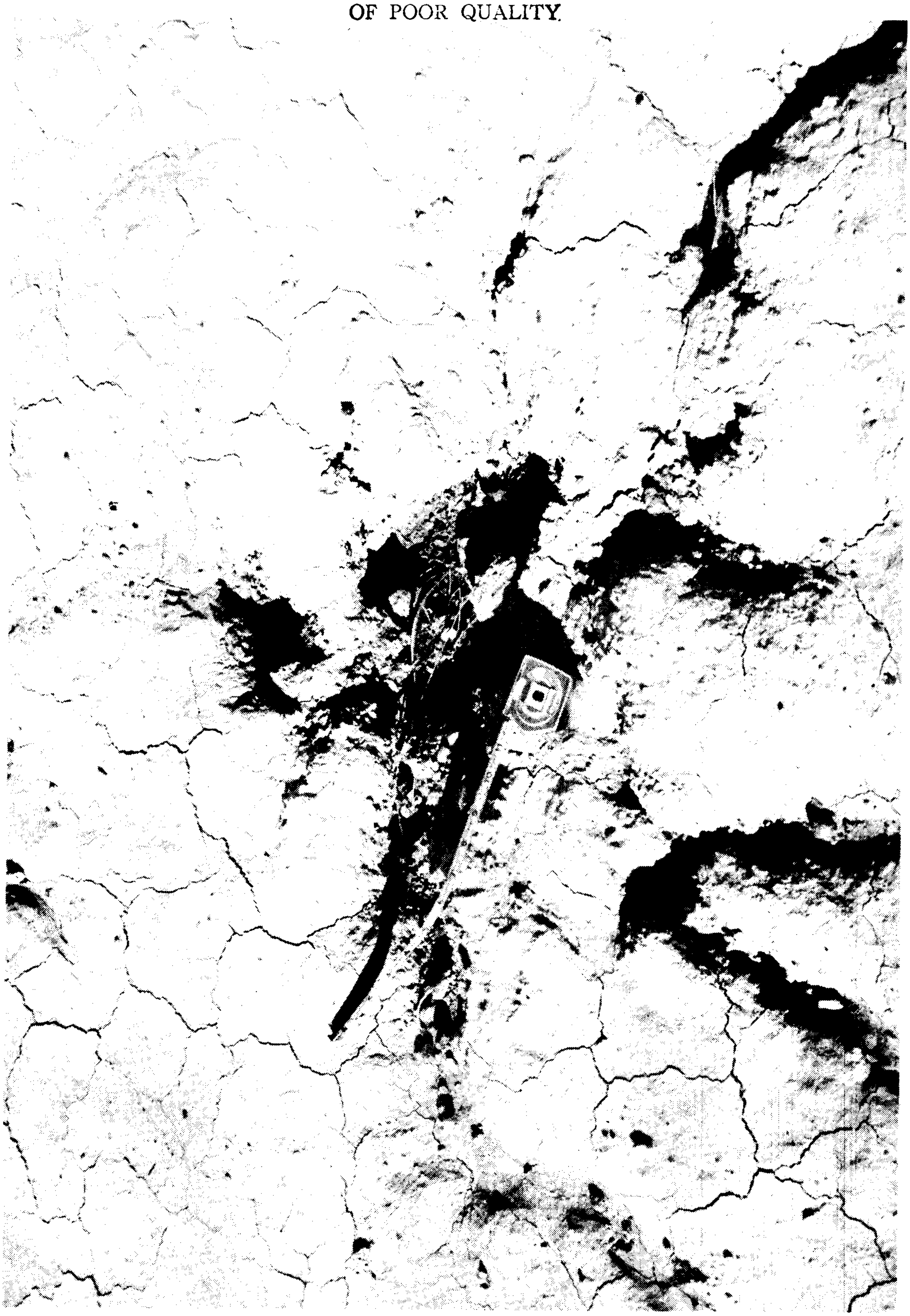

Figure 18. Fissures and Crevices in Eroded Embankment of a Sewage Evaporation Pond

Figure 19. Broad View of Embankment Erosion at a Sewage Evaporation Pond

Using a mixture of bentonite would not be satisfactory because the lining only would be effective if it was continually saturated and not allowed to dry. Bentonite would erode as readily as the original clay liner and also has a relatively short useful life.

Soil cement was ruled out because of its high cost and the need for virtual reconstruction of the ponds.

Although it has a long useful life, the use of Gunite was ruled out because of its high cost.

Thus, the use of a fabric-formed concrete lining was chosen because of its reasonable cost and long useful life.

c. Description of the Selected Alternative: Fabric-Formed Concrete

The selected alternative for repair of the ponds' eroded embankments is a cast-in-place, concrete, erosion-control mat that is easily installed above and below the water. The mat is a permeable, woven panel of continuous double-layer synthetic fabric joined together to serve as a forming material for the construction of concrete erosion-control revetments. This fabric envelope, in a mat configuration, is positioned over the slope to be protected and filled with a pumpable, fine-aggregate concrete slurry (Figure 20). The permeable fabric prevents the loss of mortar during underwater placement, allows excess mixing water to escape, and assures a low water/cement ratio and accelerated hardening that results in the production of a durable concrete structure.

The double-layer fabric formwork is maintained in its parallel relationship by interior spacer cords to form a lining of uniform minimal thickness.

No problems or risks are expected in the implementation of these recommendations regarding repair of the embankment linings of the sewage evaporation ponds at both the Echo and Mars Sites.

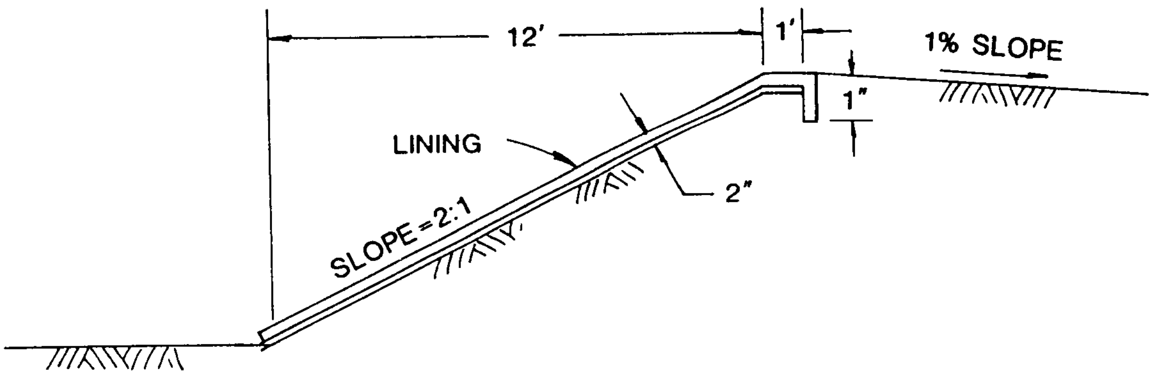

Figure 20. Schematic of Recommended Concrete, Erosion-Control, Mat-Lining for Repair of Inner Embankments of Sewage Evaporation Ponds

MARS STATION
DSS 14

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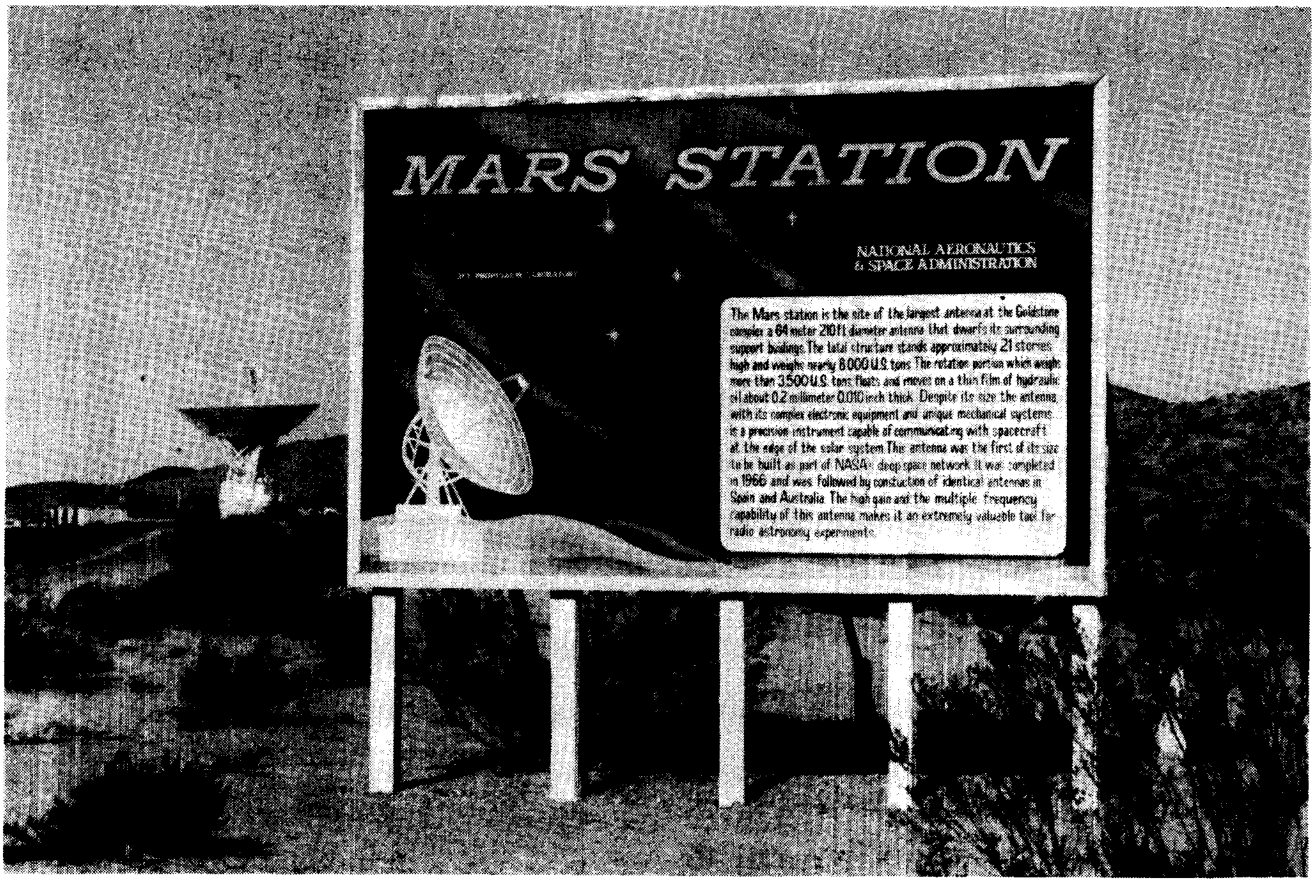

Built in 1966, the 64-meter (210 ft) antenna, standing more than 234 ft tall, permitted the DSN's transmitter power and receiver sensitivity to increase 6.5 times compared to that of a 26-meter antenna. It also extended the range of the DSN into deep space by 2.5 times. The 64-meter parabolic dish is being extended to 70 meters (230 ft) to be ready for the Voyager 2 spacecraft's encounter with the planet Neptune in 1989.

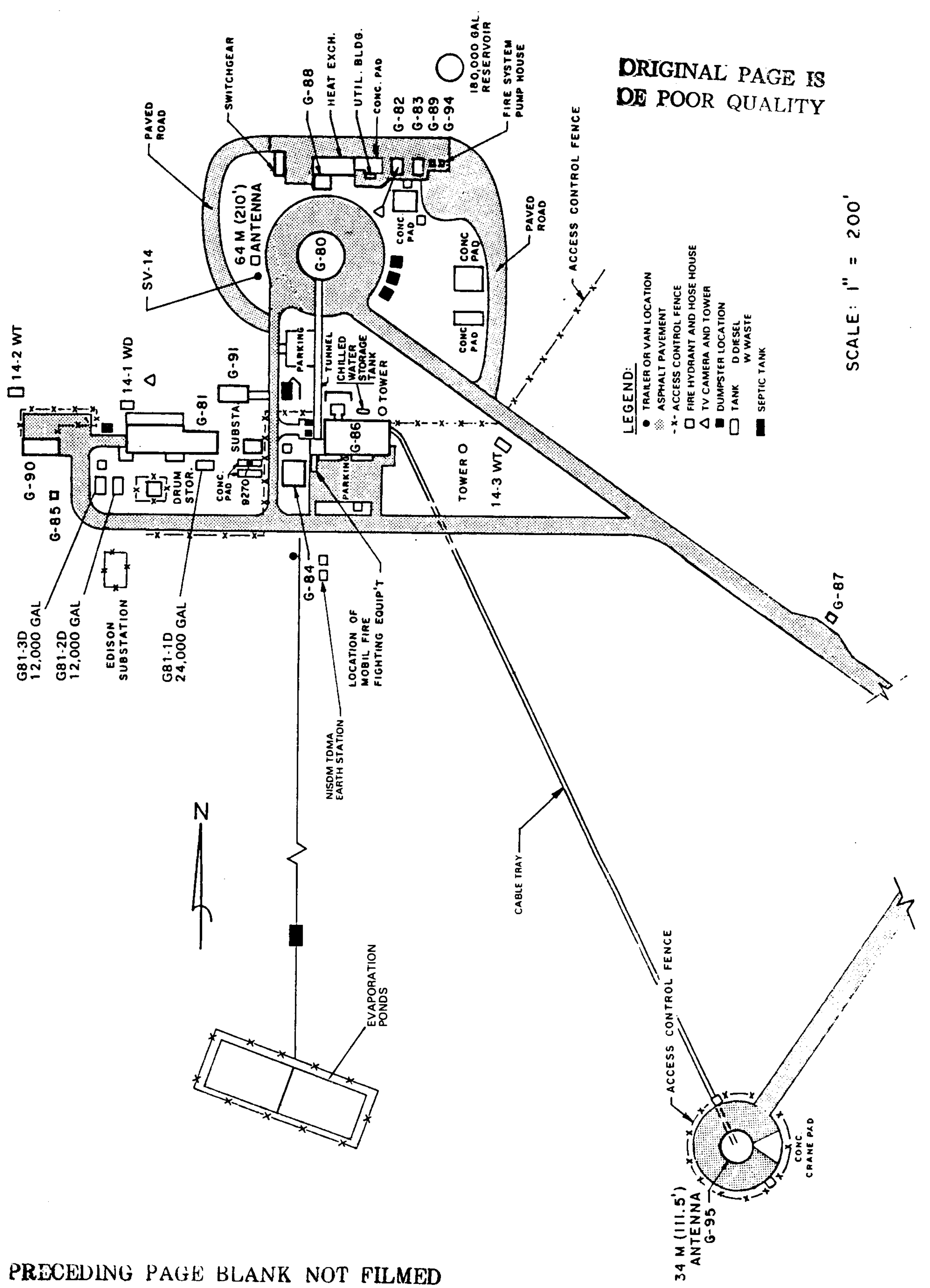

Figure 21. Mars Site: Plot Plan.

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K. MARS SITE (DSS 14 AND DSS 15)

The Mars Site (Figure 21) was subjected to both an investigation of subsurface contamination at a hazardous-materials and waste-storage area (Figures 22 and 23) and to an examination of its sewage evaporation ponds.

1. Subsurface Contamination Investigation

The original sampling plan for the subsurface contamination study called for the use of the CME-75 drill rig to obtain borehole samples (Figures 24 and 25) but repeated efforts failed to penetrate through the rocky soil. In some instances, a shallow borehole resulted but then the sampler was refused. Because of the inability to recover samples from the boreholes, pits were dug by hand. It was not possible to obtain samples from depths greater than 1-1/2 ft.

Of the four pits, hand dug to a depth of 1-1/2 ft at the Mars site (Figure 23), pits B1 and B2 were located at the eastern end of the fenced, asphalt paved area. Pit B3 was located just west of the dumpster location and pit B4 was located just south of the diesel waste-oil tank (14-1).

Eight soil samples collected from the Mars site were analyzed for total petroleum hydrocarbons. Four of the eight samples also were analyzed for halogenated volatile organics and for aromatic volatile organics.

2. Sewage Evaporation Ponds

The sewage evaporation ponds at the Mars site are located south of the main building cluster. Similar to the evaporation ponds at the Echo Site, the Mars evaporation ponds are configured end-to-end, separated by a common embankment, and oriented northwest to southeast (Figures 13 and 21). Each pond has an area of approximately 8,600 square feet and an operating volume of 22,700 cubic ft. With the average number of persons working at Mars Station at 48 persons per day, the average daily flow to the ponds is approximately 420 gallons.

The Mars evaporation ponds show similar erosion of their embankment linings as seen for the embankment linings of the sewage evaporation ponds at the Echo Site (see Figure 26 and Section IV J1). Recommended repair of the eroded embankment linings at the Mars Site ponds involves the same technique and materials (fabric-formed, concrete, erosion-control mat) as recommended for the Echo Site ponds (see Section IV J2a, b, and c).

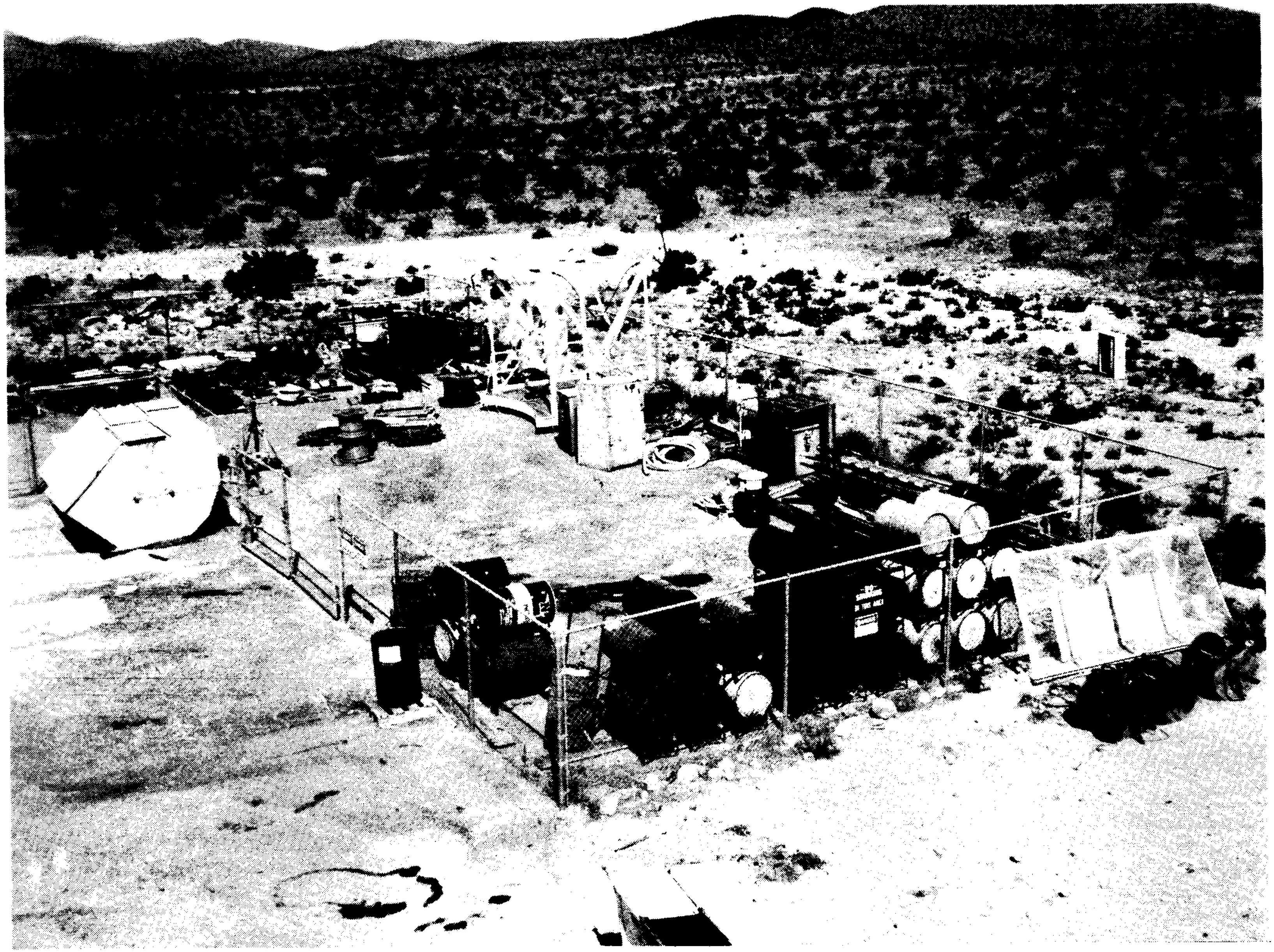

Figure 22. Mars Site: View of Hazardous-Materials and Waste-Storage Area Tested for Subsurface Contamination

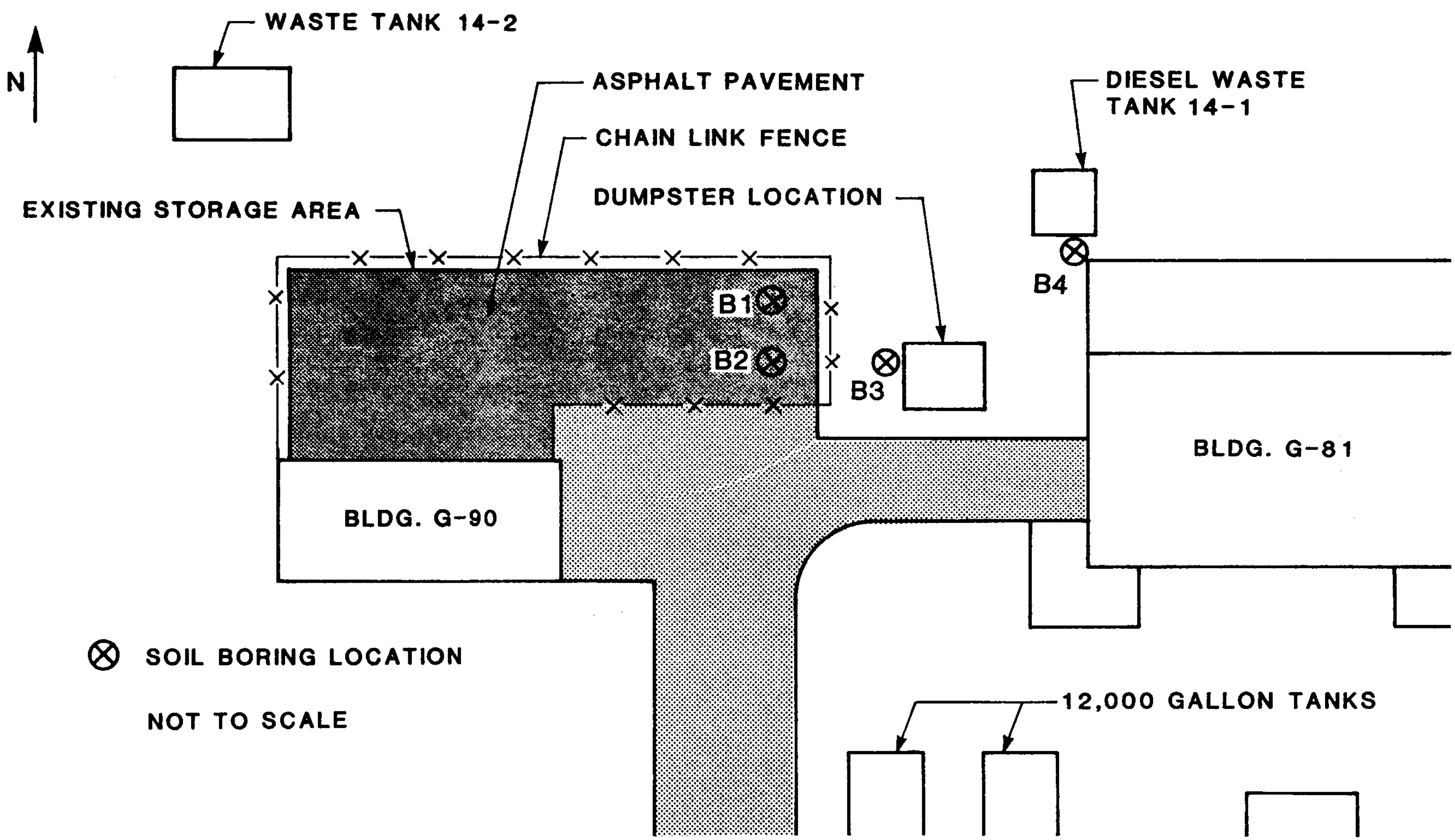

Figure 23. Mars Site: Locations of Hand-Dug Pits at the Hazardous-Materials and Waste-Storage Area near Building G-81

Figure 24. Mars Site: Close-up View of the CME-75 Drill Rig Used to Obtain Soil Samples

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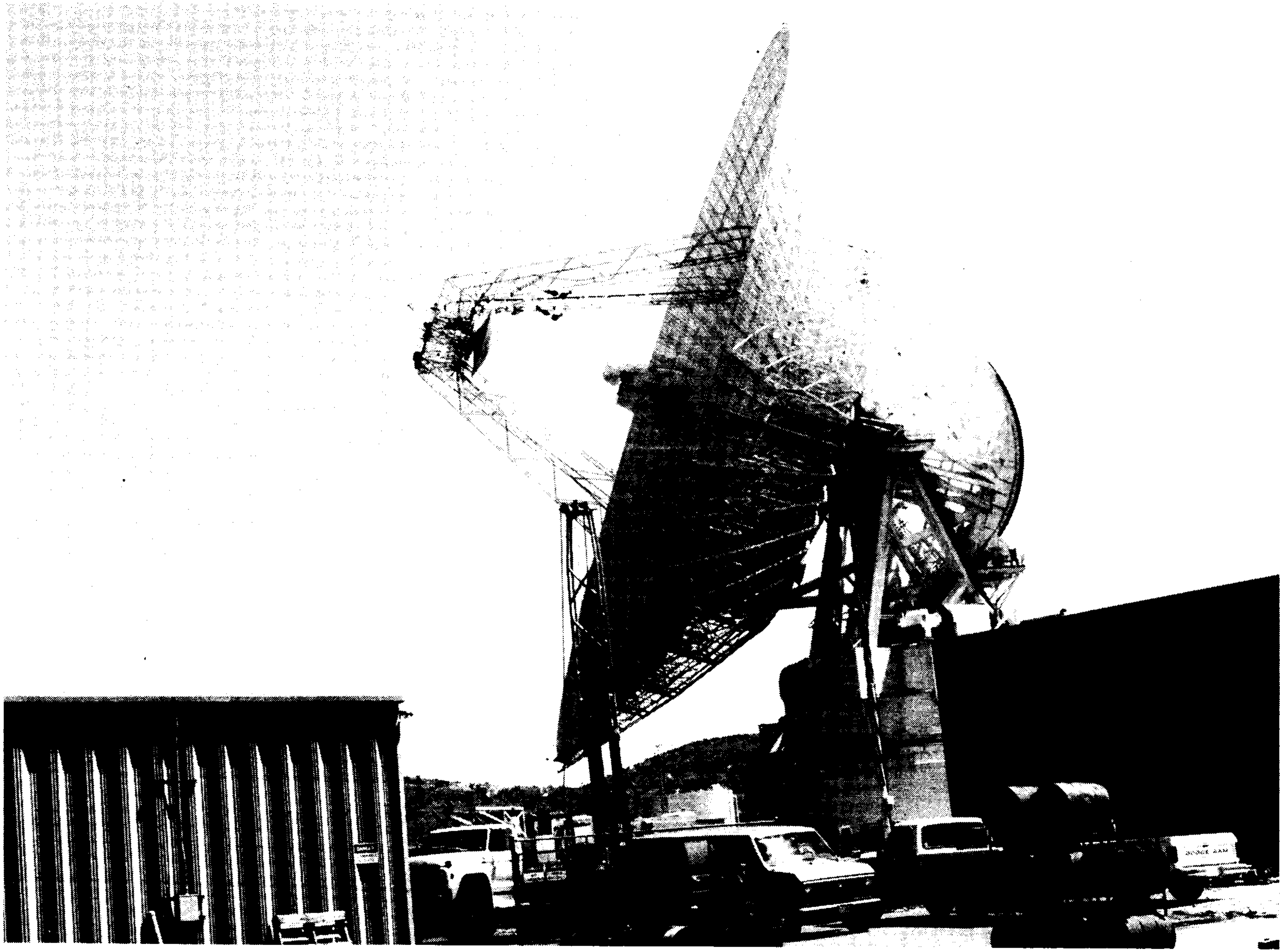

Figure 25. Mars Site: General View of the CME-75 Drill Rig Used to Obtain Soil Samples

Figure 26. Mars Site: Embankment Erosion at Sewage Evaporation Ponds

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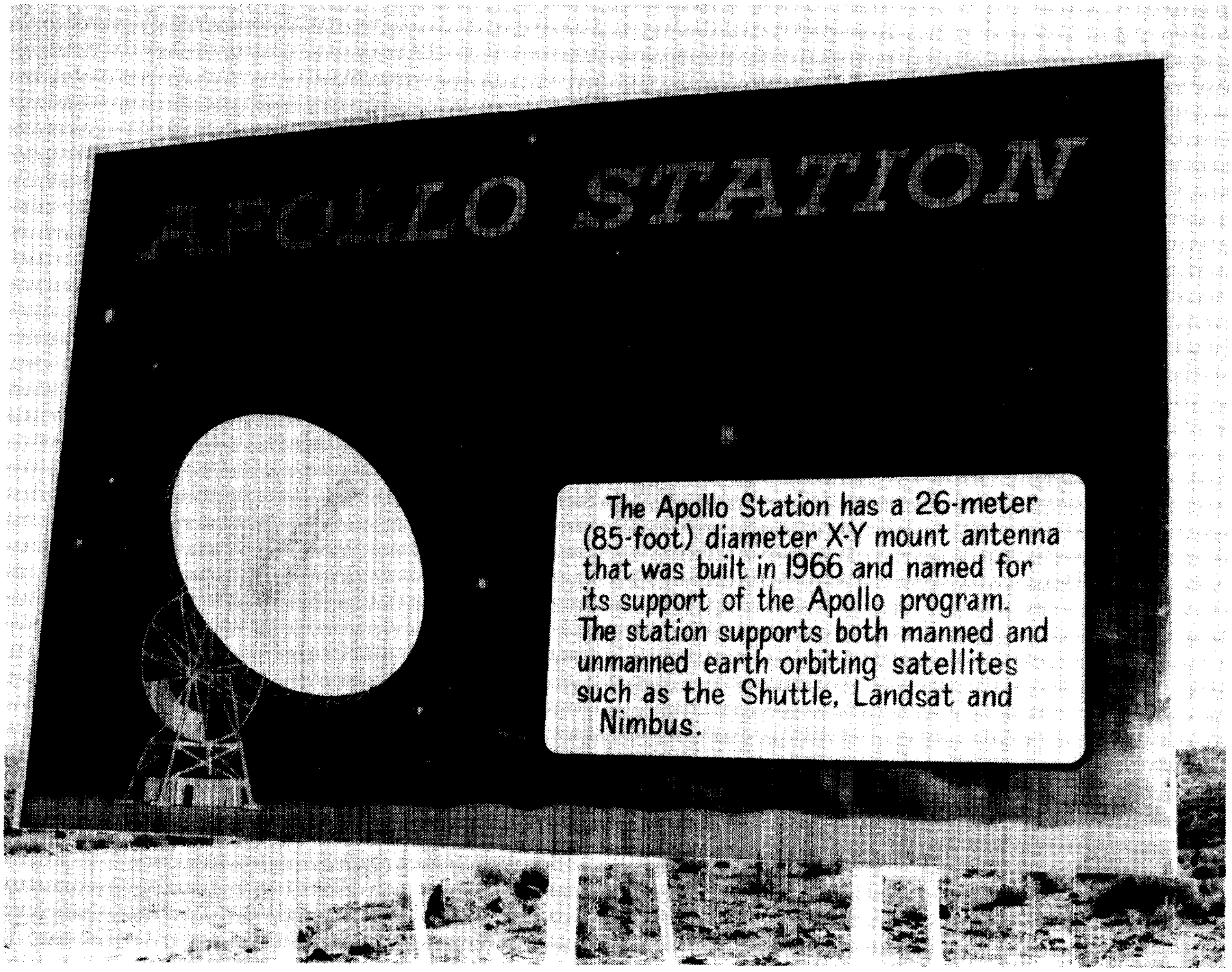
APOLLO STATION
DSS 16



This 26-meter (85 ft) antenna, built in 1965 by the NASA Goddard Space Tracking and Data Network (STDN) to support the manned Apollo missions to the Moon, was transferred to the DSN in October 1984. The antenna is used to support satellites in both low- and high-Earth orbits as well as STS (Space Shuttle) missions.

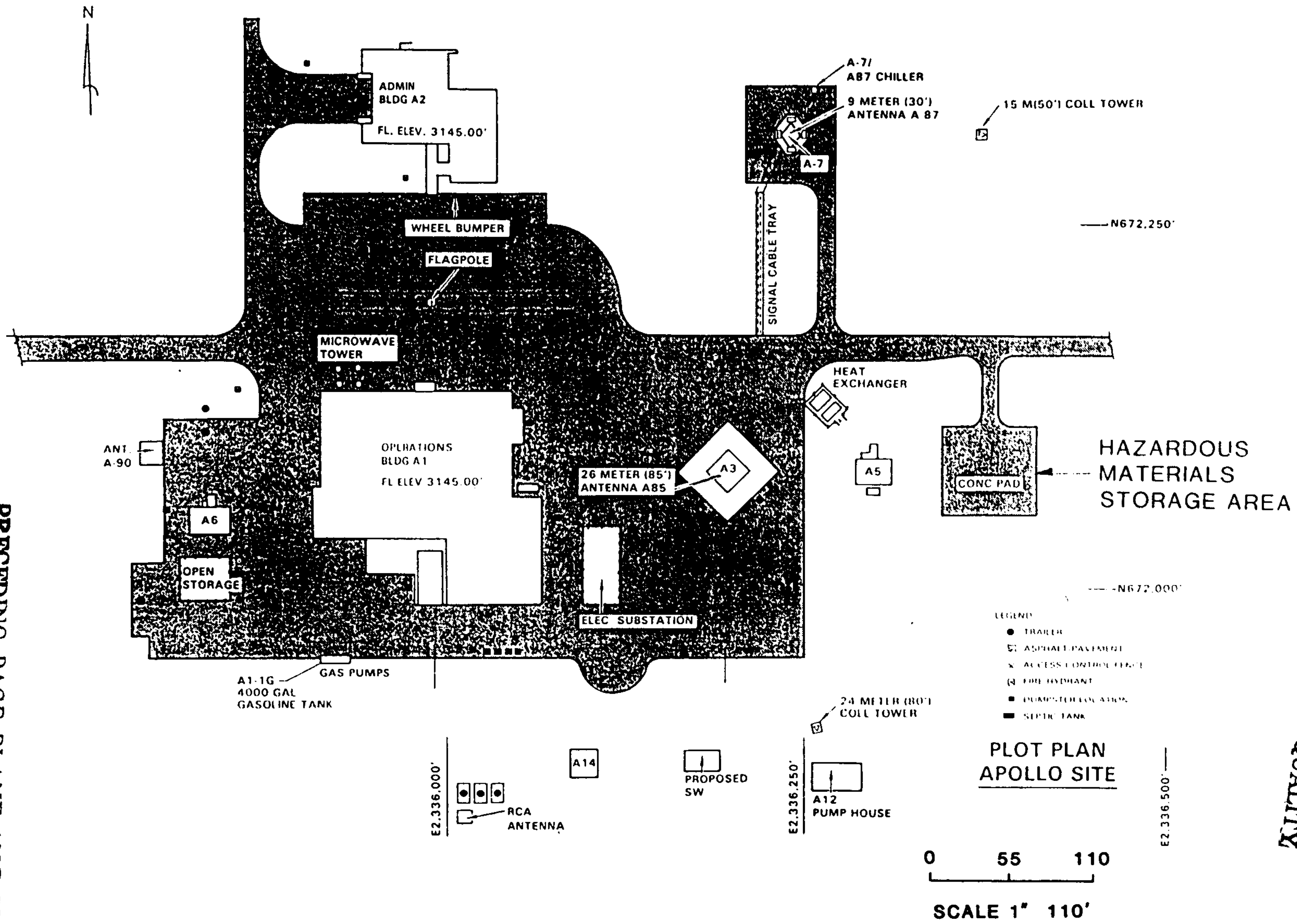


Figure 27. Apollo Site: Plot Plan Showing Location of Hazardous-Materials Storage Area

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L. APOLLO SITE

Although the Apollo Site does not have sewage evaporation ponds, it does have an existing hazardous-materials storage area (Figures 27 and 28) and a possible former dumpsite area (Figure 29) that may have contributed to subsurface contamination. Thus, seven soil borings to test for subsurface contamination were drilled at the Apollo Site.

As shown in Figure 30, five of the borings, B1, B2, B3, B6, and B7, were placed along the western, southern and eastern perimeters of the concrete pad at the existing storage area. Each of the borings B1, B2 and B3 were drilled to a depth of 15 feet. Borings B6 and B7 were drilled to depths of 12 feet and 10 feet, respectively. Borings B4 and B5 were drilled in a suspected former dump area located approximately 35 feet south of the concrete pad, and went down to depths of 10 feet and 8-1/2 feet, respectively.

Twelve soil samples from the Apollo site were analyzed for total petroleum hydrocarbons. Seven of the 12 samples also were analyzed for halogenated volatile organics and for volatile aromatic organics.

Figure 28. Apollo Site: General View of Hazardous-Materials Storage Area

Figure 29. Apollo Site: Possible Former Dumpsite Area Tested for Subsurface Contamination

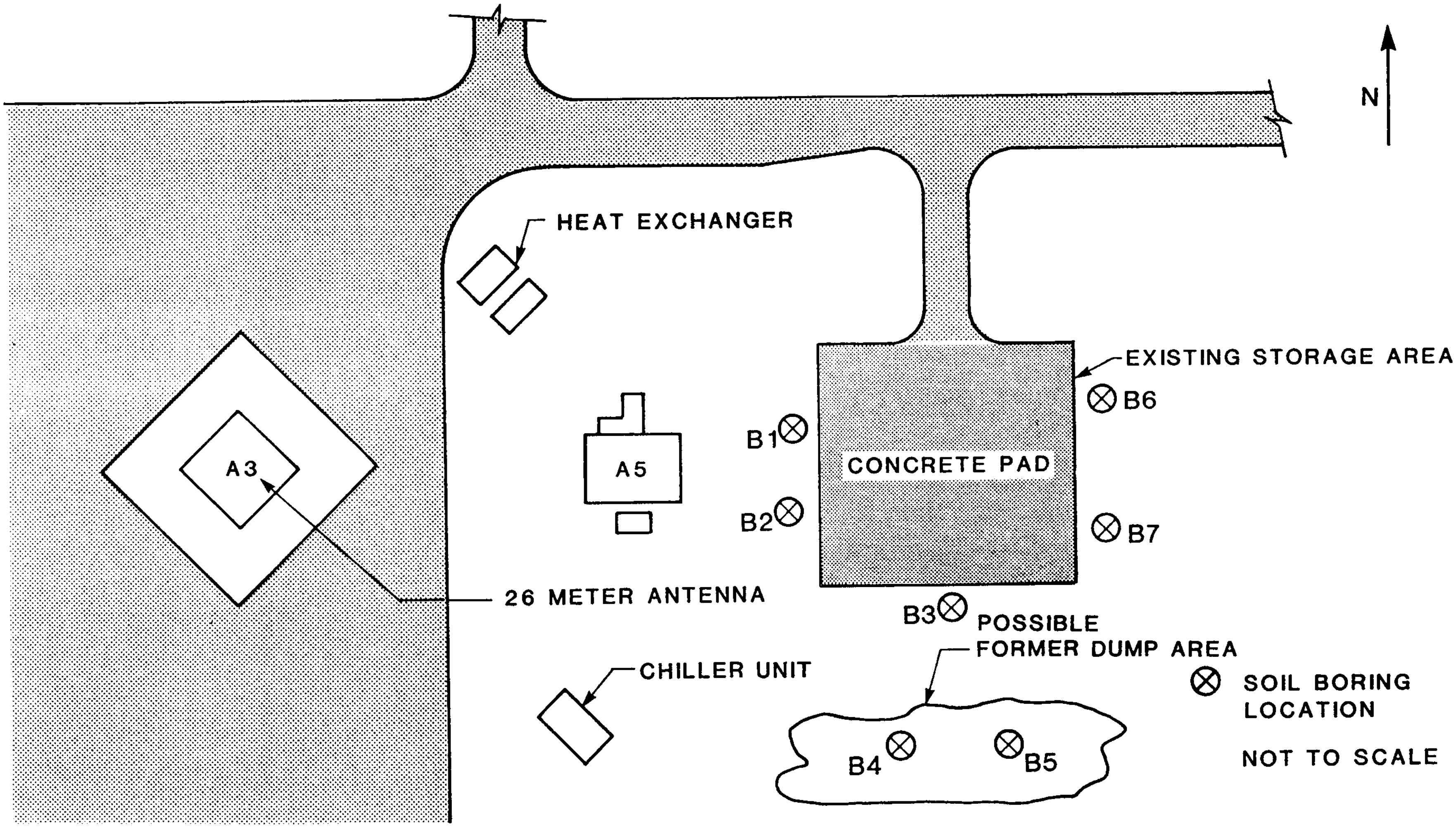

Figure 30. Apollo Site: Borehole Locations in both Existing Hazardous-Materials Storage Area and in Possible Former Dumpsite

Figure 29. Apollo Site: Possible Former Dumpsite Area Tested for Subsurface Contamination

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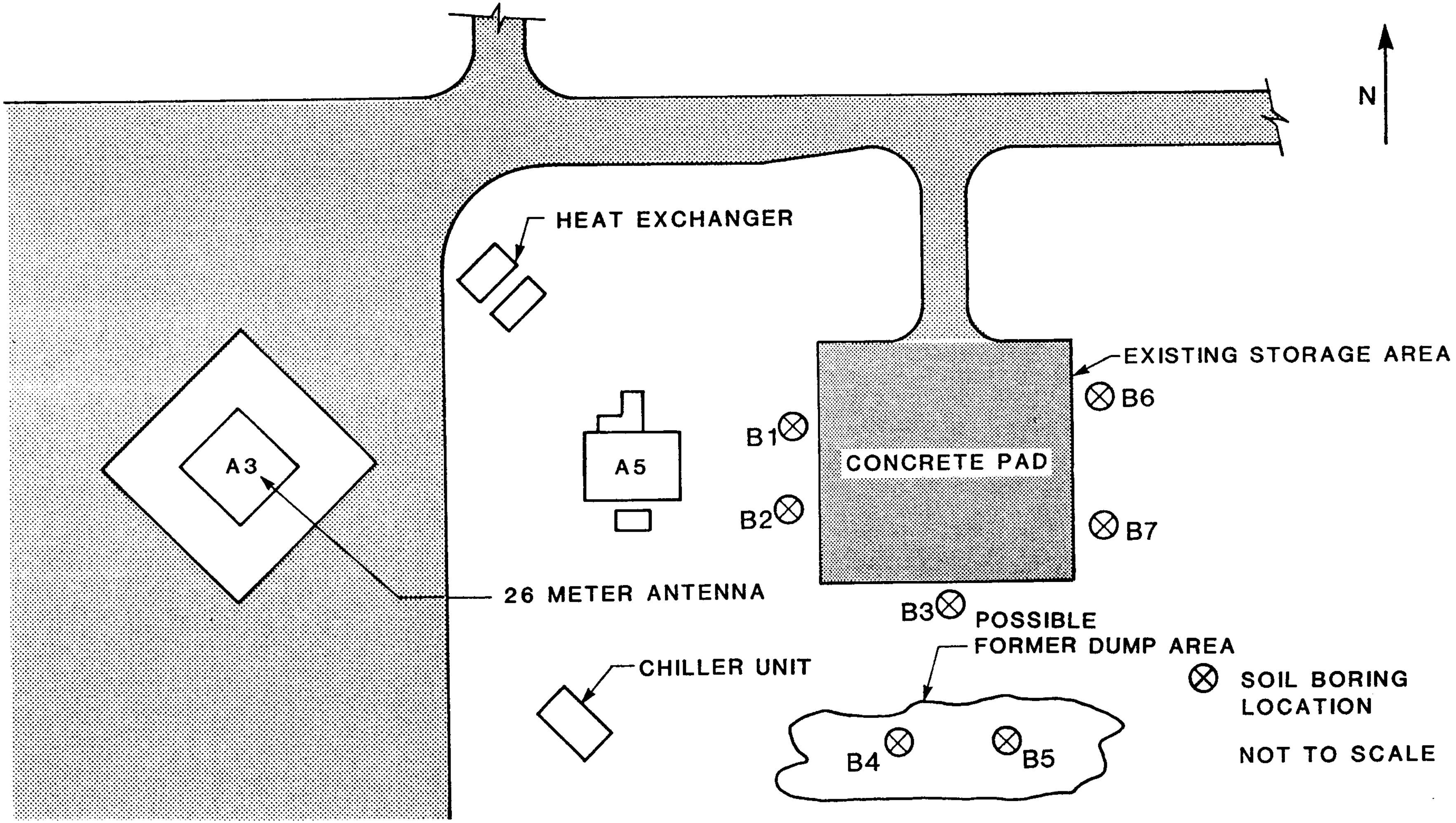

Figure 30. Apollo Site: Borehole Locations in both Existing Hazardous-Materials Storage Area and in Possible Former Dumpsite

MOJAVE BASE STATION

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In addition to the six NASA/JPL DSSs the Goldstone Complex also has a 12-meter (40 ft) antenna at the Mojave Base Station, located near DSS 16, the Apollo Station. This antenna now is operated by NOAA.

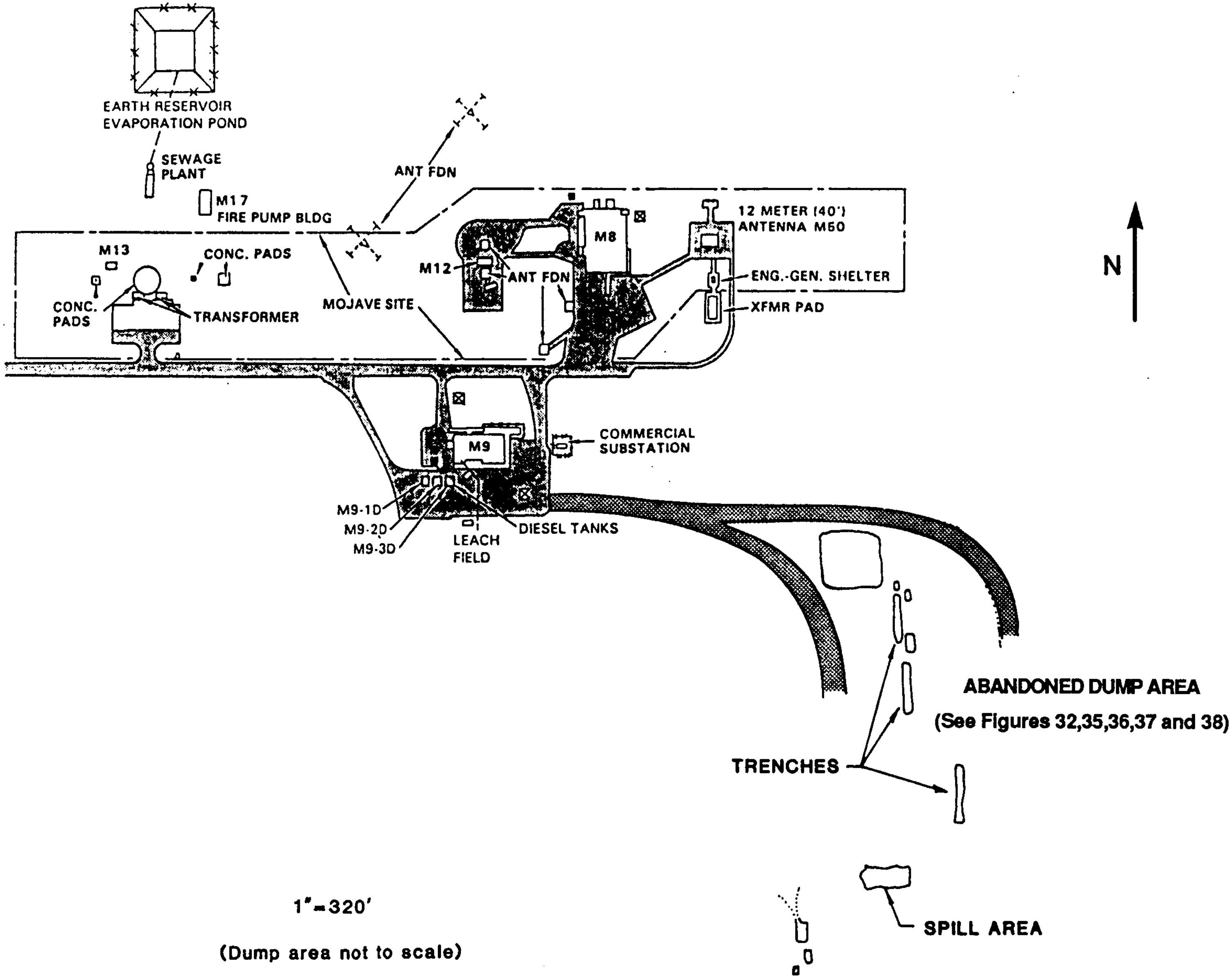

Figure 31. Mojave Base Site: Plot Plan and Location of Abandoned Dumpsite and Abandoned Sewage Plant and Sewage Evaporation Pond

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M. MOJAVE BASE SITE (NOAA ANTENNA)

The Mojave Base Site contains both an abandoned dumpsite, with a potential for subsurface contamination (Figures 31 and 32), and a fenced and abandoned sewage evaporation pond (Figures 33 and 34).

1. Subsurface Contamination Investigation

The field program at the Mojave Base Site included hand-augering a single boring within the abandoned sewage evaporation pond and backhoe excavation of seven pits within the abandoned dumpsite. A thorough visual inspection of the abandoned dumpsite also was made and is described in Section V.

The boring at the abandoned sewage evaporation pond was hand-augered to a depth of five feet and was located approximately 15 feet north of the sewage plant discharge pipe (Figure 34). The two samples collected from this boring at 1- and 5-ft depths, respectively, were analyzed for priority pollutant metals. The sample collected at the 5-ft depth also was analyzed for volatile halogenated and aromatic organics.

Five of the seven backhoe pits were dug at the abandoned dumpsite adjacent to the three trenches used for trash disposal (Figure 35). The northern and southern trenches were open while the center trench had been backfilled (Figures 36 and 37). These pits were excavated to a depth of 7-1/2 to 8-1/2 feet. The two remaining pits were shallower, approximately 3 feet deep, and were located in a burned area and a stained area as shown in Figure 35.

Fifteen soil samples collected from the Mojave dumpsite pits were analyzed for priority pollutant metals. Seven of the fifteen samples were also analyzed for volatile halogenated and aromatic organic compounds. In addition, five of the samples were analyzed for total petroleum hydrocarbons (Figure 38).

2. Visual Inspection of the Mojave Abandoned Dumpsite

For about 20 years, from the mid-1960s to 1985, the Mojave Base Site was not used by JPL but by another NASA agency. During this period, an area southeast of the antenna at the Mojave Base Station was used by this agency as a repository for trash, scrap, and surplus materials. In 1985, the Mojave Base Site came under JPL control. At that time, no further dumping of trash or other unauthorized materials into this dumpsite was permitted. The location of the abandoned dumpsite in relation to the Mojave Base Station is shown in Figure 31. Cleanup and restoration are required for this now abandoned dumpsite area. The existing debris and materials can be broadly classified as (1) trash, (2) scrap metal, both ferrous and non-ferrous, (3) cable and wire, (4) scrap wood, and (5) unserviceable mechanical and electrical equipment. This material has been disposed of on the surface or in trenches cut by a bulldozer. The following paragraphs describe the nature of the debris, the disposal areas, and their location within the dumpsite.

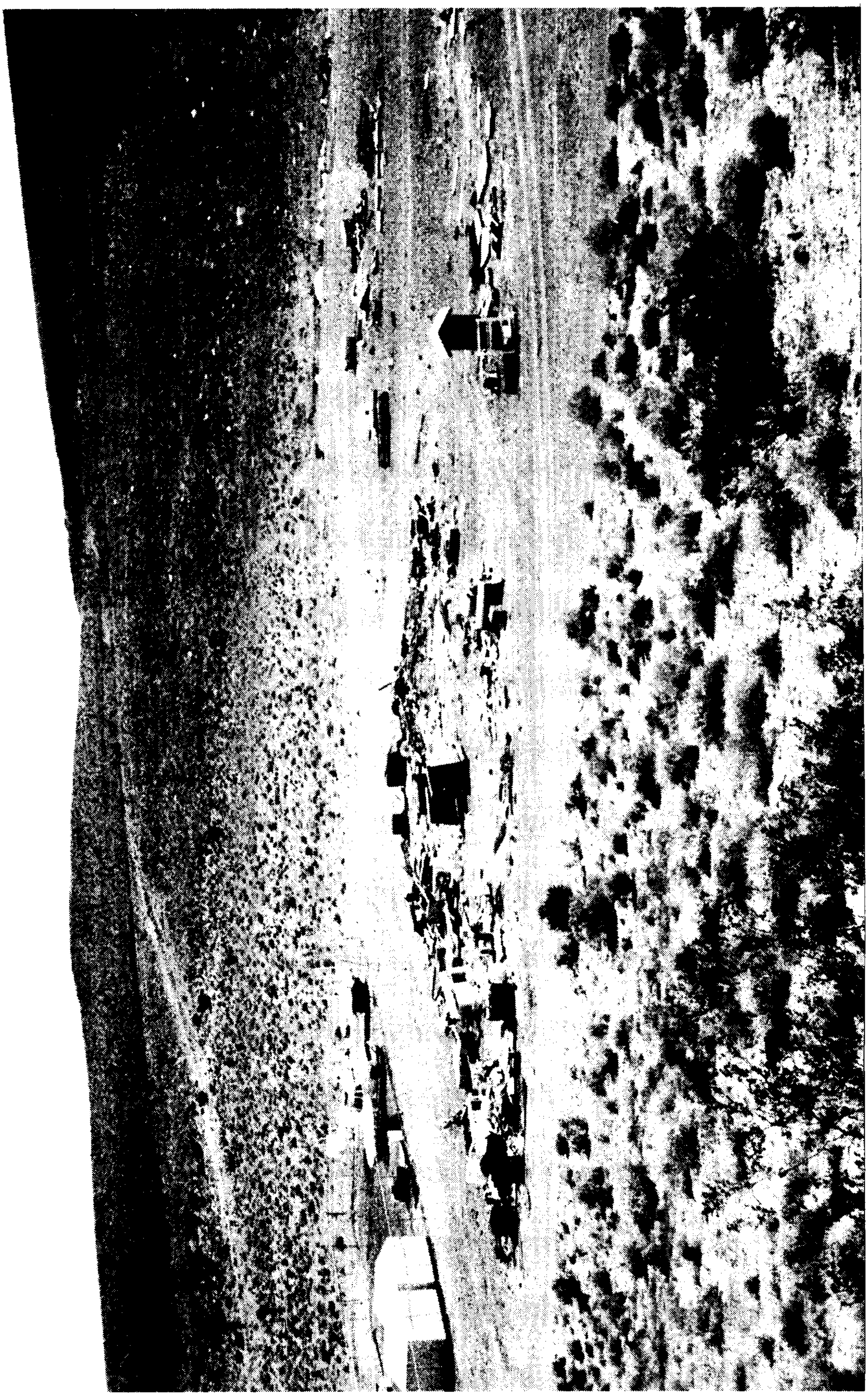

Figure 32. Mojave Base Site: Overview of Abandoned Dumpsite

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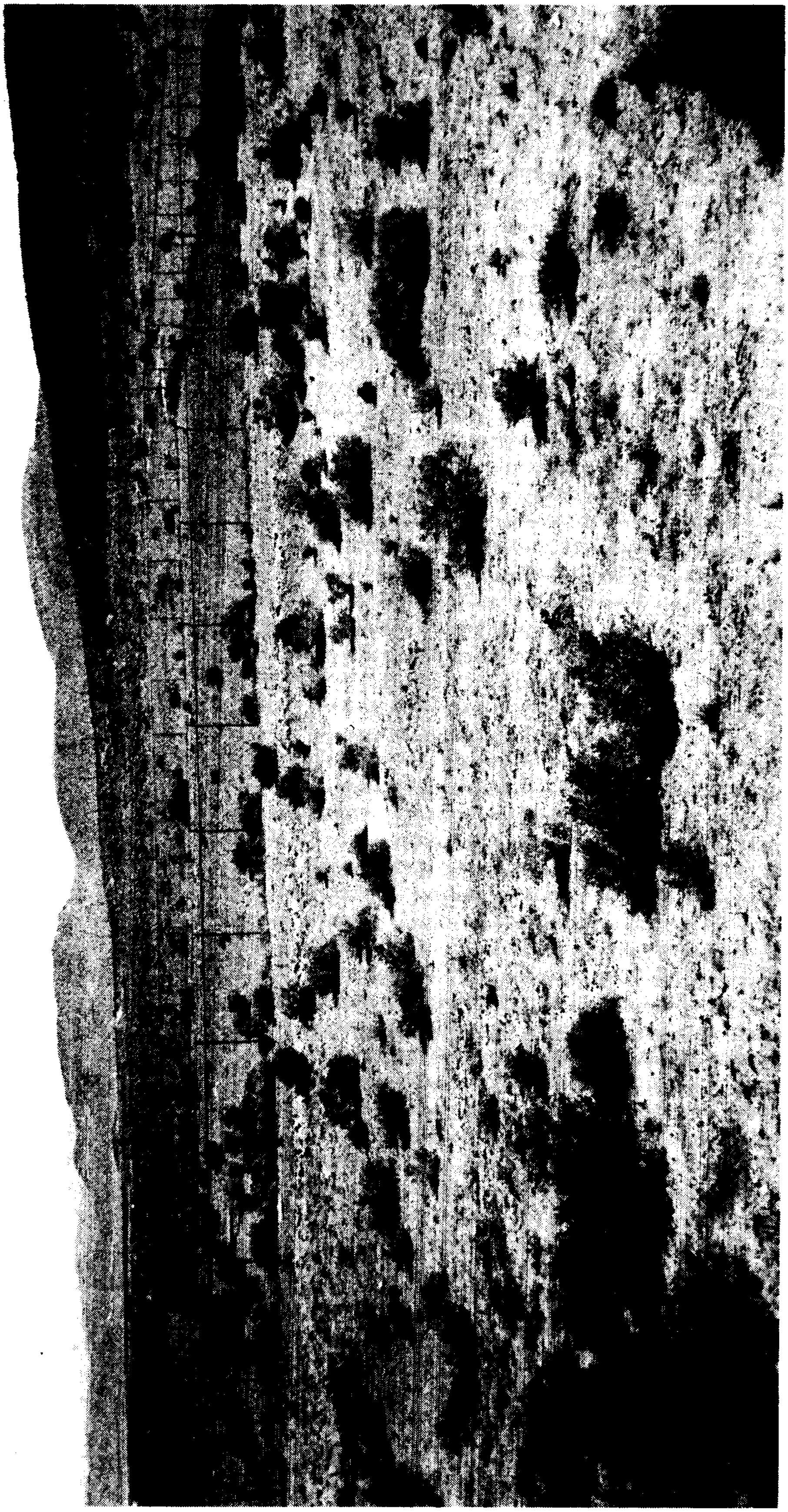

Figure 33. Mojave Base Site: Fenced and Abandoned Sewage Evaporation Pond Scheduled to be Properly Closed According to Environmental Regulations.

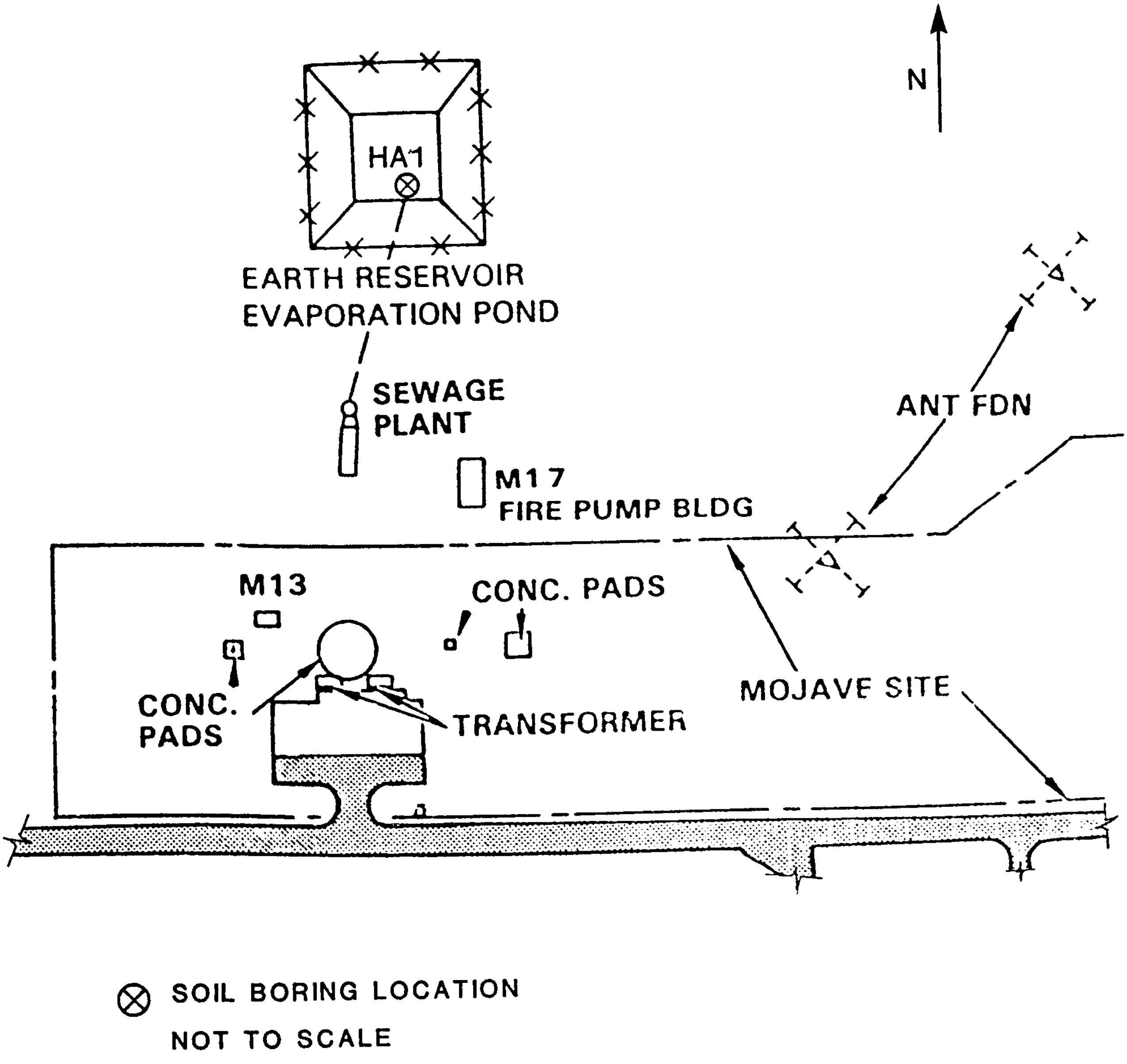

Figure 34. Mojave Base Site: Schematic Detail of Abandoned Sewage Evaporation Pond and Location of Single Borehole

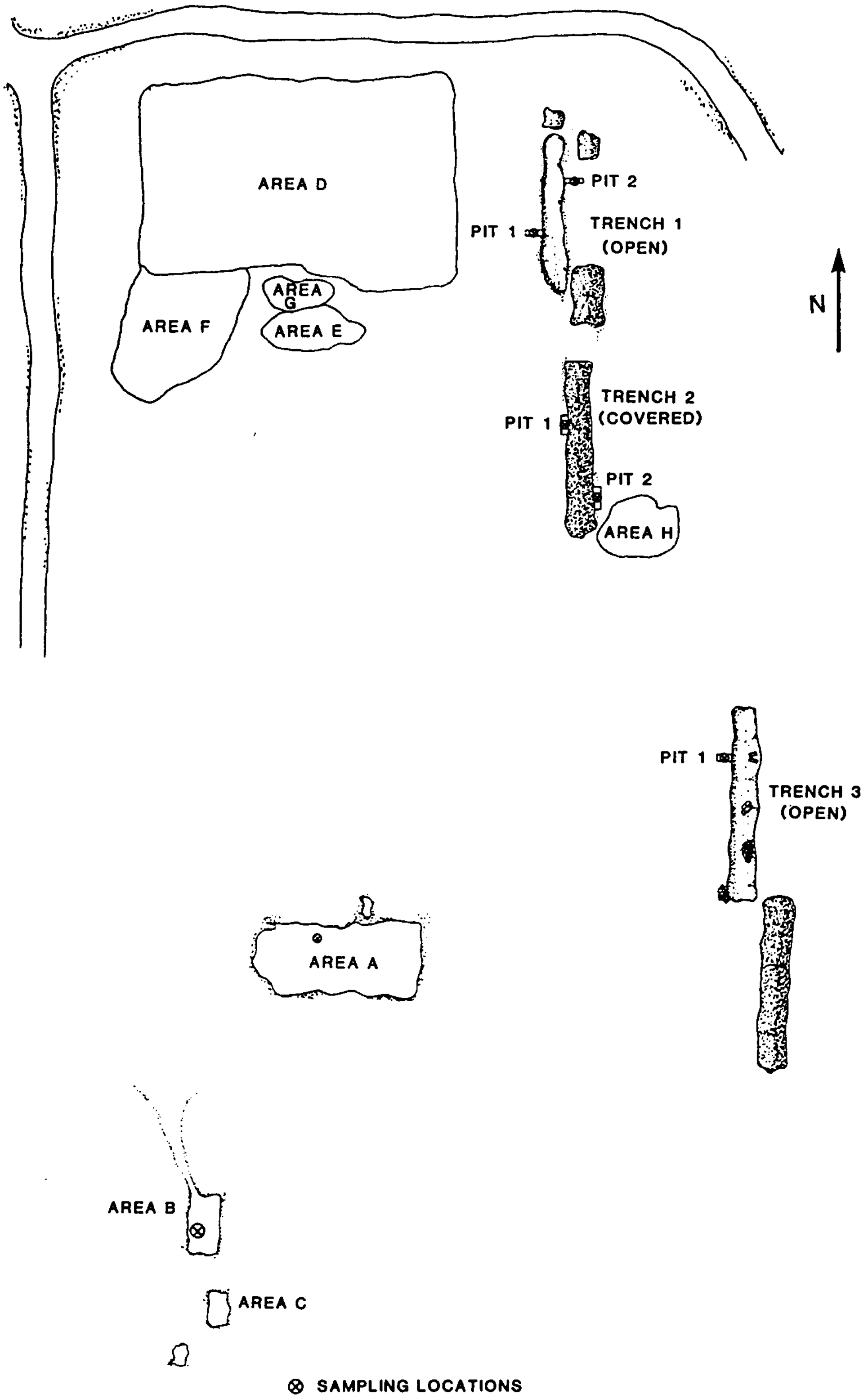

Figure 35. Mojave Base Site: Location of Open and Covered Trash-Trenches and Seven Excavated Sampling Pits at the Abandoned Dump Site (see Figure 31 for Location of Area within Mojave Base Site)

Figure 36. Mojave Base Site: Backhoe Excavation of a Pit Adjacent to an Open Trash-Trench at Abandoned Dumpsite

Figure 37. Mojave Base Site: Backhoe Excavation of a Pit Adjacent to a Covered Trash-Trench at Abandoned Dumpsite

Figure 38. Mojave Base Site: HNu Photoionization Meter "Sniffing" for Volatile Organic Materials from an Excavated Pit Adjacent to an Open Trash-Trench at Abandoned Dumpsite (Note Plastic Sheet to Avoid Cross-Contamination between Trench and Pit)

a. <u>Open and Covered Trash-Trenches at Abandoned Dumpsite</u>

All three trenches, used to receive trash, are 3 to 5 feet deep and 8 to 14 feet wide, but vary in length. All are oriented in a north-south direction, and are identified as Trenches 1, 2, and 3 in Figure 35.

Trench 1 appears to be the newest of the three trenches. The trench is uncovered and has approximate dimensions of 80 ft long by 12 ft wide by 4 ft deep. The following 15 varieties of debris were observed in this trench:

wooden sawhorses	cable and conduit
wooden cable reels	discarded office records
wooden pallets	panelboard
canvas	sagebrush
sheet metal panels	cyclone fence posts with concrete bases
fiberglass roofing insulation	empty five-gallon buckets
concrete	an empty five-gallon drum

During the backhoe sampling adjacent to this trench, a vertical cross-section of debris was exposed. This debris, observed in the cross-section, was similar to that noted on the surface. Although it is estimated that this trench contains 100 cubic yards of debris, none of the debris was of potentially hazardous materials.

Trench 2 is approximately 90 ft long, 10 to 14 ft wide and has been backfilled. Little surface evidence exists to indicate the contents of the trench. Additional debris has been placed on top of the backfill material. This includes wooden pallets, welding shop refuse (rod stubs, cutoff metal, etc.), steel landing mats, conduit trays, and cinder block.

During the backhoe sampling adjacent to this trench, a vertical cross-section of debris was exposed. The debris noted at this trench included old fire hose, wooden pallets, scrap metal, cable, and a lead-acid battery. There was no evidence of drums. The only hazardous item revealed during the field investigation was the lead-acid battery. Based on the surface "footprint" of Trench 2, it could contain as much as 250 cubic yards of material, but the fill dirt no doubt comprises much of this volume.

Trench 3 is approximately 100 ft long by 10 ft wide and is uncovered. The 12 varieties of debris in this trench, as determined by a visual examination, include the following:

wooden pallets	cable and conduit
old tires	concrete pieces
empty 55-gallon drums (labeled cleaning concentrate)	strips of metal aircraft landing mat
dry-cell batteries	sheets of fiberglass insulation
sheets of cardboard	beverage cans
old cardboard boxes	tarred roofing insulation

During the backhoe sampling adjacent to this trench, a vertical cross-section of debris was exposed. Debris, observed in the cross-section, was similar to that noted on the surface. Based on visual observation, the potentially hazardous materials include the dry-cell batteries and the empty drums. It is estimated that this trench contains 100 cubic yards of debris.

b. Surface Disposal at the Abandoned Dumpsite

Figure 35 shows the approximate locations of areas that were used for the surface disposal (or storage) of debris and other materials. The following describes the nature of the materials located at each of the areas.

Area A, with an area of approximately 2,000 ft^2, is the location of an obvious spill of an organic substance (see Section V). In addition to the contaminated soil at this location, the following seven varieties of surface debris was noted:

- old chairs
- fire hose
- wooden pallets
- an old television set
- half drums (cut longitudinally)
- loose nails
- a wooden and metal box

No hazardous materials were noted in the estimated volume of 8 cubic yards of debris at Area A.

Areas B and C had been used as a site for burning the rubber and plastic insulation from copper and aluminum wire and cable. The total area is approximately 10,000 ft^2 and contains, in addition to unburned or partially burned wire, the following:

- concrete slabs
- insulated asphalt roofing material
- empty five-gallon pails
- cardboard tubes
- dexion-type structural frames
- wooden pallets

The soils in this area contain elevated levels of copper, lead, and zinc as a result of the burning activities (see Section V). Other than these priority pollutant metals, no other hazardous materials were detected. The volume of debris in this area is estimated to be 20 cubic yards. Windblown debris also is present in an area to the north and west of Areas B and C.

Area D, the largest of the surface-disposal sites, is approximately 150 feet square and apparently was initially intended to be a "bone yard" rather than a disposal area. At later stages, however, "trash" was placed at the site. The following is a listing of the 27 diverse materials observed in this area:

- wooden pallets
- antenna mast sections
- concrete slabs
- coils of wire, conduit, and cable
- sheet metal electrical cabinet
- lead acid batteries
- kitchen appliances (stove, refrigerator)
- unserviceable mechanical equipment
  - pumps
  - laboratory centrifuge
  - service station gasoline pump
  - air compressor and receiver tank
  - electric motors
- electrical conduit fittings
- a shop work bench and cabinet

plywood sheets	lengths of galvanized pipe
ventilation louvres and frames	full sandbags
glass arc-lamp lenses and frames	electronic materials
steel aircraft landing mats	- old telephones
wooden and metal cable reels	- printed circuits
overhead light fixtures	water tank (est. 300 gallons)
old automobile tires	vinyl tile-covered metal frames

The only potentially hazardous items that were visible in Area D were the lead-acid batteries. A sample of the vinyl tile, submitted for asbestos analysis, was asbestos-free. (See Appendix E for laboratory report). Area D is estimated to contain approximately 250 cubic yards of debris.

Area E, with about 15 cubic yards of debris, contains widely dispersed wooden pallets and plywood frames, inner tubes, rubber hose, banding wire, and concrete blocks. No hazardous materials were noted.

Area F is roughly 40 ft by 40 ft and contains the following eight items:

a 6'x 4'x 8' high concrete block and wooden building (probably a guard shack)	electronic waste
old tires	wooden pallets
concrete slabs and parking lot bumpers	metal parts
rubber insulation	roll of guy wire

No potentially hazardous materials were noted in the approximately 25 cubic yards of material estimated to be in this area.

Area G, with approximately 10 cubic yards of debris, is located immediately east of Area F and contains several concrete sewer tops and concrete slabs, but no potentially hazardous materials.

A large area (roughly 10 to 15 acres) to the east of Area D contains windblown debris. This material has a distribution of about one piece of debris per 100 ft^2 and consists of plywood, fiberglass insulation, light sheet metal, etc. All totaled, this debris material would have an estimated volume of about 10 cubic yards.

Area H is adjacent to Trench 2 and contains discarded cyclone fencing material including rolls of wire mesh, fence posts with concrete, horizontal stabilizing bars, and a few old doors and inner tubes. Less than 5 cubic yards of material, none hazardous, is located in Area H.

In addition to the above debris areas, a single water tank (est. 10,000 gal) is located north of the dump site. This tank is unserviceable and is to be discarded.

3. Summary of Debris Found at the Abandoned Mojave Base Dumpsite

The only hazardous debris visually observed at the Mojave dumpsite were discarded dry-cell and lead-acid batteries. Several empty drums, buckets, and pails could have a slight amount of residual hazardous contents if they had been used for material other than the originally stated contents.

There essentially are the following nine classes of materials at the Mojave dumpsite:

(1) Wood and other combustible materials such as cardboard and paper.
(2) Scrap ferrous metal.
(3) Scrap non-ferrous metals.
(4) Wire, conduit, and cable.
(5) Unserviceable machinery.
(6) Non-metallics such as glass and concrete.
(7) Inert "trash".
(8) Re-useable equipment such as antenna masts, cyclone fencing, and lighting fixtures and components.
(9) Contaminated soils.

The following is a summary of the estimated volumes of the uncompacted debris at the Mojave site:

Location		Volume, cu. yds
Trench 1		100
Trench 2		250
Trench 3		100
Area A		250
Area B		25
Area C		10
Area D		8
Area E		15
Area F		20
Area G		20
Area H		5
	Total	800 cubic yards (approximately)

Much of the volume is composed of wooden pallets, cable reels, and similar materials that are bulky, but not heavy. If compressed, the volume could be substantially reduced.

4. Abandoned Sewage Treatment Plant and Sewage Evaporation Pond at the Mojave Base Site

The wastewater system at the Mojave Base Site includes septic tanks, leach fields, an above-ground package plant for the treatment of sewage (Figures 34 and 39), and one sewage evaporation pond (Figures 33 and 40). This pond has an operating capacity of 70,000 cubic feet. GDSCC personnel report that the package treatment plant and pond system were abandoned after a brief operational testing period approximately 8 years ago.

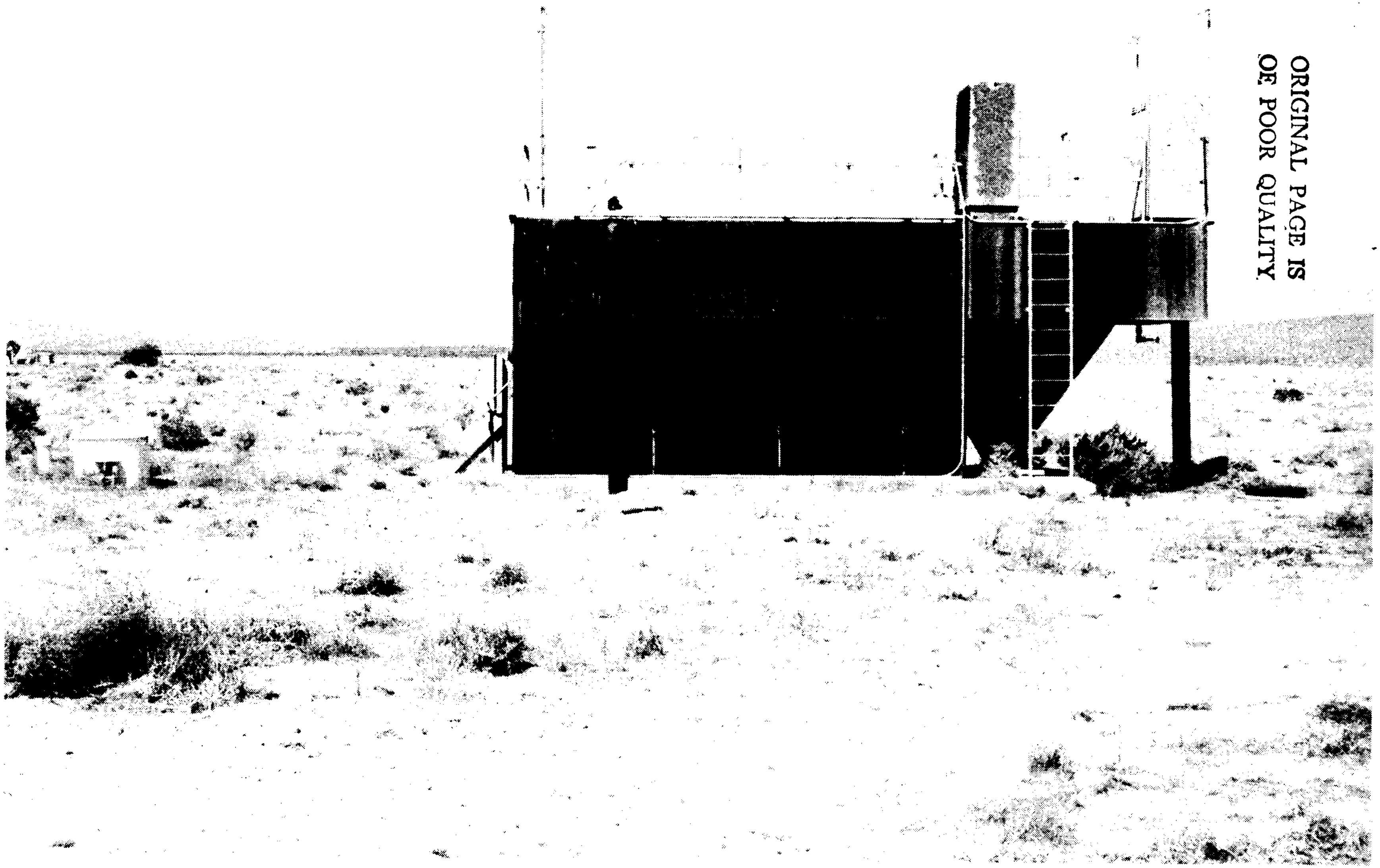

Figure 39. Mojave Base Site: View of Abandoned Sewage Treatment Plant Scheduled to be Removed from the Site

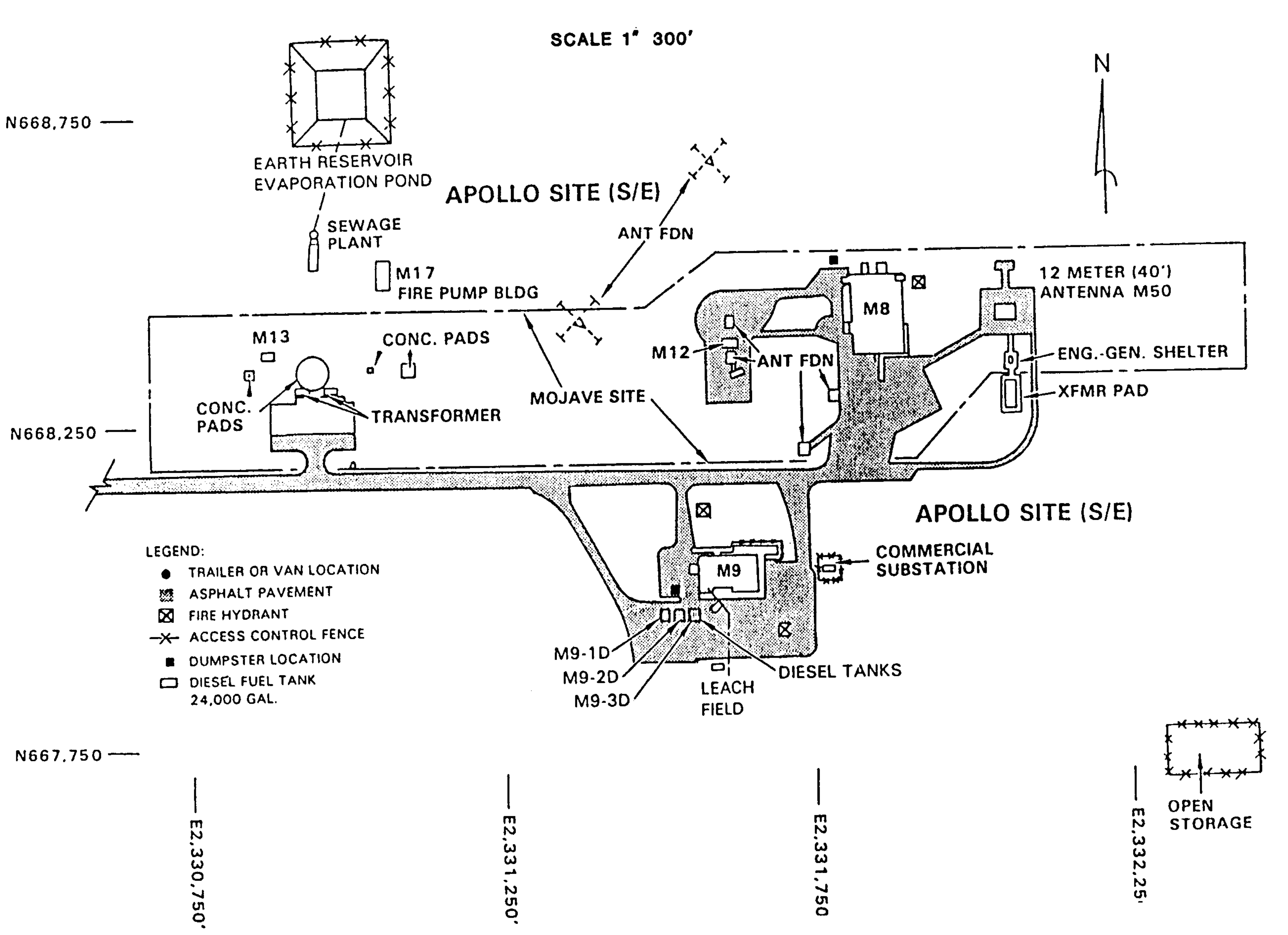

Figure 40. Mojave Base Site: Plot Plan and Location of Abandoned Sewage Treatment Plant and Sewage Evaporation Pond

The Mojave sewage evaporation pond appears to be structurally sound. There is no evidence of any liner material on the embankments of the abandoned Mojave pond. It is unknown whether a liner was ever installed. Indigenous plant species, such as sagebrush, now are growing over the site.

a. Proposed Closure of the Abandoned Mojave Sewage Evaporation Pond

Closure of the Mojave pond will require San Bernardino County approval and will entail the removal of the package treatment plant and its associated equipment. One manhole will be removed and backfilled to existing ground level. The security fencing surrounding the pond will be removed and stored at the GDSCC for future use.

The embankments will be pushed into the pond depression and the entire pond area will be graded to conform to the appearance of the existing adjacent terrain.

No problems or risks are expected to be experienced in the implementation of these recommendations regarding pond closure.

SECTION V

ANALYTICAL RESULTS OF THE SUBSURFACE CONTAMINATION STUDY

Soil samples were collected at the Mars, Apollo, and Mojave Base Sites as part of the program for field investigation at the GDSCC. Analytical results for soil samples were reviewed, summarized and evaluated. This section presents and discusses the results of the laboratory analyses.

A. LABORATORY RESULTS OF TESTS OF COLLECTED SOIL SAMPLES

Soil samples collected at the Mars, Apollo, and Mojave Base Sites were analyzed for volatile halogenated and aromatic organics, and for total petroleum hydrocarbons. The soil sampling methods and procedures employed at each site are discussed in Section IV. Results of organic analyses for soil borings at each site, presented in Table 4 by sample location and depth, reflect the analysis of only those volatile organic compounds that were detected. A complete listing of the compounds included in the analyses for volatile halogenated and aromatic organics is given in the laboratory analytical reports presented in Appendix A. The approximate locations where samples were collected at the Mars, Apollo, and Mojave Base Sites are shown in Figures 23, 30, and 34, and 35, respectively.

In addition to the organic analyses, soil samples collected at the Mojave abandoned dumpsite and sewage evaporation pond also were analyzed for priority pollutant metals. A summary of these metal-analyses is presented in Table 5. Soil samples were analyzed for priority pollutant metals by Environmental Protection Agency (EPA) methods specified in the California Administrative Code (CAC) Title 22, Article 11, Section 66699. In Table 5, the individual metal concentrations are compared to the State of California's Total Threshold Limit Concentrations (TTLC) values.

The raw data for Tables 4 and 5 were taken from original laboratory analytical reports presented in Appendix A. All analytical results and detection limits reported for sediment samples in Tables 4 and 5 are expressed on a wet-weight basis.

B. QUALITY CONTROL ANALYTICAL RESULTS

Quality control results for analyses of soil samples collected at the GDSCC are summarized in this subsection. The analyses were performed by the Brown and Caldwell Laboratories in Pasadena, California. Quality control samples were analyzed to determine the precision and accuracy of the analytical procedures and methods used in this subsurface contamination investigation. Laboratory quality control samples were run at a frequency of 10 percent of the field samples received for each analysis. These quality control samples consisted of duplicate samples, spiked samples, reagent blanks, and laboratory control standards. The summaries of the quality control results, which present the results of laboratory quality control analyses, are given in Appendix B.

Table 4. Summary of Analytical Results for Volatile Organics and Total Petroleum Hydrocarbons

			Concentration (mg/kg)[a,d]			
Site	Sample Location	Sample Depth (ft)	Total Petroleum Hydrocarbons	Halogenated Volatile Organics	Aromatic Volatile Organics	Hnu (ppm)
Mars	Boring 1	0.5	1,900	--	--	0.5
		1.5	670	<DL	<DL	0.5
	Boring 2	0.5	16,000	--	--	ND
		1.5	58	<DL	<DL	ND
	Boring 3	0.5	13,000	--	--	5
		1.5	13,000	<DL	<DL	10
	Boring 4	0.5	63	--	--	ND
		1.5	17	<DL	<DL	1
Apollo	Boring 1	5	4,500	Methylene chloride 0.3 Others <DL	<DL[b]	ND[c]
		10	1,500	<DL	<DL	ND
	Boring 2	0.5	39	--	--	25
		1.5	--	--	--	7.0
		5	140	Carbon Tetrachloride 12[e] Others <DL	<DL	ND
	Boring 3	0.5	<DL	--	--	ND
		1.5	--	--	--	ND
		7	30	<DL	<DL	0.5
		10	--	--	--	ND
	Boring 4	0.5	16,000	--	--	ND
		1.5	--	--	--	1
	Boring 5	0.5	22,000	<DL	<DL	0.5
		5	19,000	<DL	<DL	ND
	Boring 6	0.5	510	--	--	ND
		5	1,700	<DL	<DL	ND
	Boring 7	0.5	--	--	--	ND
		1.5	--	--	--	ND
		5	35	<DL	<DL	ND

Table 4. Summary of Analytical Results for Volatile Organics and Total Petroleum Hydrocarbons (Cont'd)

			Concentration (mg/kg)[a,d]			
Site	Sample Location	Sample Depth (ft)	Total Petroleum Hydrocarbons	Halogenated Volatile Organics	Aromatic Volatile Organics	Hnu (ppm)
Mojave Abandoned Dumpsite	Trench 1 Pit 1	1	--	--	--	ND[c]
		3	--	<DL[b]	<DL	ND
		7	--	--	--	ND
	Trench 1 Pit 2	1	--	--	--	ND
		3	--	<DL	<DL	ND
		6	--	--	--	ND
	Trench 2 Pit 1	1	--	<DL	<DL	ND
		3	--	--	--	ND
		6.5	--	--	--	ND
	Trench 2 Pit 2	1	--	--	--	ND
		3	--	<DL	<DL	ND
		6	--	--	--	ND
	Trench 3 Pit 1	1	--	--	--	ND
		3	--	<DL	<DL	ND
		6	--	--	--	ND
	Area A "Stain"	0.5	31,000	--	--	ND
		1	25	<DL	<DL	ND
		2	<DL	<DL	<DL	ND
	Area B "Burn"	0.33	<DL	--	--	ND
		1	<DL	--	--	ND

Table 4. Summary of Analytical Results for Volatile Organics and Total Petroleum Hydrocarbons (Cont'd)

			Concentration (mg/kg)[a,d]			
Site	Sample Location	Sample Depth (ft)	Total Petroleum Hydrocarbons	Halogenated Volatile Organics	Aromatic Volatile Organics	Hnu (ppm)
Mojave Abandoned Sewage Evaporation Pond	Pond Inlet	0.5	--	--	--	ND
		5	--	<DL	<DL	ND
Laboratory Detection limit			10	0.3	0.3	

[a] All results are presented on a wet-weight basis.

[b] <DL = less than specified detection limit.

[c] None detected above background concentration of 0 ppm.

[d] A dash indicates that analysis was not performed for the sample.

[e] The presence of carbon tetrachloride was confirmed by a second analysis using column gas-chromatography.

Table 5. Summary of Analytical Results for Priority Pollutant Metals

Site	Sample Location	Sample Depth (ft)	Metal Concentration (mg/kg/)[a] Be	Cd	Cr	Cu	Pb	Ni	Ag	Th	Zn	Sb	As	Se	Hg
Mojave Abandoned Dumpsite	Trench 1 Pit 1	1	0.28	<DL[b]	9.3	14.0	<DL	7	<DL	<DL	19	<DL	5.7	<DL	0.4
		3	0.12	<DL	2.5	5.3	<DL	5	<DL	<DL	8	<DL	1.8	<DL	0.4
	Trench 1 Pit 2	1	0.45	<DL	7.1	12.0	<DL	9	<DL	6	17	<DL	3.7	0.5	0.4
		3	0.19	<DL	3.6	8.8	<DL	6	<DL	<DL	12	<DL	1.3	<DL	0.4
	Trench 2 Pit 1	1	0.41	<DL	9.3	12.0	<DL	11	<DL	<DL	19	<DL	2.3	<DL	0.4
		3	0.44	<DL	8.1	21.0	<DL	11	<DL	<DL	22	<DL	4.3	<DL	0.4
	Trench 2 Pit 2	1	0.25	<DL	5.0	8.7	<DL	11	<DL	<DL	16	<DL	2.7	<DL	0.4
		3	0.48	<DL	9.1	16.0	<DL	14	<DL	6	24	<DL	4.5	<DL	0.4
	Trench 3 Pit 1	1	0.30	<DL	7.9	10.0	<DL	14	<DL	<DL	15	<DL	2.2	<DL	0.4
		3	0.35	<DL	9.1	16.0	<DL	14	<DL	6	18	<DL	4.1	<DL	0.4
	Area A "Stain"	0.5	0.58	<DL	11.0	21.0	7	17	<DL	8	37	<DL	2.1	<DL	0.4
		1	0.42	<DL	6.9	14.0	<DL	11	<DL	5	23	<DL	2.6	0.5	0.4
		2	0.24	<DL	5.6	7.7	<DL	7	<DL	<DL	14	<DL	2.9	<DL	0.4
	Area B "Burn"	0.33	0.12	<DL	3.1	10,000	3,000	7	15.0	<DL	2,000	<DL	2.1	<DL	0.4
		1	0.15	<DL	3.9	8.7	<DL	8	<DL	<DL	12	<DL	1.3	<DL	0.4

Table 5. Summary of Analytical Results for Priority Pollutant Metals (Cont'd)

Site	Sample Location	Sample Depth (ft)	Metal Concentration (mg/kg/)[a]												
			Be	Cd	Cr	Cu	Pb	Ni	Ag	Th	Zn	Sb	As	Se	Hg
Mojave Abandoned Sewage Evaporation Pond	Pond Inlet	0.5	0.12	<DL	3.2	7.6	<DL	5	<DL	<DL	11	<DL	1.4	<DL	0.4
		5	0.36	<DL	7.3	7.8	<DL	7	<DL	<DL	17	<DL	1.6	<DL	0.4
Laboratory detection limit			0.2	0.5	1	0.5	5	1	0.2	5	0.8	8	0.3	0.4	0.4
		TTLC[c]	75	100	2,500	2,500	1,000	2,000	500	700	5,000	500	500	100	20

[a] All results are presented on a wet weight basis.
[b] <DL = Less than specified laboratory detection limit.
[c] TTLC = Total Threshold Limit Concentration. California Administrative Code (CAC) Title 22, Article II Criteria of Identification of Hazardous Wastes, Subpart 66699. Persistent and Bioaccumulative Toxic Substance.

C-2

Internal duplicate samples were generated for analysis by splitting randomly selected samples to obtain two identical samples. Duplicate samples were analyzed to determine the precision of the analyses. The term precision refers to the relative percentage difference (RPD) in values obtained for two duplicate samples. The RPD was calculated as follows:

$$RPD = \frac{2(V_1 - V_2)}{(V_1 + V_2)} \times 100$$

where,

V_1 V_2 = The two values obtained by the analysis of duplicate samples: The degree of precision, or RPD, to be expected is dependent upon the sample matrix, specific analytical method, and the concentration of the analysate relative to its detection limit.

The RPD of laboratory duplicates for petroleum hydrocarbons and metal analyses were calculated and evaluated based upon a control limit of plus or minus 20 RPD. RPDs were not calculated for volatile organic analyses, because sample duplicate concentrations were reported below the laboratory detection limit. The RPD values obtained for internal duplicate samples are presented in Appendix B. All RPD values were within the control limit.

Randomly selected samples were spiked to obtain recovery data used in the determination of the accuracy of an analysis. The accuracy of the analyses was determined by analyzing a given sample and its corresponding spiked sample. Accuracy was expressed as percentage recovery (PR) and is calculated using the following formula.

$$PR = \frac{SSR - SR}{SA} \times 100$$

where,

SR = Sample Result: The value obtained by analyzing the sample before spiking.

SA = Spike Added: The concentration increase corresponding to the spike addition to the sample.

SSR = Spiked Sample Result: The value obtained by analyzing the spiked sample (with the spike added).

The percentage recovery (PR) was calculated for each spiked sample. The PRs for volatile organic compounds were compared to the expected ranges for recoveries provided in the statistical accuracy and precision data of the individual EPA methods. Review of the PRs indicated that most of the volatile organic compounds analyzed were within the expected ranges listed in the EPA method descriptions. The percentage recoveries of metal were compared and evaluated on the basis of established laboratory accuracy-control charts. PRs for metals analyses were compared to warning limits and control limits established by the laboratory. These limits are presented in Appendix B. Recoveries for all metals were within the accepted warning and control limits. The PR values obtained for laboratory spiked samples for all analyses are presented in Appendix B.

Laboratory control standards and reagent blanks were performed to calibrate instrument and equipment. Reagent blanks also served to verify that procedures used did not introduce contaminants affecting the analytical results.

The sample holding times specified by the EPA method for volatile halogenated and aromatic organic analyses and total petroleum hydrocarbons (TPH) analysis are 14 and 28 days, respectively. All analyses were performed within the specified EPA limit. The sample holding time for all metals analyzed, except mercury, for which the holding time is set at 28 days, has been established at 6 months. All holding times for metal analyses were met.

Laboratory detection limits for all analysis of soil samples are presented in Table 2.

C. DISCUSSION OF ANALYTICAL RESULTS

1. Mars Site

Four pits were hand dug to depths of 1.5 ft at the Mars site. Borehole samples could not be obtained due to the rocky soil. At each pit, soil samples were collected at depths of 0.5 ft and 1.5 ft and analyzed for TPH. Location of the soil pits are shown on Figure 23. Soil samples collected from 1.5-ft depths also were analyzed for volatile halogenated and aromatic organics. No volatile organic compounds were detected in any of the samples above the laboratory detection limit of 0.3 mg/kg. All chemical results for soil samples collected at the Mars site are summarized in Table 5.

TPH were detected in all samples collected from the Mars site. In pit B3, which is located immediately west of the dumpster between buildings G-81 and G-90, the concentration of TPH was 13,000 mg/kg at both 0.5- and 1.5-ft depths. HNu readings taken in the field at pit B3 indicated organic vapor concentrations of 0.5 and 10 ppm for soil at the 5- and 10-ft depths. Pit B3, although located on an unpaved surface outside of the existing drum storage area, displayed higher concentrations of TPH and organic vapor than pits B1, B2, and B4.

Pits B1 and B2, located approximately 8 ft apart along the eastern edge of the existing storage area, contained high concentrations of TPH in the first half foot of soil. Unlike pit B3, the concentration of TPH in pits B1 and B2 decreased as the sample depth increased. The TPH concentrations at pit B1 were 1,900 and 670 mg/kg at depths of 0.5 ft and 1.5 ft, respectively. At pit B2 the TPH concentrations detected at 0.5 ft and 1.5 ft depths were 16,000 and 58 mg/kg, respectively. Based on chemical analyses, the TPH contamination in the area of pits B1 and B2 appears to be concentrated in the first one half foot of soil. Organic vapor field measurements taken during digging activities at borings B1 ranged from 0-5 ppm. No organic vapor was detected during digging at pit B2.

Soil samples collected at pit B4 exhibited the lowest concentrations of TPH when compared with pits B1, B2, and B3. Pit B4 is located just south of the diesel-waste tank (14-1) at building G-81. TPH concentrations of 63 and

17 mg/kg were detected in pit B4 at depths of 0.5 ft and 1.5 ft, respectively. Although HNu readings, taken at the 1.5 ft depth indicated an organic vapor concentration of 1 ppm, no volatile organic compounds were detected in the soil sample.

2. Apollo Site

The locations of the seven soil borings drilled at the Apollo Site are shown on Figure 30. Soil samples collected at a depth greater than 5 ft were analyzed for volatile halogenated and aromatic organics and TPH while samples collected from 0.5 ft below the ground surface were analyzed for TPH only. No volatile organic compounds were detected in soil samples from borings B3, B4, B5, B6, and B7. Volatile halogenated organics were detected at borings B1 and B2. Results of chemical analyses for the samples collected at the Apollo site are summarized in Table 4.

Borings B1 and B2 are located approximately 53 ft apart along the eastern perimeter of the concrete pad. Both borings were drilled to a depth of 15 ft. In the 5-ft depth samples collected at borings B1 and B2, methylene chloride (CH_2Cl_2) was detected at the detection limit of 0.3 mg/kg and carbon tetrachloride (CCl_4) was detected at a concentration of 12 mg/kg, respectively. These organic compounds often are found in cleaning and degreasing solvents and their presence may indicate the possibility of a former solvent storage or cleaning site in the area of borings B1 and B2.

Organic vapor measurements were collected during drilling using an HNu photoionization meter. No organic vapor was detected during drilling activities at boring B1. Total petroleum hydrocarbons were detected at concentrations of 4,500 and 1,500 mg/kg at depths of 5 ft and 10 ft, respectively. At boring B2, HNu readings of 25 and 7 parts per million (ppm) were detected at depths of 0.5 ft and 7.5 ft, respectively. An HNu reading taken at the same depth in boring B2 (5 ft) at which carbon tetrachloride was detected, showed no organic vapor present. Total petroleum hydrocarbon concentrations at boring B2 were 39 and 140 mg/kg for depths of 0.5 ft and 5 ft, respectively.

Results of chemical analyses of soils removed from borings B1 and B2 indicate contamination present in the subsurface soil. Subsurface contamination appears to be the greatest within the first 5 ft below ground surface. All results of chemical analyses of soils for the Apollo site are summarized in Table 4.

Soil samples collected at borings B4 and B5 were found to contain high concentrations of total petroleum hydrocarbons. In boring B4, only one soil sample, collected at a depth of 0.5 ft, could be obtained because of sampler refusal at depths greater than 5 ft. The subsoil, which is predominately rock fragments, prevented the collection of samples at depths of 5, 7, 10, and 15 ft. The sample collected at 0.5 ft was analyzed for TPH and was found to contain a concentration of 16,000 mg/kg. An HNu reading taken during drilling indicated an organic vapor concentration of 1 ppm at a depth of 1.5 ft below ground surface. No organic vapor was detected at the sample depth of 0.5 ft.

Total petroleum hydrocarbons were detected at concentrations of 12,000 and 19,000 mg/kg in boring B5 soil samples collected at depths of 0.5 and 5 ft, respectively. No volatile halogenated or aromatic organic compounds were detected at either depth at this boring. Organic vapor measurements were recorded during drilling at boring B5. HNu readings indicated a concentration of 0.5 ppm organic vapor at a depth of 5 ft. No organic vapor was detected at a depth of 0.5 ft. Additional samples could not be collected at boring B5 due to auger refusal at the 8.5-ft level at which rock was encountered.

Borings B4 and B5 are located at a suspected former dump area as shown in Figure 29. Results of chemical analysis of soil samples collected from borings B4 and B5 indicate TPH contamination to a depth of 5 ft below ground surface. Based on these analyses, further contamination beyond 5 ft into the layers of rock fragments cannot be determined.

Results of sampling at borings B3 and B7 indicated low levels of TPH. Borings B3 and B7 are located along the south and southwestern perimeter of the concrete pad. Boring B3 was drilled to a depth of 15 ft and samples collected at 0.5 and 7 ft. An HNu reading of 0.5 ppm organic vapor was obtained at a depth of 7 ft during drilling at boring B3. A soil sample collected at this depth was analyzed for volatile halogenated and aromatic organics and none were detected. The TPH concentration at 7 ft depth was 30 mg/kg. Boring B7 was drilled to a depth of 10 ft and soil samples collected at 0.5 and 5 ft. No organic vapor was detected during drilling activities at this boring. Soil samples analyzed for volatile organics indicated no compounds present at the 5 ft depth. The TPH concentration of at this depth was 35 mg/kg. Borings B3 and B7 exhibited the least amount of subsurface contamination of all soil borings drilled at the Apollo Site.

Boring B6 is located along the northwestern perimeter of the concrete pad and is adjacent to the existing drum storage area. Results of chemical analysis of soil samples collected at boring B6 indicate TPH contamination to a depth of five ft. TPH were measured at concentrations of 510 mg/kg and 1,700 mg/kg at depths of 0.5 ft and 5 ft, respectively.

3. Mojave Base Site

a. Mojave Abandoned Dumpsite

The following areas of concern were investigated at the abandoned dumpsite:

(1) Three trenches that contain mostly metal and wood debris. (For a complete description of the debris found at the dumpsite trenches see Section IV).

(2) Area A, a heavily stained area of soil at the dump.

(3) Area B, a burned area consisting mainly of copper wire and electrical cables. The locations of these areas are shown in Figure 35.

Five pits were dug to a maximum of 7 ft at the three trenches. Samples were collected at 1 ft and 3 ft for analysis of volatile organics and priority pollutant metals. Results of the chemical analyses indicate no organic compounds present and HNu readings taken at each trench during excavation indicated no organic vapor present. Complete summaries of analytical and field results are presented in Tables 4 and 5.

Results of priority pollutant metal analysis from soil samples collected in trenches 1 through 3 indicated concentrations well below the State of California's Total Threshold Limit Concentration (TTLC) values for identifying a hazardous waste. Metal concentrations were relatively consistent for all soil samples collected from the three trenches.

Soil samples collected from the stained soil (Area A) at the dumpsite were analyzed for TPH, volatile halogenated and aromatic organic compounds, and priority pollutant metals. The location of Area A is shown in Figure 35. No volatile organics were detected in samples collected at depths of 0.5-, 1-, and 2-ft. The odor and color of the soil within the top 6 in. is markedly different from that observed at 1- and 2-ft depths. Although the soil sample collected at a depth of 0.5 ft exhibited a distinct fuel-oil odor, no organic vapor was detected during excavation using an HNu photoionization meter. The TPH concentration at the 0.5 ft depth was 31,000 mg/kg.

Soil samples collected at 1- and 2-ft depths also were analyzed for TPH. The concentration of TPH at the 1 ft depth was 25 mg/kg while the concentration at 2 ft was below the detection limit of 10.0 mg/kg. The concentrations of metals at this pit were in the same range as those detected in the three trenches. In general, the concentration of a metal decreased with increasing depth. Based on the chemical results and visual observations made in the field, the soil in the stained area is contaminated with a high concentration of TPH and is considered a hazardous waste. The extent of the contamination appears to be contained within the top 6 in. of the soil.

Two soil samples were collected at the burned area (Area B) at depths of 0.5 ft and 1 ft and analyzed for TPH and priority pollutant metals. Results of the chemical analyses indicated high concentrations of copper, lead, and zinc. No petroleum hydrocarbons were detected above the laboratory detection limit of 10 mg/kg and HNu readings taken in the field indicated no organic vapor present. The concentrations of copper (10,000 mg/kg) and lead (3,000 mg/kg) in the 0.5 ft depth soil sample exceed the State of California TTLC limits of 2,500 and 1,000 mg/kg, respectively. The concentration of zinc at 0.5 depth was 2,000 mg/kg which is less than half the TTLC limit of 5,000 mg/kg. The concentration of these metals at the 1-ft depth are well below the TTLC limits and are consistent with those values detected in soil samples collected from the trenches in which no contamination was found. Based on the chemical analyses at this site, the top 6 inches of soil is contaminated with high concentrations of copper and lead and is considered hazardous. The extent of contamination appears to be contained within the first foot of soil.

b. Mojave Sewage Evaporation Pond

Results of the chemical analyses from soil samples collected at the abandoned Mojave sewage evaporation pond indicated no volatile organics present and priority pollutant metal concentrations well below State of California TTLC limits. Soil samples were collected at 0.5-ft and 5-ft depths from a hand-augered boring located in the pond approximately 15 ft north of the sewage plant discharge pipe (Figure 34). HNu readings, obtained during soil boring activities, indicated no organic vapors were present. A complete summary of the chemical results for these soil samples collected from the Mojave sewage evaporation pond is presented in Tables 4 and 5.

SECTION VI

ALTERNATIVE AND RECOMMENDED ACTIONS TO REMEDY SUBSURFACE CONTAMINATION AT THE GDSCC SITES

A. BACKGROUND

The mitigation of any existing hazardous environmental contamination has been mandated by a number of Federal, state and local regulations. The mitigation measures employed usually are site-specific and are tailored to accommodate the peculiarities of each site, the applicable regulations, and the overall impact of the alternative mitigation methods. Sufficient leeway exists within the regulations that several options may be available for the mitigation of contamination at any site. Coordination with the regulatory agencies is required for the selection of the appropriate method to remedy any site-contamination.

B. ALTERNATIVE ACTIONS TO REMEDY ENVIRONMENTAL CONTAMINATION

1. Contaminated Soils

The following alternative actions are available to JPL to mitigate the soil contamination at the Mars, Apollo, and Mojave Sites:

a. No Action. No action to correct the existing soil contamination may be considered if the risk of increased environmental damage is not great, or if remedial actions themselves may result in greater environmental damage. In particular, soil contamination that is not likely to spread, or that is in locations where ground water is at a considerable depth, may be left untreated if the nature of the contamination poses no threat to humans or animals. If the contamination is subject to natural degradation, elimination of the contaminant by this natural process may be acceptable. The no-action alternative must be adopted with the approval of the regulating authorities.

b. Biodegradation. The use of in-situ biodegradation of petroleum hydrocarbons is a proven and accepted technology. Natural bacteria exist in the soil that will cause the chemical breakup of the hydrocarbons. Conditions in the site, however, may not be suitable to permit the degradation to occur to the extent desired. Treatment of the soils with bacterial nutrients, innoculations with desirable strains of bacteria, and physical breakdown of the soils to permit more rapid migration of nutrients and bacterial strains will assist in the nearly-complete removal of hydrocarbon contaminants. The presence of heavy metals or non-petroleum hydrocarbons will reduce the effectiveness of the biodegradation approach. It is estimated that hydrocarbon removal efficiencies in excess of 90% can be achieved by biodegradation.

The preliminary approach to a typical biodegradation program will include a thorough review of existing laboratory and field data, additional sampling, if required, determination of the type and activity of existing natural bacteria in the soils, and a laboratory determination of the optimum nutrient-addition rates and conditions. Following a successful laboratory investigation, field work would include soil disking and mixing, innoculation and/or nutrient additions, periodic checks on the progress by soil sample analyses, and further soil conditioning if required.

c. Physical Removal of Contaminated Soil. The physical removal of contaminated soils is a widely used and accepted method of clean-up for certain sites. Removal may be effected in bulk or by placing the contaminated soil in containers, with the choice dictated primarily by the requirements of the facility receiving the soil as a hazardous waste. Removal and transport of contaminated soils, however, does not remove the soils from the environment; it merely relocates them. The resulting hazards presented by the unwanted spread of contamination during excavation, handling, and transport must be evaluated against the overall effects of other techniques. Total soil removal is usually a very costly alternative, particularly if transportation costs are high and the site is a long distance from landfills approved to receive hazardous waste.

d. Sealing of Soil Surface. The process of surface sealing involves placement of a relatively impermeable cap or cover over the contamination to minimize future spreading by water or erosion. The cap may consist of either compacted natural materials (clay), or synthetic covers (impermeable synthetic liners). Concrete and asphalt also are commonly used as capping materials. Capping is most often used to prevent the contamination of groundwater that would arise through the percolation of rainwater through the contamination to the groundwater table. If the contaminants are insoluble and/or are tightly bound in the soils, capping may not result in increased environmental protection.

e. In-Situ Encapsulation. In-situ encapsulation involves the consolidation and solidification of the contaminated soils by the introduction of polymerizing chemicals or grouting materials to immobilize and fix the contamination in place. Encapsulation is a viable alternative particularly when the chemical nature of the contamination lends itself to reactions with the agents used. The contaminated soils must be receptive to the introduction of the fixing agents. The primary use of the encapsulation alternative is to prevent the migration of contamination to nearby groundwater.

f. On-Site Treatment. A number of chemical and physical treatment steps may be performed on contaminated soils. On-site treatment involves excavation of contaminated material and treatment of the material on-site, usually by fixation or contaminant destruction with a portable incineration unit. Materials treated in this manner are usually replaced at the site with no transportation of contaminated materials being required. The on-site treatment alternative usually is limited to large quantities of material and may be prohibited in some locations because of the resulting air contamination by hazardous chemicals or particulates.

Other on-site treatments of contaminants might utilize differences in size, specific gravity, or magnetic response for the separation of hazardous components. Priority pollutant metals cannot be destroyed by on-site treatment but may be altered to a less environmentally-damaging state.

2. Debris

Debris located at the Mojave Base Site must be removed primarily for aesthetic reasons and to comply with applicable regulations regarding the cleanup of unlicensed landfills. The debris falls into three categories: 1) hazardous, 2) non-hazardous, non-combustible, and 3) non-hazardous, combustible. The hazardous materials will require segregation for packaging, transportation, and placement in an approved hazardous waste repository. The non-hazardous materials can be burned on site (with the appropriate burning permit), or transported off-site for salvage or disposal in a conventional landfill.

C. SITE-SPECIFIC RECOMMENDATIONS

The following alternatives, based on an analysis of the following factors, are recommended for the contaminated sites at GDSCC:

(1) Effectiveness

(2) Operation and maintenance requirements

(3) Demonstrated and expected reliability

(4) External factors that affect implementation

(5) Time to achieve beneficial results

(6) Time needed to carry out the implementation

(7) Safety

(8) Cost

The nature of the subsurface investigation at all of the sites was insufficient to define precisely the quantities of contaminated soils. Any permanent remedial actions must be accompanied by a definitive sampling program to determine the extent of the contamination.

1. Mars Site

The area surrounding the Mars hazardous-materials storage site could not be sampled to depths greater than 1.5 feet. These samples were found to contain petroleum hydrocarbons. This facility at the Mars Site is scheduled to be abandoned and replaced with a new facility in 1989. To prevent the possible spread of the existing contaminants prior to the permanent closure of the site, it is recommended that an asphalt or concrete cap be placed over the contaminated area as defined by this study. When the area is abandoned, the closure plan will address the permanent actions to be taken.

2. Apollo Site

There are two areas of contamination at the Apollo Site. One is the depressed area south of the concrete pad (site of borings 4 and 5). This area is contaminated with petroleum hydrocarbons to a depth of 5 ft. Approximately 370 cubic yards of soil in this site could be contaminated. It is recommended that this area be backfilled with local soils and capped with about a one-foot layer of Goldstone Lake "clay" suitably contoured to prevent ponding over the area.

It is also recommended that the areas within 8 ft of the concrete pad be covered with an asphalt or concrete cap over the contamination to mitigate potential leaching of low-level, near-surface hydrocarbon contamination. The cap should slope away from the existing concrete pad to provide positive runoff of precipitation.

The existing hazardous materials storage area is to be abandoned in 1989. At that time, a more thorough subsurface investigation will be required. The need to perform permanent mitigation of the existing condition is not believed to be warranted now because a closure plan will more thoroughly examine the appropriate alternatives.

In the meantime, to prevent future escape of hazardous materials spills and leaks, a containment berm should be constructed around the perimeter of the hazardous-materials storage pad. The need for more elaborate spill containment is not considered necessary at this time.

3. Mojave Base Site

a. Petroleum Hydrocarbon Clean-up, Area A. It is estimated that about 75 cubic yards of soil are contaminated with petroleum hydrocarbons at the Mojave Base Site. The origin of this contamination is unknown but it is suspected that it is old lubricating and/or fuel oil that was intentionally discarded. Volatile components of this material (if ever present) have apparently volatilized and have disappeared. No indication of volatile compounds was noted either during field sampling and monitoring or from the laboratory analysis.

The area of contamination is about 30 ft by 65 ft (about 2,000 ft^2). Test pits dug by hand or with the backhoe (the latter was used to remove soil from the "worst-looking" part of the site) indicate the average depth of soil contamination to be only a few inches deep. Sampling of the site was not performed in sufficient detail, however, to confirm this extent of contamination over the entire spill area.

It is recommended that no action be taken to mitigate this condition. The level of petroleum hydrocarbons in the soil sample collected at 0.5-ft depth was 31,000 ppm. The San Bernardino County action level for such contamination is 1,000 ppm indicating that, under most conditions, some action is required. It is believed that the nature, degree, and quantity of the soil contamination at the Mojave area, however, pose no threat to the environment and that no action is a reasonable alternative.

The contamination is void of volatiles. The remaining "heavy ends" are not water soluble or subject to complete saturation by flowing water because they are tightly bound in the very fine particle matrix of the desert soil. Rainstorms are infrequent (average rainfall is about 2.5 inches per year) and published data indicate that the water table is several hundred feet below the surface at the contaminated area. It is believed that no groundwater contamination will occur from this oil contamination.

If the no-action alternative is unacceptable, in-situ biodegradation of the site is recommended. Complete removal of the soils is also considered a viable, but more costly, alternative. Capping, encapsulation and on-site treatment are not considered to be effective mitigation alternatives for the soils at this location.

b. <u>Heavy Metal Soil Contamination Clean-up, Area B</u>. It is estimated that about 25 cubic yards of soil are contaminated with heavy metals (notably copper) at Area B of the Mojave Base Site. These metals resulted from the attempted burning of the insulation from discarded copper wire and cable. Apparently the intensity of the flame from the burning insulation was sufficient to oxidize much of the fine copper so that it could not be salvaged.

The area of contamination is approximately 25 ft x 25 ft (625 ft^2). A test pit dug with the back-hoe in the "worst-looking" part of the site indicates the soil contamination to be only a few inches deep, although the sampling of the site was not performed in sufficient detail to confirm the extent of contamination over the entire burn-area.

The small area that does show contamination with elevated levels of copper and lead does not pose a threat to the environment. The copper contamination is believed to be present largely as metallic copper or copper oxides. Both of these materials are insoluble in water and are not subject to migration by flowing water. Rainstorms are infrequent and the water table is suspected to be several hundred feet below the contaminated area. Groundwater contamination is not likely to occur. Vegetation is encroaching on the burn area indicating that the elevated copper levels do not adversely affect the local plant growth.

Because of the remoteness of the location and because the nature, degree, and quantity of the soil contamination at this site do not present a threat to the environment, no action is a reasonable alternative.

If the no-action alternative is unacceptable, removal will be the most positive method for mitigation of the burn-area. Removal would entail excavation of the top 12 inches of soil. Although contamination is not believed to extend to this depth, control of the excavation process is not precise.

The excavated soil would be removed in bulk or placed in 55-gallon drums depending upon the requirements of the as-yet-unidentified receiving landfill. Following soil removal, the resulting excavation will be partially backfilled by contouring the area. It is not expected that additional fill material would be needed.

Other methods of mitigation such as capping, in situ or on-site treatment are not considered viable alternatives.

c. Surface Debris. The following remedial actions are recommended for the Mojave Base Site:

(1) Segregate and dispose of materials as described below:

Material	Disposal Method
Wood and other combustibles (est. 20%)	Burn
Scrap metal, wire, conduit and unserviceable machinery (est. 30%)	Haul for reclaim or disposal
Non-metallic components and trash (est. 40%)	Haul to landfill
Recyclable equipment (est. 10%)	Haul off site for reclamation

SECTION VII

UNDERGROUND STORAGE TANK COMPLIANCE PROGRAM

A. BACKGROUND

At present, there are 15 underground storage tanks (USTs) located at the GDSCC that are used to store the fluids essential to the facility's operations, including gasoline, diesel oil, and hydraulic oil. The on-site storage of these fluids is particularly important because of the remote, isolated location of the GDSCC. A summary of these USTs at the GDSCC is provided in Table 6. A detailed description of the Underground Storage Tanks Compliance Program, carried out at the GDSCC, is found in JPL Publication 87-4 (Volume 2), June 15, 1987. Underground storage of liquids, however, can lead to sub-surface contamination if the USTs or their ancillary equipment (piping, valves, manhole covers) leak the contents of the tanks into the surrounding soil.

In December 1983, laws governing the permitting, testing, and management of USTs were adopted by San Bernardino County, in which the GDSCC is located. The regulations promulgated under these laws are listed in Division 8, Title 3, Underground Storage of Hazardous Substances, of the San Bernardino County Code. In January 1986, JPL was notified by the San Bernardino County Department of Environmental Health Services (DEHS), the agency responsible for overseeing implementation of the regulations, that the tanks at the GDSCC were required to comply with these regulations.

B. REGULATORY REQUIREMENTS

The purpose of enacting the regulations governing underground storage tanks in San Bernardino County was to protect the environment from degradation caused by unauthorized releases from these tanks. To achieve this goal, the County regulations require that existing USTs meet one of the following alternatives:

(1) Be removed from service by excavation or closure-in-place.

(2) Be replaced with new tanks meeting more stringent leak prevention criteria.

(3) Be precision-tested on a yearly basis.

(4) Be monitored by an internal and/or external monitoring system capable of providing early detection of unauthorized releases.

The deadline for compliance with these regulations was January 1, 1987.

In a July 31, 1986 meeting with DEHS representatives, JPL personnel explained that the tanks at GDSCC could not meet the January 1, 1987 deadline for full compliance due to several factors, including the NASA/JPL budget-funding cycle and the necessity to maintain operations at the antenna tracking stations. In response, the DEHS staff agreed to waive the requirement for full compliance provided JPL would implement the following four actions before January 1, 1987:

(1) Precision test all of the USTs at the GDSCC.

(2) Temporarily close those USTs that were no longer in use by steam-cleaning, degassing, and sealing the tanks. (These temporarily closed tanks must be excavated and removed by 1989).

(3) Establish inventory control on the USTs remaining in-service.

(4) Provide on-going reporting of the inventory control/tank monitoring activities for the in-service tanks.

Kern Environmental Services (KES), Bakersfield, California, was selected to implement the tank-testing and temporary-closure activities beginning December 1, 1986. During the course of the program JPL elected to abandon one of the USTs in place.

C. PROGRAM FOR PRECISION-TESTING OF UNDERGROUND STORAGE TANKS

Using the Horner EZY-CHEK method, precision tank-integrity testing was performed on the GDSCC's 27 USTs between December 1, 1986 and January 21, 1987. This method is capable of detecting a leak of 0.05 gallons/hour and is approved for use by the DEHS. The EZY-CHECK method uses a high and low liquid-level test to differentiate between leaks in the tank shell and leaks located above the top of the tank (in a manway or piping-run, for example). Tests were conducted by KES operators certified by Horner Creative Products, manufacturer of the EZY-CHEK.

During the testing program, KES identified 15 tanks that passed high liquid-level precision tests on the first test. These tanks and their appurtenances then were certified as product tight, within applicable test criteria, by KES. Eight of these 15 tanks were kept in service. The remaining seven tanks were placed under temporary closure.

Twelve USTs at the GDSCC failed their initial high liquid-level tests. KES then conducted low liquid-level tests on each of these 12 tanks. The low-level test results indicated that the tank shells of each of the twelve USTs were not leaking. It was concluded, therefore, that the leaks identified during the high-level tests were located somewhere in the piping, manways, valves, etc. of these tanks. The GDSCC elected to repair the leak(s) on seven of these tanks, have the tanks retested to confirm the effectiveness of the repair, and return the tanks to service. Of the five remaining tanks, four were left unrepaired and were placed under temporary closure while the fifth tank was permanently abandoned in-place. JPL and the SBC Health Services inspector personnel did not observe any significant soil contamination resulting from the leaks identified during the tank testing program.

Table 6. Summary of Underground Storage Tanks at the GDSCC

Tank	Size (gallons)	Product	Precision Test Results	Current Status
ECHO SITE:				
G25-1G	10,000	Unleaded	Piping Leak	Temporary Closure
G25-2G	10,000	Unleaded	Piping Leak	Abandoned In Place
G42-1G	2,000	Unleaded	Pass	In Service
G42-2D	2,000	Diesel	Piping Leak	Temporary Closure
TF-3D	12,000	Diesel	Pass	Temporary Closure
TF-4D	12,000	Diesel	Pass	Temporary Closure
G27-1D	12,000	Diesel	Pipe Leak-Repaired	In Service
G27-2D	12,000	Diesel	Pipe Leak-Repaired	In Service
G27-3D	15,000	Diesel	Pass	In Service
G24-1D	12,000	Diesel	Pipe Leak-Repaired	In Service
G24-2D	12,000	Diesel	Pipe Leak-Repaired	In Service
MARS SITE:				
G81-1DA	12,000	Diesel	Pipe Leak-Repaired	In Service
G81-1DB	12,000	Diesel	Pipe Leak-Repaired	In Service
G81-2D	12,000	Diesel	Pass	In Service
G81-3D	12,000	Diesel	Pass	In Service
14-1WO	940	Waste Oil	Pass	In Service
14-1HO	10,000	Hydraulic Oil	Pass	In Service
14-2HO	10,000	Hydraulic Oil	Pass	In Service
MOJAVE BASE SITE:				
M9-1D	24,000	Diesel	Pass	In Service
M9-2D	24,000	Diesel	Pass	Temporary Closure
M9-3D	24,000	Diesel	Piping Leak	Temporary Closure
M9-4D	500	Waste Oil	Pass	Temporary Closure
M56-1WO	7,500	Waste Oil	Pass	Temporary Closure
M27-1G	4,000	Unleaded	Pipe Leak-Repaired	In Service
APOLLO SITE:				
A1-1G	4,000	Unleaded	Pass	Temporary Closure
A1-2G	7,500	Unleaded	Piping Leak	Temporary Closure
GOLDSTONE DRY LAKE AIRPORT:				
G71-1	2,000	Aviation Fuel	Pass	Temporary Closure

D. PROGRAM FOR TEMPORARY CLOSURE OF UNDERGROUND STORAGE TANKS

Eleven USTs at the GDSCC were temporarily closed for eventual excavation, removal, and disposal in 1989. Selection of the particular tanks to be placed under temporary closure was based both on the current and future need for the tank and on results of the precision testing . Temporary closure of these USTs involved (a) steam-cleaning each tank to remove residual sludge and liquid, (b) purging the tank of remaining flammable vapors and, (c) sealing the tank with a concrete cap.

E. IN-PLACE ABANDONMENT OF AN UNDERGROUND STORAGE TANK

At the conclusion of the precision testing program, and with the approval of the San Bernardino County inspectors, one UST was abandoned in-place. Because this particular tank (G25-2G) was located partially under a parking lot retaining wall, its future excavation would be fraught with difficulties. Consequently, JPL permanently closed this tank in an environmentally proper way and abandoned it. Prior to the tank's abandonment, soil samples were collected from three soil borings located adjacent to the tank to determine if the tank had leaked any of its contents in the past. Laboratory analysis of these samples did not detect any petroleum hydrocarbons and the tank was filled with concrete to complete the abandonment procedure.

F. INVENTORY CONTROL OF UNDERGROUND STORAGE TANKS NOW IN SERVICE

Each of the 15 USTs remaining in service at the GDSCC currently are being monitored by inventory reconciliation to detect possible leakage. GDSCC personnel use a stick gauge to determine liquid-level measurements within these tanks. Variations in reconciled inventories are recorded and compared to allowable variations defined in the San Bernardino County Underground Storage Tank Standards. Quarterly reports, stating whether observed variations fell within allowable limits, are submitted to DEHS. Variations exceeding allowable limits must be reported to DEHS within one working day.

G. PROPOSED ACTIVITIES FOR ENVIRONMENTAL COMPLIANCE OF UNDERGROUND STORAGE TANKS

Each of the 11 USTs that are under temporary closure at GDSCC must be excavated and removed by 1989. JPL has contracted Engineering-Science, Inc., Pasadena, California, to prepare an Engineering Report that addresses (a) the removal of the 11 USTs presently under temporary closure, (b) the removal of the 15 remaining USTs now in service and, (c) the installation of 13 new USTs meeting the newest standards for environmental protection. Implementation of the activities described in this Engineering Report is scheduled for late 1988.

SECTION VIII

CERTIFICATION

I hereby certify that all work performed by Engineering-Science, Inc., Pasadena, California, in its investigation of both subsurface contamination and in its recommendation of procedures for the repair/closure of sewage evaporation ponds 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: April 15, 1988

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

Stamp/Seal

REGISTERED PROFESSIONAL ENGINEER
LEONARD H. KUSHNER
No. 9003
Exp. MAR 31 1989
ELECTRICAL
STATE OF CALIFORNIA

REGISTERED PROFESSIONAL ENGINEER
LEONARD H. KUSHNER
No. 1086
Exp. SEP 30 1989
SAFETY
STATE OF CALIFORNIA

APPENDIX A

REPORTS OF ANALYTICAL DATA

TABLE A-1. Page Locations Of Analytical Results Summaries For Soil Samples

Site	Sample Identification	Total Petroleum Hydrocarbons	Priority Pollutant Metals	Volatile Halogenated Organics	Volatile Aromatic Organics
MARS	JPL-MARS-BA-6"	A-34			
	JPL-MARS-B1-1.5'	A-25		A-26,27	A-25
	JPL-MARS-B2-6"	A-34			
	JPL-MARS-B2-1.5'	A-25		A-26,27	A-25
	JPL-MARS-B3-6"	A-34			
	JPL-MARS-B3-1.5'	A-25		A-26,27	A-25
	JPL-MARS-B4-6"	A-34			
	JPL-MARS-B4-1.5'	A-25		A-26,27	A-25
APOLLO	JPL-A-B1-5'A	A-25		A-26,27	A-25
	JPL-A-B1-10'A	A-36			
	JPL-A-B1-10'B			A-29,30	A-28
	JPL-A-B2-6"A	A-34			
	JPL-A-B2-5'A	A-35			
	JPL-A-B2-5'B			A-29,30	A-28
	JPL-A-B3-6"A	A-35			
	JPL-A-B3-7'A	A-35			
	JPL-A-B3-7'B			A-29,30	A-28
	JPL-A-B4-6"A	A-35			
	JPL-A-B5-6"A	A-35			
	JPL-A-B5-5'A	A-36			
	JPL-A-B5-5'B			A-29,30	A-28
	JPL-A-B6-6"A	A-36			
	JPL-A-B6-5'A	A-36			
	JPL-A-B6-5'B			A-32,33	A-28
	JPL-A-B7-5'A	A-36			
	JPL-A-B7-5'B			A-32,33	A-31
MOJAVE					
Abandoned Dumpsite	JPL-MD-T1-P1-12"		A-23		
	JPL-MD-T1-P1-3'		A-10	A-12,13	A-11
	JPL-MD-T1-P2-12"		A-23		
	JPL-MD-T1-P2-3'B		A-10	A-12,13	A-11
	JPL-MD-T2-P1-12"		A-23		
	JPL-MD-T2-P1-3'		A-10	A-12,13	A-11
	JPL-MD-T2-P2-12"		A-24		
	JPL-MD-T2-P2-3'		A-14	A-16,17	A-15
	JPL-MD-T3-P1-12"		A-23		
	JPL-MD-T3-P1-3'		A-10	A-12,13	A-11

Note: A blank space indicates no analyses conducted.

TABLE A-1. Page Locations Of Analytical Results Summaries For Soil Samples

Site	Sample Identification	Total Petroleum Hydrocarbons	Priority Pollutant Metals	Volatile Halogenated Organics	Volatile Aromatic Organics
Area A "Stain"	JPL-MD-A-6"	A-22	A-22		
	JPL-MD-A-12"	A-18	A-18	A-20,21	A-19
	JPL-MD-A-24"	A-6	A-6	A-8,9	A-7
Area B "Burn"	JPL-MD-B1-4"	A-22	A-22		
	JPL-MD-B1-12"	A-22	A-22		
Abandoned Sewage Evaporation Pond	JPL-ML-HA1-6"		A-23		
	JPL-ML-HA1-5'		A-10	A-12, 13	A-11

Note: A blank space indicates no analyses conducted.

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ANALYTICAL REPORT

LOG NO: P87-08-122

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Reported: 30 AUG 87

Bob Adam
Engineering Science
75 N. Fair Oaks Ave.
Pasadena, CA 91103

Project: PE 039.01

REPORT OF ANALYTICAL RESULTS

LOG NO	SAMPLE DESCRIPTION, BLANK WATER SAMPLES	DATE SAMPLED
08-122-49	Reagent blank	

PARAMETER	08-122-49
Vol.Halocarbons (EPA-8010)	
Date Extracted	08/11/87
Dilution Factor, Times 1	1
1,1,2,2-Tetrachloroethane, mg/kg	<0.3
1,1-Dichloroethane, mg/kg	<0.3
1,1-Dichloroethene, mg/kg	<0.3
1,2-Dichloroethane, mg/kg	<0.3
trans-1,2-Dichloroethene, mg/kg	<0.3
1,2-Dichloropropane, mg/kg	<0.3
2-Chloroethylvinylether, mg/kg	<0.3
Bromodichloromethane, mg/kg	<0.3
Bromomethane, mg/kg	<0.3
Bromoform, mg/kg	<0.3
Chlorobenzene, mg/kg	<0.3
Carbon Tetrachloride, mg/kg	<0.3
Chloroethane, mg/kg	<0.3
Chloroform, mg/kg	<0.3
Chloromethane, mg/kg	<0.3
Dibromochloromethane, mg/kg	<0.3
Dichlorodifluoromethane, mg/kg	<0.3
Methylene chloride, mg/kg	<0.3
1,1,1-Trichloroethane, mg/kg	<0.3
Trichloroethylene, mg/kg	<0.3
Trichlorofluoromethane, mg/kg	<0.3
Vinyl chloride, mg/kg	<0.3
cis-1,3-Dichloropropene, mg/kg	<0.3
trans-1,3-Dichloropropene, mg/kg	<0.3

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AMENDED REPORT

11/2/87

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REPORT OF ANALYTICAL RESULTS

LOG NO	SAMPLE DESCRIPTION, SOIL SAMPLES	DATE SAMPLED
08-122-1	JPL-MD-A-24"	04 AUG 87

PARAMETER	08-122-1
Beryllium, mg/kg	0.24
Cadmium, mg/kg	<0.5
Chromium, mg/kg	5.6
Copper, mg/kg	7.7
Lead, mg/kg	<5
Nickel, mg/kg	7
Silver, mg/kg	<0.2
Thallium, mg/kg	<5
Zinc, mg/kg	14
Antimony, mg/kg	<8
Arsenic, mg/kg	2.9
Selenium, mg/kg	<0.4
Mercury, mg/kg	<0.4
Petroleum Hydrocarbons, IR (EPA Method 418.1), mg/kg	<10
Nitric Acid Digestion, Date	08/13/87

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REPORT OF ANALYTICAL RESULTS

LOG NO	SAMPLE DESCRIPTION, SOIL SAMPLES	DATE SAMPLED
08-122-1	JPL-MD-A-24"	04 AUG 87

PARAMETER	08-122-1
Vol.Aromatics (EPA-8020)	
Date Extracted	08/10/87
Dilution Factor, Times 1	1
Chlorobenzene, mg/kg	<0.3
1,2-Dichlorobenzene, mg/kg	<0.3
1,3-Dichlorobenzene, mg/kg	<0.3
1,4-Dichlorobenzene, mg/kg	<0.3
Benzene, mg/kg	<0.3
Ethylbenzene, mg/kg	<0.3
Toluene, mg/kg	<0.3
Additional Compounds:	
Total Xylene Isomers, mg/kg	<0.3

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REPORT OF ANALYTICAL RESULTS

LOG NO	SAMPLE DESCRIPTION, SOIL SAMPLES	DATE SAMPLED
08-122-1	JPL-MD-A-24"	04 AUG 87

PARAMETER	08-122-1
Vol.Halocarbons (EPA-8010)	
Date Extracted	08/10/87
Dilution Factor, Times 1	1
1,1,2,2-Tetrachloroethane, mg/kg	<0.3
1,1,2-Trichloroethane, mg/kg	<0.3
1,1-Dichloroethane, mg/kg	<0.3
1,1-Dichloroethene, mg/kg	<0.3
1,2-Dichloroethane, mg/kg	<0.3
trans-1,2-Dichloroethene, mg/kg	<0.3
1,2-Dichloropropane, mg/kg	<0.3
2-Chloroethylvinylether, mg/kg	<0.3
Bromodichloromethane, mg/kg	<0.3
Bromomethane, mg/kg	<0.3
Bromoform, mg/kg	<0.3
Chlorobenzene, mg/kg	<0.3
Carbon Tetrachloride, mg/kg	<0.3
Chloroethane, mg/kg	<0.3
Chloroform, mg/kg	<0.3
Chloromethane, mg/kg	<0.3
Dibromochloromethane, mg/kg	<0.3
Dichlorodifluoromethane, mg/kg	<0.3
Methylene chloride, mg/kg	<0.3
Tetrachloroethene, mg/kg	<0.3
1,1,1-Trichloroethane, mg/kg	<0.3
Trichloroethylene, mg/kg	<0.3
Trichlorofluoromethane, mg/kg	<0.3
Vinyl chloride, mg/kg	<0.3

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REPORT OF ANALYTICAL RESULTS

LOG NO	SAMPLE DESCRIPTION, SOIL SAMPLES	DATE SAMPLED
08-122-1	JPL-MD-A-24"	04 AUG 87

PARAMETER			08-122-1		
cis-1,3-Dichloropropene, mg/kg			<0.3		
trans-1,3-Dichloropropene, mg/kg			<0.3		

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REPORT OF ANALYTICAL RESULTS

LOG NO	SAMPLE DESCRIPTION, SOIL SAMPLES	DATE SAMPLED
08-122-2	JPL-ML-HA1-5'	04 AUG 87
08-122-3	JPL-MD-T1P2-3'B	04 AUG 87
08-122-4	JPL-MD-T1P1-3'	04 AUG 87
08-122-5	JPL-MD-T3P1-3'	04 AUG 87
08-122-6	JPL-MD-T2P1-3'	04 AUG 87

PARAMETER	08-122-2	08-122-3	08-122-4	08-122-5	08-122-6
Beryllium, mg/kg	0.36	0.19	0.12	0.35	0.44
Cadmium, mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Chromium, mg/kg	7.3	3.6	2.5	9.1	8.1
Copper, mg/kg	7.8	8.8	5.3	16	21
Lead, mg/kg	<5	<5	<5	<5	<5
Nickel, mg/kg	7	6	5	14	11
Silver, mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Thallium, mg/kg	<5	<5	<5	6	<5
Zinc, mg/kg	17	12	8	18	22
Antimony, mg/kg	<8	<8	<8	<8	<8
Arsenic, mg/kg	1.6	1.3	1.8	4.1	4.3
Selenium, mg/kg	<0.4	<0.4	<0.4	<0.4	<0.4
Mercury, mg/kg	<0.4	<0.4	<0.4	<0.4	<0.4
Nitric Acid Digestion, Date	08/13/87	08/13/87	08/13/87	08/13/87	08/13/87

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REPORT OF ANALYTICAL RESULTS

LOG NO	SAMPLE DESCRIPTION, SOIL SAMPLES	DATE SAMPLED
08-122-2	JPL-ML-HA1-5'	04 AUG 87
08-122-3	JPL-MD-T1P2-3'B	04 AUG 87
08-122-4	JPL-MD-T1P1-3'	04 AUG 87
08-122-5	JPL-MD-T3P1-3'	04 AUG 87
08-122-6	JPL-MD-T2P1-3'	04 AUG 87

PARAMETER	08-122-2	08-122-3	08-122-4	08-122-5	08-122-6
Vol.Aromatics (EPA-8020)					
Date Extracted	08/10/87	08/10/87	08/10/87	08/10/87	08/10/87
Dilution Factor, Times 1	1	1	1	1	1
Chlorobenzene, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
1,2-Dichlorobenzene, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
1,3-Dichlorobenzene, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
1,4-Dichlorobenzene, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
Benzene, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
Ethylbenzene, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
Toluene, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
Additional Compounds:					
Total Xylene Isomers, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3

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REPORT OF ANALYTICAL RESULTS

LOG NO	SAMPLE DESCRIPTION, SOIL SAMPLES	DATE SAMPLED
08-122-2	JPL-ML-HA1-5'	04 AUG 87
08-122-3	JPL-MD-T1P2-3'B	04 AUG 87
08-122-4	JPL-MD-T1P1-3'	04 AUG 87
08-122-5	JPL-MD-T3P1-3'	04 AUG 87
08-122-6	JPL-MD-T2P1-3'	04 AUG 87

PARAMETER	08-122-2	08-122-3	08-122-4	08-122-5	08-122-6
Vol.Halocarbons (EPA-8010)					
Date Extracted	08/10/87	08/10/87	08/10/87	08/10/87	08/10/87
Dilution Factor, Times 1	1	1	1	1	1
1,1,2,2-Tetrachloroethane, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
1,1,2-Trichloroethane, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
1,1-Dichloroethane, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
1,1-Dichloroethene, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
1,2-Dichloroethane, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
trans-1,2-Dichloroethene, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
1,2-Dichloropropane, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
2-Chloroethylvinylether, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
Bromodichloromethane, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
Bromomethane, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
Bromoform, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
Chlorobenzene, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
Carbon Tetrachloride, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
Chloroethane, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
Chloroform, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
Chloromethane, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
Dibromochloromethane, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
Dichlorodifluoromethane, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
Methylene chloride, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
Tetrachloroethene, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3

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REPORT OF ANALYTICAL RESULTS

LOG NO	SAMPLE DESCRIPTION, SOIL SAMPLES	DATE SAMPLED
08-122-2	JPL-ML-HA1-5'	04 AUG 87
08-122-3	JPL-MD-T1P2-3'B	04 AUG 87
08-122-4	JPL-MD-T1P1-3'	04 AUG 87
08-122-5	JPL-MD-T3P1-3'	04 AUG 87
08-122-6	JPL-MD-T2P1-3'	04 AUG 87

PARAMETER	08-122-2	08-122-3	08-122-4	08-122-5	08-122-6
1,1,1-Trichloroethane, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
Trichloroethylene, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
Trichlorofluoromethane, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
Vinyl chloride, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
cis-1,3-Dichloropropene, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
trans-1,3-Dichloropropene, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3

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REPORT OF ANALYTICAL RESULTS

LOG NO	SAMPLE DESCRIPTION, SOIL SAMPLES	DATE SAMPLED
08-122-7	JPL-MD-T2P2-3'	04 AUG 87

PARAMETER	08-122-7
Beryllium, mg/kg	0.48
Cadmium, mg/kg	<0.5
Chromium, mg/kg	9.1
Copper, mg/kg	21
Lead, mg/kg	<5
Nickel, mg/kg	14
Silver, mg/kg	<0.2
Thallium, mg/kg	<5
Zinc, mg/kg	24
Antimony, mg/kg	<8
Arsenic, mg/kg	4.5
Selenium, mg/kg	<0.4
Mercury, mg/kg	<0.4
Nitric Acid Digestion, Date	08/13/87

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REPORT OF ANALYTICAL RESULTS

LOG NO	SAMPLE DESCRIPTION, SOIL SAMPLES	DATE SAMPLED
08-122-7	JPL-MD-T2P2-3'	04 AUG 87

PARAMETER	08-122-7
Vol.Aromatics (EPA-8020)	
Date Extracted	08/10/87
Dilution Factor, Times 1	1
Chlorobenzene, mg/kg	<0.3
1,2-Dichlorobenzene, mg/kg	<0.3
1,3-Dichlorobenzene, mg/kg	<0.3
1,4-Dichlorobenzene, mg/kg	<0.3
Benzene, mg/kg	<0.3
Ethylbenzene, mg/kg	<0.3
Toluene, mg/kg	<0.3
Additional Compounds:	
Total Xylene Isomers, mg/kg	<0.3

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REPORT OF ANALYTICAL RESULTS

LOG NO	SAMPLE DESCRIPTION, SOIL SAMPLES	DATE SAMPLED
08-122-7	JPL-MD-T2P2-3'	04 AUG 87

PARAMETER	08-122-7
Vol.Halocarbons (EPA-8010)	
Date Extracted	08/10/87
Dilution Factor, Times 1	1
1,1,2,2-Tetrachloroethane, mg/kg	<0.3
1,1,2-Trichloroethane, mg/kg	<0.3
1,1-Dichloroethane, mg/kg	<0.3
1,1-Dichloroethene, mg/kg	<0.3
1,2-Dichloroethane, mg/kg	<0.3
trans-1,2-Dichloroethene, mg/kg	<0.3
1,2-Dichloropropane, mg/kg	<0.3
2-Chloroethylvinylether, mg/kg	<0.3
Bromodichloromethane, mg/kg	<0.3
Bromomethane, mg/kg	<0.3
Bromoform, mg/kg	<0.3
Chlorobenzene, mg/kg	<0.3
Carbon Tetrachloride, mg/kg	<0.3
Chloroethane, mg/kg	<0.3
Chloroform, mg/kg	<0.3
Chloromethane, mg/kg	<0.3
Dibromochloromethane, mg/kg	<0.3
Dichlorodifluoromethane, mg/kg	<0.3
Methylene chloride, mg/kg	<0.3
Tetrachloroethene, mg/kg	<0.3
1,1,1-Trichloroethane, mg/kg	<0.3
Trichloroethylene, mg/kg	<0.3
Trichlorofluoromethane, mg/kg	<0.3
Vinyl chloride, mg/kg	<0.3

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Project: PE 039.01

REPORT OF ANALYTICAL RESULTS

LOG NO	SAMPLE DESCRIPTION, SOIL SAMPLES	DATE SAMPLED
08-122-7	JPL-MD-T2P2-3'	04 AUG 87

PARAMETER	08-122-7
cis-1,3-Dichloropropene, mg/kg	<0.3
trans-1,3-Dichloropropene, mg/kg	<0.3

BROWN AND CALDWELL LABORATORIES

373 SOUTH FAIR OAKS AVENUE PASADENA, CA 91105 • (818) 795-7553

ANALYTICAL REPORT

LOG NO: P87-08-122

Received: 07 AUG 87
Reported: 30 AUG 87

Bob Adam
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75 N. Fair Oaks Ave.
Pasadena, CA 91103

Project: PE 039.01

REPORT OF ANALYTICAL RESULTS

LOG NO	SAMPLE DESCRIPTION, SOIL SAMPLES	DATE SAMPLED
08-122-8	JPL-MD-A-12"	04 AUG 87

PARAMETER	08-122-8
Beryllium, mg/kg	0.42
Cadmium, mg/kg	<0.5
Chromium, mg/kg	6.9
Copper, mg/kg	14
Lead, mg/kg	<5
Nickel, mg/kg	11
Silver, mg/kg	<0.2
Thallium, mg/kg	5
Zinc, mg/kg	23
Antimony, mg/kg	<8
Arsenic, mg/kg	2.6
Selenium, mg/kg	0.5
Mercury, mg/kg	<0.4
Petroleum Hydrocarbons, IR (EPA Method 418.1), mg/kg	25
Nitric Acid Digestion, Date	08/13/87

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REPORT OF ANALYTICAL RESULTS

LOG NO	SAMPLE DESCRIPTION, SOIL SAMPLES	DATE SAMPLED
08-122-8	JPL-MD-A-12"	04 AUG 87

PARAMETER	08-122-8
Vol.Aromatics (EPA-8020)	
Date Extracted	08/10/87
Dilution Factor, Times 1	1
Chlorobenzene, mg/kg	<0.3
1,2-Dichlorobenzene, mg/kg	<0.3
1,3-Dichlorobenzene, mg/kg	<0.3
1,4-Dichlorobenzene, mg/kg	<0.3
Benzene, mg/kg	<0.3
Ethylbenzene, mg/kg	<0.3
Toluene, mg/kg	<0.3
Additional Compounds:	
Total Xylene Isomers, mg/kg	<0.3

BROWN AND CALDWELL LABORATORIES

ANALYTICAL REPORT

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LOG NO	SAMPLE DESCRIPTION, SOIL SAMPLES	DATE SAMPLED
08-122-8	JPL-MD-A-12"	04 AUG 87

PARAMETER	08-122-8
Vol.Halocarbons (EPA-8010)	
Date Extracted	08/10/87
Dilution Factor, Times 1	1
1,1,2,2-Tetrachloroethane, mg/kg	<0.3
1,1,2-Trichloroethane, mg/kg	<0.3
1,1-Dichloroethane, mg/kg	<0.3
1,1-Dichloroethene, mg/kg	<0.3
1,2-Dichloroethane, mg/kg	<0.3
trans-1,2-Dichloroethene, mg/kg	<0.3
1,2-Dichloropropane, mg/kg	<0.3
2-Chloroethylvinylether, mg/kg	<0.3
Bromodichloromethane, mg/kg	<0.3
Bromomethane, mg/kg	<0.3
Bromoform, mg/kg	<0.3
Chlorobenzene, mg/kg	<0.3
Carbon Tetrachloride, mg/kg	<0.3
Chloroethane, mg/kg	<0.3
Chloroform, mg/kg	<0.3
Chloromethane, mg/kg	<0.3
Dibromochloromethane, mg/kg	<0.3
Dichlorodifluoromethane, mg/kg	<0.3
Methylene chloride, mg/kg	<0.3
Tetrachloroethene, mg/kg	<0.3
1,1,1-Trichloroethane, mg/kg	<0.3
Trichloroethylene, mg/kg	<0.3
Trichlorofluoromethane, mg/kg	<0.3
Vinyl chloride, mg/kg	<0.3

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REPORT OF ANALYTICAL RESULTS

LOG NO	SAMPLE DESCRIPTION, SOIL SAMPLES	DATE SAMPLED
08-122-8	JPL-MD-A-12"	04 AUG 87

PARAMETER	08-122-8
cis-1,3-Dichloropropene, mg/kg	<0.3
trans-1,3-Dichloropropene, mg/kg	<0.3

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REPORT OF ANALYTICAL RESULTS

LOG NO	SAMPLE DESCRIPTION, SOIL SAMPLES	DATE SAMPLED
08-122-9	JPL-MD-A-6"	04 AUG 87
08-122-10	JPL-MD-B1-12"	04 AUG 87
08-122-11	JPL-MD-B1-4"	04 AUG 87

PARAMETER	08-122-9	08-122-10	08-122-11
Beryllium, mg/kg	0.58	0.15	0.12
Cadmium, mg/kg	<0.5	<0.5	0.6
Chromium, mg/kg	11	3.9	3.1
Copper, mg/kg	21	8.7	10,000
Lead, mg/kg	7	<5	3000
Nickel, mg/kg	17	8	7
Silver, mg/kg	<0.2	<0.2	15
Thallium, mg/kg	8	<5	<5
Zinc, mg/kg	37	12	2000
Antimony, mg/kg	<8	<8	<8
Arsenic, mg/kg	2.1	1.3	2.1
Selenium, mg/kg	<0.4	<0.4	<0.4
Mercury, mg/kg	<0.4	<0.4	<0.4
Petroleum Hydrocarbons, IR (EPA Method 418.1), mg/kg	31,000	<10	<10
Nitric Acid Digestion, Date	08/13/87	08/13/87	08/13/87

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REPORT OF ANALYTICAL RESULTS

LOG NO	SAMPLE DESCRIPTION, SOIL SAMPLES	DATE SAMPLED
08-122-12	JPL-ML-HA1-6"	04 AUG 87
08-122-13	JPL-MD-T1P2-12"	04 AUG 87
08-122-14	JPL-MD-T1P1-12"	04 AUG 87
08-122-15	JPL-MD-T3P1-12"	04 AUG 87
08-122-16	JPL-MD-T2P1-12"	04 AUG 87

PARAMETER	08-122-12	08-122-13	08-122-14	08-122-15	08-122-16
Beryllium, mg/kg	0.12	0.45	0.28	0.30	0.41
Cadmium, mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Chromium, mg/kg	3.2	7.1	9.3	7.9	9.3
Copper, mg/kg	7.6	12	14	10	12
Lead, mg/kg	<5	<5	<5	<5	<5
Nickel, mg/kg	5	9	7	14	11
Silver, mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Thallium, mg/kg	<5	6	5	<5	<5
Zinc, mg/kg	11	17	19	15	19
Antimony, mg/kg	<8	<8	<8	<8	<8
Arsenic, mg/kg	1.4	3.7	5.7	2.2	2.3
Selenium, mg/kg	<0.4	0.5	<0.4	<0.4	<0.4
Mercury, mg/kg	<0.4	<0.4	<0.4	<0.4	<0.4
Nitric Acid Digestion, Date	08/13/87	08/13/87	08/13/87	08/13/87	08/13/87

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ANALYTICAL REPORT

LOG NO: P37-08-122

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REPORT OF ANALYTICAL RESULTS

LOG NO	SAMPLE DESCRIPTION, SOIL SAMPLES	DATE SAMPLED
08-122-17	JPL-MD-T2P2-12"	04 AUG 87

PARAMETER	08-122-17
Beryllium, mg/kg	0.25
Cadmium, mg/kg	<0.5
Chromium, mg/kg	5.0
Copper, mg/kg	8.7
Lead, mg/kg	<5
Nickel, mg/kg	11
Silver, mg/kg	<0.2
Thallium, mg/kg	<5
Zinc, mg/kg	16
Antimony, mg/kg	<8
Arsenic, mg/kg	2.7
Selenium, mg/kg	<0.4
Mercury, mg/kg	<0.4
Nitric Acid Digestion, Date	08/13/87

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REPORT OF ANALYTICAL RESULTS

LOG NO	SAMPLE DESCRIPTION, SOIL SAMPLES	DATE SAMPLED
08-122-18	JPL-MARS-B1-1.5'	06 AUG 87
08-122-19	JPL-MARS-B2-1.5'	06 AUG 87
08-122-20	JPL-MARS-B3-1.5'	06 AUG 87
08-122-21	JPL-MARS-B4-1.5'	06 AUG 87
08-122-22	JPL-A-B1-5'A	05 AUG 87

PARAMETER	08-122-18	08-122-19	08-122-20	08-122-21	08-122-22
Petroleum Hydrocarbons, IR (EPA Method 418.1), mg/kg	670	58	13,000	17	4500
Vol.Aromatics (EPA-8020)					
Date Extracted	08/11/87	08/11/87	08/11/87	08/11/87	08/11/87
Dilution Factor, Times 1	1	1	1	1	1
Chlorobenzene, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
1,2-Dichlorobenzene, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
1,3-Dichlorobenzene, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
1,4-Dichlorobenzene, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
Benzene, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
Ethylbenzene, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
Toluene, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
Additional Compounds:					
Total Xylene Isomers, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3

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REPORT OF ANALYTICAL RESULTS

LOG NO	SAMPLE DESCRIPTION, SOIL SAMPLES	DATE SAMPLED
08-122-18	JPL-MARS-B1-1.5'	06 AUG 87
08-122-19	JPL-MARS-B2-1.5'	06 AUG 87
08-122-20	JPL-MARS-B3-1.5'	06 AUG 87
08-122-21	JPL-MARS-B4-1.5'	06 AUG 87
08-122-22	JPL-A-B1-5'A	05 AUG 87

PARAMETER	08-122-18	08-122-19	08-122-20	08-122-21	08-122-22
Vol.Halocarbons (EPA-8010)					
Date Extracted	---	08/11/87	08/11/87	08/11/87	08/11/87
Dilution Factor, Times 1	---	1	1	1	1
1,1,2,2-Tetrachloroethane, mg/kg	---	<0.3	<0.3	<0.3	<0.3
1,1,2-Trichloroethane, mg/kg	---	<0.3	<0.3	<0.3	<0.3
1,1-Dichloroethane, mg/kg	---	<0.3	<0.3	<0.3	<0.3
1,1-Dichloroethene, mg/kg	---	<0.3	<0.3	<0.3	<0.3
1,2-Dichloroethane, mg/kg	---	<0.3	<0.3	<0.3	<0.3
trans-1,2-Dichloroethene, mg/kg	---	<0.3	<0.3	<0.3	<0.3
1,2-Dichloropropane, mg/kg	---	<0.3	<0.3	<0.3	<0.3
2-Chloroethylvinylether, mg/kg	---	<0.3	<0.3	<0.3	<0.3
Bromodichloromethane, mg/kg	---	<0.3	<0.3	<0.3	<0.3
Bromomethane, mg/kg	---	<0.3	<0.3	<0.3	<0.3
Bromoform, mg/kg	---	<0.3	<0.3	<0.3	<0.3
Chlorobenzene, mg/kg	---	<0.3	<0.3	<0.3	<0.3
Carbon Tetrachloride, mg/kg	---	<0.3	<0.3	<0.3	<0.3
Chloroethane, mg/kg	---	<0.3	<0.3	<0.3	<0.3
Chloroform, mg/kg	---	<0.3	<0.3	<0.3	<0.3
Chloromethane, mg/kg	---	<0.3	<0.3	<0.3	<0.3
Dibromochloromethane, mg/kg	---	<0.3	<0.3	<0.3	<0.3
Dichlorodifluoromethane, mg/kg	---	<0.3	<0.3	<0.3	<0.3
Methylene chloride, mg/kg	---	<0.3	<0.3	<0.3	0.3
Tetrachloroethene, mg/kg	---	<0.3	<0.3	<0.3	<0.3

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REPORT OF ANALYTICAL RESULTS

LOG NO	SAMPLE DESCRIPTION, SOIL SAMPLES	DATE SAMPLED
08-122-18	JPL-MARS-B1-1.5'	06 AUG 87
08-122-19	JPL-MARS-B2-1.5'	06 AUG 87
08-122-20	JPL-MARS-B3-1.5'	06 AUG 87
08-122-21	JPL-MARS-B4-1.5'	06 AUG 87
08-122-22	JPL-A-B1-5'A	05 AUG 87

PARAMETER	08-122-18	08-122-19	08-122-20	08-122-21	08-122-22
1,1,1-Trichloroethane, mg/kg	---	<0.3	<0.3	<0.3	<0.3
Trichloroethylene, mg/kg	---	<0.3	<0.3	<0.3	<0.3
Trichlorofluoromethane, mg/kg	---	<0.3	<0.3	<0.3	<0.3
Vinyl chloride, mg/kg	---	<0.3	<0.3	<0.3	<0.3
cis-1,3-Dichloropropene, mg/kg	---	<0.3	<0.3	<0.3	<0.3
trans-1,3-Dichloropropene, mg/kg	---	<0.3	<0.3	<0.3	<0.3

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LOG NO	SAMPLE DESCRIPTION, SOIL SAMPLES	DATE SAMPLED
08-122-23	JPL-A-B2-5'B	06 AUG 87
08-122-24	JPL-A-B3-7'B	06 AUG 87
08-122-25	JPL-A-B5-5'B	06 AUG 87
08-122-26	JPL-A-B6-5'B	05 AUG 87
08-122-27	JPL-A-B1-10'B	05 AUG 87

PARAMETER	08-122-23	08-122-24	08-122-25	08-122-26	08-122-27
Vol.Aromatics (EPA-8020)					
Date Extracted	08/11/87	08/11/87	08/11/87	08/11/87	08/11/87
Dilution Factor, Times 1	1	1	1	1	1
Chlorobenzene, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
1,2-Dichlorobenzene, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
1,3-Dichlorobenzene, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
1,4-Dichlorobenzene, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
Benzene, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
Ethylbenzene, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
Toluene, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
Additional Compounds:					
Total Xylene Isomers, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3

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LOG NO	SAMPLE DESCRIPTION, SOIL SAMPLES	DATE SAMPLED
08-122-23	JPL-A-B2-5'B	06 AUG 87
08-122-24	JPL-A-B3-7'B	06 AUG 87
08-122-25	JPL-A-B5-5'B	06 AUG 87
08-122-26	JPL-A-B6-5'B	05 AUG 87
08-122-27	JPL-A-B1-10'B	05 AUG 87

PARAMETER	08-122-23	08-122-24	08-122-25	08-122-26	08-122-27
Vol.Halocarbons (EPA-8010)					
Date Extracted	08/11/87	08/11/87	08/11/87	08/11/87	08/11/87
Dilution Factor, Times 1	1	1	1	1	1
1,1,2,2-Tetrachloroethane, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
1,1,2-Trichloroethane, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
1,1-Dichloroethane, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
1,1-Dichloroethene, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
1,2-Dichloroethane, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
trans-1,2-Dichloroethene, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
1,2-Dichloropropane, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
2-Chloroethylvinylether, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
Bromodichloromethane, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
Bromomethane, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
Bromoform, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
Chlorobenzene, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
Carbon Tetrachloride, mg/kg	12	<0.3	<0.3	<0.3	<0.3
Chloroethane, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
Chloroform, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
Chloromethane, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
Dibromochloromethane, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
Dichlorodifluoromethane, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
Methylene chloride, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
Tetrachloroethene, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3

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REPORT OF ANALYTICAL RESULTS

LOG NO	SAMPLE DESCRIPTION, SOIL SAMPLES	DATE SAMPLED
08-122-23	JPL-A-B2-5'B	06 AUG 87
08-122-24	JPL-A-B3-7'B	06 AUG 87
08-122-25	JPL-A-B5-5'B	06 AUG 87
08-122-26	JPL-A-B6-5'B	05 AUG 87
08-122-27	JPL-A-B1-10'B	05 AUG 87

PARAMETER	08-122-23	08-122-24	08-122-25	08-122-26	08-122-27
1,1,1-Trichloroethane, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
Trichloroethylene, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
Trichlorofluoromethane, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
Vinyl chloride, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
cis-1,3-Dichloropropene, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3
trans-1,3-Dichloropropene, mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3

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REPORT OF ANALYTICAL RESULTS

LOG NO	SAMPLE DESCRIPTION, SOIL SAMPLES	DATE SAMPLED
08-122-28	JPL-A-B7-5'B	05 AUG 87

PARAMETER	08-122-28
Vol.Aromatics (EPA-8020)	
Date Extracted	08/11/87
Dilution Factor, Times 1	1
Chlorobenzene, mg/kg	<0.3
1,2-Dichlorobenzene, mg/kg	<0.3
1,3-Dichlorobenzene, mg/kg	<0.3
1,4-Dichlorobenzene, mg/kg	<0.3
Benzene, mg/kg	<0.3
Ethylbenzene, mg/kg	<0.3
Toluene, mg/kg	<0.3
Additional Compounds:	
Total Xylene Isomers, mg/kg	<0.3

BROWN AND CALDWELL LABORATORIES

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ANALYTICAL REPORT

LOG NO: P37-08-122

Received: 07 AUG 87
Reported: 30 AUG 87

Bob Adam
Engineering Science
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Pasadena, CA 91103

Project: PE 039.01

REPORT OF ANALYTICAL RESULTS

LOG NO	SAMPLE DESCRIPTION, SOIL SAMPLES	DATE SAMPLED
08-122-28	JPL-A-B7-5'B	05 AUG 87

PARAMETER	08-122-28
Vol.Halocarbons (EPA-8010)	
Date Extracted	08/11/87
Dilution Factor, Times 1	1
1,1,2,2-Tetrachloroethane, mg/kg	<0.3
1,1,2-Trichloroethane, mg/kg	<0.3
1,1-Dichloroethane, mg/kg	<0.3
1,1-Dichloroethene, mg/kg	<0.3
1,2-Dichloroethane, mg/kg	<0.3
trans-1,2-Dichloroethene, mg/kg	<0.3
1,2-Dichloropropane, mg/kg	<0.3
2-Chloroethylvinylether, mg/kg	<0.3
Bromodichloromethane, mg/kg	<0.3
Bromomethane, mg/kg	<0.3
Bromoform, mg/kg	<0.3
Chlorobenzene, mg/kg	<0.3
Carbon Tetrachloride, mg/kg	<0.3
Chloroethane, mg/kg	<0.3
Chloroform, mg/kg	<0.3
Chloromethane, mg/kg	<0.3
Dibromochloromethane, mg/kg	<0.3
Dichlorodifluoromethane, mg/kg	<0.3
Methylene chloride, mg/kg	<0.3
Tetrachloroethene, mg/kg	<0.3
1,1,1-Trichloroethane, mg/kg	<0.3
Trichloroethylene, mg/kg	<0.3
Trichlorofluoromethane, mg/kg	<0.3
Vinyl chloride, mg/kg	<0.3

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REPORT OF ANALYTICAL RESULTS

LOG NO	SAMPLE DESCRIPTION, SOIL SAMPLES	DATE SAMPLED
08-122-28	JPL-A-B7-5'B	05 AUG 87

PARAMETER	08-122-28
cis-1,3-Dichloropropene, mg/kg	<0.3
trans-1,3-Dichloropropene, mg/kg	<0.3

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REPORT OF ANALYTICAL RESULTS

LOG NO	SAMPLE DESCRIPTION, SOIL SAMPLES	DATE SAMPLED
08-122-29	JPL-MARS-BA-6"	06 AUG 87
08-122-30	JPL-MARS-B2-6"	06 AUG 87
08-122-31	JPL-MARS-B3-6"	06 AUG 87
08-122-32	JPL-MARS-B4-6"	06 AUG 87
08-122-33	JPL-A-B2-6"A	06 AUG 87

PARAMETER	08-122-29	08-122-30	08-122-31	08-122-32	08-122-33
Petroleum Hydrocarbons, IR (EPA Method 418.1), mg/kg	1900	16,000	13,000	63	39

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REPORT OF ANALYTICAL RESULTS

LOG NO	SAMPLE DESCRIPTION, SOIL SAMPLES	DATE SAMPLED
08-122-34	JPL-A-B2-5'A	06 AUG 87
08-122-35	JPL-A-B3-6"A	06 AUG 87
08-122-36	JPL-A-B3-7'A	06 AUG 87
08-122-37	JPL-A-B4-6"A	05 AUG 87
08-122-38	JPL-A-B5-6"A	06 AUG 87

PARAMETER	08-122-34	08-122-35	08-122-36	08-122-37	08-122-38
Petroleum Hydrocarbons, IR (EPA Method 418.1), mg/kg	140	<10	30	16,000	22,000

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REPORT OF ANALYTICAL RESULTS

LOG NO	SAMPLE DESCRIPTION, SOIL SAMPLES	DATE SAMPLED
08-122-39	JPL-A-B5-5'A	06 AUG 87
08-122-40	JPL-A-B6-6"A	05 AUG 87
08-122-41	JPL-A-B6-5'A	05 AUG 87
08-122-42	JPL-A-B7-5'A	05 AUG 87
08-122-43	JPL-A-B1-10'A	05 AUG 87

PARAMETER	08-122-39	08-122-40	08-122-41	08-122-42	08-122-43
Petroleum Hydrocarbons, IR (EPA Method 418.1), mg/kg	19,000	510	1700	35	1500

APPENDIX B

REPORTS OF QUALITY CONTROL ANALYTICAL DATA

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ANALYTICAL REPORT

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REPORT OF ANALYTICAL RESULTS

LOG NO	SAMPLE DESCRIPTION, SOIL SAMPLES	DATE SAMPLED
08-122-44	JPL-MD-B1-12" BC/QC DUP	04 AUG 87

PARAMETER	08-122-44
Beryllium, mg/kg	0.15
Cadmium, mg/kg	<0.5
Chromium, mg/kg	3.8
Copper, mg/kg	8.2
Lead, mg/kg	<5
Nickel, mg/kg	7
Silver, mg/kg	<0.2
Thallium, mg/kg	<5
Zinc, mg/kg	11
Antimony, mg/kg	<8
Arsenic, mg/kg	1.2
Selenium, mg/kg	<0.4
Mercury, mg/kg	<0.4
Petroleum Hydrocarbons, IR (EPA Method 418.1), mg/kg	<10
Nitric Acid Digestion, Date	08/13/87

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REPORT OF ANALYTICAL RESULTS

LOG NO	SAMPLE DESCRIPTION, BLANK WATER SAMPLES	DATE SAMPLED
08-122-45	Reagent blank	

PARAMETER	08-122-45
Beryllium, mg/L	<0.001
Cadmium, mg/L	<0.02
Chromium, mg/L	<0.04
Copper, mg/L	<0.02
Lead, mg/L	<0.2
Nickel, mg/L	<0.04
Silver, mg/L	<0.01
Thallium, mg/L	<0.2
Zinc, mg/L	<0.03
Antimony, mg/L	<0.3
Arsenic, mg/L	<0.01
Selenium, mg/L	<0.02
Mercury, mg/L	<0.0008
Petroleum Hydrocarbons, IR (EPA Method 418.1), mg/kg	<10
Nitric Acid Digestion, Date	08/13/87

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REPORT OF ANALYTICAL RESULTS

LOG NO	SAMPLE DESCRIPTION, SOIL SAMPLES	DATE SAMPLED
08-122-46	JPL-MD-B1-12" BC/QC SPK	04 AUG 87

PARAMETER	08-122-46
Beryllium, Percent	99
Cadmium, Percent	87
Chromium, Percent	93
Copper, Percent	97
Lead, Percent	90
Nickel, Percent	95
Silver, Percent	102
Thallium, Percent	89
Zinc, Percent	91
Antimony, Percent	46
Arsenic, Percent	71
Selenium, Percent	49
Mercury, Percent	108
Petroleum Hydrocarbons, IR (EPA Method 418.1), Percent	89
Nitric Acid Digestion, Date	08/13/87

BROWN AND CALDWELL LABORATORIES

ANALYTICAL REPORT

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REPORT OF ANALYTICAL RESULTS

LOG NO	SAMPLE DESCRIPTION, WATER SAMPLES	DATE SAMPLED
08-122-47	Laboratory control standard	

PARAMETER	08-122-47
Beryllium, Percent	101
Cadmium, Percent	100
Chromium, Percent	98
Copper, Percent	100
Lead, Percent	102
Nickel, Percent	102
Silver, Percent	100
Thallium, Percent	103
Zinc, Percent	100
Antimony, Percent	89
Arsenic, Percent	96
Selenium, Percent	100
Mercury, Percent	103
Petroleum Hydrocarbons, IR (EPA Method 418.1), Percent	114
Nitric Acid Digestion, Date	08/13/87

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ANALYTICAL REPORT

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REPORT OF ANALYTICAL RESULTS

LOG NO	SAMPLE DESCRIPTION, SOIL SAMPLES	DATE SAMPLED
08-122-48	JPL-MARS-B3-1.5' BC/QC DUP	06 AUG 87

PARAMETER	08-122-48
Petroleum Hydrocarbons, IR (EPA Method 418.1), mg/kg	11,000
Vol.Aromatics (EPA-8020)	
Date Extracted	08/11/87
Dilution Factor, Times 1	1
Chlorobenzene, mg/kg	<0.3
1,2-Dichlorobenzene, mg/kg	<0.3
1,3-Dichlorobenzene, mg/kg	<0.3
1,4-Dichlorobenzene, mg/kg	<0.3
Benzene, mg/kg	<0.3
Ethylbenzene, mg/kg	<0.3
Toluene, mg/kg	<0.3
Additional Compounds:	
Total Xylene Isomers, mg/kg	<0.3

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REPORT OF ANALYTICAL RESULTS

LOG NO	SAMPLE DESCRIPTION, SOIL SAMPLES	DATE SAMPLED
08-122-48	JPL-MARS-B3-1.5' BC/QC DUP	06 AUG 87

PARAMETER	08-122-48
Vol.Halocarbons (EPA-8010)	
Date Extracted	08/11/87
Dilution Factor, Times 1	1
1,1,2,2-Tetrachloroethane, mg/kg	<0.3
1,1,2-Trichloroethane, mg/kg	<0.3
1,1-Dichloroethane, mg/kg	<0.3
1,1-Dichloroethene, mg/kg	<0.3
1,2-Dichloroethane, mg/kg	<0.3
trans-1,2-Dichloroethene, mg/kg	<0.3
1,2-Dichloropropane, mg/kg	<0.3
2-Chloroethylvinylether, mg/kg	<0.3
Bromodichloromethane, mg/kg	<0.3
Bromomethane, mg/kg	<0.3
Bromoform, mg/kg	<0.3
Chlorobenzene, mg/kg	<0.3
Carbon Tetrachloride, mg/kg	<0.3
Chloroethane, mg/kg	<0.3
Chloroform, mg/kg	<0.3
Chloromethane, mg/kg	<0.3
Dibromochloromethane, mg/kg	<0.3
Dichlorodifluoromethane, mg/kg	<0.3
Methylene chloride, mg/kg	<0.3
Tetrachloroethene, mg/kg	<0.3
1,1,1-Trichloroethane, mg/kg	<0.3
Trichloroethylene, mg/kg	<0.3
Trichlorofluoromethane, mg/kg	<0.3
Vinyl chloride, mg/kg	<0.3

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Project: PE 039.01

REPORT OF ANALYTICAL RESULTS

LOG NO	SAMPLE DESCRIPTION, SOIL SAMPLES	DATE SAMPLED
08-122-48	JPL-MARS-B3-1.5' BC/QC DUP	06 AUG 87

PARAMETER	08-122-48
cis-1,3-Dichloropropene, mg/kg	<0.3
trans-1,3-Dichloropropene, mg/kg	<0.3

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Project: PE 039.01

REPORT OF ANALYTICAL RESULTS

LOG NO	SAMPLE DESCRIPTION, BLANK WATER SAMPLES	DATE SAMPLED
08-122-49	Reagent blank	

PARAMETER	08-122-49
Petroleum Hydrocarbons, IR (EPA Method 418.1), mg/kg	<10
Vol.Aromatics (EPA-8020)	
Date Extracted	08/11/87
Dilution Factor, Times 1	1
Chlorobenzene, mg/kg	<0.3
1,2-Dichlorobenzene, mg/kg	<0.3
1,3-Dichlorobenzene, mg/kg	<0.3
1,4-Dichlorobenzene, mg/kg	<0.3
Benzene, mg/kg	<0.3
Ethylbenzene, mg/kg	<0.3
Toluene, mg/kg	<0.3
Additional Compounds:	
Total Xylene Isomers, mg/kg	<0.3

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REPORT OF ANALYTICAL RESULTS

LOG NO	SAMPLE DESCRIPTION, BLANK WATER SAMPLES	DATE SAMPLED
08-122-49	Reagent blank	

PARAMETER	08-122-49
Other Vol.Halocarbons (EPA-8010)	<0.3

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REPORT OF ANALYTICAL RESULTS

LOG NO	SAMPLE DESCRIPTION, SOIL SAMPLES	DATE SAMPLED
08-122-50	JPL-MARS-B3-1.5' BC/QC SPK	06 AUG 87

PARAMETER	08-122-50
Petroleum Hydrocarbons, IR (EPA Method 418.1), Percent	87
Vol.Aromatics (EPA-8020)	
Date Extracted	08/11/87
Dilution Factor, Times 1	1
Chlorobenzene, Percent	60
1,2-Dichlorobenzene, Percent	91
1,3-Dichlorobenzene, Percent	91
1,4-Dichlorobenzene, Percent	100
Benzene, Percent	100
Ethylbenzene, Percent	80
Toluene, Percent	91

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REPORT OF ANALYTICAL RESULTS

LOG NO	SAMPLE DESCRIPTION, SOIL SAMPLES	DATE SAMPLED
08-122-50	JPL-MARS-B3-1.5' BC/QC SPK	06 AUG 87

PARAMETER	08-122-50
Vol.Halocarbons (EPA-8010)	
Date Extracted	08/11/87
Dilution Factor, Times 1	1
1,1,2,2-Tetrachloroethane, Percent	110
1,1-Dichloroethane, Percent	84
1,1-Dichloroethene, Percent	88
1,2-Dichloroethane, Percent	100
trans-1,2-Dichloroethene, Percent	84
1,2-Dichloropropane, Percent	110
Bromodichloromethane, Percent	110
Bromoform, Percent	110
Carbon Tetrachloride, Percent	100
Chloroform, Percent	110
Methylene chloride, Percent	100
1,1,1-Trichloroethane, Percent	84
Trichloroethylene, Percent	140
Trichlorofluoromethane, Percent	56
trans-1,3-Dichloropropene, Percent	80
Other Vol.Halocarbons (EPA-8010)	<0.3

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REPORT OF ANALYTICAL RESULTS

LOG NO	SAMPLE DESCRIPTION, WATER SAMPLES	DATE SAMPLED
08-122-51	Laboratory control standard	

PARAMETER	08-122-51
Petroleum Hydrocarbons, IR (EPA Method 418.1), Percent	114
Vol.Aromatics (EPA-8020)	
Dilution Factor, Times 1	1
Chlorobenzene, Percent	51
1,2-Dichlorobenzene, Percent	97
1,3-Dichlorobenzene, Percent	87
1,4-Dichlorobenzene, Percent	84
Benzene, Percent	100
Ethylbenzene, Percent	67
Toluene, Percent	56
Other Vol.Aromatics (EPA-8020)	<0.3
Additional Compounds:	
Total Xylene Isomers, Percent	140

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REPORT OF ANALYTICAL RESULTS

LOG NO	SAMPLE DESCRIPTION, WATER SAMPLES	DATE SAMPLED
08-122-51	Laboratory control standard	

PARAMETER	08-122-51
Vol.Halocarbons (EPA-8010)	
Date Extracted	08/20/87
Dilution Factor, Times 1	1
1,1,2,2-Tetrachloroethane, Percent	88
1,1-Dichloroethane, Percent	60
1,1-Dichloroethene, Percent	64
1,2-Dichloroethane, Percent	76
trans-1,2-Dichloroethene, Percent	64
1,2-Dichloropropane, Percent	76
Bromodichloromethane, Percent	76
Bromoform, Percent	72
Carbon Tetrachloride, Percent	80
Chloroform, Percent	80
Methylene chloride, Percent	48
1,1,1-Trichloroethane, Percent	60
Trichloroethylene, Percent	84
Trichlorofluoromethane, Percent	52
trans-1,3-Dichloropropene, Percent	64
Other Vol.Halocarbons (EPA-8010)	---

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REPORT OF ANALYTICAL RESULTS

LOG NO	SAMPLE DESCRIPTION, SOIL SAMPLES	DATE SAMPLED
08-122-52	JPL-MARS-B2-6" BC/QC DUP	06 AUG 87

PARAMETER	08-122-52
Petroleum Hydrocarbons, IR (EPA Method 418.1), mg/kg	19,000

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Project: PE 039.01

REPORT OF ANALYTICAL RESULTS

LOG NO	SAMPLE DESCRIPTION, BLANK WATER SAMPLES	DATE SAMPLED
08-122-53	Reagent blank	

PARAMETER	08-122-53
Petroleum Hydrocarbons, IR (EPA Method 418.1), mg/kg	<10

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REPORT OF ANALYTICAL RESULTS

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LOG NO	SAMPLE DESCRIPTION, SOIL SAMPLES	DATE SAMPLED
08-122-54	JPL-MARS-B2-6" BC/QC SPK	06 AUG 87

PARAMETER	08-122-54
Petroleum Hydrocarbons, IR (EPA Method 418.1), Percent	96

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REPORT OF ANALYTICAL RESULTS

LOG NO	SAMPLE DESCRIPTION, WATER SAMPLES	DATE SAMPLED
08-122-55	Laboratory control standard	

PARAMETER	08-122-55
Petroleum Hydrocarbons, IR (EPA Method 418.1), Percent	114

Amended report 10/30/87. Correction highlighted above. -- P. Duerksen

Robert Peck for
Edward Wilson, Laboratory Director

APPENDIX C

CHAIN-OF-CUSTODY RECORDS

ORIGINAL PAGE IS
OF POOR QUALITY

ENGINEERING-SCIENCE

CHAIN OF CUSTODY RECORD

P87-08-122

ES JOB NO.: PE039.01

PROJECT NAME/LOCATION: JPL GOLDSTONE DSCC

SAMPLER(S): (Signature) ROBERT ADAM, GERRY SLATTERY

SHIP TO: BROWN + CALDWELL LABORATORIES

DATE	TIME	SAMPLE DESCRIPTION		NO. OF CONTAINERS	Priority Pollutant Metals		8010	8020	TPH 418.1				REMARKS
34-87	0800	JPL-ML-HA1-5'	Oxidation Pond	1	✓		✓	✓					
	0800	JPL-ML-HA1-6"		1	✓								
	1905	JPL-MD-A-24"	STAIN AREA	1	✓		✓	✓	✓				
	1900	JPL-MD-A-6"		1	✓				✓				
	1900	JPL-MD-A-12"		1	✓		✓	✓	✓				Correction E.W.4.
	1800	JPL-MD-T1P2-12"	TRENCH 1 (Pit 2)	1	✓								
	1820	JPL-MD-T1P2-3'B		1	✓		✓	✓					
	1940	JPL-MD-B1-12"	BURN AREA	1	✓				✓				
	1930	JPL-MD-B1-4"		1	✓				✓				
	1705	JPL-MD-T1P1-3'	TRENCH 1 (Pit 1)	1	✓		✓	✓					
	1655	JPL-MD-T1P1-12"		1	✓								
	1605	JPL-MD-T3P1-3'	Trench 3 pit 1	1	✓		✓	✓					
	1555	JPL-MD-T3P1-12"		1	✓								
	1400	JPL-MD-T2P1-3'	Trench 2 pit 1	1	✓		✓	✓					
	1400	JPL-MD-T2P1-12"		1	✓								

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Robert W. Adam	5-7-87				

Relinquished by: (Signature)	Date/Time	Received for Laboratory by: (Signature)	Date/Time	Remarks
		R. E. Farin		

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ENGINEERING-SCIENCE

CHAIN OF CUSTODY RECORD

P87-08-122

ES JOB NO.	PROJECT NAME/LOCATION	SHIP TO:
PE039.01	JPL GOLDSTONE DSCC	BROWN & CALDWELL LABORATORIES

SAMPLER(S): (Signature) ROBERT ADAM, GERRY SLATTERLY

DATE	TIME	SAMPLE DESCRIPTION	NO. OF CON-TAINERS	ANALYSES REQUIRED: Priority Pollutant	Metals	8010	8020					REMARKS
8-4-87	1520	JPL-MD-T2P2-3' (Trench 2 (Pit 2))	1	✓		✓	✓					
"	1510	JPL-MD-T2P2-12"	1	✓								

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)
[signature]	8-7-87				

Relinquished by: (Signature)	Date/Time	Received for Laboratory by: (Signature)	Date/Time	Remarks
		R. E. Farris		

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P87-08-122

ENGINEERING-SCIENCE

CHAIN OF CUSTODY RECORD

ES JOB NO.	PROJECT NAME/LOCATION
PE039.01	JPL - GOLDSTONE

SAMPLER(S): (Signature) A. Slattery

SHIP TO:

DATE	TIME	SAMPLE DESCRIPTION	NO. OF CONTAINERS	8010	8020	418.1						REMARKS
8/6/87	11:15	JPL MARS B1 6"	1			X						
"	11:15	" " B1 1½'	1	X	X	X						
"	13:00	" " B2 6"	1			X						
"	13:00	" " B2 1½'	1	X	X	X						
"	13:20	" " B3 6"	1			X						
"	13:20	" " B3 1½'	1	X	X	X						
"	13:40	" " B4 6"	1			X						
"	13:40	" " B4 1½'	1	X	X	X						
8/5	0820	JPL - A - B1 - 5'A	"	X	X	X						
8/6	0805	" " B2 - 6"A	1			X						
"	0820	" " B-2 - 5'A	1			X						
"	0820	" " B-2 - 5'B	1	X	X							
"	0940	" " B-3 - 6"A	1			X						
"	1010	" " B3 - 7'A	1			X						
"	1010	" " B3 - 7'B	1	X	X							

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Robert W. Adams	8-7-87				

Relinquished by: (Signature)	Date/Time	Received for Laboratory by: (Signature)	Date/Time	Remarks
		R. E. Fain		

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P87-08-122

ENGINEERING-SCIENCE

CHAIN OF CUSTODY RECORD

ES JOB NO.	PROJECT NAME/LOCATION
PE.039.01	JPL - GOLDSTONE

SAMPLER(S): (Signature) A. Slattery

SHIP TO:

DATE	~~TIME~~ DATE	TIME	SAMPLE DESCRIPTION	NO. OF CON-TAINERS	8010	8020	418.1						REMARKS
	8/5/87	1530	JPL - A - B4 - 6"A	1			X						
	8/6/87	0720	" " B5 - 6"A	1			X						
	"	0735	" " B5 - 5'A	1			X						
	"	0735	" " B5 - 5'B	1	X	X							
	8/5	1300	" " B6 - 6"A	1			X						
8/5		1310	" " B6 - 5'A	1			X						
8/5	1310		" " B6 - 5'B	1	X	X							
8/5	1430		" " B7 - 5'A	1			X						
	8/5/87	0840	" " B1 - 10'A	1			X						
	"	0835	" " B1 - 10'B	1	X	X							
8/5	1430		B7 - 5'B	1	X	X							

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Robert W. Jelen	8-7-87				

Relinquished by: (Signature)	Date/Time	Received for Laboratory by: (Signature)	Date/Time	Remarks
		R. E. Farris		

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APPENDIX D

DRILLINGS LOGS

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ENGINEERING-SCIENCE

DRILLING RECORD

WELL ID: B1	DRILLING STARTED: Aug 6 1987 0800
LOCATION: GOLDSTONE / APOLLO	DRILLING COMPLETED: 0900
PROJECT NO: PE 039.01	DRILLING METHOD: 8" HSA
DRILLER: FOUND. ENG.	SAMPLING METHOD: SPLIT SPOON
LOGGER:	STATIC WATER LEVEL: —
GEOLOGIST: G. SLATTERY	WATER LEVEL DATE: —
SIGNATURE: G. Slattery	WATER LEVEL DATUM: —

DEPTH IN FEET BELOW L.S.	SAMPLER BLOWS	PERCENT RECOVERY	SAMPLE ID	SAMPLE DESCRIPTION	NOTES
0		100%	B1 6"	SAND & GRAVEL - Moderate yellowish brown (10 YR 5/4), poorly sorted, subround to subangular grains, minor silt, cobbles to 3--40 cm. SP-GP	HNu Readings 6" → No Response
5		50%	B1 5'	siltier, very slightly plastic SP-SM	5' → No Response Note: Brass tubes destroyed for the at 5' level. Only one retained.
10		100%	B1 10'		
15		50%	B1 15'	END OF BORING AT 15 FEET	

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ENGINEERING–SCIENCE

DRILLING RECORD

WELL ID: B2	DRILLING STARTED: 8/5/83 0750
LOCATION: GOLDSTONE / APOLLO	DRILLING COMPLETED: 0905
PROJECT NO: PE039.01	DRILLING METHOD: 8"- HSA
DRILLER: FOUND. ENG.	SAMPLING METHOD: SPLIT SPOON
LOGGER:	STATIC WATER LEVEL: ——
GEOLOGIST: G. SLATTERY	WATER LEVEL DATE: ——
SIGNATURE: G. Slattery	WATER LEVEL DATUM: ——

DEPTH IN FEET BELOW L.S.	SAMPLER BLOWS	PERCENT RECOVERY	SAMPLE ID	SAMPLE DESCRIPTION	NOTES
0		100 %	B2 6"	SAND AND GRAVEL – Mod. yellowish brown (10 YR 5/4), poorly sorted, subrd to subangular, minor silt cobbles to 30-40 cm. SP-GP	HNu readings 6" → 25ppm 1½' → 7ppm
5		100 %	B2 5'		5' → No Response
10		50 %	B2 10'	Rig Response suggests coarser cobbles at approx 12½'	
15		0 %	N/A	SAMPLER REFUSED – END OF BORING	

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ENGINEERING-SCIENCE

DRILLING RECORD

PAGE 1 OF 1

WELL ID: B3	DRILLING STARTED: 8/5/87 0920
LOCATION: GOLDSTONE/APOLLO	DRILLING COMPLETED: 1045
PROJECT NO: PE 039.01	DRILLING METHOD: 8" HSA
DRILLER: FOUND. ENG.	SAMPLING METHOD: SPLIT SPOON
LOGGER:	STATIC WATER LEVEL: —
GEOLOGIST: G. SLATTERY	WATER LEVEL DATE: —
SIGNATURE: A. Slattery	WATER LEVEL DATUM: —

DEPTH IN FEET BELOW L.S.	SAMPLER BLOWS	PERCENT RECOVERY	SAMPLE ID	SAMPLE DESCRIPTION	NOTES
0		100%	B3 6"	SAND AND GRAVEL - Moderate yellowish brown (10 YR 5/4), poorly sorted, subround to sub-angular, minor silt, cobbles to 30-40 cm. SP-GP	HNu Readings 6" → No Response 1½' → No Response
5		0%		SAMPLER REFUSED	
7'		100%	B3 7'		7' → ½ ppm
10		100%	B3 10'	gravels slightly smaller - ≈15 cm	10' → No Response
15		100%	B3 15'	END OF BORING	

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ENGINEERING-SCIENCE

DRILLING RECORD

PAGE 1 OF 1

WELL ID: B4	DRILLING STARTED: Aug 5, 1987 1520
LOCATION: GOLDSTONE / APOLLO	DRILLING COMPLETED: 1645
PROJECT NO: PE039.01	DRILLING METHOD: 8" HSA
DRILLER: FOUND. ENG.	SAMPLING METHOD: SPLIT SPOON
LOGGER:	STATIC WATER LEVEL: —
GEOLOGIST: G. SLATTERY	WATER LEVEL DATE: —
SIGNATURE: G. Slattery	WATER LEVEL DATUM: —

DEPTH IN FEET BELOW L.S.	SAMPLER BLOWS	PERCENT RECOVERY	SAMPLE ID	SAMPLE DESCRIPTION	NOTES
0		100%	B4 6"	SAND AND GRAVEL - Moderate yellowish brown (10 YR 5/4), poorly sorted subround to subangular minor silts, cobbles to 30-40 cm. SP-GP	HNu Readings 6" → No Response 1½' → 1 ppm
5		0%		SAMPLER REFUSED	
		50%	B4 7'	SAMPLE IS PREDOMINATELY ROCK FRAGMENTS	Efforts to select sample levels to avoid boulder layers have not worked; layers do not appear to be laterally continuous.
10		0%		SAMPLER REFUSED	
				?	
15		0%		SAMPLER REFUSED - END BORING	

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DRILLING RECORD

WELL ID: B5	DRILLING STARTED: Aug 6 1987 0710
LOCATION: GOLDSTONE/APOLLO	DRILLING COMPLETED: 0750
PROJECT NO: PE 039.01	DRILLING METHOD: 8" HSA
DRILLER: FOUND. ENG.	SAMPLING METHOD: SPLIT SPOON
LOGGER:	STATIC WATER LEVEL: —
GEOLOGIST: G. SLATTERY	WATER LEVEL DATE: —
SIGNATURE: G. Slattery	WATER LEVEL DATUM: —

DEPTH IN FEET BELOW L.S.	SAMPLER BLOWS	PERCENT RECOVERY	SAMPLE ID	SAMPLE DESCRIPTION	NOTES
0		100%	B5 6"	SAND AND GRAVEL – Moderate yellowish brown (10 YR 5/4), poorly sorted, subround to sub-angular, minor silt, cobbles to 30-40 cm. SP-GP	HNu Readings 6" → No Response
5		100%	B5 5'		5' → 1/2 ppm
5½		—	—	AUGER REFUSED – END OF BORING AT 5½'	

ENGINEERING-SCIENCE

DRILLING RECORD

WELL ID: B6	DRILLING STARTED: Aug 5, 1987 1250
LOCATION: GOLDSTONE / APOLLO	DRILLING COMPLETED: 1345
PROJECT NO: PE 039.01	DRILLING METHOD: 8" HSA
DRILLER: FOUND. ENG.	SAMPLING METHOD: SPLIT SPOON
LOGGER:	STATIC WATER LEVEL: —
GEOLOGIST: G. SLATTERY	WATER LEVEL DATE: —
SIGNATURE: G. Slattery	WATER LEVEL DATUM: —

DEPTH IN FEET BELOW L.S.	SAMPLER BLOWS	PERCENT RECOVERY	SAMPLE ID	SAMPLE DESCRIPTION	NOTES
0					HNu Readings
		100%	B6 6"	SAND AND GRAVEL - Moderate yellowish brown (10YR5/4), poorly sorted, subround to sub-angular, minor silt, cobbles to 30-40 cm. SP-GP	6" → No Response
5		100%	B6 5'		5' → No Response
10				Very hard drilling - will drill deeper to sample	
		50%	B6 12'	END OF BORING AT 12'	

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ENGINEERING-SCIENCE

DRILLING RECORD

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WELL ID: B7	DRILLING STARTED: Aug 5, 1987 1405
LOCATION: GOLDSTONE/APOLLO	DRILLING COMPLETED: 1505
PROJECT NO: PE 039.01	DRILLING METHOD: 8" HSA
DRILLER: FOUND. ENG.	SAMPLING METHOD: SPLIT SPOON
LOGGER:	STATIC WATER LEVEL: —
GEOLOGIST: G. SLATTERY	WATER LEVEL DATE: —
SIGNATURE: G. Slattery	WATER LEVEL DATUM: —

DEPTH IN FEET BELOW L.S.	SAMPLER BLOWS	PERCENT RECOVERY	SAMPLE ID	SAMPLE DESCRIPTION	NOTES
0		0%		NO SAMPLE - SAMPLER REFUSED	HNu Readings 6" → No Response
				SAND AND GRAVEL - Moderate yellowish brown (10 YR 5/4), poorly sorted, subrounded to subangular grains, minor silt cobbles to 30-40cm. SP-GP	1½' → No Response
5'		100%	B7 5'		5' → No Response
10'		0%		Rock jams Auger head - No Sample - END OF BORING AT 10 FEET	

ENGINEERING-SCIENCE

DRILLING RECORD

WELL ID: B1	DRILLING STARTED: Aug 6, 1987 1300
LOCATION: GOLDSTONE / MARS	DRILLING COMPLETED: 1315
PROJECT NO: PE 039.01	DRILLING METHOD: SHOVEL
DRILLER: FOUND. ENG.	SAMPLING METHOD: SMALL SPOON
LOGGER:	STATIC WATER LEVEL: —
GEOLOGIST: G. SLATTERY	WATER LEVEL DATE: —
SIGNATURE: G. Slattery	WATER LEVEL DATUM: —

DEPTH IN FEET BELOW L.S.	SAMPLER BLOWS	PERCENT RECOVERY	SAMPLE ID	SAMPLE DESCRIPTION	NOTES
0					HNu Readings
6"		100%	B1 6"	SAND AND GRAVEL - Dark yellowish brown (10 YR 4/2), poorly sorted, angular sand grains, predominately medium to coarse, minor silts, boulders to 50 cm. SP - GP	0 - 5 ppm
1'					
1½'		100%	B1 1½'	END OF EXCAVATION AT 1½ FEET	
				Note: LARGE BOULDERS IN THIS AREA PREVENT THE USE OF THE AUGERS FOR DRILLING. Because the levels of volatiles detected are low, 3D-B4 at this site will be dug to 1½' by shovel and sampled by spoon at 6" and 1½' below grade.	

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ENGINEERING-SCIENCE

DRILLING RECORD

WELL ID: B2	DRILLING STARTED: Aug 6, 1987 1040
LOCATION: GOLDSTONE / MARS	DRILLING COMPLETED: 1245
PROJECT NO: PE 039.01	DRILLING METHOD: SHOVEL
DRILLER: FOUND. ENG.	SAMPLING METHOD: SMALL SHOVEL
LOGGER:	STATIC WATER LEVEL: —
GEOLOGIST: G. SLATTERY	WATER LEVEL DATE: —
SIGNATURE: G. Slattery	WATER LEVEL DATUM: —

DEPTH IN FEET BELOW L.S.	SAMPLER BLOWS	PERCENT RECOVERY	SAMPLE ID	SAMPLE DESCRIPTION	NOTES
0				SAND AND GRAVEL - Dark yellowish brown (10 YR 4/2), poorly sorted, predominately medium to coarse grained sands, minor silts, boulders to 50 cm, angular sand grains. SD-GP.	HNu Readings No Response
6"		100%	32 6"		
1'					
1½'		100%	32 1½'	END OF EXCAVATION AT 1½ FEET	
				** SEE NOTE ON MARS BORING 31.	

ENGINEERING-SCIENCE

DRILLING RECORD

WELL ID: B3	DRILLING STARTED: Aug 6, 1987 1315
LOCATION: GOLDSTONE / MARS	DRILLING COMPLETED: 1335
PROJECT NO: PE 039.01	DRILLING METHOD: SHOVEL
DRILLER: FOUND. ENG.	SAMPLING METHOD: SMALL SHOVEL
LOGGER:	STATIC WATER LEVEL: —
GEOLOGIST: G. SLATTERY	WATER LEVEL DATE: —
SIGNATURE: G. Slattery	WATER LEVEL DATUM: —

DEPTH IN FEET BELOW L.S.	SAMPLER BLOWS	PERCENT RECOVERY	SAMPLE ID	SAMPLE DESCRIPTION	NOTES
0				SAND & GRAVEL - Dark yellowish brown (10 YR 4/2), poorly sorted, angular sand grains, predominantly medium to coarse grained, minor silt, boulders to 50 cm. SP-GP	HNu Readings
6"		100%	B3 6"		5 ppm
1'					
1½'		100%	B3 1½'	END OF EXCAVATION AT 1½ FEET	10 ppm
				SEE NOTE ON B1.	

ENGINEERING-SCIENCE

DRILLING RECORD

WELL ID: B4	DRILLING STARTED: Aug 6, 1987 1320
LOCATION: GOLDSTONE / MARS	DRILLING COMPLETED: 1350
PROJECT NO: PE 039.01	DRILLING METHOD: SHOVEL
DRILLER: FOUND. ENG	SAMPLING METHOD: SPOON
LOGGER:	STATIC WATER LEVEL: —
GEOLOGIST: G. SLATTERY	WATER LEVEL DATE: —
SIGNATURE: G. Slattery	WATER LEVEL DATUM: —

DEPTH IN FEET BELOW L.S.	SAMPLER BLOWS	PERCENT RECOVERY	SAMPLE ID	SAMPLE DESCRIPTION	NOTES
0				SAND AND GRAVEL - Dark yellowish brown (10 YR 4/2), poorly sorted, angular sand grains, predominantly medium to coarse grained, minor silt, boulders to 50 cm. SP-GP	HNu Readings
6"		100%	B4 6"		6" → No Response
1½'		100%	B4 1½'	END OF EXCAVATION AT 1½'	1½' → 1 ppm

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APPENDIX E

ANALYSIS FOR ASBESTOS IN VINYL TILE COLLECTED FROM ABANDONED DUMPSITE AT MOJAVE BASE SITE

HAGER LABORATORIES, INCORPORATED

11234 E. Caley Avenue
Englewood, Colorado 80111
(303) 790-2727   (800) 282-1835

Analysis for Chemicals
Harmful to Humankind

REPORT ON SERVICE NUMBER 27729AN
September 3, 1987

To: Tim Mustard   PE 039-03
Engineering - Science
Denver, Colorado

Analysis: The following sample was submitted for analysis: One bulk sample for asbestos identification and content determination.

Method: ASBESTOS (identification)
Each sample was analyzed following EPA method 600/M4-82-020. Duplicate portions of each bulk material were immersed in liquid media of known index of refraction on a microscope slide and observed at 100 power using a McCrone Dispersion Staining Objective with polarizing light. Characteristics of the fibers under polarizing light and under dispersion staining conditions using four media were compared to similarly prepared samples of known asbestos types. Estimates of the asbestos fiber content were made by comparing the quantity of non-asbestos material to asbestos fibers.

Results: The results are found on Table 1.

Discussion: Detection limit for bulk samples is 1% asbestos fibers.

Laboratory data are filed and available upon request.

Hager Laboratories Inc. has been AIHA accredited since 1977 and EPA approved for asbestos since 1979. A portion of each sample is retained for subsequent review and future analysis.

If you have any questions, please call customer service.

Submitted by: David A. Randle
David A. Randle
Supervisor

DAR/sn

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SN 27729AN
September 3, 1987

TABLE 1

Sample Number	Asbestos (sample contains)
ES-1	no detected asbestos

APPENDIX F

FIELD NOTEBOOK NOTES

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8-4-87

7:10am ES & DRILL CO. LEFT BARSTOW FOR JPL
Enroute to Irwin Rd. Exit- Drill Rig brokedown
9:45am Arrived @ JPL w/ ES + BACKHOE

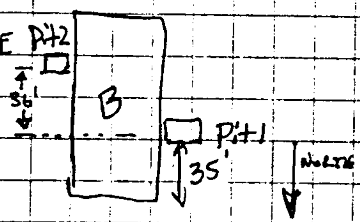
10:15am SUPPORT TRUCK ARRIVED - DRILL RIG IN BARSTOW FOR REPAIRS - ESTIMATED 2-3 HOURS UNTILL REPAIR ARE COMPLETE

10:30am BEGAN SETUP & DECONTAMINATION AREA
CLEANED SAMPLE TUBES / SAMPLER FOR BACKHOE
NO USE OF BACKHOE IN MORNING - ON DOWNTIME
12:30 LUNCH BREAK 1HR.
1:30 WORK BEGAN - BACKHOE

TRENCH #2 SITE INVESTIGATION & SAMPLING

PIT 1

	DEPTH	HNu	TRASH
*	1 FT	ND	
	2 FT	ND	BATTERY, HOSE, PIPE
*	3 FT	ND	
	4½ FT	ND	
*	6½	ND	

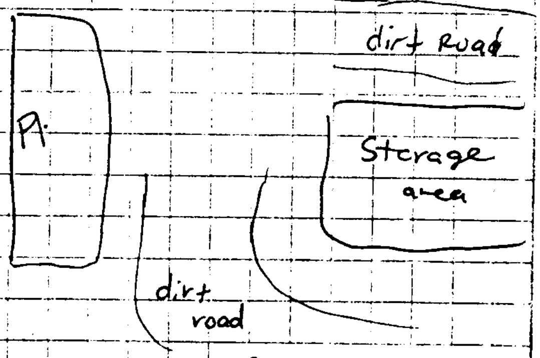


Trench appears to be approx 4' depth based on soil structure + garbage ~~found during excavation.~~

ORGANICS
ND= NOT DETECTED ABOVE BACKGROUND WHICH IS EQUAL TO 0.1 ppm

SAMPLES COLLECTED

* JPL-MD-T2-P1-1' 1400 8/4/87
* JPL-MD-T2-P1-3' 1400 8/4/87
* JPL-MD-T2-P1-6' 1425 8/4/87



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PROJECT ____________________ Continued From Page ________

1445 Backfilling of trench complete
Excavated soil backfilled into trench, and plastic placed into barrel.

1500 HRS. START TRENCH 2 - PIT 2

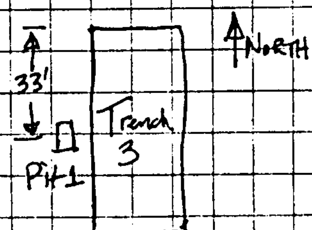
DEPTH	HNu	TRASH
1'	ND	WOOD, CABLE
* 3'	ND	hard soil
4'	ND	

Sample @ 1' - analyze for metals only
" @ 3' - " " " + 8020/8010
" @ ~~4~~6' - " " " + 8020/8010

1540 END OF BACKFILL T2P2. STEAM CLEANING BACKHOE BUCKET.

1550 START EXCAVATION OF PIT 1 (AND ONLY) AT TRENCH 3 (SOUTHERN TRENCH) BOB C. HAS REC'D APPROVAL FROM DAVE FOR ONLY ONE PIT BECAUSE THE TRENCH IS RELATIVELY SHORT.

DEPTH	HNu
1	ND
2	ND
3	ND
6	ND



SAMPLES COLLECTED AT	ANALYSIS
1'	P.P. Metals
3'	8020/8010/P.P. Metals
6'	" " "

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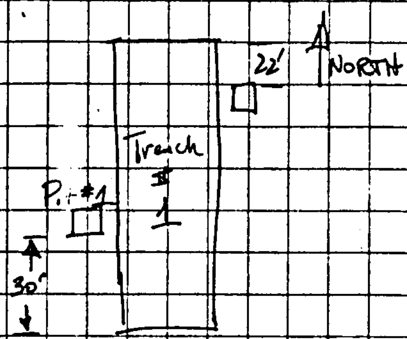
4:30 T3P1 Backfilled - Steamcleaning Backhoe Bucket.

4:45 START EXCAVATION AT TRENCH 1/PIT 1. (NORTH TRENCH)

DEPTH	HNu
1½	ND
3	ND
6	ND



SAMPLES	ANALYSIS
1'	Metals
3'	8010/8020/Metals
7'	P.P. Metals

1735 T1P1 COMPLETE. EXCAVATION FILLED STEAM CLEANING BACKHOE BUCKET

1750 START T1P2 EXCAVATION.

DEPTH	HNu
1	ND
2	ND
3	ND

SAMPLES AT	ANALYSIS	
1'	P.P. Metals	
3'	8020/8010/P.P. Metals	
3'B	" " "	← Sample in trench wall where color change noted.
6'	P.P. Metals	

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Signed ________ Date ________ Signed ________ Date ________

Notebook No. ______

PROJECT ______

Continued From Page ______

1845 START AT DISCOLORED AREA AFTER CLEANING BACKHOE BUCKET. SAMPLES COLLECTED ARE LABLED:
~~1B~~ JPL-MD-"A" ~~2~~ — Area A
No HNu response noted during excavation
Samples Collected @
6", 12", AND 24"

1920 START AT BORN AREAS.

PIT B1 SAMPLED AT 4" & 12"
3-4 inch discolored layer noted at surface

PIT B1 - located on North side of South Burn Area.
Both Areas were the same (visually) and B1 samples are thought to be representative of both born piles

1946 FINAL BACKHOE CLEANING. STRAIGHTENING Vehicles. Cleaning Equipment.

MOJAVE ABANDONED LAGOON - 8-5-87

0800 am Hand Augar sampling -

Soil samples collected @ 6" and 5'

analyzed for priority pollutant metals — JPL-ML-HA1-6"

analyzed for PP metals 8010/8020 — JPL-ML-HA1-5'

NO HNU responce noted during excavation

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Aug 5, 1987 GOLDSTONE LOG

6:20 ON-Site w/ Bob Coale
6:50 Drillers arrive @ ECHO
7:00 LEAVE ECHO FOR APOLLO
7:20 ON-Site @ APOLLO
7:50 START B-2
9:05 B-2 COMPLETE (1:15)
9:20 START B-3
10:45 END OF B-3 (1:25)
MOVE DRUM RACK
11:30 TO ECHO FOR LUNCH
12:50 START B-6
1:45 END B6
2:05 START B7
3:20 START B4
4:45 END OF B4
5:25 Heading to Mojave to Steam Clean Augers
6:05 Leaving Mojave (power failure due to storm — two augers left to clean)

Aug 6, 1987

5:55 Arrive @ Guard House
6:10 At Mojave - steam clean last augers
6:35 Drillers Arrive
6:50 At Apollo
7:10 Start B5
8:20 Start B1
9:10 Grouting boreholes (top 1-2')
9:40 Going to MARS - Dave will bring drillers over when grouting is complete
10:00 At MARS - checking in
10:20 Decon set up - Stand by for Drillers
10:40 Rig at MARS - set up on B2

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PROJECT ______ JOB NO. ______ DATE ______ SHEET 1
DETAIL ______ BY ______ OF 2

Aug 6 (cont)

11:05 - UNABLE TO DRILL B2 due to large Boulders
11:20 - LUNCH
1:15 B3 Dig
1:50 B4 completed
2:40 Done At MARS
3:15 Clean-up complete - to Echo
4:05 Meeting complete leaving
4:10 Off-site
4:20 Out of Fort Irwin

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PROJECT ________ JOB NO. ____
DETAIL ________
DATE ____
BY ____
SHEET 2
OF 2

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	DEPTH	HNu	Soil
B-2	6"	25ppm (b)	
	1½'	6-7 (SN)	1A 10 YR 5/4 moderate yellowish brown poorly sorted predom S & G cobbles 30-40 cm minor silt sbrd - sub Ang SP - GP Firm but Friable
	5'		
	10'		HARD DRIVE - only 10'A collected
	≈ 12'		based on rig feel: coarser cobbles/boulders encountered. Alternately easier and harder drilling suggests that bould/cobble layers are interbedded w/ finer layers
	15'		Sampler refused
B-3	6"	NR (b)	
	1½'	NR (SN)	Description Same As Above - possibly fewer cobbles
	5'		SAMPLE REFUSED
	7'	½ ppm	SAMPLED
	10'	NR	gravels to 15cm - predom 5cm
	15'		

b = boring vapor
SN = Sampler nose vapor

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PROJECT GOLDSTONE JOB NO. ____
DETAIL ____
DATE Aug 5, 6, 1984 BY [initials]
SHEET 1 OF 4

c-3

DEPTH	HNu	Soil
B-6		
6"	NR	
5'	NR	
10'		Drilling conditions suggest that no sample will be collected here - drill deeper
12'		Collect sample - End of Boring ONLY 12'A collected
B7		
6"	NR	NOT ABLE TO SAMPLE AT THIS LEVEL - BOULDERS
1'	NR	
5'	NR	
10'		ROCK JAMS INTO AUGER LEAD - NO SAMPLE - END OF DRILLING
B4		
6"	NR	Soil appears mortar - some CARDBOARD
1½	1ppm (SN)	Soil Description As other borings
5'		SAMPLER REFUSED
7'		SAMPLE COLLECTED - ALMOST COMPLETELY FRACTURED ROCK FRAGMENTS 7'A only
10'		SAMPLER REFUSED

NOTE: EFFORTS TO ADJUST SAMPLING DEPTHS TO AVOID BOULDER LAYERS (SINCE B-6) HAVE NOT WORKED. SOILS ARE NOT LATERALLY CONSISTENT, CHANNALIZED DEPOSITS LIKELY

15'		SAMPLER REFUSED - END OF BORING

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PROJECT GOLDSTONE JOB NO. ____ DATE 8/5/84 SHEET 2
DETAIL ____ BY [initials] OF 4

	DEPTH	HNu	Soil
B5	6"	NR	
	5'	½ ppm	SAMPLED
	8½'		Augers Refused
B1	6"	NR	
	5'	NR	A little siltier than before - very slightly plastic - Brass tubes drove together only on tube recovered. SM-SP
	10'		Sample
	15'		SAMPLE - only one tube recovered

MARS

B2	1'	NR	Very difficult drilling. Boulders to 50 cm encountered

Angular s. poorly sorted predom med - coarse w/ minor silts
SP-GP Dark yellowish brown 10 YR 4/2

PLAN : WILL SAMPLE 5' CUTTINGS → DOESN'T WORK; ONLY COBBLES COME UP AUGERS SO : PULL AUGERS - TAKE MATERIAL FROM AUGER FLIGHTS. UNABLE TO DRILL → WILL DIG EACH BORING BY HAND TO ~1½ FEET - SAMPLES WILL BE COLLECTED AT 6" & 18". NO APPRECIABLE VOLATILES ARE BEING DETECTED BY HNu

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	DETAIL ____	BY ____	OF 4

	DEPTH	HNu
B1	0-1½	0-5 ppm
B3	6"	5 ppm
	1'	10 ppm
B4	6"	NR
	1'	2 ppm

Holes Backfilled to ~8to6" AND surfaced with bentonite

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PROJECT ______ JOB NO. ______ DATE ______ SHEET 4

DETAIL ______ BY ______ OF 4

Part Two:
Guide to Implement Environmental Compliance Programs

ABSTRACT

PART TWO

This report, which is included as Part Two of the Environmental Projects: Volume 5 document, details the management duties and responsibilities needed to maintain compliance with applicable environmental laws and regulations at a facility of the size and type similar to a Deep Space Communications Complex (DSCC).

GLOSSARY

PART TWO

APCA	Air Pollution Control Act
CAC	California Administrative Code
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CWA	Clean Water Act
EC	Environmental Coordinator (GDSCC)
EMP	Environmental Management Program
E/SRT	Emergency/Spill Response Team
FIFRA	Federal Insecticide, Fungicide and Rodenticide Act
GDSCC	Goldstone Deep Space Communications Complex
HSST	Hazardous Substances Storage Tanks
HSWA	Hazardous and Solid Waste Amendments (1984)
JPL	Jet Propulsion Laboratory
MSDS	Material Safety Data Sheets
OSHA	Occupational Safety and Health Administration
PCBs	polychlorinated biphenyls
RCRA	Resource Conservation and Recovery Act
TDA	Office of Telecommunications and Data Acquisition (JPL)
TSCA	Toxic Substances Control Act

CONTENTS

PART TWO: GUIDE TO IMPLEMENT ENVIRONMENTAL COMPLIANCE PROGRAMS

SECTION I

ENVIRONMENTAL DUTIES AND RESPONSIBILITIES AT A DEEP SPACE COMMUNICATIONS COMPLEX (DSCC)

This Guide describes the types of management duties and responsibilities to be addressed by a Contractor to implement an Environmental Compliance Program at a facility equivalent in both size and diversity to the Goldstone Deep Space Communications Complex (GDSCC). The environmental laws and regulations of the United States serve as the bases for the specific environmental compliance program at the GDSCC. These laws and regulations, however, also can be used as a guide to implement Environmental Compliance Programs at similar facilities at foreign locations.

A. GENERAL DUTIES AND RESPONSIBILITIES

The Contractor shall conduct all of its activities at the Goldstone DSCC in strict compliance with all applicable Federal, state, and local environmental laws and regulations and in accordance with NASA and JPL policies and directives. To fulfill this requirement, the Contractor shall develop and operate an environmental management program specifically for the Goldstone DSCC. In addition, the Contractor shall adequately train its employees in proper environmental practices and procedures as specified in environmental laws, regulations, policies, and directives. Training records shall be maintained at the GDSCC in the files of the Contractor's appointed Environmental Coordinator (EC).

B. ANNUAL WRITTEN REPORT

The Contractor shall provide an annual written statement to JPL, certifying that all employees have been adequately trained as required by environmental laws, regulations, policies, and directives.

C. SUBMISSION OF WRITTEN TRAINING SCHEDULE

The Contractor shall submit to the Jet Propulsion Laboratory (JPL), for approval, a written schedule of described training (including on-going or refresher training), to be provided to its employees. This written schedule shall be submitted one month prior to the start of each fiscal year, and shall outline the Contractor's training plans for the following fiscal year.

D. DESIGNATION OF ENVIRONMENTAL COORDINATOR (EC)

The Contractor shall designate one of its on-site, GDSCC staff to serve full-time as Environmental Coordinator (EC). The EC shall, at a minimum, have a degree from an accredited, four-year college, with a major speciality in industrial hygiene or in environmental or chemical engineering, plus at least three years experience in environmental management. The EC shall be responsible for the day-to-day management of the Goldstone Environmental Program.

E. MAINTENANCE OF A CENTRAL ENVIRONMENTAL FILE

The Environmental Coordinator shall maintain a central environmental file. All records, copies of reports and documents, correspondence, manifests, Material Safety Data Sheets (MSDS), training records, permits and any other pertinent items, shall be maintained in this file. The Contractor shall comply with requirements for maintaining the files as are found in the various environmental regulations, and as may be required by JPL.

F. MAINTENANCE OF A FILE OF MATERIAL SAFETY DATA SHEETS (MSDS)

The Contractor shall maintain a file of Material Safety Data Sheets (MSDS) that describe all hazardous materials used or stored at the GDSCC. MSDS must be readily available to emergency response personnel. Employees must be given an opportunity to read the MSDS for each material that they may encounter in the workplace. The Contractor shall keep a record verifying that employees have read the appropriate MSDS.

G. WORKER RIGHT-TO-KNOW PROGRAM

Within six months of the contract date, the Contractor shall implement a worker right-to-know program at the GDSCC in accordance with all applicable federal and state regulations.

H. OPERATION OF WASTE-MANAGEMENT FACILITIES

The Contractor shall operate the solid-waste management facilities, hazardous-waste management facilities, waste-water management facilities, storage-tank facilities, and any facilities, systems, and equipment, not identified above, that are associated with compliance with the environmental laws, regulations, policies and directives.

I. PAYMENT OF FEES, TAXES AND FINES ASSOCIATED WITH ENVIRONMENTAL MAINTENANCE

The Contractor shall pay all fees, taxes, and fines associated with Federal, state and local environmental laws and regulations, including, but not limited to those relating to hazardous waste, solid waste, PCBs, asbestos, releases of hazardous materials and wastes (including air emissions subject to regulation by the appropriate Air Pollution Control District), pesticides, storage tanks, water, and wastewater.

J. LEGAL AND FINANCIAL RESPONSIBILITY

As may be imposed by any environmental agency, the Contractor shall accept legal and financial responsibility for mismanagement of any element in the environmental program.

SECTION II

THE ENVIRONMENTAL MANAGEMENT PROGRAM

A. PREPARATION AND SUBMISSION OF AN ENVIRONMENTAL MANAGEMENT PLAN

As part of the requirement for the Environmental Management Program (EMP), the Contractor shall prepare an Environmental Management Plan (Plan), to be submitted for review and approval by JPL within six months of the contract date. This Plan shall consist of the program objectives, scope, applicability, a program organization chart, duties and responsibilities of key personnel involved with the program, a list of required records and reports, a list of permits held by the facility and their renewal dates, a description of the waste-minimization program, a description of the training program, and specific standard operating procedures to be identified by the Contractor (e.g., waste-collection procedures, storage procedures, tank-inventory reconciliation procedures, facility-recordkeeping procedures, training requirements). The Plan shall be updated annually or more often, as necessary, or at intervals directed by JPL. On an annual basis, or whenever changes are made to the Plan, JPL shall review and approve the contents of the Plan, and may suggest that additional standard operating procedures be implemented.

B. PROVISION OF AN EMERGENCY RESPONSE PLAN

The Contractor shall provide an Emergency Response Plan, and submit this Plan to JPL for review/approval within six months of the contract date. This plan shall address actions to be taken in the event of spills and other emergencies. This Plan will include the following: an organization chart of the Contractor's emergency/spill response team (E/SRT) structure; a list of the duties and responsibilities of E/SRT members; designation of the Contractor's Emergency Coordinator and alternates; a list of names, addresses, and telephone numbers of E/SRT members and outside responders or agencies; protocol for communications during an emergency/spill event; a list of emergency equipment available at the GDSCC; equipment locations, quantities of equipment available, and an inspection checklist and schedule; a table of recordkeeping and reporting requirements; and specific procedures for responding to emergencies/spills.

C. PROVISION OF EMERGENCY RESPONSE SCENARIOS

In addition, within six months of the contract date, the Contractor shall develop and submit to JPL for review/approval various response scenarios for areas at the GDSCC that may likely be involved in a spill. The purpose of the scenarios is to provide model situations for emergency/spill response training drills and to increase the readiness of the E/SRT. The Contractor will define the level of its capability to respond to emergencies/spills (e.g., first response capabilities, cleanup capabilities). Based on these capabilities, the Contractor will make appropriate arrangements with an outside response team for on-call services in the event that an emergency/spill surpasses the Contractor's capability to respond. In effect, the Contractor is required to have the capability to respond effectively to any hazardous-substance release or emergency, either through its in-house resources or through the use of any pre-designated outside assistance.

D. PROVISION OF A FACILITIES INSPECTION CHECKLIST AND INSPECTION SCHEDULE

As part of the Environmental Management Program, the Contractor shall include a facilities inspection checklist and an inspection schedule. The Contractor shall conduct routine inspections of all facilities and areas covered by the environmental program. The purpose of inspections is to check compliance status, physical conditions, and safety conditions at each site. For at least three years, the Contractor shall retain copies of completed inspection checklists and all deficiency/correction report sheets. In addition to facility inspections, the Contractor shall conduct a quarterly records audit to determine whether all necessary records are being kept. JPL also will conduct compliance audits periodically to determine whether the Contractor's environmental program is effective. The Contractor agrees to cooperate with the JPL compliance audits and based on these audit findings, will take corrective actions as required.

SECTION III

ENVIRONMENTAL LAWS, REGULATIONS AND POLICIES

At a minimum, the Contractor shall include in its environmental management plan, program elements that address current environmental laws, regulations, policies, and directives, including, but not limited to the following:

(1) Hazard-Communication Program Elements

- a. Federal Right-to-Know Legislation
- b. State Right-to-Know Legislation
- c. Local Emergency Response Right-to-Know Ordinances

(2) Hazardous and Solid-Waste Program Elements

- a. Resource Conservation and Recovery Act (RCRA) regulations
- b. Hazardous and Solid Waste Amendments of 1984 (HSWA) and impending regulations
- c. California Health and Safety Code
- d. California Administrative Code (CAC), Titles 14, 22, and 23

(3) Toxics Program Element

- a. Toxic Substances Control Act (TSCA) regulations

(4) Hazardous Substances Release Program Elements

- a. Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) regulations
- b. Clean Water Act (CWA) regulations
- c. California Health and Safety Code
- d. California Administrative Code, Titles 19 and 23
- e. Local Emergency Response Ordinances

(5) Pesticide Program Element

- a. Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) regulations

(6) Air Program Elements

- a. Air Pollution Control Act (APCA) regulations
- b. San Bernardino County Air Pollution Control Rules

(7) Hazardous Substance Storage-Tank Program Elements

- a. Resource Conservation and Recovery Act regulations
- b. Hazardous and Solid Waste Amendments of 1984 and impending regulations
- c. California Health and Safety Code

d. California Administrative Code, Titles 22 and 23
e. San Bernardino County Hazardous Substance Storage-Tank Requirements

(8) Water and Wastewater Program Elements

a. Clean Water Act (CWA) Regulations
b. California Health and Safety Code
c. California Regional and Water Quality Control Board: Lahontan Region Rules

(9) Asbestos Management Program Elements

a. Toxic Substances Control Act
b. Occupational Health and Safety Act
c. California Occupational Health and Safety Act
d. California Administrative Code, Title 8

The Contractor shall be responsible for identifying applicable Federal, state, and local laws and regulations that are not listed above, including any similar items in its Management Plan, and maintaining copies of these laws and regulations in the Environmental Coordinator's file at the GDSCC. This includes new laws and regulations that may be enacted during the period of contract performance. JPL will provide the Contractor with any special information concerning NASA and JPL environmental policy and directives.

SECTION IV

HAZARDOUS-WASTE MANAGEMENT PROGRAM

The Contractor shall develop and operate a program that will ensure regulatory compliance for hazardous-waste and solid-waste activities conducted at the GDSCC. At a minimum, the hazardous-waste program shall address the following activities and requirements:

A. GENERATOR'S ACTIVITIES

1. Use of an EPA Generator's I.D. Number

The Contractor shall use an EPA Generator's I.D. number supplied by JPL. The Contractor shall not be required to obtain its own I.D. number.

2. Preparation and Submission of Hazardous-Waste Generator Reports

The Contractor shall prepare all generator reports required by law. The Contractor will submit these reports to the designated JPL representative for review and approval prior to submission to the appropriate agency by the Contractor. A minimum of one month shall be allowed for the JPL review process so that reports reach the agencies by the required date. The Contractor shall sign all required reports as the agent for JPL.

3. Implementation of a Hazardous-Waste Minimization Program

The Contractor shall implement a waste-minimization program within six months of the contract date, and shall comply with the generator's certification statement that appears on the Uniform Hazardous-Waste Manifest. The waste minimization program shall be submitted to JPL for review and approval prior to implementation.

4. Completion of Uniform Hazardous-Waste Manifests

The Contractor shall be responsible for the completion of all Uniform Hazardous-Waste Manifests and shall comply with all manifest notification, recordkeeping, and deficiency reporting requirements as required by law. The Contractor shall sign all manifests as the agent for JPL and shall not ship hazardous wastes without a manifest.

B. STORAGE ACTIVITIES

1. Operation of a Hazardous-Waste Storage Facility

The Contractor shall not operate a hazardous-waste storage facility in a mode that requires a hazardous-waste management facility permit (i.e., storage of any waste in excess of ninety (90) days).

2. Maintenance of Hazardous-Waste Storage Areas

The Contractor shall not operate a hazardous-materials or waste-storage facility in a mode that is in violation of any applicable law or regulation. Hazardous-materials storage areas shall be maintained in the same safe, well-kept manner as hazardous-waste storage areas.

3. Training of Personnel in Use of Hazardous-Waste Storage Facilities

The Contractor shall provide adequate training for personnel using any hazardous-materials/waste-storage facility, and shall provide necessary safety and emergency equipment at a location readily accessible to each storage site.

4. Designation of Hazardous-Waste Storage Locations

The Contractor shall designate hazardous-materials and waste-storage locations (to be approved by the designated JPL representative). No other locations shall be used for storage of hazardous materials or wastes. Each location will be provided with a unique identification number. All areas used for storage will be concrete (or otherwise protected from spills infiltrating into the soil) and shall be provided with other features as required by law.

C. TREATMENT ACTIVITIES

The treatment of hazardous waste shall not be permitted at the GDSCC.

D. DISPOSAL ACTIVITIES

1. Ban on Waste-Disposal Activities at the GDSCC

The Contractor shall not engage in any hazardous-waste disposal activities of any kind within the legal boundaries of the GDSCC.

2. Proper Disposal and Transport of Hazardous Wastes

The Contractor shall send hazardous wastes to appropriately permitted, off-site (commercial) treatment, recycling, or disposal facilities. Properly licensed haulers of hazardous wastes will be used to transport all hazardous wastes off-site.

3. Recordkeeping of all Waste Intake/Disposal Activity

The Contractor shall keep a log (including all manifests), of all waste intake/disposal activity. The log shall list each item taken into storage and released for transport to a waste-management facility (or recycled for use on-site). The log shall be used as a means to monitor usage and accumulation time (no waste may be stored in excess of 90 days). The log also shall serve as a database for completing annual and biennial reports and computing annual taxes or fees owed to the state. A log of hazardous-materials intake and use also shall be maintained. The log is to monitor quantities of materials purchased versus quantities used. The purpose of this recordkeeping is to reduce the risk of spills and the quantities of unused materials that require disposal as wastes. By doing this, not only will the quantities of new hazardous substances stored at the GDSCC be kept to a minimum but the length of time that materials are stored also will be kept to a minimum before they are used.

SECTION V

SOLID-WASTE MANAGEMENT PROGRAM

At a minimum, items to be included under the solid-waste management program are as follows:

A. MAINTENANCE OF FILE OF SOLID-WASTE FACILITY PERMITS

The Contractor shall maintain a file of all solid-waste facility permits (waste discharge requirements issued by the Lahontan Regional Water Quality Control Board and solid-waste facility permits issued by the State Solid-Waste Management Board). The Contractor shall ensure that permit conditions are met at all times and that the facilities are in compliance with all requirements for operation of Class III solid-waste disposal facilities under California Administrative Code, Titles 23 and 14 and in conformance with the County Solid-Waste Management Plan and any other applicable regulations.

B. RELATIONSHIP BETWEEN HAZARDOUS-WASTE AND SOLID-WASTE DISPOSAL SITES

The Contractor shall ensure that no hazardous waste is deposited into a GDSCC solid-waste disposal site.

C. OPERATION AND INSPECTION OF SOLID-WASTE DISPOSAL SITES

At a minimum of every 5 years (beginning with the first year of contract initiation), the Contractor shall have the operational solid-waste disposal sites inspected by a registered civil engineer for the purpose of reviewing the site design, implementation status, operations plan, and remaining capacity. The Contractor shall prepare and submit the report of findings to JPL for review and approval prior to the Contractor's submission of the report to the San Bernardino Department of Environmental Health Services and the State Solid-Waste Management Board. The Contractor shall sign as the agent for JPL.

D. GROUNDWATER MONITORING PROGRAM PLAN

Within six months of the contract date, the Contractor shall prepare a groundwater monitoring program plan (as required by CAC, Title 23, Chapter 3, Subchapter 15, Article 5). The Contractor shall submit this plan to JPL for review and approval prior to the Contractor's submission of the plan to the Lahontan Regional Water Quality Control Board. The Contractor shall sign as the agent for JPL.

E. PERMIT APPLICATION AND OPERATIONS PLAN

Within six months of the contract date, the Contractor shall prepare a revised permit application and operations plan. The Contractor shall submit this plan for review and approval by JPL for expansion of the

GDSCC solid-waste disposal site to include an additional and remaining four acres. Following JPL review/approval, the Contractor shall submit applications to appropriate environmental agencies for approval.

F. CLOSURE PLANS

The Contractor shall prepare a closure plan for the existing Echo Site landfill. This will be done in accordance with requirements in the solid-waste facility permit and CAC Title 14 regulations. In addition, within six months of the contract date, the Contractor shall submit closure plans in accordance with permit requirements for landfills at the Mojave/Apollo Sites. Closure plans shall be submitted for review/approval by JPL prior to the Contractor's submittal of plans to agencies. The Contractor shall be responsible for properly closing all landfills, in accordance with permit conditions and plans.

G. COLLECTION BIN STORAGE

The Contractor shall manage collection bins in accordance with all environmental requirements. Storage in bins should not exceed seven days duration.

H. DAILY OPERATING RECORDS

The Contractor shall maintain a daily operating log that includes records of weights or volumes of waste disposed of, and length and depth of cuts made in natural terrain where fill will be placed.

I. CONTROL OF WINDBLOWN MATERIALS

The Contractor, in operation of a landfill, shall provide adequate control of windblown materials.

J. MAINTENANCE OF COVER ON A LANDFILL

The Contractor, in operation of a landfill, shall maintain a minimum thickness of six inches of cover on a daily basis, or at another frequency as approved by the county.

K. MAINTENANCE OF SIGNS AND SECURITY FENCING

The Contractor shall maintain appropriate signs and security fencing at a landfill facility.

L. CONTROL OF GASES FORMED IN LANDFILLS

As determined to be necessary, the Contractor shall control any landfill gases formed so as not to create a hazard or nuisance.

M. GRADING TO PROMOTE DRAINAGE

The Contractor shall provide grading at the disposal site sufficient to promote proper drainage and prevent ponding of liquids.

N. TRAINING OF LANDFILL-SITE PERSONNEL

The Contractor shall provide adequate training for disposal and landfill operators. Adequate staff shall be maintained as well as emergency equipment to be used at the site.

O. MAINTENANCE OF LANDFILL EQUIPMENT

The Contractor shall maintain landfill equipment in clean and good working condition.

P. COMPLIANCE WITH LANDFILL COMPACTION REQUIREMENTS

The Contractor shall be in compliance with landfill compaction requirements.

SECTION VI

MANAGEMENT OF TOXIC-MATERIALS PROGRAM

A. MANAGEMENT OF ASBESTOS

The Contractor shall operate in compliance with the Asbestos Management and Abatement Plan prepared by JPL for the GDSCC.

1. Control of Access to Asbestos-Containing Areas

The Contractor shall control access to those areas that contain asbestos and where asbestos has been determined to pose a potential or actual health risk. Personnel working in such areas must be trained to work in asbestos environments, and must wear proper protective equipment and clothing.

2. Disposal of Asbestos-Containing Materials

Prior to completion of the Asbestos Abatement Plan, the Contractor shall properly dispose of all asbestos-containing materials. A semiannual report of all incidents or activities involving asbestos, including storage for disposal and its ultimate disposal, shall be submitted to JPL.

B. MANAGEMENT OF POLYCHLORINATED BIPHENYLS (PCBs)

The contractor shall comply with all JPL requirements for management of polychlorinated biphenyls (PCBs) at the GDSCC.

SECTION VII

HAZARDOUS-SUBSTANCES RELEASE PROGRAM

A. RESPONSIBILITY FOR RESPONSE TO RELEASE OF HAZARDOUS SUBSTANCES

The Contractor shall be responsible for responding to all releases of hazardous substances at the GDSCC. A report of spills will be made verbally to the designated JPL representative within eight hours of discovery of a release. Unless directed otherwise by JPL, the Contractor shall contact the appropriate environmental agency within 24 hours of discovery of a release. Criteria for the determination of the necessity for the reporting of spills will be those found in Section 102 of CERCLA for reporting "Reportable Quantities" of hazardous substances released to the environment along with any other applicable rules (e.g., CAC Title 23, reporting requirements for releases from underground tanks).

B. RECORDKEEPING OF SPILLS AND RELEASES OF HAZARDOUS SUBSTANCES

The Contractor shall keep records of spills in a log, and note the date and time of spill, type of material spilled, quantity spilled, impact of spill, reasons for the spill, actions taken to control and clean up the spill, climatic conditions affecting the spill or the spread of spilled material, notation of actions to be taken to minimize the probability for a reoccurrence of a similar spill. The spill log shall be available for review by JPL at all times.

SECTION VIII

PESTICIDES MANAGEMENT PROGRAM

A. FAMILIARITY WITH APPLICABLE PESTICIDE REGULATIONS

The Contractor shall be familiar with applicable pesticide regulations found in FIFRA regulations (40 CFR Parts 162, Regulations for the Enforcement of FIFRA; Part 165, Regulations for the Acceptance of Certain Pesticides and Recommended Procedures for the Disposal and Storage of Pesticides and Pesticide Containers; and Part 171, Certification of Pesticide Applicators).

B. USE OF CERTIFIED PESTICIDE SERVICES AND REGISTERED PESTICIDES

The Contractor shall use only certified pesticide applicator services and registered pesticides. On occasion, applicators shall be observed to ensure that they are operating in a safe and legal manner. A copy of the applicator's certification shall be maintained at the GDSCC. Copies of MSDS shall be on file for each pesticide used on site.

C. STORAGE AND DISPOSAL OF PESTICIDES

The Contractor shall store and dispose of pesticides and pesticide containers in accordance with the requirements of 40 CFR Part 165. In no case, however, shall the Contractor store pesticides in containers that exceed 1 pound capacity.

D. SIGN-OFF SHEET TO BE FILLED OUT BY PESTICIDE APPLICATOR

At the end of each pesticide-application session, the Contractor shall require the applicator to fill out and complete a sign-off sheet. At a minimum the sign-off sheet should include information on the date of treatment, areas treated, name of applicator, pests controlled, pesticide used, quantity used, method of application/equipment used.

E. INSPECTION FOR PEST CONTROL

The Contractor shall perform all of the necessary Occupational Safety and Health Administration (OSHA) inspections for pest control, including monthly inspections of the eating and food-preparation areas in the cafeteria. A food-facility sanitation check list, which includes observations on rodent and insect control, should be prepared and used by the Contractor during these inspections.

SECTION IX

MANAGEMENT PROGRAM FOR AIR POLLUTION

A. SURVEY OF SOURCES AND RATES OF AIR POLLUTION

The Contractor shall maintain an up-to-date survey of all stationary sources and rates of air pollution emissions at the GDSCC.

B. AIR POLLUTION CONTROL PERMITS

The Contractor shall obtain the necessary data to determine whether equipment or processes require air pollution control permits. The Contractor then shall apply for the necessary permits for the existing equipment that have no permits, or for new equipment that requires permits. The Contractor shall ensure that existing permits are up-to-date (e.g., annual permits are renewed), and that the GDSCC is operating within proper permit conditions.

C. IDENTIFICATION AND TAGGING OF PERMITTED EQUIPMENT

The Contractor shall identify and tag permitted equipment using a serialized numbering system, so that permits can be matched easily to the appropriate equipment.

D. POSTING OF PERMITS

The Contractor shall post all air pollution control permits, or facsimiles, on or within 25 feet of the equipment described on the permit. A copy of the permit should be maintained in a designated file in the GDSCC office of the Contractor's Environmental Coordinator.

E. RECORDKEEPING OF SOLVENTS, COATINGS AND FUELS

The Contractor shall keep and complete up-to-date records on the use of coatings and solvents, consumption of fuel, specifications of coatings, solvents, and fuels, and other pertinent data related to these materials.

SECTION X

HAZARDOUS-SUBSTANCES STORAGE TANKS (HSST) PROGRAM

A. THE HSST-MONITORING PROGRAM

The Contractor shall operate in accordance with the presently on-going JPL/GDSCC monitoring program for HSSTs. This program primarily involves the routine inspections of tanks, piping, pumps, valves, gauges, meters, and other equipment associated with tanks, as well as inventory reconciliation of the tanks' contents. The GDSCC's program for HSST monitoring is found in its Leak Detection and Monitoring Program Plan for storage tanks. Details concerning monitoring, reporting, and recordkeeping requirements can be found in the San Bernardino County Underground Tank Ordinance. A copy of the JPL/GDSCC detection and monitoring plan is available from the JPL Telecommunications and Data Acquisition (TDA) Safety Office.

B. FAMILIARITY WITH HSST-MONITORING PLANS

The Contractor shall be familiar and in compliance with on-going monitoring requirements found in the GDSCC Underground Tank Leak Detection Plan. The Contractor also shall be familiar with county rules, and use these rules, in conjunction with the GDSCC Plan, to implement the on-going Underground Tank Monitoring Program at the GDSCC (e.g., inventory reconciliation, recordkeeping, and reporting).

C. TRAINING FOR HSST-MONITORING PERSONNEL

In accordance with regulations, the Contractor shall provide appropriate training for personnel who are involved in the HSST-monitoring program. The San Bernardino County Ordinance contains a description of the appropriate training requirements.

D. RENEWAL OF TANK PERMITS

The Contractor shall be responsible for the renewal of storage tank permits.

E. PROCEDURE FOR REPORTING LEAKS IN UNDERGROUND STORAGE TANKS

The Contractor shall be responsible for ensuring that all underground tanks and pipes are in good, non-leaking condition. Within eight hours of its discovery, the Contractor shall report verbally to JPL any detected leakage. The Contractor shall prepare all necessary reports on spills, as described in the regulations, and shall submit these reports to JPL for review and approval, before the Contractor submits these leakage reports to the appropriate environmental agency.

F. RESPONSIBILITY FOR THE INTEGRITY OF ABOVEGROUND TANKS AND PIPES

The Contractor shall be responsible for ensuring that all aboveground tanks and pipes are in good, non-leaking condition.

G. LABELING OF TANKS

The Contractor shall be responsible for the proper labeling of all tanks for both contents and capacity.

SECTION XI

MANAGEMENT PROGRAM FOR BOTH WATER AND WASTEWATER

A. MAINTENANCE OF WASTEWATER FACILITIES

The Contractor shall maintain the condition of all oxidation/percolation ponds and wastewater management facilities in accordance with permit conditions and applicable environmental regulations.

B. PREVENTION OF INDUSTRIAL DISCHARGES INTO SEPTIC TANK SYSTEMS

The Contractor shall make every effort to keep industrial discharges (e.g., acids, solvents), from entering septic tank systems.

C. RECORDKEEPING FOR WASTEWATER FACILITIES

The Contractor shall make all reports and keep all records of wastewater facilities as required in accordance with permits.

D. RENEWAL OF PERMITS FOR WASTEWATER FACILITIES

The Contractor shall inform the designated JPL representative whenever permits for wastewater facilities require updating. The Contractor also shall prepare the necessary application forms for the renewal/update of permits as required. These permit-renewal application forms shall be submitted to JPL for review and approval before the Contractor submits the application forms to the appropriate environmental agency.