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JPL

July 8, 1992

Mr. Kenneth Kumor
NEPA Coordinator
National Aeronautics and Space Administration
Code JXG, Room 3T35
Two Independence Square
Washington, DC 20546

Dear Mr. Kumor:

I am enclosing five copies of the latest version of the Mars Observer Environmental Assessment. This version incorporates the additional comments you submitted to Sandra Dawson the other week; and, as you explained in our phone discussion earlier today, it now awaits distribution to the appropriate federal and state agencies and the public for review.

Please contact Sandra Dawson (at 818-354-1240) or myself (at 818-354-5618) if you have any questions or require any further assistance.

Sincerely,

Douglas S. Abraham

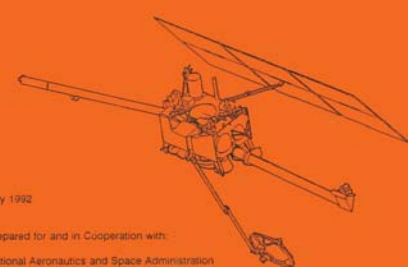
Douglas S. Abraham
Launch Approval Planning Group
MS 602-102

642-1

NASA

Mars Observer Mission

ENVIRONMENTAL ASSESSMENT



July 1992

Prepared for and in Cooperation with:

National Aeronautics and Space Administration
Office of Space Science and Applications
Solar System Exploration Division
Washington, DC 20546

JPL
Jet Propulsion Laboratory
California Institute of Technology

JPL D-8609

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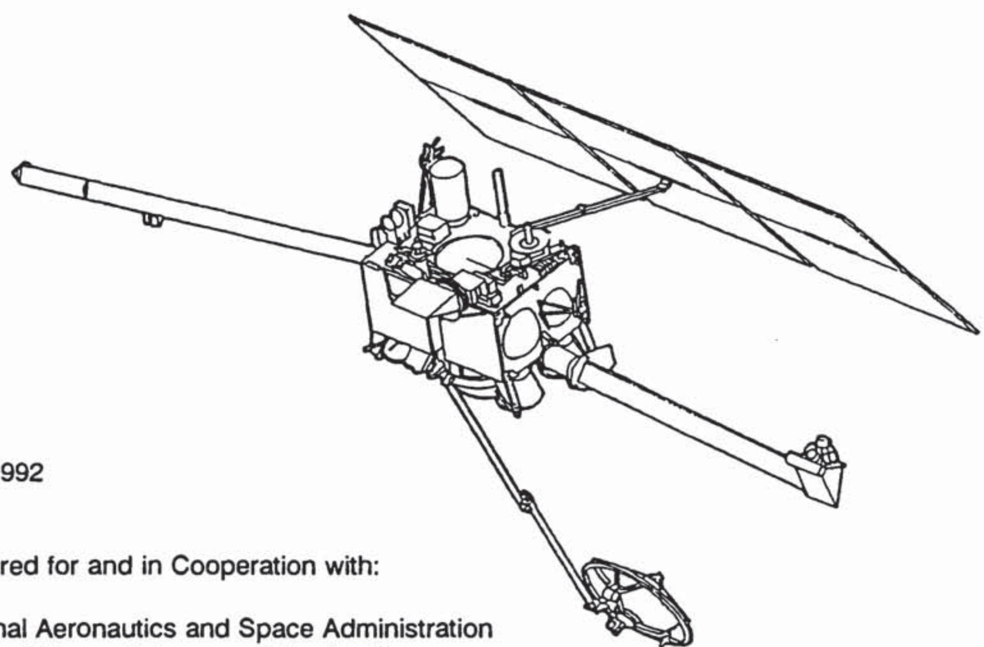
NASA

Mars Observer Mission

ENVIRONMENTAL ASSESSMENT



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EXECUTIVE SUMMARY

PROPOSED ACTION

This environmental assessment addresses the proposed action to complete the integration and launch the Mars Observer spacecraft from Cape Canaveral Air Force Station, Florida between September 16 and October 6, 1992. The Spacecraft and its Transfer Orbit Stage (TOS) will be assembled and integrated at the Kennedy Space Center and transferred to Launch Complex 40 on Cape Canaveral Air Force Station. The launch vehicle, a Commercial Titan, will be assembled in the Integrate-Transfer-Launch Facilities on Cape Canaveral Air Force Station before being transferred to Launch Complex 40. The Commercial Titan Launch Vehicle is a growth version of the existing Titan 34D design. This growth version uses two five and one-half segment Titan 34D solid rocket motors attached alongside a two-stage, liquid propellant core vehicle. See Section 2.3.2 for more detail. While most of the checkout of the spacecraft and launch vehicle will be performed at individual integration buildings, operations completed at the launch site will include mating of the payload with the booster vehicle, integrated systems tests and checkout, liquid propellant servicing, and ordnance installation.

PURPOSE AND NEED FOR THE ACTION

The Mars Observer mission will deliver a spacecraft platform to a low-altitude polar orbit around Mars where it will collect global observations of basic geological, geophysical and climatological processes of the planet. The Mission is part of the Solar System Exploration Program to the inner planets designed to maintain a sufficient level of scientific investigation and accomplishment so that the United States retain a leading position in solar system exploration through the end of the century. The Program consists of a specific sequence of missions, based on technological readiness, launch opportunities, rapidity of data return, and a balance of scientific disciplines.

ALTERNATIVES CONSIDERED

The proposed action is to complete the integration and launch the Mars Observer spacecraft. The alternative to the proposed action is no-action. This alternative would result in termination of the mission. While minimal environmental impacts would be avoided by cancellation of the single launch, the loss of the scientific knowledge and database that could lead to future technological advances would be significant.

Alternative U.S. launch vehicles for the Mars Observer satellite include the Shuttle, Scouts, Deltas, Atlas's or Titans. Of these, only the Shuttle or the larger Titans have the capacity to launch the Mars Observer satellite into low earth orbit. Because NASA's policy is to use the Shuttle primarily for missions requiring human interaction and a manned mission is not required to launch the Mars Observer spacecraft, the Project has selected a Titan. The appropriately sized launch vehicle for this mission is the Commercial Titan.

SUMMARY OF ENVIRONMENTAL IMPACTS

The only expected environmental effects of the proposed action are associated with normal launch vehicle operation and are summarized below.

Air Quality

The majority of air emissions will be produced during the launch of the spacecraft. The launch vehicle relies on the two solid rocket motors (SRMs) for lift-off and a first liquid stage that will not be ignited until approximately 108 seconds into the flight when the vehicle will be well away from the launch complex. Thus, local air emissions will be produced only by ignition of the SRMs.

The proposed launch will not significantly impact air quality of Cape Canaveral Air Force Station or surrounding areas. The air pollutants presenting potential hazards of the ground level exhaust produced by the solid rocket motors are carbon monoxide, hydrogen chloride and aluminum oxide particulates. Carbon monoxide concentrations are not predicted to exceed the one-hour average National Ambient Air Quality Standards. Hydrogen chloride concentrations along the path of the ground cloud would not exceed the National Research Council's recommendation that one-hour average hydrogen chloride concentrations in connection with community exposure during spaceshuttle launches. The peak concentrations of particulate aluminum oxide are not expected to exceed the twenty-four hour average National Ambient Air Quality Standard for suspended particulates smaller than ten microns.

Of the major detectable exhaust products produced from ignition of the liquid fuel stages carbon monoxide and the nitrous oxides are of concern. However, because the launch vehicle will be well away from the launch complex before ignition of the liquid stages, the relatively small emissions of these criteria pollutants will have little incremental impact in this area where ambient concentrations are well below the National Ambient Air Quality Standards.

Potential ozone layer effects from solid rocket emissions, particularly hydrogen chloride, will be indistinguishable from effects caused by other natural and man-made causes.

Water Resources

No significant impacts to the ground or surface water quality around Launch Complex 40 are expected to be associated with the processing or launch of the Mars Observer spacecraft. Most of the deluge, launch complex washdown and fire suppressant water will be collected in the launch duct sump which drains to percolation ponds, preventing its release to surface water bodies. The remaining will be blown by the exhaust onto uncontrolled areas of the launch facility, where it will either percolate into highly permeable soils or vaporize and disperse into the atmosphere. Mixing with natural ground-water is expected to dilute contaminates released by a given launch to acceptable levels.

The impact of the exhaust cloud on surface water quality from the launch will likely be restricted to the area adjacent to the Launch Complex. Depending upon the wind direction and speed, the launch may result in short-term acidification of local surface waters. If a significant portion of the exhaust cloud drifts eastward toward the Atlantic Ocean, no significant impact due to hydrochloric acid deposition will occur because of the extensive bicarbonate buffering capacity of ocean water. Under certain atmospheric conditions, portions of the Banana River and adjacent marshes could potentially experience a short-term increase in acidity due to acid deposition. Deposition of aluminum oxide particulates in surface waters will also depend on atmospheric conditions. If the particulates are deposited in the coastal marsh or the Banana River, tidal flushing in the marsh areas will prevent accumulation of significant quantities.

Land Quality

No facilities will be modified for the launch of this mission. The environmental effects on land quality will be impacts associated with the disposal or treatment of solid wastes and material storage areas. Processing and launch of the Mars Observer Mission is not expected to add any unusual additional load to normal operations at Cape Canaveral Air Force Station.

Impacts to wetlands from the launch would not exacerbate impacts from other Cape Canaveral Air Force Station activities or launches. Depending on meteorological conditions, deposition of hydrogen chloride and aluminum hydroxide from the ground cloud during the launch could affect the biota and water quality in these areas. Impacts would result from decrease in pH associated with the hydrogen chloride deposition. The wetlands to the west of the launch complex are lagoon with recharge occurring from groundwater, rainfall, and gate access from the Banana River. Natural buffering should raise the pH to normal levels within a few hours after deposition. At the normal pH of the receiving waters, aluminum hydroxide is insoluble and nontoxic to organisms.

A consistency determination conducted for the Complementary Vehicle Program at Cape Canaveral concluded that the Program was consistent to the maximum extent practicable with State Coastal Management Programs, based on compatible land use, absence of significant environmental impacts and compliance with applicable regulations. Processing and launch of the Mars Observer spacecraft would add no significant impact beyond those associated with that program.

Noise Sources and Impacts

The noise impact of the Mars Observer Spacecraft launch will be limited due to the rapid ascent of the vehicle, distance to uncontrolled areas, and flight path over the ocean. Because the launch of the Commercial Titan would involve very short exposure duration (one to two minutes), no significant adverse public health impacts would be expected from launch noise.

Biota

Local wildlife will not be exposed to hazardous or toxic chemicals as a result of activities at Launch Complex 40. Containment provisions at the launch site will prevent spilled propellants or contaminated water from being released to the surrounding environment. Wildlife in the direct path of the ground level exhaust cloud may experience short-term elevated levels of hydrochloric acid; however, in studies of Titan III launches at Cape Canaveral Air Force Station, hydrogen chloride has not been detected within the ground cloud in toxic concentrations. Elevated noise levels associated with the launch event could possibly cause a temporary hearing loss in sensitive wildlife living near the launch pad.

Overall, no significant long-term adverse impacts to aquatic biota are expected to occur as a result of the ground level exhaust cloud from launch of the Mars Observer spacecraft. Because no surface water bodies receive direct runoff from the site during deluge water discharge, there should be no impacts to surface waters or their associated biota. Localized fish kills in the Banana River are not expected to occur as a result of the launch due to the distance of the Launch Complex from the Banana River and the relatively small exhaust cloud produced by the Commercial Titan. However, depending upon atmospheric conditions, temporary increases in acidity in the wetlands and Banana River receiving the heaviest hydrogen chloride could adversely affect aquatic resources including fish and insects. In addition, some of the aluminum hydroxide entering the aquatic environment may solubilize as a result of the temporary acidification of the Banana River; however the ambient pH would be quickly restored due to water flow and mixing. At this pH, aluminum is insoluble and nontoxic to most aquatic organisms.

Threatened and Endangered Species

Light surveys have been completed for Launch Complex 40 and a light management plan designed to reduce beach lighting is being developed. With the implementation of this and other light management plans, impacts to endangered sea turtle populations would not be expected to be associated with the processing and launch of the Mars Observer spacecraft.

The Fish and Wildlife Service has designated no critical habitat for the Florida scrub jay or the southeastern beach mouse at Cape Canaveral Air Force Station. Acidic deposition from hydrogen chloride in the ground cloud that forms following ignition and combustion of the SRMs may injure or destroy vegetation very near the launch pads and along the path of the ground cloud; however, habitat or forage will not be altered to the extent that populations of threatened species will be adversely affected.

Community Impacts

Because Launch Complex 40 is already being used for space launches and the land area has been disturbed, no additional adverse impacts on existing land uses are expected.

Launch of the Mars Observer spacecraft will not require additional operational personnel; operational personnel will be from the current employment pool at Cape Canaveral Air Force Station. No impact on housing is expected as no additional permanent personnel are expected beyond those currently employed at Cape Canaveral Air Force Station.

No significant archaeological and/or historical sites are expected to be affected by the launch of the Mars Observer mission.

SECTION 1

PROPOSED ACTION AND ALTERNATIVES

1.1 PURPOSE AND NEED FOR ACTION

1.1.1 Background

The Mars Observer mission, as part of the National Aeronautics and Space Administration's (NASA) Solar System Exploration program, will deliver a spacecraft platform to a low-altitude near-polar orbit around Mars where it will collect global observations of basic geological, geophysical and climatological processes of the planet. This mission will be launched in September 1992 and arrive at Mars in August 1993. The Spacecraft will carry a complement of eight science instruments that will be used to collect data on the climatology, surface composition, topography, gravity field, and magnetic field of Mars. Thorough mapping of the Martian surface will continue for a period of one Martian year (687 days) to allow the spacecraft to study how Mars' atmosphere and surface change throughout the planet's seasons. Towards the end of the mapping phase, the mission will provide a data relay capability to supplement the Russian Mars 1994 Mission. At the end of the mission, the spacecraft will be left in the mapping orbit. This orbit satisfies require-ments of NASA's Planetary Protection Program that the spacecraft not enter the Martin atmosphere before the year 2039.

This Environmental Assessment addresses the proposed action to complete the integration and launch the Mars Observer spacecraft in September 1992. Alternative approaches, including the no-action alternative, are described in Section 1.3.

1.1.2 Purpose of the Proposed Mission

The Mars Observer Mission supports two primary objectives of the United States' Solar System Exploration Program:

(1) Origin and Evolution: To determine the present nature of the solar system, its planets, moons, and primitive bodies, and to search for other planetary systems in various stages of formation in order to understand how the solar system formed, evolved, and (at least in one case) produced environments that could sustain life.

(2) Comparative Planetology: To better understand the planet Earth by determining the general processes that govern all planetary development and by understanding why the "terrestrial" planets of the solar system are so different from each other.

1.1.2.1 <u>Origin and Evolution</u>. Previous explorations of Mars has revealed an intriguing world of large mountains and deep canyons, and a surface etched by erosion during ancient floods. Part of its surface resembles the Earth's Moon and shows massive impact basins, cratered highland regions, and extensive flooding by lavas. Other surface regions resemble Earth's mountains, volcanos, dried-up riverbeds, desert sand dunes, atmosphere with variable cloud patterns, and seasonal polar caps. Mars has evolved to an advanced stage, approaching the development level of Earth. Its internal heat engine may still be active, producing present volcanic activity and exhaling internal gases into the atmosphere.

Although significant insights into the evolution of the planet have been gained from previous explorations, large gaps in scientific knowledge still remain. Scientists know, for example, that the planet has a long and varied volcanic history, but little is known of the chemical composition of the volcanic rocks and lavas. There is good evidence that Mars has undergone major climatic changes, but global atmospheric dynamics, the distribution and transport of volatiles during the Martian year, and the structure and photochemistry of the upper atmosphere is poorly understood. Even the existence of an intrinsic Martian magnetic field remains controversial.

One of the more important outstanding issues is the role of water in the evolution of the Martian surface. The surface of Mars reveals erosional features that suggest the prior presence of large amounts of flowing water. The scale of the features seems to require the water to have been recycled in a hydrologic cycle that may have involved rainfall over long periods of time. Liquid water is not now stable under the conditions on the Martian surface, but the presence of abundant stream channels indicates that conditions must have been different in the past. In the current environment, water is present in only minute amounts in the atmosphere, but near the surface it may occur as ground ice, adsorbed on minerals, or combined in hydrous minerals. Knowledge of the distribution, amount, and forms of water on Mars will lead to a greater understanding of the role that water has played in the various geologic processes that shaped its surface.

The Mars Observer mission, while orbiting the planet, will provide systematic data over an entire Martian year that will greatly improve scientific understanding of Mars' geology and climate. These data, which cannot be collected from Earth or Earth orbit, will extend and complement existing measurements and will more precisely define the evolutionary history of the Red Planet.

1.1.2.2 Comparative Planetology. Every object in the solar system contains part of the record of planetary origin and evolution. These geologic records are in the form of chemical and isotopic fingerprints, as well as in the stratigraphic sequences, structural relationships and morphology of the landforms. The unmanned exploration of Mars reinforced the notion that planetary processes, like those found to operate on Earth, are universal. Mars' surface reveals evidence of volcanic, alluvial, glacial, eolian, and tectonic process that have led to stratigraphic systems, structural relations, and landforms that are generally understandable from a terrestrial perspective.

Earth, Venus, and Mars form a related triad of inner solar system planets composed of "rocky" silicate material and possessing significant atmospheric veils. Although roughly similar in size, mass, composition, and distance from the Sun, these terrestrial planets vary widely in ways that are striking and important. The thin, dry, cold Martian atmosphere, providing little protection from solar ultraviolet radiation, renders the surface of this planet unsuitable for life similar to that found on the Earth. The dry surface of Venus, blanketed with an atmosphere one hundred times as massive as Earth's, traps solar radiation so efficiently that its temperature is above the melting point of lead. Both Mars and Venus have large features on their surfaces, including volcanoes, valleys, mountains, and elevated plateaus. Yet only Earth has the supportive combination of temperature, atmosphere, and abundant liquid water necessary to sustain advanced life.

As a result of previous explorations of Mars, scientists have begun making meaningful comparisons between Mars and its two neighbors, Venus and Earth. These discoveries have awakened scientists' appreciation for the susceptibility of terrestrial environments to large evolutionary changes. Venus and Mars provide natural laboratories for investigating the nature and the causes of change in terrestrial environments. Detailed comparisons of these worlds will greatly advance scientific understanding of Earth and its early history. By comparing differences and similarities in the evolutionary histories of the planets, it is possible to better understand the processes that formed and modified them.

1.1.2.3 Science Objectives. The Mars Observer Mission has five primary scientific objectives:

(1) Determine the global elemental and mineralogical character of the surface material;

(2) Define globally the topography and gravitational field;

(3) Establish the nature of the magnetic field;

(4) Determine the time and space distribution, abundance, sources, and sinks of volatile materials and dust over a seasonal cycle; and

(5) Explore the structure of the atmosphere and aspects of its circulation.

The first three objectives involve remote surface measurements of Mars. The goal of the mission is to obtain global maps of the surface elements and minerals, topography, and the gravitational field and to establish the existence and nature of the magnetic field. The maps will be used to evaluate the distribution of chemical elements and minerals in relation to the age, morphology, emplacement mode, and weathering of the surface material. Simultaneous measurements of the gravitational field, surface topography, and magnetic field will further an understanding of both the surface and the interior of the planet.

The last two objectives involve atmospheric measurements. The goal of the mission is to obtain seasonal maps of volatiles (carbon dioxide and water) and dust. The maps will be used to understand the current climate of Mars and how active processes such as weathering, erosion, water transport, and dust deposition are modifying the surface at present. A dynamic understanding of the current climate will aid in projecting backwards in time to predict the climate during periods when Mars' orbit, axial characteristics, and atmospheric pressure were different.

1.1.3 Need for the Action

1.1.3.1 Space Leadership and the Solar System Exploration Program. The National Aeronautics and Space Act of 1958 established NASA's mandate to conduct activities in space that contribute substantially to the expansion of human knowledge and to "the preservation of the role of the United States as a leader in aeronautical and space science and technology and in the applications thereof to the conduct of peaceful activities within and outside the atmosphere." (42 U.S.C. 2451(c)(5)

Solar system exploration consists of three phases: reconnaissance, involving flyby missions; exploration, generally conducted with orbiting spacecraft and atmospheric probes; and intensive study, involving soft landers, sample return, and human exploration. The Voyager 2 encounter with Neptune in August 1989 virtually completed the reconnaissance phase. With the exception of Pluto, all the planets and most of the larger moons have been studied by spacecraft at close range.

To continue in a leadership role for the United States, NASA, in coordination with the National Academy of Sciences, has developed a coordinated set of scientific priorities and formulated a long range Program of scientifically valid, affordable planetary missions. The essential part of the Program strategy is a balanced set of missions and research that stresses continuity, commonality, cost-effectiveness, and the use of existing technology. It consists of a specific sequence of missions, based on technological readiness, launch opportunities, rapidity of data return, and a balance of disciplines. The program contains a sufficient level of scientific investigation and accomplishment so that the United States can achieve priority scientific objectives and thereby retain a leading position in solar system exploration through the end of the century. The first recommended mission of the Program, a Venus Radar Mapper named Magellan, was launched in 1989. The Mars Observer is the next mission recommended in that series.

1.1.3.2 Support of Space Exploration Initiative. In 1989, the President of the United States proposed a human space exploration initiative that includes the goal of human exploration of Mars. The results from this Mars Observer Mission will help prepare for a human mission by characterizing the environment in which the spacecraft and crew must function and by identifying the most promising landing site locations for robotic exploration and piloted landing on the surface.

1.1.3.3 International Cooperation. The United States is expanding its space coordination activities with Russia. The most recent activities the U.S./Russia Space Cooperation Agreement of 1987. In support of these efforts, Russia will place a French-built transponder on the Mars Observer Spacecraft to serve as a communication relay for the planned 1994 and 1996 Russian Mars balloon, small station, penetrator and rover missions.

1.2 ALTERNATIVES

Alternative actions to the launch of the Mars Observer Mission include the no-action alternative or launching on a different launch vehicle.

1.2.1 No-Action Alternative

The no-action alternative would result in termination of the mission. Cancellation would be inconsistent with national policy as stated in the Directive on National Space Policy (see section 1.1.3.1) and the Commercial Space Launch Act which specifies that the U.S. government should encourage private sector launches (DOT, 1986). The environmental impacts of the Commercial Titans are small relative to the on-going launch vehicle program sponsored by the Air Force at Cape Canaveral. While minimal environmental impacts would be avoided by cancellation of the single launch, the loss of the scientific knowledge and database that could lead to future technological advances would be significant.

1.2.2 Alternative Launch Vehicles

The type of launch vehicle chosen for a launch depends largely on the payload and orbit required; a heavier payload taken to a higher orbit requires a larger launch vehicle. The U. S. government's near term Commercial Space Launch Policy is to launch government satellites on U.S. manufactured launch vehicles (The White House, 1990), although a launch of the spacecraft on a foreign vehicle would likely have the same scope of environmental impacts as those described in Chapter 4. Existing U.S. launch vehicles include the Shuttle, Scouts, Deltas, Atlas's or Titans (DOT, 1986). Of these, only the Shuttle or the larger Titans have the capacity to launch the Mars Observer satellite into low earth orbit. Because NASA's policy is to use the Shuttle primarily for missions requiring human interaction and a manned mission is not required to launch the Mars Observer spacecraft, the Project has selected a Titan.

Four launch vehicles could lift the 5450 pound spacecraft into a low earth orbit (Table 1-1). The appropriately sized launch vehicle for this mission is the Commercial Titan.

Table 1-1. Performance of Titan Launch Vehicles: Low Earth Orbit[1]

LAUNCH VEHICLE	PERFORMANCE (LB)
Commercial Titan	Low Earth Orbit[2]: 32,500
Titan 34D	Low Earth Orbit[3]: 34,900
Titan IV	Low Earth Orbit[4]: 39,000
Titan IV/SRMU	Low Earth Orbit[4]: 50,000

[1]Source: MMC, 1989

[2]80 x 140 Nautical Miles

[3]80 x 90 Nautical Miles

[4]80 x 95 Nautical Miles

SECTION 2

MISSION AND FACILITIES DESCRIPTION

2.1 MISSION DESIGN

The spacecraft will be launched from the Eastern Test Range, Cape Canaveral Air Force Station, Florida during the Mars opportunity of September/October 1992. The interplanetary trajectory will require a flight time of about eleven months. Arriving at Mars in August 1993, the spacecraft will be inserted into an initial elliptical orbit, which will facilitate transition of the orbit plane to the desired solar orientation. Over a period of about four months in a sequence of seven planned maneuvers, the spacecraft will be maneuvered into the sun-synchronous mapping orbit. Repetitive observations of the planet's surface and atmosphere will be conducted from the mapping orbit for a complete Martian year (687 days). The mapping orbit will have a repeating groundtrack that allows global coverage to be built up from repeated instrument swaths. The Sun-synchronous inclination provides coverage of 99.9% of the planet.

2.2 SPACECRAFT DESCRIPTION

The Mars Observer spacecraft structure is based on the RCA -K communications satellite. It features a three axis attitude control and stabilization system, a deployable high gain antenna and a six panel solar array articulated for Sun and Earth tracking. The spacecraft configuration in mapping orbit is shown in Figure 2-1 (GE, 1991). The sensing instruments will be oriented towards Mars. The spacecraft high gain antenna will be oriented towards earth. The dry spacecraft mass (with the TOS adapter, see below) is 950 kilograms (2090 pounds). The spacecraft will carry up to 166 kilograms (365 pounds) of government furnished property (mainly science instruments) for an approximate total spacecraft mass at lift-off of 2478 kilograms (5450 pounds).

The portions of the spacecraft that are relevant to assessing potential environmental impacts are the propulsion, power, and pyrotechnic subsystems.

2.2.1 Propulsion Subsystem

The propulsion subsystem provides the impulse capability to initiate trajectory corrections, orbital positioning and three-axis attitude control maneuvers (Figure 2-2) (GE, 1991). This subsystem consists of two independent assemblies: the bipropellant equipment assembly and monopropellant equipment assembly. Bipropellant propulsion is used for Figure 2-1: Spacecraft Configuration in Mapping Orbit spacecraft maneuvers requiring large velocity changes; the monopropellant system provides orbit maintenance with reaction wheel unloading capability.

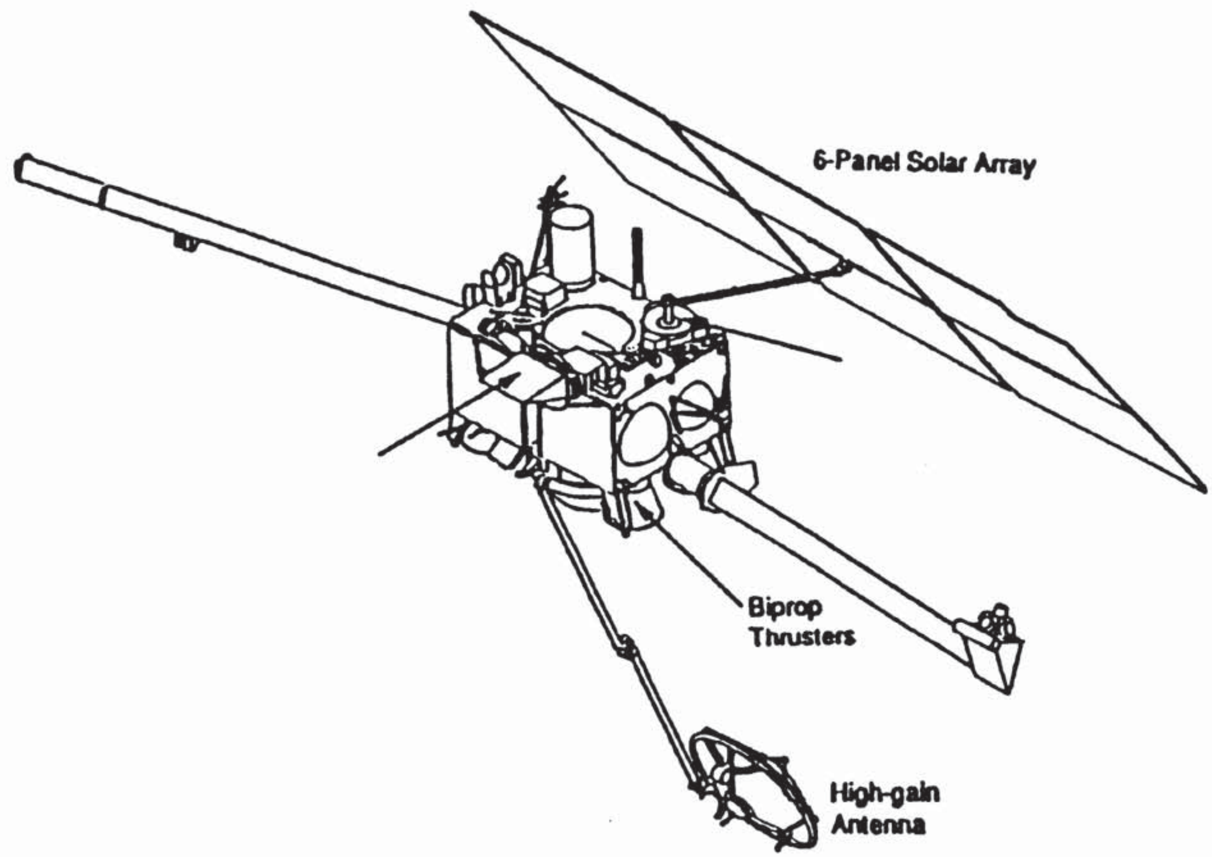

Figure 2-1. Spacecraft Configuration in Mapping Orbit

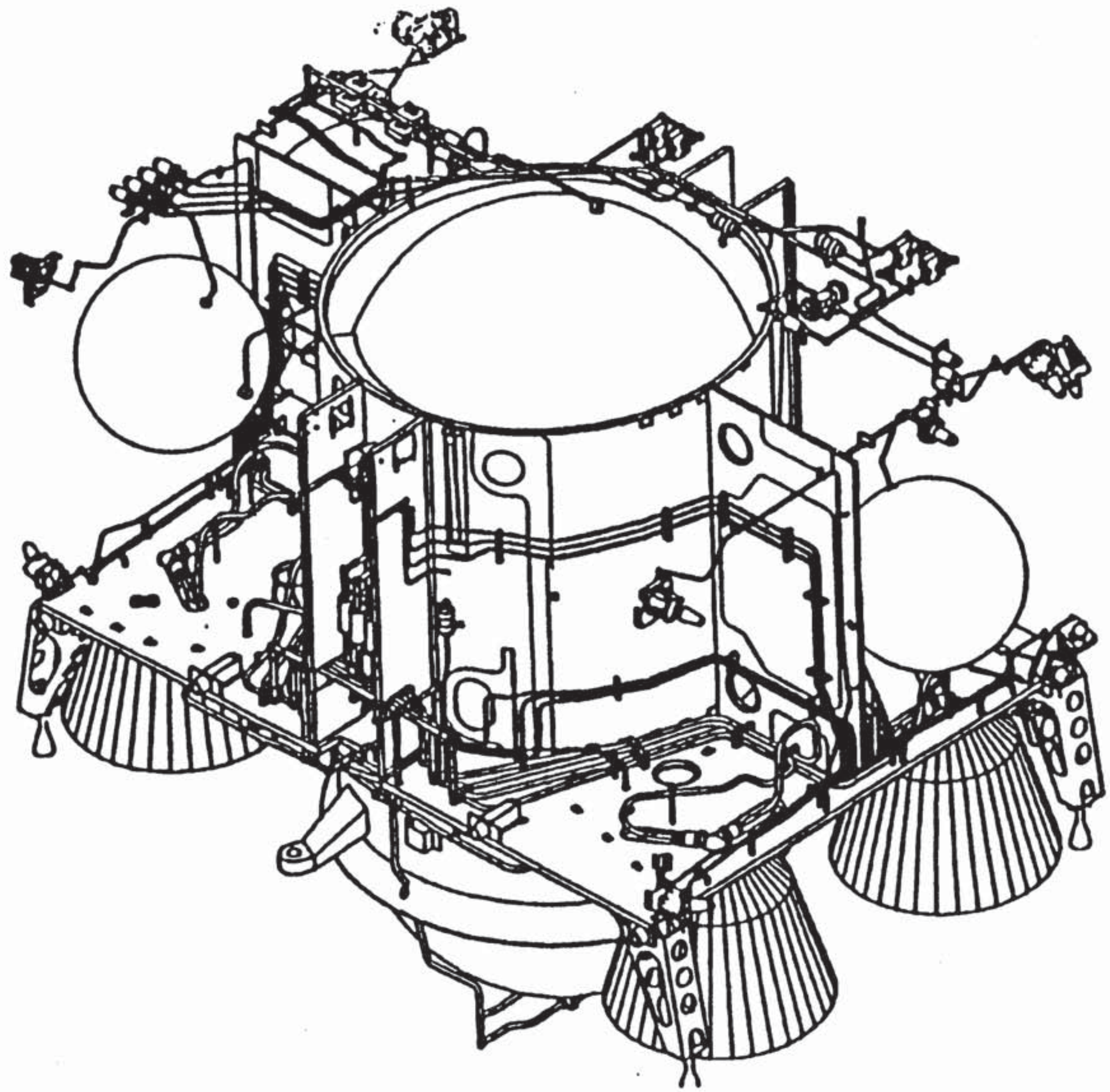

Figure 2-2. Propulsion Subsystem Configuration

2.2.1.1 Bipropellant Equipment. The bipropellant equipment assembly consists of four 490 Newton (100 pound-force) bipropellant rocket engines, four 22 Newton (5 pound-force) bipropellant rocket engines, and two 1.07 meter (42 inch) propellant tanks. The engines are used in a regulated mode (using a high pressure helium source and regulator) and are configured into two fully redundant systems.

Propellants (532 kilograms (1070 pounds) of monomethyl hydrazine fuel and 832 kilograms (1830 pounds) of nitrogen tetroxide oxidizer) are stored in two spherical titanium tanks mounted inside the cylinder of the spacecraft structure, with the fuel tank at the top and the oxidizer tank at the bottom. Each tank has a capacity of 0.6428 cubic meters and is designed to a maximum expected operating pressure of 300 pounds per square inch absolute (absolute). Propellants are fed to the thrusters from these two tanks which contain a propellant management device.

Helium pressurant is stored at a maximum of 4500 pounds per square inch (absolute) in a stainless steel shell tank with a composite overwrap. The helium pressure is regulated by a series redundant regulator which maintains both the fuel tank and the oxidizer tank at 269 pounds per square inch (absolute) during the engine firings. Four series dual redundant check valves in the pressurant manifold isolate the ullage volumes of the two propellant tanks to prevent propellant liquid and vapor from migrating up the pressurant lines and inter-mixing.

The thermal control design maintains propellant temperatures within design limits. Thermal control is accomplished with redundant propellant line, tank and component heaters. Passive thermal control is also provided by thermal blankets and tape wrap on lines and components. Titanium heat shields surround the 490 Newton thrusters to protect the spacecraft structures from overheating as a result of direct radiation from the hot combustion chamber during burns.

2.2.1.2 Monopropellant Equipment. The monopropellant equipment assembly consists of eight 4.45 (1 pound-force) Newton catalytic rocket engine assemblies, four 0.9 Newton (0.2 pound-force) catalytic rocket engine assemblies plumbed into two half systems, and two 0.48 meter (19 inch) hydrazine tanks. Half-system isolation is accomplished using three latch valves. The tanks contain helium pressurant and a maximum of 42 kilograms (92.4 pounds) of hydrazine. Each tank has an internal volume of 0.058 cubic meters and is designed to a maximum expected operating pressure of 400 pounds per square inch (absolute).

2.2.1.3 Flight Termination System. The Mars Observer spacecraft does not provide flight termination system capability for the bipropellant and monopropellant subsystem. The Eastern Space and Missile Center, Missile Flight Analysis Division has granted a non-compliance waiver (Kaisler, 1991) based on: (1) two mechanical barriers between the spacecraft propellant tanks and thrusters and three electrical inhibits between the spacecraft power and propellant thruster valves are sufficient to render the propulsion system single failure tolerant; (2) stabilized powered "flight" of the Mars Observer spacecraft in the atmosphere is a non-credible event due to the low thrust-to-weight ratio; (3) Mars Observer spacecraft propellant load is minor compared to the Titan III launch vehicle; and (4) Titan III Inadvertent Separation Destruct System will render the transfer vehicle essentially non-propulsive in the event of a spacecraft or launch vehicle separation during launch and ascent (GE, 1991).

2.2.2 Power Subsystem

The electrical power subsystem provides the required generation, storage, control and distribution of electrical power for the flight system during all phases of the Mars Observer Mission. During launch, ascent and parking orbit, power is provided by nickel cadmium batteries which are fully charged during ground processing. After separation from the upper stage, power generation will be initiated following solar array deployment. The solar array has two deployment configurations. In the cruise configuration, four solar panels will be utilized (Figure 2-3) (GE, 1991). After completing orbit insertion around Mars, the remaining two solar panels will be deployed (Figure 2-1) (GE, 1991).

The solar array is sized to provide sufficient power for normal operations of the spacecraft including power required to recharge batteries and provide heating power. The six panels of the solar array are arranged into a two by three matrix. The Solar Array Panel Deployment System is a two-stage deployment system designed to deploy and support the 24.5 square meter solar array. The solar array is capable of delivering a maximum steady state load current of 30 amps to the electrical bus and 25 amps of battery charge current for a total output of 55 amps.

The two rechargeable nickel-cadmium batteries each consist of two packs, with one pack containing nine cells and the other containing eight cells. The batteries are rated at 42.0 ampere hours and the system is designed to operate with one cell shorted out. During ground processing, battery charging is accomplished from an external power supply. No more than ten minutes before actual launch, the external power input will be removed and the spacecraft batteries will supply all spacecraft power requirements. After deployment, the solar arrays will be used to charge the batteries in addition to powering the spacecraft instruments.

2.2.3 Pyrotechnic Subsystem

The spacecraft will use three types of pyrotechnic devices: separation nuts, cable cutters and pyrotechnic valves. Separation from the TOS will be initiated by the use of separation nuts. Separation nuts are ordnance actuated devices which provide an explosive charge to release bolts used in the separation mechanism. Deployment of the solar array assembly, high gain antenna assembly, the magnetometer and gamma ray spectrometer deployment assemblies will occur using cable cutters which are pyro actuated and use an electro-explosive charge to sever cables on deployable mechanisms. Pyrotechnic valves prevent damage to propellant tanks during loading operations and minimize a center of gravity shift during ascent propulsion functions. The valves are

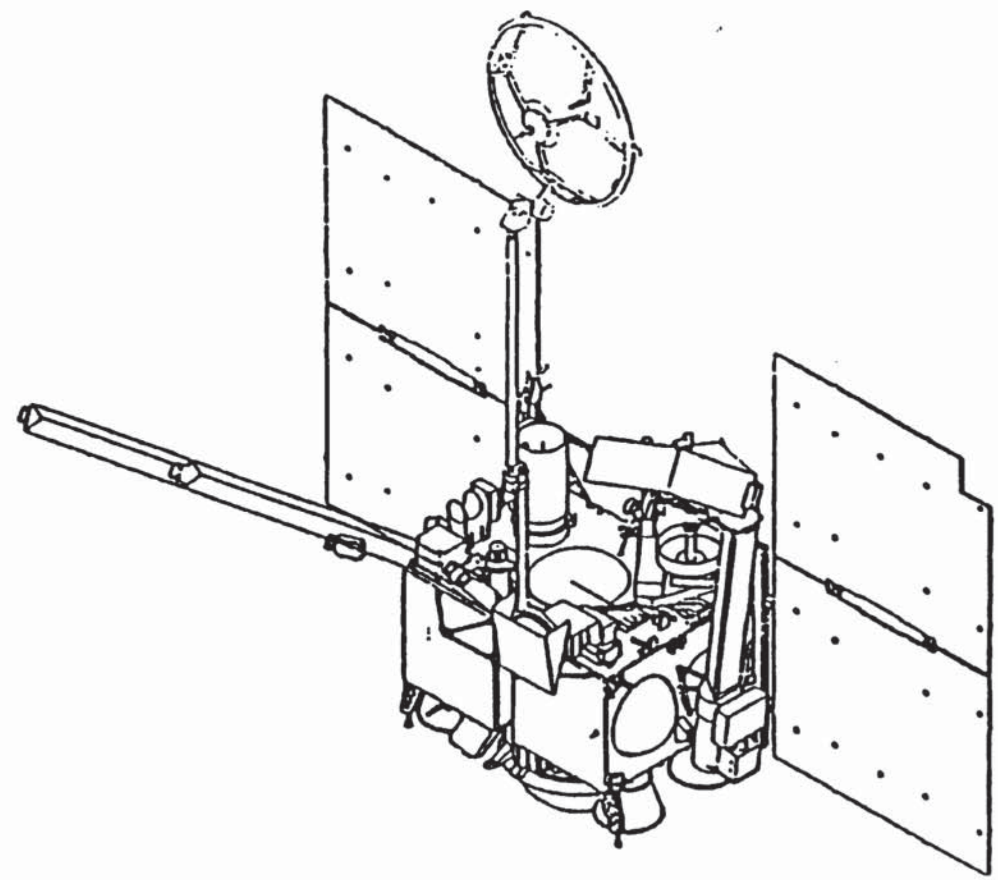

Figure 2-3. Mars Observer Cruise Configuration

pyro actuated devices which use an electro-explosive charge to provide a flow path thus introducing pressurant to the reaction control system propellant regulator and ultimately to the propellant tanks.

2.2.4 Spacecraft Safety Design Features

All hardware and support equipment will be designed and operated in a manner to ensure safety for both personnel and equipment during all phases of fabrication, test, and operations. This is accomplished to the maximum degree practicable by intrinsically safe hardware design.

All functional elements in the bipropellant and monopropellant equipment are fully redundant. The system design provides for isolation of any failed mission critical equipment. All thrusters are functionally redundant with latch valve isolation of thruster sets. Propellant manifolding is designed to make all propellant available to any operating thruster set. The all-welded titanium tube construction with titanium to stainless steel transition joints provides a leak-free, structurally sound system. System design includes two fault tolerant electrical inhibits to preclude untimely monopropellant thruster firing, to prevent a rocket engine assembly latch valve coil from being continuously powered and to prevent inadvertent bipropellant engine firing.

Three safety inhibits to prevent the premature firing of a pyrotechnic initiator are included on both the primary and backup sides of the pyrotechnic bus for all pyrotechnic devices. In addition to the spacecraft inhibits, inhibit commands can be passed through the umbilical when the spacecraft is connected to Launch Site Equipment. This provides an additional ground safety inhibit to prevent spurious pyrotechnic commands from initiating hazardous functions.

Science instrument safety requirements have been established and are required to be incorporated into the instrument designs by the contract or letter of agreement for the procurement of the science instrument. Compliance with the agreements to meet all safety requirements established for the Project is verified by design reviews, verification tests and analyses.

2.3 LAUNCH VEHICLE

The integrated payload launch configuration is shown in Figure 2-4 (GE, 1991). This configuration consists of the Mars Observer Spacecraft, Transfer Orbit Stage, Titan adapter, boattail, extension module aft skirt and payload fairing. The solar array and the high gain antenna/boom are stowed in a folded configuration.

2.3.1 Transfer Orbit Stage

The Transfer Orbit Stage (TOS) is a solid rocket motor propulsive stage capable of transferring spacecraft from park orbit to planetary transfer injection orbit. Major elements of the TOS flight vehicle are a solid rocket motor propulsion module, a monopropellant reaction control system, avionics

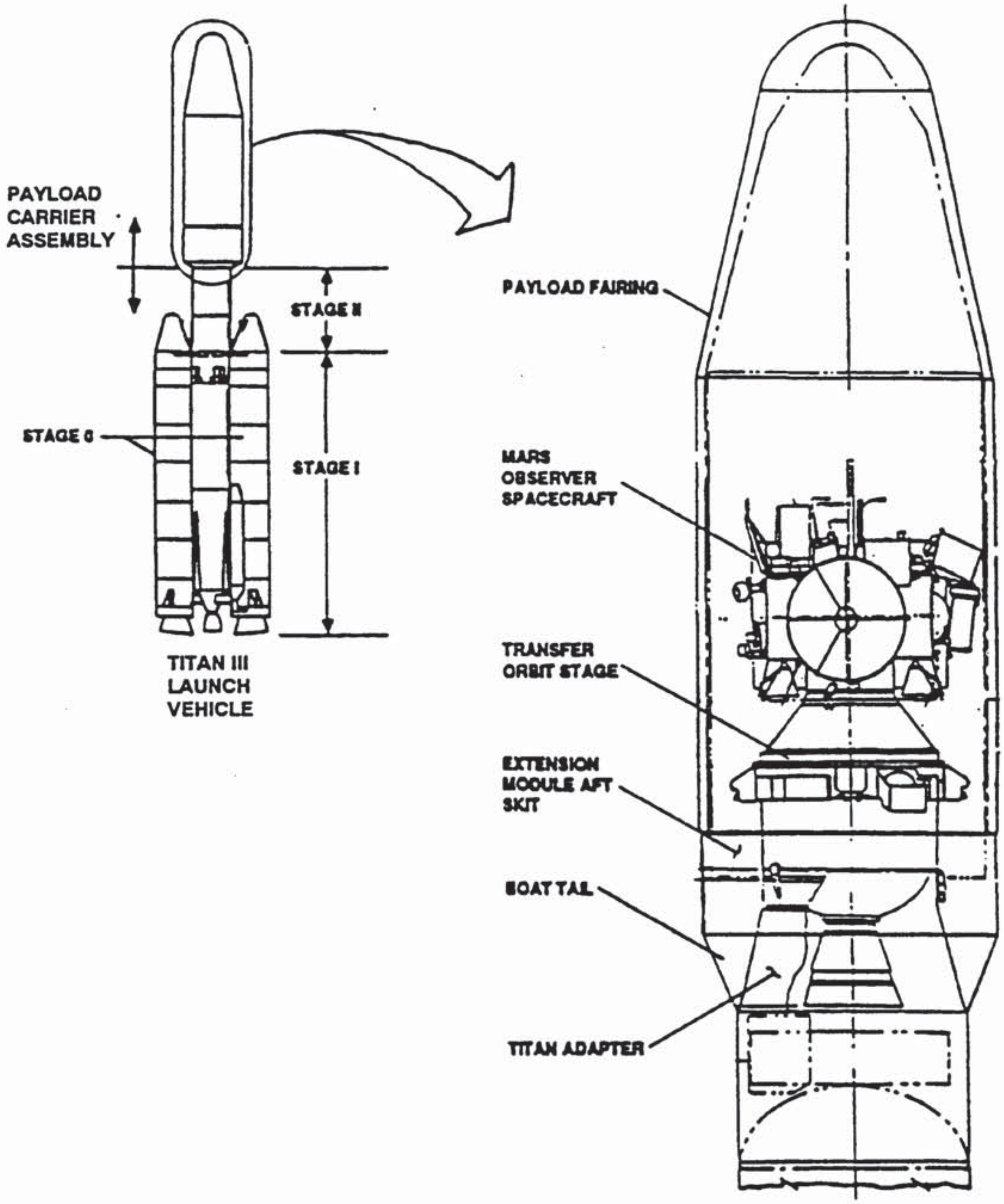

Figure 2-4. Integrated Payload Configuration

equipment for attitude control and event sequencing, and a forward skirt for structural attachment of a spacecraft adapter to the TOS (see Figure 2-5) (GE, 1991).

The solid rocket motor nominal propellant load is 21,460 pounds of solid hydroxyl-terminated polybutadine grain. The reaction control system uses monopropellant liquid hydrazine to provide thrust for attitude control. The nominal propellant load is 30 pounds (MMC, 1990).

The TOS Solid Rocket Motor (SRM) is provided its own Flight Termination System. The MO/TOS flight termination is accomplished either by command destruct or inadvertent separation activated destruct. The command destruct system is activated by receipt of a command from Range Safety to redundant command control receivers mounted on the Titan core vehicle. Upon receipt of a command, destruct is accomplished by means of redundant Explosively Formed Projectiles which are directed at the SRM. The Inadvertent Separation Destruct System is the means by which the payload SRM is destroyed if the payload separates from the core vehicle inadvertently. This system is activated by means of redundant separation sense jumpers routed through the payload interface connectors. If the jumpers are broken, destruct is accomplished by means of Explosively Formed Projectiles. The entire Inadvertent Separation Destruct System is resident on the payload adapter so that it is not dependent on remote power sources.

2.3.2 Commercial Titan Launch Vehicle

The Commercial Titan Launch Vehicle is a growth version of the existing Titan 34D design (Figure 2-6). The design uses two five and one-half segment Titan 34D solid rocket motors attached alongside a two-stage, liquid propellant core vehicle. Each motor contains 464,348 pounds of propellant, consisting of powdered aluminum fuel, ammonium perchlorate oxidizer, and a binder of polybutadine acrylic acid acrylonitrile, and will develop a maximum of 1.396 million pounds of thrust (vacuum). Flight control is provided by a fluid-injection, thrust vector control system supplied from a side-mounted tank on each motor carrying 8,424 pounds of Nitrogen Tetroxide. Eight staging rockets on each SRM assure positive separation at SRM burnout.

Stage I of the core vehicle contains 294,500 pounds of Aerozine 50 and Nitrogen Tetroxide. The engine delivers 546,000 pounds thrust (vacuum) at a specific impulse of 301.7 seconds. Stage II contains 76,900 pounds of Aerozine 50 and Nitrogen Tetroxide and delivers 103,320 pounds thrust (vacuum) at a specific impulse of 315.5 seconds. The Stage II 2A Skirt Contains the major elements of the flight control, electrical, telemetry, guidance, command destruct and antenna systems for the boost phase.

The Single Payload Carrier is attached to the top of the liquid booster. It consists of the Extension Module Assembly, one payload adapter, the Payload Fairing, boattail and separation ordnance to deploy the payload. The payload is encapsulated in the two half-shells of the fairing. The fairing is jettisoned in two segments by ordnance-initiated gas expansion bellows approximately eleven seconds after Stage I and II separation.

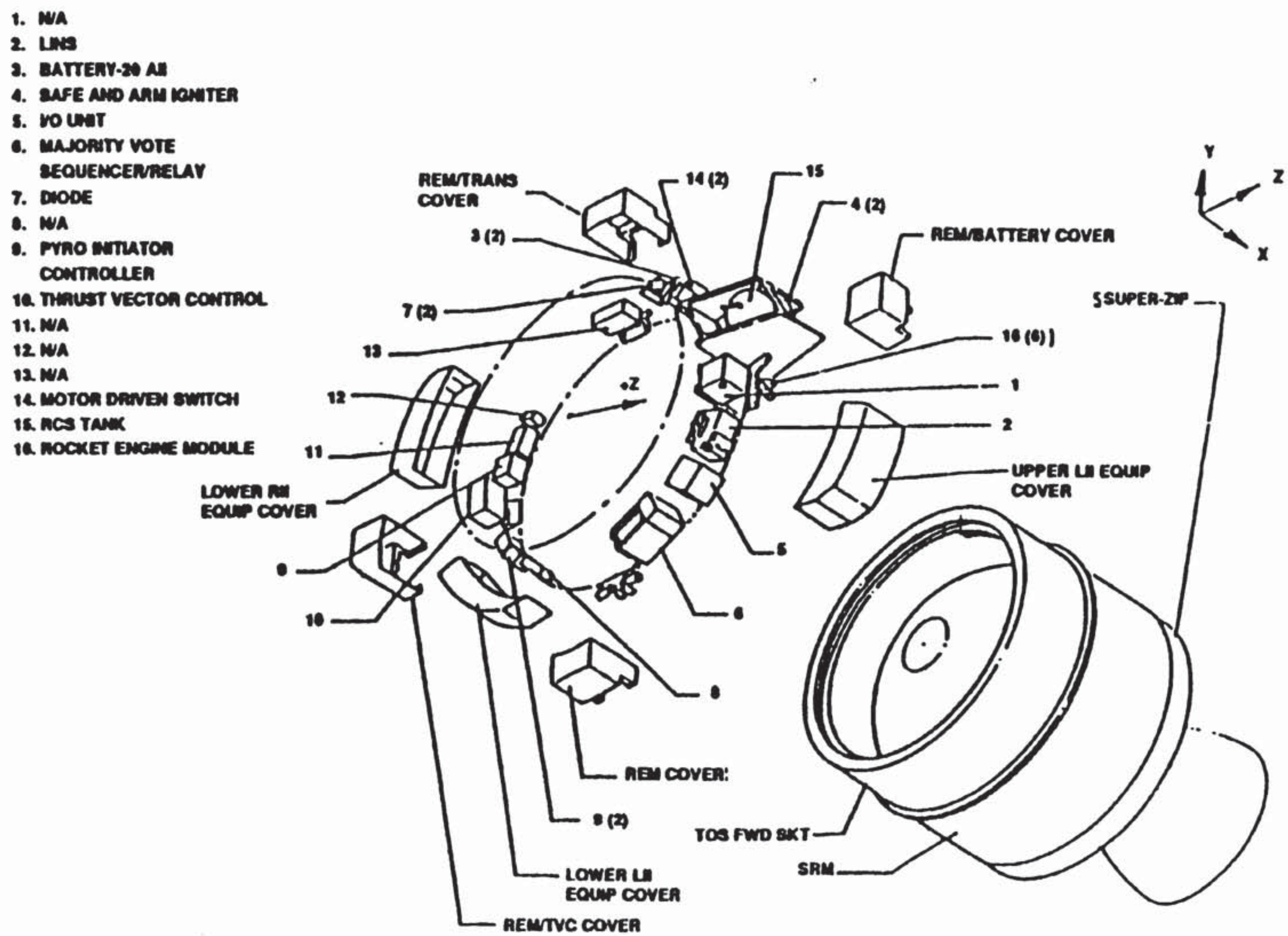

Figure 2-5. Transfer Orbit Stage

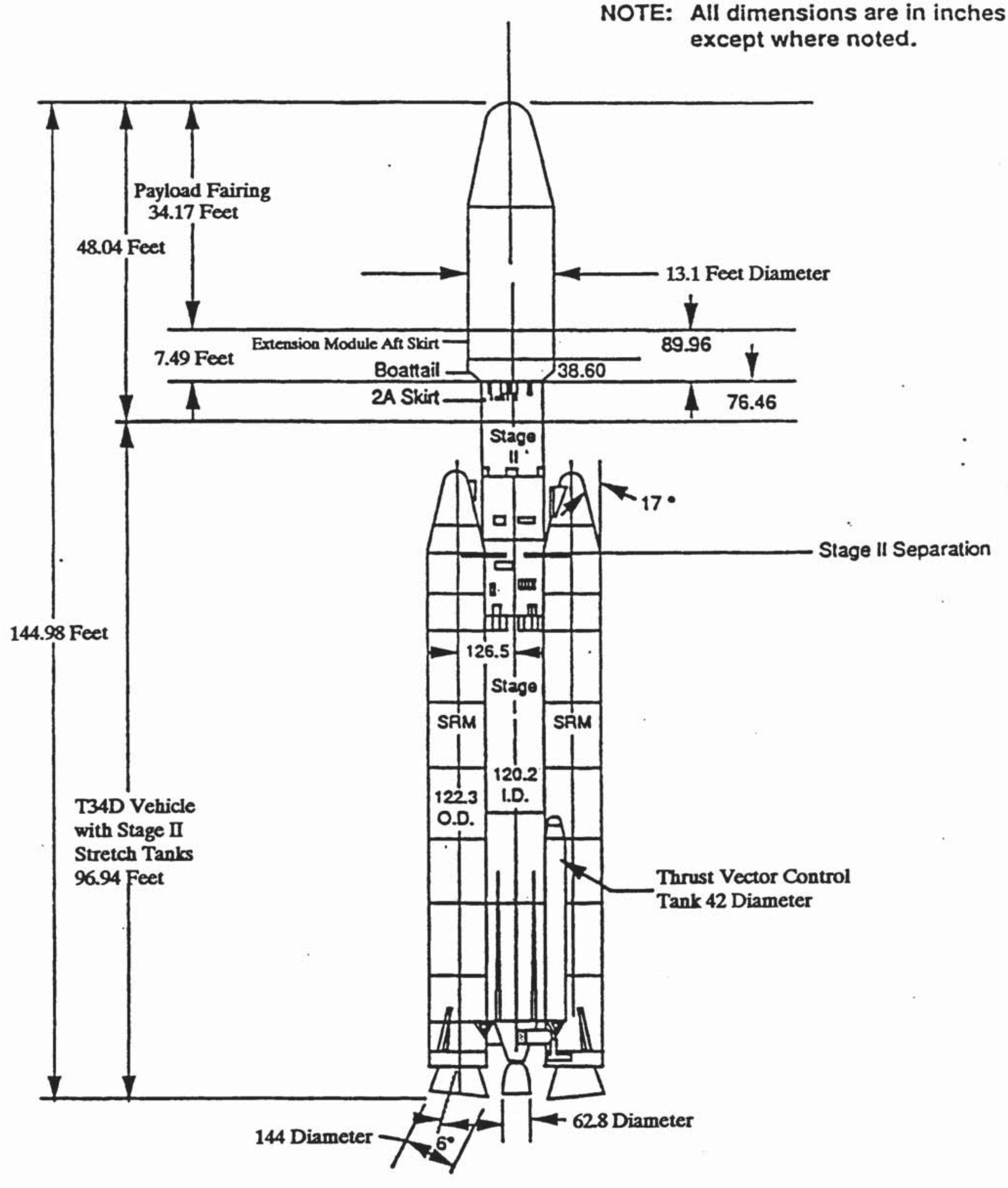

Figure 2-6. Commerical Titan Outboard Profile Single Payload Configuration

Although the Commercial Titan is a derivation of the Titan 34D, some variances exist between these two launch vehicles. The major Commercial Titan items not common to the Titan 34D include elongation of the Payload Fairing, addition of an Extension Module, Payload Adapter and boattail, and modifications to the Attitude Control System Modules, the liquid engines and the Flight Termination System (Figure 2-7). Despite the differences between the Commercial Titan and the Titan 34D, the mission of the Commercial Titan will be similar to previous Titan 34D missions. The improvements incorporated into the Commercial Titan will ensure that safety is enhanced beyond that of the Titan 34D.

2.4 PRELAUNCH OPERATIONS

Because the U.S. government has sponsored expendable vehicle launches for over thirty years, launch procedures have become a standardized and routine process. Many of the proven government launch operation procedures will be utilized for the launch of the Mars Observer Mission. In addition to the proven safety of these procedures, launch personnel are experienced and well versed in following these procedures.

The operational phases and configuration changes for the integrated payload include prelaunch, launch and ascent, parking orbit insertion and injection into a planetary transfer trajectory.

2.4.1 Kennedy Space Center Operations

2.4.1.1 Facilities for Payload Assembly. The facilities at the Kennedy Space Center (KSC) required by the Project for prelaunch operations include the Payload Processing Facility (AO Building), the Hazardous Processing Facility, the Explosive Safe Facilities and the MIL-71 DSN Facility to support prelaunch and compatibility testing between the spacecraft, the Deep Space Network, and the Jet Propulsion Laboratory Mission Operations System (Figure 2-8) (GE, 1991). No new facilities will be constructed for the launch of the Mars Observer mission.

The Mars Observer spacecraft will be transported to the KSC in an environmentally controlled Spacecraft Shipping/Storage Container and delivered to the Payload Processing Facility for payload checkout and assembly. The spacecraft propulsion subsystem will be pressurized to a low blanket pressure (approximately 50 pounds per square inch) and no propellants will be on board. Deployable booms and antennas will be in the stowed position and some ordnance devices may be installed. The batteries will be installed in the spacecraft; however, they will be de-energized. The main enable and battery enable flight plugs will be removed, thereby removing power to all spacecraft subsystems. Transportation speed will be limited and controlled by convoy to prevent exposing the spacecraft to excessive loads.

Operations at the Payload Processing facility are primarily associated with the removal, inspection, and electrical checkout of the spacecraft as it arrives at KSC and preparation to move it to the Payload Hazardous Processing Facility.

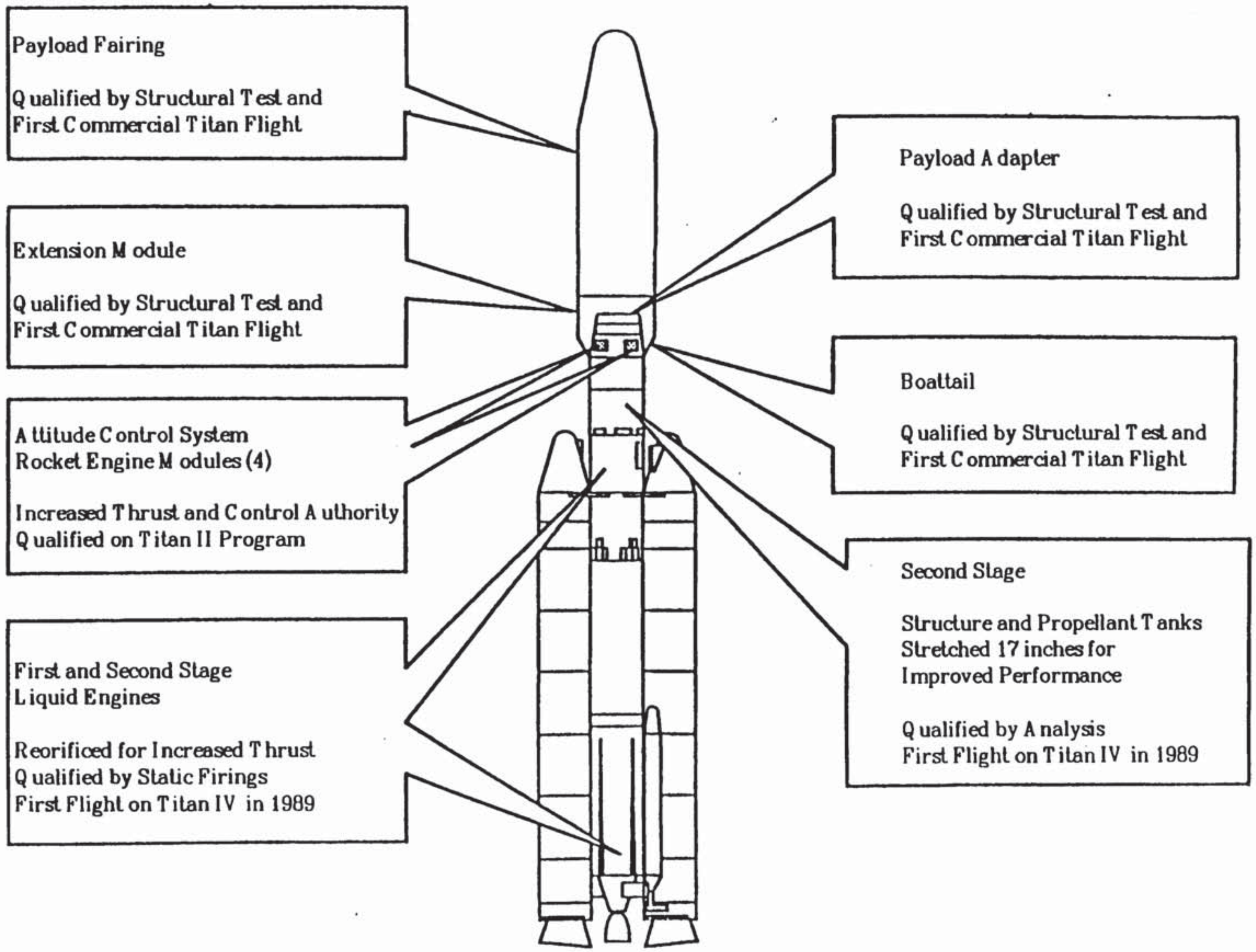

Figure 2-7. Major Differences Between the Commercial Titan and the Standard Titan 334D

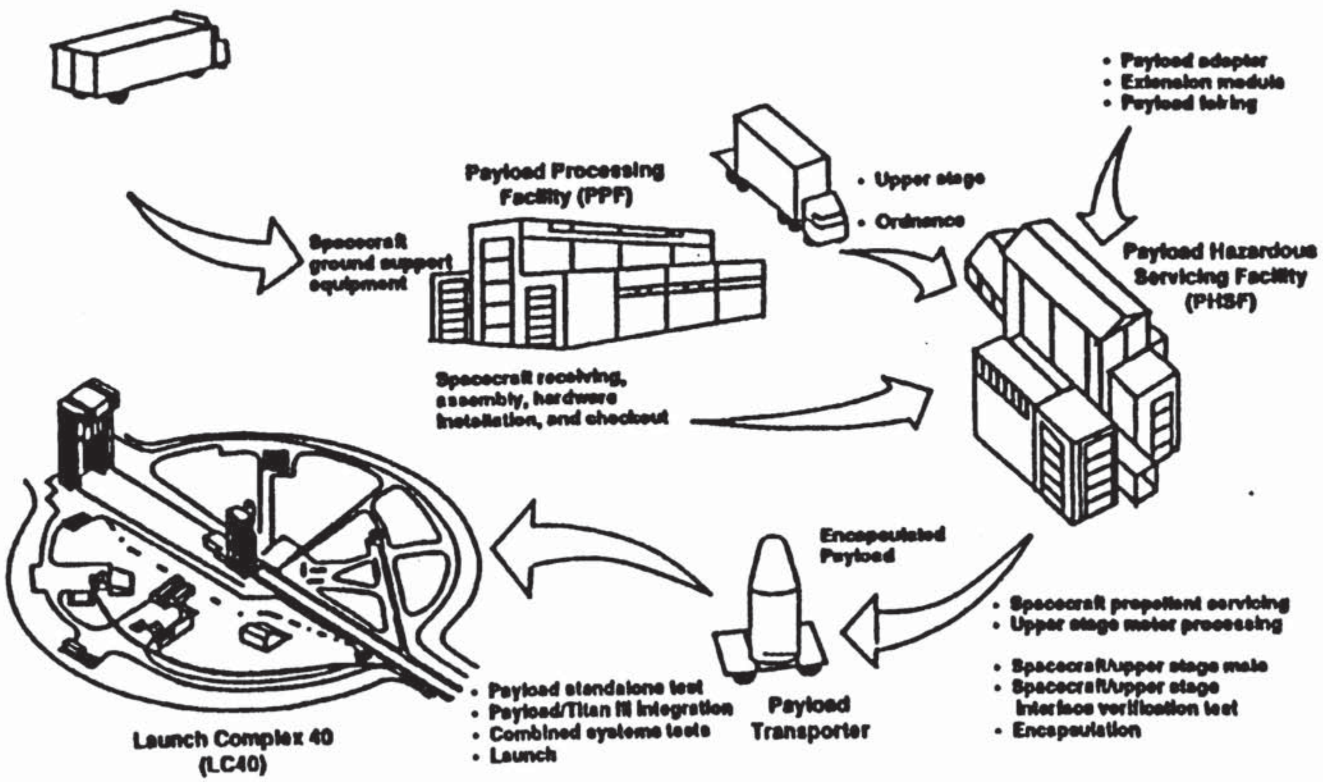

Figure 2-8. Spacecraft Ground Processing Flow

Hazardous spacecraft operations will be performed in the Payload Hazardous Processing Facility. Facility operations include spacecraft weighing and balance, propulsion subsystem leak check, propellant loading and pressurization, spacecraft/adaptor/TOS mating, ordnance installation, final thermal insulation installation, spacecraft/TOS interface test, and encapsulation.

The propellants for the monopropellant and bipropellant systems will be sent to the launch site in Department of Transportation-approved and sealed containers.

The TOS forward skirt will arrive at KSC with all basic subsystems installed with the exception of avionics boxes, batteries, ordnance, and propellants. Processing at the Hazardous Processing Facility will include installation of avionics boxes, batteries, and ordnance initiators, ordnance and subsystem tests, propellant loading, SRM tests and mating with the TOS forward skirt.

Following spacecraft preparations, the Mars Observer spacecraft will be mated to the TOS at the separation interface and a functional interface test will be performed to verify the electrical interface. The final task at the Payload Hazardous Processing Facility will be to encapsulate the payload in the Titan III fairing. At the time of encapsulation, the spacecraft will be fully fueled, at flight pressure, and all ordnance will be installed; however, the Main Enable and Ordnance Arming flight plugs will not be in place.

2.4.1.2 Hazardous Operations. Hazards that cannot be eliminated by design are dealt with by proper procedures, safeguards, operations techniques, training programs, and monitoring and alarm systems. Project safety requirements are documented in the Project Safety Plan which defines the approach to be used and requirements to be met though all Project activities (GE, 1991, JPL, 1989). The Plan requires safety activities commensurate with the potential hazards to either equipment or personnel associated with the Project. It identifies Project organizational requirements, responsibilities, and authorities for assuring the safety of personnel, equipment and facilities.

2.4.1.2.1 Propulsion System Hazardous Operations. The propulsion subsystem will require up to six hazardous operations during ground processing operations: monopropellant, bipropellant and pressurant loading, and monopropellant, bipropellant and pressurant contingency offloading. Contingency offloading will only be performed if a system failure occurs. The hazardous propellants and pressurants are gaseous helium, monomethyl hydrazine, nitrogen tetroxide, and hydrazine.

The propulsion system will be loaded using detailed step-by-step test procedures developed specifically for the spacecraft propulsion subsystem. The propulsion subsystem will be leak and functionally tested prior to propellant loading and application of flight pressure. Testing will be conducted in a controlled area with non-essential personnel removed and Electrostatic Discharge Standard Procedures in effect. Propellant loading and pressurization will be performed by trained propellant handlers using specialized fluid handling and loading carts. All loading equipment will be precision cleaned and detailed maintenance for ground support equipment will be performed.

A Mars Observer propellant offloading plan has been prepared and detailed step-by-step test procedures will be developed to safely offload propellants from the spacecraft in the event that an emergency situation develops. Propellant vapor detectors will be operational at all times when the spacecraft is fueled. In the event of propellant leakage, the area will first be evacuated, exhaust systems will be activated and emergency crews will be summoned. After power to the spacecraft is removed, the leak source will be determined, the faulty system depressurized and liquid propellants offloaded.

2.4.1.2.2 Power System Hazardous Operations. The two Mars Observer flight batteries will be installed in the spacecraft prior to its arrival at KSC. At KSC, battery charging, reconditioning, and capacity tests will be performed. Because the electrical power system presents potential hazards including battery leakage or rupture, electrical shock due to high voltage and current sources, and spacecraft fire due to electrical component failures, the battery voltage, current, and temperature will be closely monitored during these operations and they will be immediately discontinued should any anomaly be detected.

2.4.1.2.3 Pyrotechnics Hazardous Operations. During ground processing at launch site facilities or transportation to launch complex 40, damage to the spacecraft, Titan fairing or injury to personnel could occur caused by inadvertent firing of initiators and the release of deployable elements. In addition to safety controls designed to preclude inadvertent firing of the initiators during ground processing, carefully specified testing and verification techniques, delayed installation of the arming plugs and the use of explicit installation procedures and trained ordnance handlers to install the electroexplosive devices will minimize ordnance hazards. Finally, ordnance installation procedures will not be started or will be terminated should lightning pass within five nautical miles of the facility.

2.4.2 CCAFS Operations

The Commercial Titan Launch Vehicle will be launched from Launch Complex 40 at Cape Canaveral Air Force Station (CCAFS). Cape Canaveral AFS consists of a narrow strip of land measuring 11 miles by 4.5 miles on the central coast of east Florida. Launch Complex 40 is located on the northeastern coastline of CCAFS, approximately 1000 feet east of the Banana River and 1600 feet west of the Atlantic Ocean (Figure 2-9) and is one element of the Integrate-Transfer-Launch (ITL) facilities in which the Commercial Station Titan will be assembled, integrated and launched (Figure 2-10). No new facilities will be constructed for the launch of the Mars Observer spacecraft.

The Commercial Titan Launch Vehicle will be processed and launched by the Martin Marietta Corporation, which has an agreement with the Department of the Air Force to allow commercial launches from the Launch Complex 40 in government fiscal years 1989 through 1992. This agreement is subject to certain provisions that will be met to ensure the safety and launch of the Mars Observer mission between September 16 and October 6, 1992.

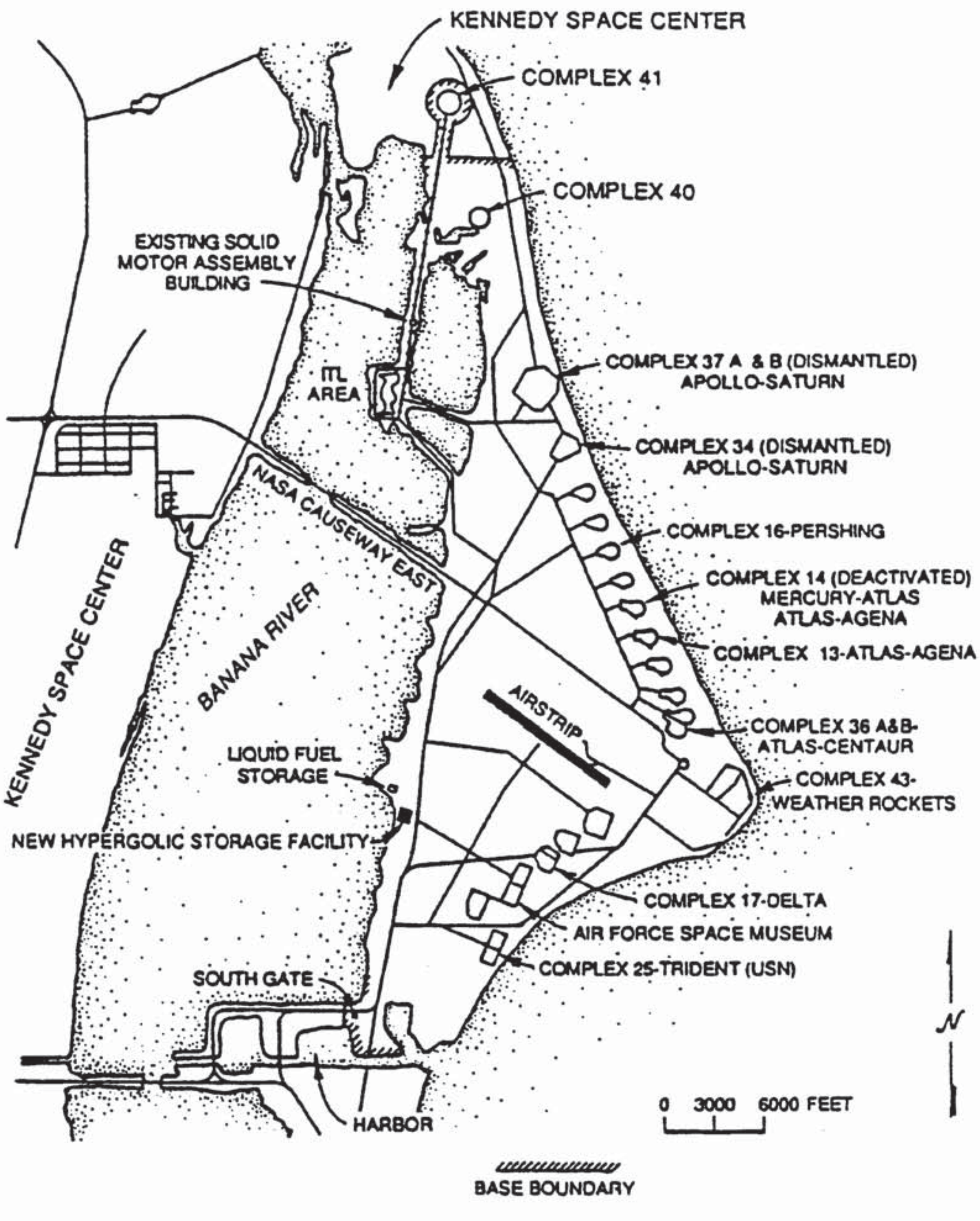

Figure 2-9. Launch Complexes and Support Facilities at Cape Canaveral Air Force Station.

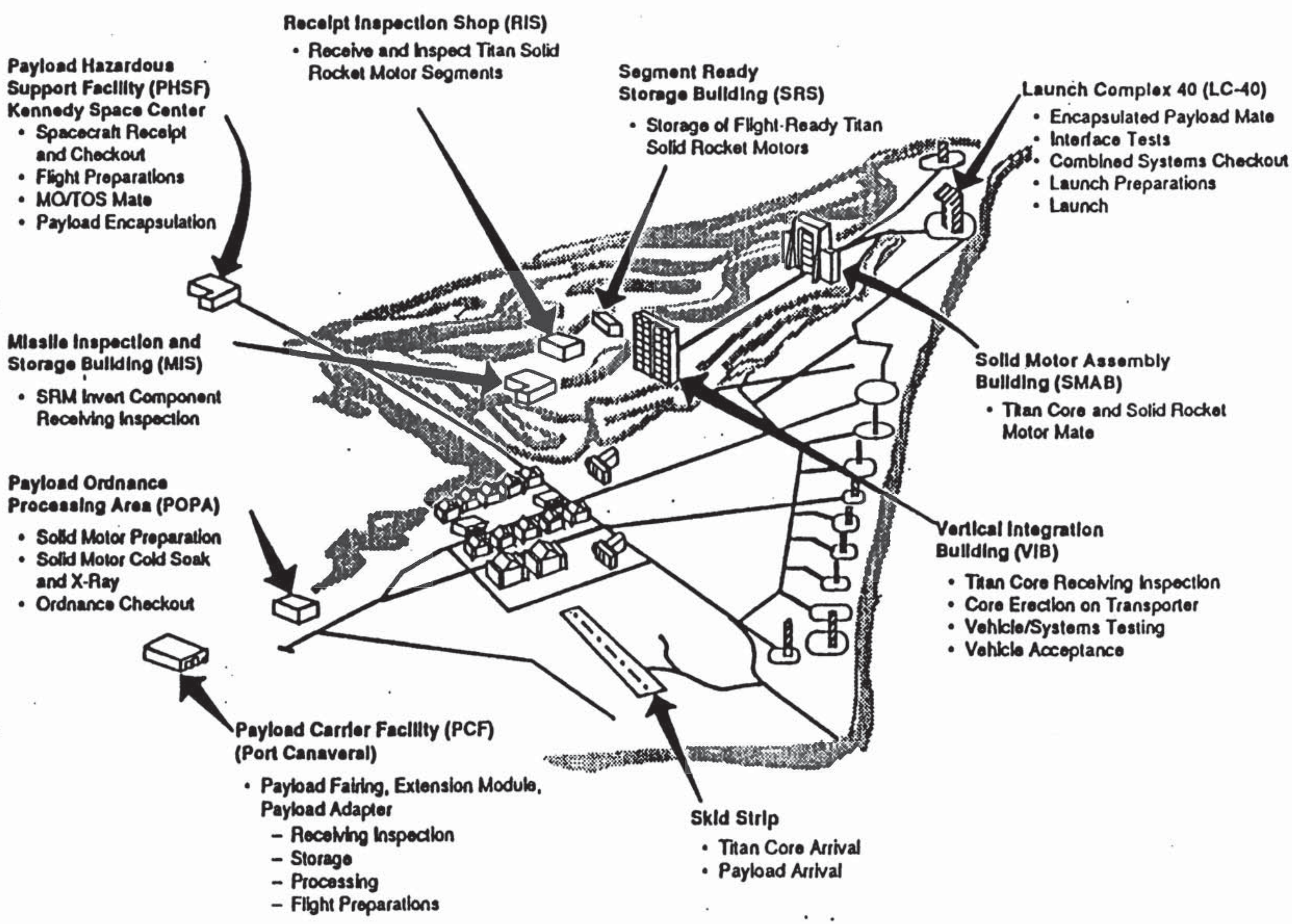

Figure 2-10. Commercial Titan Processing Facilities

2.4.2.1 Facilities for Commercial Titan Launch Vehicle Assembly. The ITL permits maximum use of the launch complex because most prelaunch activities are conducted at remote integration buildings. Operations at the launch complex are minimized by assembling and checking the vehicle before transporting it to the launch complex. In the ITL concept, the liquid propellant stages will be received, assembled vertically, and checked out in the Vertical Integration Building at the same time the solid rocket motor segments are being assembled and checked out in the Solid Motor Assembly Building. The core vehicle will then be transported to the Solid Motor Assembly Building and joined with the solid rocket motors.

2.4.2.2 Transport to Launch Complex 40. The spacecraft, completely assembled, checked out, integrated with the TOS, and encapsulated will be delivered to launch complex 40 for mating with the Titan III stack. The spacecraft will be transported using an air-ride truck. The transporter will be equipped with recording accelerometers. The transport route for the encapsulated spacecraft is illustrated in Figure 2-11.

Prior to transporting operations, weather conditions will be checked and if electrical storms are expected, transportation operations will be postponed to eliminate the possibility of a lightning strike to the encapsulated spacecraft. Test procedures that will specify acceptable weather conditions to initiate spacecraft transportation will be developed.

The assembled Commercial Titan Launch Vehicle will be moved to the Launch Complex by locomotives (Figure 2-12). Rail vans will be used to house primary aerospace ground equipment for the booster. The equipment in the vans will be connected to the launch vehicle core in the Vertical Integration Building and disconnected while being transported via the railway to the launch complex along with the vehicle. Disconnecting the umbilical connection precludes damage from lightning strikes during the transportation process.

2.4.2.3 Launch Complex 40. While most of the checkout is performed at individual integration buildings, the operations to be completed at the launch site will be mating of the encapsulated payload with the booster vehicle, payload verification, launch combined system test, range open-loop test, liquid propellant servicing and loading, tank pressurization, final vehicle checkout, ordnance installation and connection and launching.

2.4.2.3.1 Facilities. Launch Complex 40 consists of a concrete pad with fixed foundations supporting the launch vehicle transporter, the umbilical tower, Aerospace Ground Equipment building, and a Mobile Service Tower with the universal environmental shelter and the propellant and gas storage areas. Figure 2-13 shows the existing and proposed layout of Launch Complex 40.

The umbilical tower provides propellants, pressurization gases, and conditioned air to both the launch vehicle and to the payload fairing. The Mobile Service Tower provides facilities for mating the encapsulated integrated spacecraft system to the Commercial Titan, and for the servicing and checkout of the complete integrated launch vehicle system. Work platforms at multiple

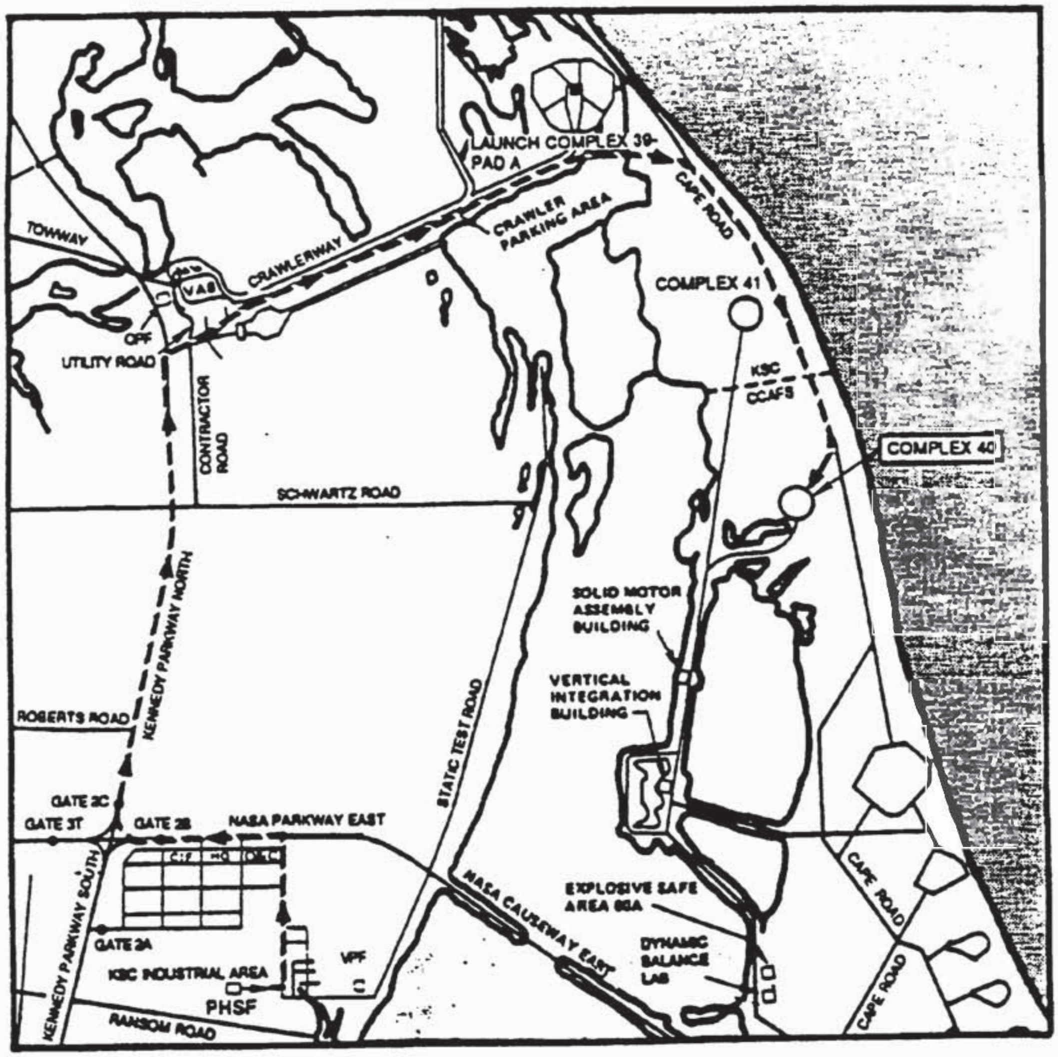

Figure 2-11. Mars Observer/TOS Transport Route

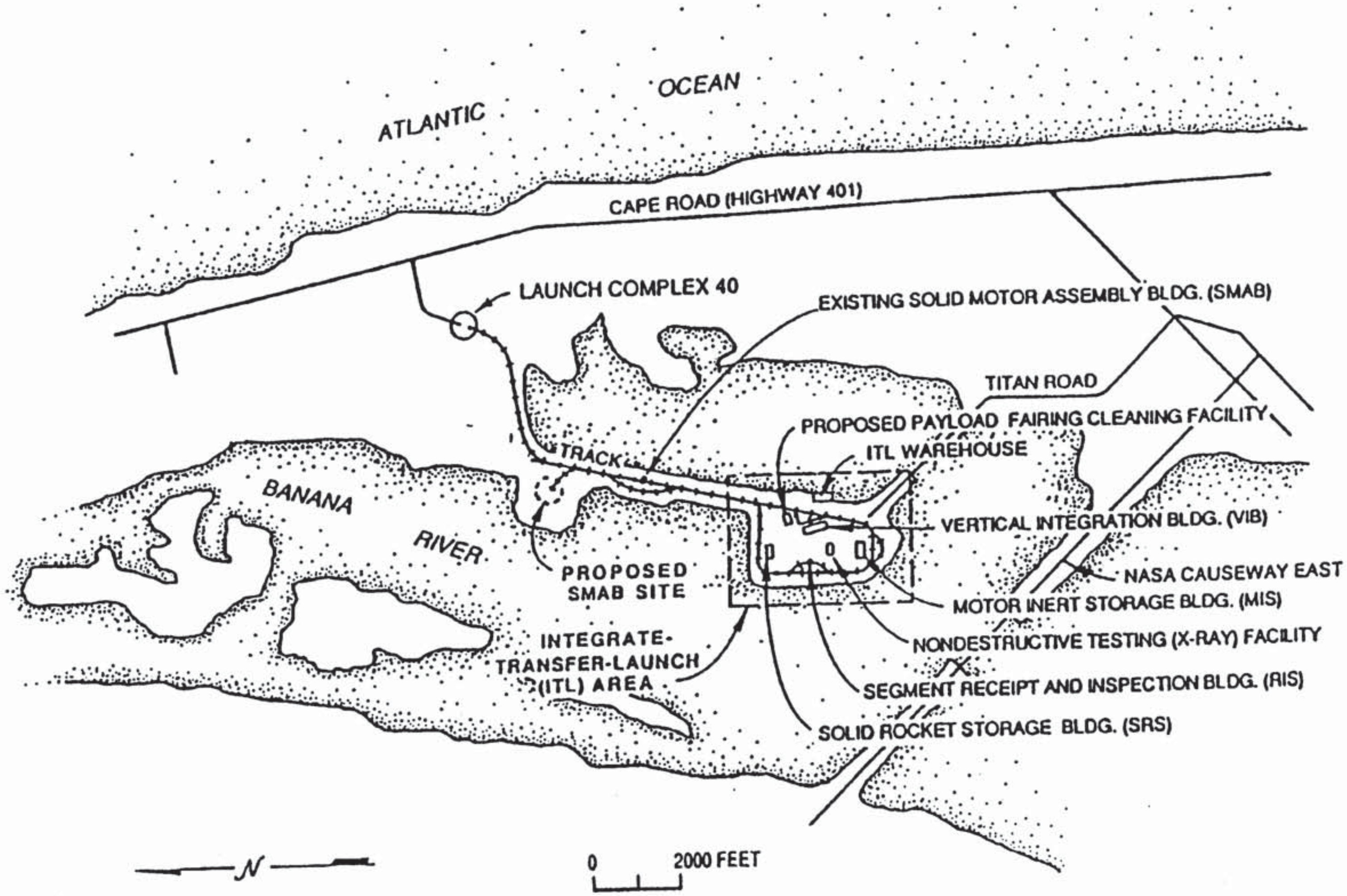

Figure 2-12. Commercial Titan Transport Route

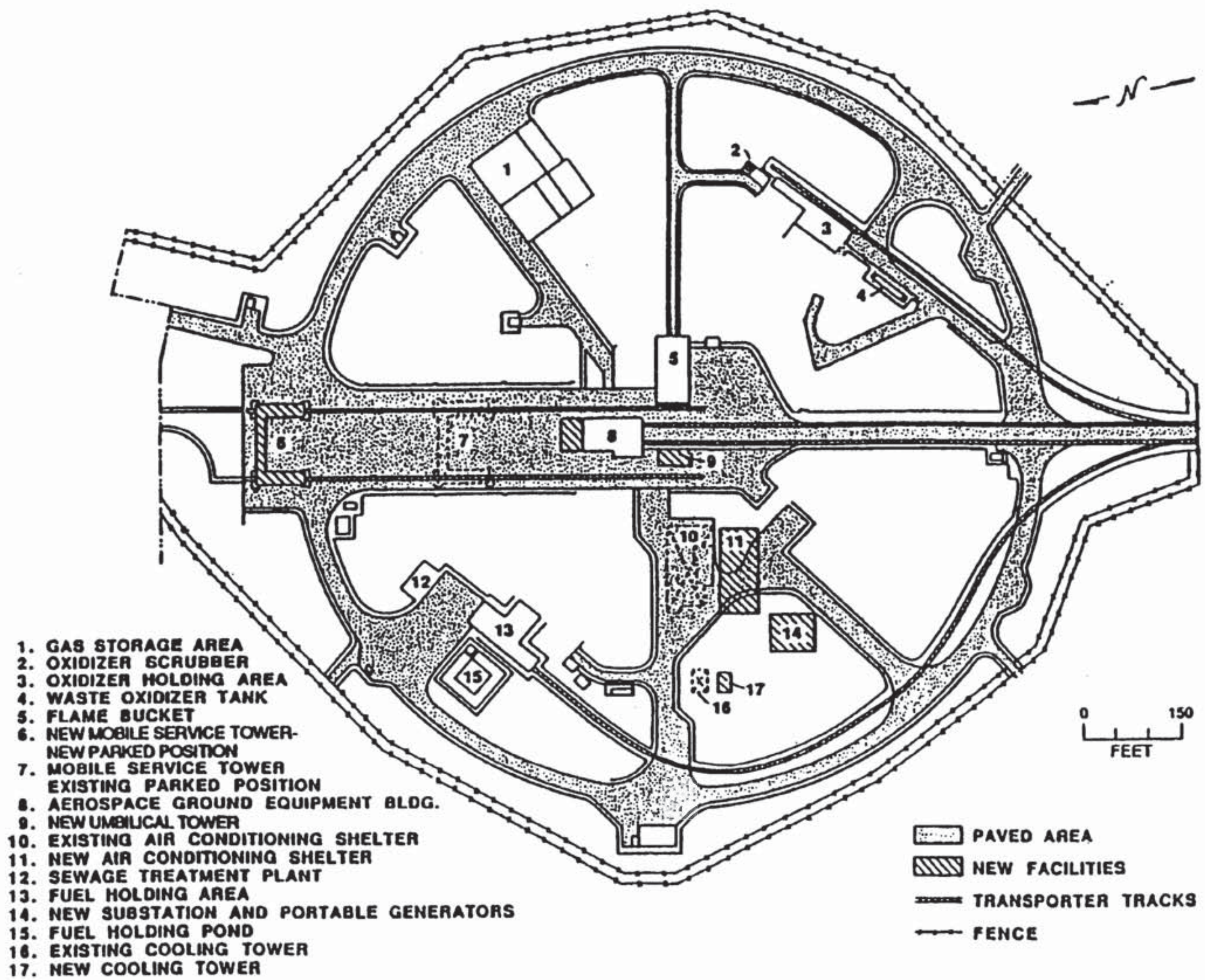

Figure 2-13. Existing and Proposed Layout of Launch Complex 40 at Cape Canaveral Air Force Station

levels provide access to the vehicle, upper stages, spacecraft, and payload fairing. The Environmental Shelter is an integral part of the Mobile Service Tower and provides a controlled environment for the spacecraft and upper stage. Just prior to launch, the platform is moved from the service position to its park position, north of the launch mount.

After arrival of the encapsulated payload at the launch complex, the transporter will be positioned on the pad at the base of the Mobile Service Tower. The payload carrier will be hoisted into the universal environmental shelter using one of the bridge cranes and a payload lifting sling. A large door within the universal environmental shelter will be opened to receive the encapsulated payload which will then be mated to the launch vehicle.

Payload operations at Launch Complex 40 are limited to tasks that can be accomplished by access through the payload carrier and boattail access doors. Payload control is by command and monitor radio frequency transmission (up to Mobile Service Tower rollback) and commercial Titan aerospace ground equipment electrical umbilical interfaces routed through the Cape Canaveral Air Force Station landline system.

Fixed and folding platforms and platform inserts on levels 10 and 11 on the Mobile Service Tower inside the universal environmental shelter provide access onto the payload. The shelter has personnel access doors at each level and airlocks at levels 10 and 11. Access to the environmentally controlled area is through the airlocks while internal stairways provide access between levels. General room air conditioning and localized payload conditioned air are provided in the shelter.

The Aerospace Ground Equipment Building, a two-story reinforced concrete structure located beneath the pad apron at the Launch Complex 40, will house the Titan III launch control and instrumentation vans. Junction boxes inside the building provide electrical and electronic interfaces with the payload and launch vehicle via the Titan launch transporter umbilical masts, and with facility power and data and command transmission landlines.

Prior to launch all stages of the Commercial Titan Launch Vehicle and the Solid Rocket Motor's Thrust Vector Control System must be serviced with propellent using the propellant transfer system. The propellant transfer system consists of compact or packaged fluids plus connecting systems that function together to store propellants and vent vapors, measure propellant transfers into the vehicle propellant tanks or return the propellants by gravity to the ready storage vessels, distribute nitrogen within the system to provide blanket pressure, assure correct pump inlet pressure, purge the system and add or remove incremental amounts of the propellants from the Stage I or Stage II vehicle tanks to optimize the load under changing temperature conditions.

The propellant transfer system consists primarily of three major areas. The launch pad area which contains the piping and components necessary to service the vehicle for all propellant transfer operations. The fuel holding area which contains two storage tanks and a pumping unit used to transfer propellants during the fuel transfer operation. And the oxidizer holding area which has one storage tank and an oxidizer propellant loading unit. The two holding areas are physically located at opposite sides of the launch complex.

High pressure gaseous nitrogen is normally provided to the launch pad by means of a high pressure supply line. Nitrogen is delivered as a liquid to the gas storage areas by liquid nitrogen trailers. It is stored in a dewar, converted to a gas, compressed and stored for subsequent used at the launch stand.

2.4.2.3.2 Hazardous Operations. Launch complex operations require adherence to strict safety regulations. Facility status safety briefings will be conducted prior to beginning launch complex operations. A walkdown of the complex will be completed prior to working in the area. All spacecraft processing at Launch Complex will be conducted using the "buddy system". During hazardous operations at the launch complex (i.e. emergency propellant offloading, spacecraft lifting, etc.) access will be restricted to only those personnel necessary to safely complete the task. Toxic vapor monitors will be in operation at all times to warn personnel should airborne concentrations exceed the established Threshold Limit Values. Proper warning lights will be used to indicate hazards present. A plan has been prepared and detailed procedures will be developed to safely offload propellants from the spacecraft in the event of an emergency at Launch Complex 40. Following demating of the spacecraft from the launch vehicle and removal of the fairing, propellants will be removed at the base of the launch pad. The propellant load carts, pressurization equipment, and rotating fixture necessary to offload propellants will be located near the complex to respond to any potential emergency condition. Propellant offloading will be performed by trained, certified personnel wearing protective equipment. Contaminated propellants will be properly contained, stored, and disposed.

2.4.2.4 Safety. The Titan III's launch reliability record is 95.8%, the best operational success record of all major free world launch systems. The success of the program is partly a function of the close coordination and cooperation between the Air Force Range Safety and the Martin Marietta Corporation System Safety and Flight Safety Organization over the last thirty-five years.

Coordination between the two organizations will be continued for Commercial Titan Launches with the use of a Range Safety Data Package. A Range Safety Data Package for the launch of Commercial Titan Launch Vehicles was approved by Range Safety on August 24, 1989. Updates to make it applicable to the Commercial Titan/Mars Observer/Transfer Orbit Stage Mission will be provided by Martin Marietta Corporation to Range Safety. A final Range Safety Data Update will be submitted approximately ninety days prior arrival of the system at the Eastern Space and Missile Center. Eastern Space and Missile Center Range Safety approval of this package will constitute a part of the final formal acceptance of the launch of the Mars Observer spacecraft.

2.4.2.4.1 Range Safety Services. Safety services for the Mars Observer spacecraft launch will be acquired from Range Safety. Range Safety reviews and approves the procedures used for all hazardous operations conducted on the Range, in accordance with Eastern Space and Missile Center Safety Regulation 127-1, "Range Safety", as well as all procedures used for installation and checkout of flight termination systems. In addition, all operations using these procedures are monitored by Range Contractor Pad Safety personnel who report directly to Range Safety. Pad Safety has the authority to terminate any operations for safety violations from the time a vehicle arrives on the Range until it is launched.

2.4.2.4.2 Range Safety Requirements. For launch vehicle design, modification, and payload unique requirements, Martin Marietta Corporation Commercial Titan engineering and system safety personnel are responsible for satisfying Range Safety requirements and interfacing with Range Safety organizations to assure compliance with Eastern Space and Missile Safety Regulation 127-1, coordination of system safety measures with the Range to include changes in design or operations and investigation of incidents or anomalies and safety in the event of impact of deorbiting space vehicles and subsequent recovery operations.

The Commercial Operations Safety organization coordinates all Air Force range safety requirements directly with the Eastern Space and Missile Center Range Safety Office. This coordination includes providing both launch vehicle and payload data required for Range Safety evaluation in addition to convening joint safety meetings, as required. Range Safety evaluation of the data provided ensures that all pertinent range safety requirements have been met or exceeded, thereby assuring that all proper precautions have been taken to ensure a safe launch.

2.4.2.4.3 Safety Reviews. Although Air Force Safety reviews are conducted for all Department of Defense Titan launch vehicles, these reviews do not apply to the Commercial Titan Launch Vehicle. Range Safety reviews of the Commercial Titan Launch Vehicle and Payloads are accomplished through the Missile System Prelaunch Safety Package (MSPSP) review and approval process. Their purpose is to ensure the safety of the Commercial Titan Launch Vehicles, the launch complex, the payload and personnel servicing the Commercial Titan and the payload.

A MSPSP will be prepared for the spacecraft and the TOS and submitted for review to Martin Marietta Corporation and Range Safety. The text will detail the launch vehicle/payload design and operations, provide an analysis of the associated hazards, discuss the design and operations functions accomplished to eliminate or mitigate the hazards, list residual hazards and rationale for acceptances and discuss all waivers or deviations to the range safety requirements set forth in Eastern Space and Missile Center Regulation 127.1. The final MSPSP will be forwarded to Range Safety for approval.

Range Safety will also be invited to participate in the Commercial Titan Preliminary Design Reviews and Critical Design Reviews. Range Safety participation in the program reviews consists of providing input to the design of safety critical systems, hazardous operations procedures and facility design/modifications. When safety concerns arise that require a response to Range Safety, a meeting is scheduled to discuss the safety concern and to reach a resolution. These meetings ensure that pertinent safety concerns affecting the launch are properly identified and resolved to the satisfaction of both Martin Marietta and the Air Force.

In addition, Range Safety technical interchange meetings will be conducted as needed to resolve safety issues that cannot be resolved through other means.

2.5 LAUNCH OPERATIONS

2.5.1 Safety Precautions

Prior to launch of the Mars Observer spacecraft, the Air Force will inform the Federal Aviation Administration of the expected launch times and dates. The Federal Aviation Administration, in turn, will control air traffic in the area. The air space within the boundaries of Kennedy Space Center and Cape Canaveral Air Force Station are normally placed off-limits to all commercial and private air traffic at elevations below 5000 feet; nine days prior to launch the elevation restriction is raised to 8000 feet. At ten minutes prior to launch, all air space up to an unlimited elevation above the launch site are placed off-limits. The Superintendent of Range Operations will notify the Federal Aviation Administration in Miami of the launch countdown at designated intervals.

The United States Coast Guard will declare an area near Cape Canaveral restricted to shipping and offshore fishing activities at a designated time prior to launch. An officer of the Guard will be present in the Range Control Center during the launch and will be alerted by helicopter surveillance of any intrusion into restricted waters; a Coast Guard cutter will be dispatched to the area if necessary.

Additional safety precautions must be considered. Meteorological restrictions will be in place based on the wind velocity, direction and altitude temperature differential. Diffusion forecast information will dictate danger area clearing requirements. Weather conditions will be monitored during launch and flight using radar and other tracking devices. Emergency services will be available and alerted during the launch in case of an accident or aborted mission at the launch site.

The Mars Observer Launch Configuration is illustrated in Figure 2-14 (GE, 1991). Prior to launch, all TOS/Mars Observer systems will be armed and operating on internal battery power. TOS Ordnance inhibits will be activated and cannot be removed until after separation from the Titan.

2.5.2 Launch

The integrated payload ascent timeline is shown in Figure 2-15 (GE, 1991) which also lists the sequence of events. The Commercial Titan Space Launch Vehicle will inject the MO/TOS and Stage II into an elliptical low perigee earth park orbit of approximately 86 by 228 nautical miles. About thirty seconds prior to Stage I/II separation, the two half-shells of the payload fairing will be separated and jettisoned by ordnance devices.

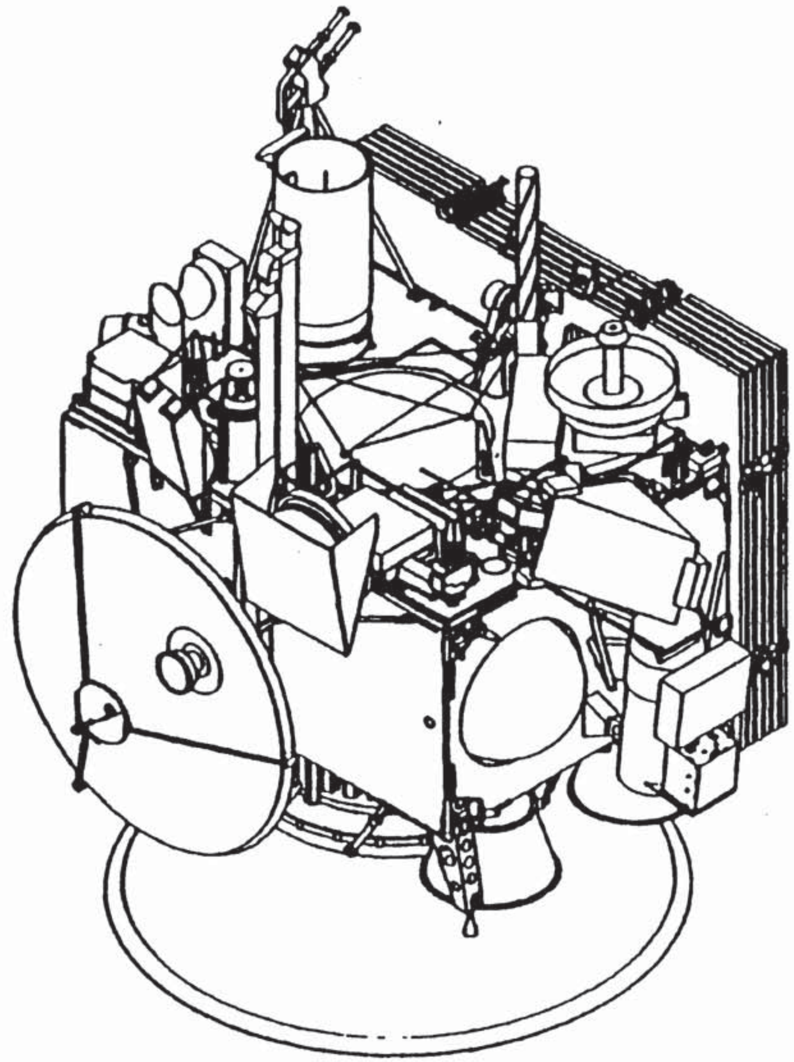

Figure 2-14. Mars Observer Launch Configuration

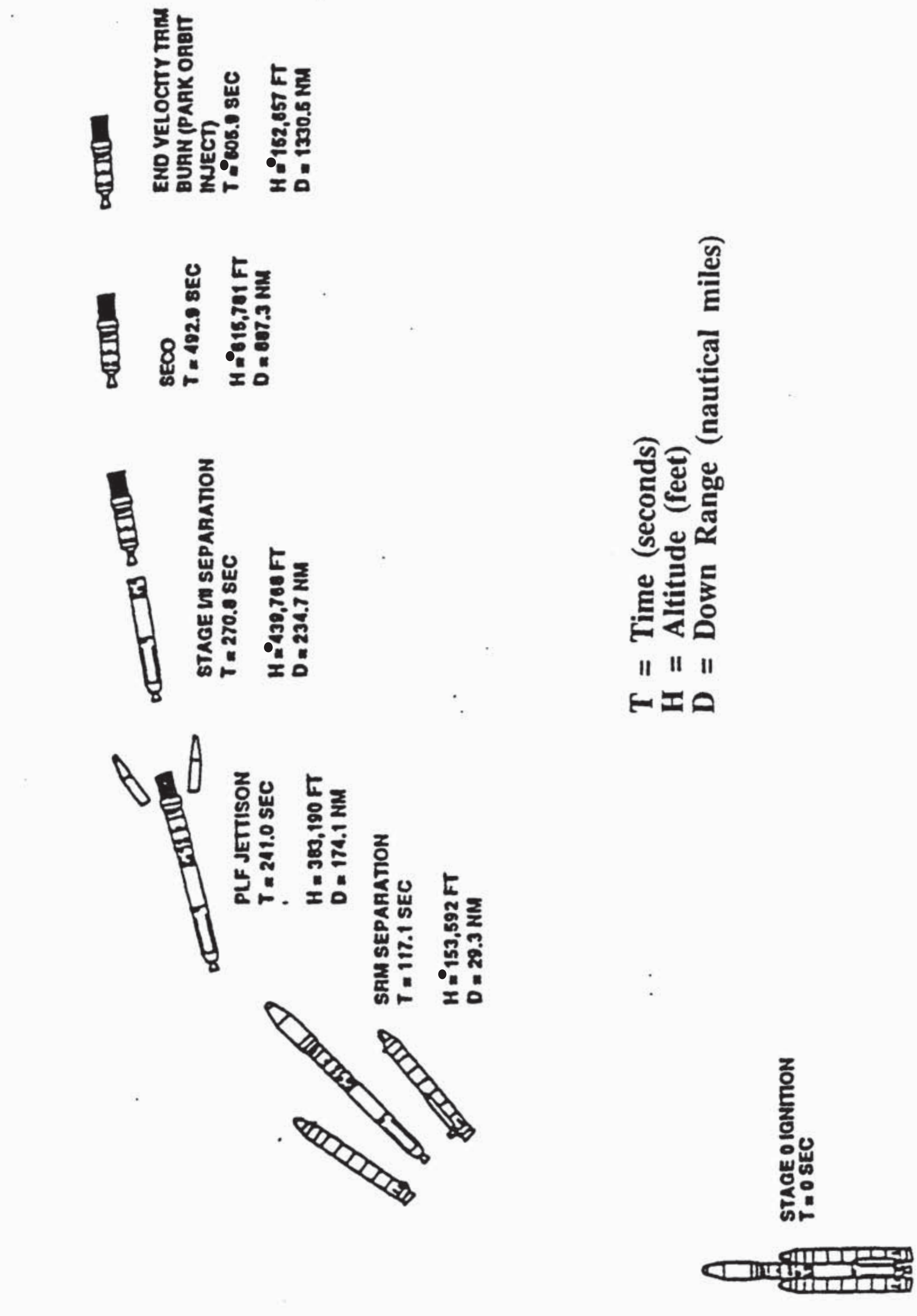

Figure 2-15. Typical Integrated Payload Ascent Sequence of Events

The Mars Observer mission scenario is to remain in park orbit for less than one revolution prior to payload deployment and subsequent TOS ignition. TOS ignition will occur when the MO/TOS hyperbolic transfer orbit perigee is correctly positioned for Mars interplanetary transfer. Stage II will be jettisoned from the payload approximately thirty minutes before TOS ignition. At Solid Rocket Motor burnout, the TOS will orient itself to the desired spacecraft separation attitude. After separation, it will perform an evasive maneuver and fire its aft pointing reaction control system thrusters to provide an impulse to change direction and preclude subsequent spacecraft recontact.

SECTION 3

GENERAL ENVIRONMENTAL CHARACTERISTICS OF CAPE CANAVERAL AIR FORCE STATION AND SURROUNDING AREA

The local environment is defined as the Cape Canaveral Air Force Station (CCAFS) and the Kennedy Space Center (KSC). The KSC/CCAFS area is located on the east coast of Florida, in Brevard County near the City of Cocoa Beach, approximately fifteen miles north of Patrick Air Force Base, about thirty miles south of Daytona Beach and forty miles due east of Orlando (see Figure 3-1) (USAF, 1986). The local area is part of the Gulf-Atlantic coastal flats and occupies Cape Canaveral and the north end of Merritt Island, both of which are barrier islands.

Cape Canaveral Air Force Station occupies approximately 15,800 acres of the barrier island that contains Cape Canaveral and adjoins the Kennedy Space Center (including National Park and Wildlife Refuge lands). Approximately 3,800 acres or twenty-five percent of the Station is developed and consists of launch complexes and support facilities. The remaining 75 percent consists of unimproved land. The station is bounded by the Kennedy Space Center on the north, the Atlantic Ocean on the east, the City of Cape Canaveral on the south, and the Banana River and Merritt Island Wildlife Refuge on the west. Kennedy Space Center occupies almost 140,000 acres, five percent of which is developed land and the rest of which is undeveloped. Nearly forty percent of KSC consists of open water areas, such as portions of the Indian River, the Banana River, Mosquito Lagoon and all of Banana creek.

A detailed description of the CCAFS local environment is presented in the Air Force's Air Force Environmental Assessment for the Titan IV/Solid Rocket Motor Upgrade Program (USAF, 1990). A brief summary is provided below.

3.1 COMMUNITY ENVIRONMENT

3.1.1 Regional Environment (USAF, 1990)

3.1.1.1 Population Distribution and Trends. All military personnel at Cape Canaveral Air Force Station are assigned to Patrick Air Force Base and perform their duties at CCAFS. The majority of the persons employed on base are contractor personnel associated with the companies associated with the missile testing and space launch operations. No permanent residents are located on base; all personnel are either stationed at Patrick Air Force Base or reside in the local communities.

About 95% of Air Force civilian and contractor personnel live in Brevard Country; the remainder live in Orange County, Indian River County, and other counties. The base is easily accessed from northern and central Brevard County. Orlando is approximately 45 west of the Cape Canaveral Air Force Base in Orange County, and the communities of south Brevard County (Melbourne, West Melbourne, Melbourne Village, Palm Bay, and Malabar), are about 30 miles away, all within commuting distance from the base.

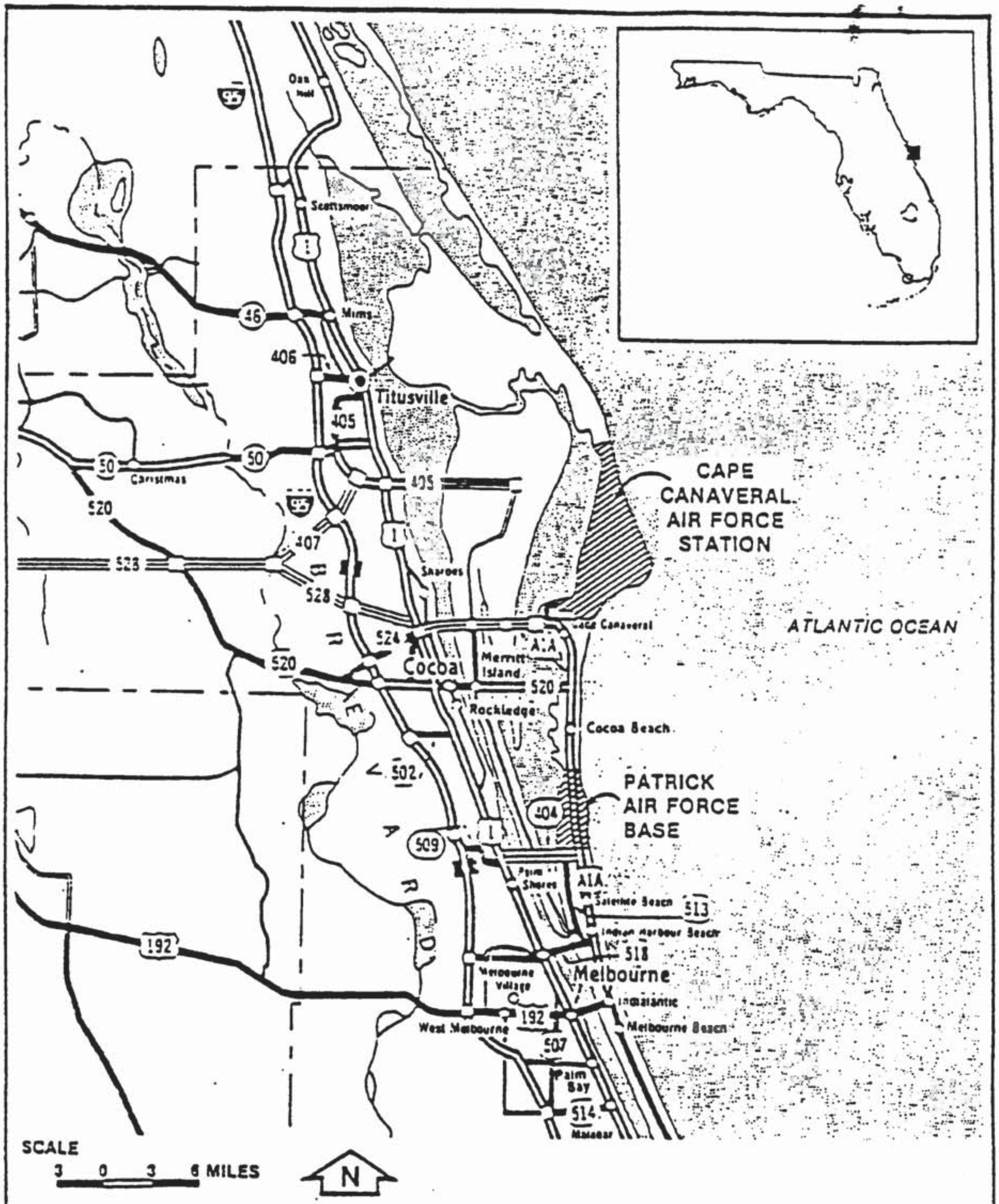

Figure 3-1 Location Map	Cape Canaveral Air Force Station

Characteristics in Brevard County are closely linked to the space program economy. Prior to 1950, the county was predominantly rural. The activation of CCAFS in the 1950s introduced a substantial population of military personnel into the county. From 1950 to 1960 the total population of Brevard County grew from 23,500 to 111,500. In-migration related to the space program continued until the late 1960s, when major cutbacks occurred in NASA operations. Employment level recovered after 1979 due to a new emphasis on space launch events. In 1985, the population of Brevard County was estimated at 338,000. The projected annual growth rate in Brevard County is 4.1% from 1985 to 1990 (407,200) and 3.2 % from 1990 to 1995 (473,000). Projected growth through 1995 is expected to be highest on the mainland in southern Brevard County and lowest on the mainland in central Brevard County.

3.1.1.2 Land Use. About 68% of the developed land use in Brevard County is agricultural, 12% is residential, 2% is commercial, 1% is industrial and 1% is institutional. The remaining 16% comprises other land uses. The developed land is clustered in three areas in a north-to-south pattern along the coast and the banks of the Indian River and Banana River. The developed areas are Titusville on the north mainland; central Brevard County, which includes Cocoa Beach, City of Cape Canaveral, Merritt Island, Cocoa, and Rockledge; and the South Brevard area, which consists of Melbourne, West Melbourne, Melbourne Village, Palm Bay, and Malabar on the mainland, and the beach communities of Satellite Beach, Indian Harbour Beach, Indialantic, and Melbourne Beach.

3.1.1.3 Economic Base (NASA, 1990). The region's economic base is tourism and manufacturing. Tourism related jobs include most jobs in amusement parks, hotels, motels, and campgrounds as well as many jobs in retail trade and various types of services. Manufacturing jobs, while probably outnumbered by tourism jobs, may provide more monetary benefits to the region because of higher average wages and a larger multiplier effect.

The region's agricultural activities include citrus groves, winter vegetable farms, pastureland, foliage nurseries, sod, livestock, and dairy production. In the central region, thirty percent of the land is forested and supports silviculture, including harvesting of southern yellow pine, cypress, sweetgum, maple, and bay trees. Large cattle ranches occupy almost all of the rural land in Osceola county. Agricultural employment declined in 1986 to 2.2 percent of the region's employment base.

Commercial fisheries of the two counties bordering the ocean (Brevard and Volusia) landed a total of 21,401,683 pounds of finfish, invertebrates and shrimp in 1988. Brevard and Volusia ranked third and fourth, respectively, among the east coast counties of Florida in total 1988 finfish landings. Brevard led east coast counties in invertebrate landings and was third with shrimp landings.

3.1.1.4 Employment. The total civilian labor force in Brevard County in October 1988 was 188,362, up from 178,321 in October 1987. The number of Brevard County residents employed was 179,321 in October 1988, yielding an unemployment rate of 4.7%. The unemployment rate rose in the last quarter to 5.1% but decreased to 4.3% in the first quarter of 1989 (USAF, 1990).

Income in the region has been increasing faster than inflation. The 1985 to 1986 average annual wage rose 3.7 percent. The 1986 average wage over all sectors was $17,604. Per capita income in the region has risen steadily since 1979 from $7,799 to $12,273 in 1984. The regional per capita income for 1987 to 1991 is projected to increase at rate somewhat greater than inflation (NASA, 1990).

3.1.1.5 Public Facilities and Emergency Services (USAF, 1990). The city of Cocoa provides potable water, drawn from the Floridan Aquifer, to the central portion of Brevard County. The maximum daily capacity is 40 million gallons per day, and average daily consumption is 26 million gallons per day.

The cities of Cocoa, Cape Canaveral, Cocoa Beach, and Rockledge each are served by their own municipal sewer systems. Unincorporated areas are served by several plants, some of which have reached capacity. Municipal systems in Cape Canaveral, Cocoa Beach and Cocoa recently were expanded and plans are under way to expand the Rockledge system.

Florida Power & Light supplies electricity to Brevard County. The police departments in the five municipalities of the central Brevard area have one officer per 631 people and fire protection has one full-time officer per 936 people. Health care within the region is available at twenty-eight general hospitals, three psychiatric hospitals, and two specialized hospitals.

3.1.1.6 Historical/Cultural Resources. There are forty-five sites within the region that are listed or eligible for listing in the National Registry of Historic Places, two in the National Registry of Historic Landmarks, and one area (Kissimmee River Prairie) that is a potential addition to the National Register of National Landmarks (USAF, 1990).

3.1.2 Local Environment (USAF, 1986)

Land Use Compatibility. CCAFS is Station No. 1 of the Eastern Test Range' a network of bases and stations established in the 1950s. The primary function of the station is to provide launch, tracking, and other facilities in support of DOD, NASA, and other range user programs. Approximately thirty percent of the station is developed and consists of launch complexes and support facilities. The remaining seventy percent consist of unimproved land.

CCAFS houses forty-one launch complexes, many of which are dismantled or have been deactivated. The base also contains a small industrial area (located at the eastern end of NASA Causeway East), Air Force Space Museum, Canaveral Harbor for the docking of submarines, NASA Mission Control, and a skid strip which was initially constructed for research and development recovery operation for missile launches. Many of the hangars located on base are used for missile assembly and testing. Future land use patterns are expected to remain similar to current on base conditions.

3.1.2.2 CCAFS Facilities and Services.

3.1.2.2.1 Transportation (USAF, 1986). Brevard County is serviced by Federal, state, and local roads. CCAFS is linked to this system by the South Gate via State Road AlA, NASA Causeway, and Cape Road. Primary highways in Brevard County include Interstate 95, U.S. 1, SR AlA, and SR 520. Urban areas on the beaches and Merritt Island are linked by causeways and bridges.

On base transportation (Figure 3-2) provides access to launch complexes, support facilities, and the industrial area. Transportation on base is limited to private vehicles and NASA bus tours. Highway improvements (e.g., the repaving of access roads) have been completed on base.

Rail transportation for Brevard County is provided by Florida East Coast Railway. A mainline traverses the cities of Titusville, Cocoa, and Melbourne. Spur lines provide access to other parts of the county. The Integrated Launch Complex is serviced by a branch line from Titusville through KSC. Maintenance of this line from the interchange north of Launch Complex 41 and launch pad is the responsibility of the United States Air Force.

3.1.2.2.2 Potable Water Supply (USAF, 1990). CCAFS receives its water supply from the City of Cocoa and uses 3 million gallons per day. To support launches, the distribution system at Cape Canaveral was constructed to provide up to 30,000 gallons per minute for ten minutes.

3.1.2.2.3 Wastewater Treatment and Disposal (USAF, 1986). CCAFS provides for its own sewage disposal with on-site packaged treatment plants. Launch Complex 40 is equipped with its own wastewater package plant located adjacent to the launch complex. The operating capacity of the wastewater package plant located adjacent to the Launch Complex is 13,000 gallons per day, and the plant currently is operating at a capacity of less than 1,000 gallons per day. In addition to the package plant, the complex is equipped with a drainfield for wastewater effluent disposal.

3.1.2.2.4 Solid and Hazardous Waste Collection and Disposal (USAF, 1986). All solid waste is collected by a range contractor and disposed of on base. The landfill is located 400 feet northeast of the CCAFS skid strip and has a life expectancy of 30 years. The landfill currently operates at 13,000 tons per year and accepts all solid waste from Patrick Air Force Base.

Hazardous wastes are accumulated at a number of locations throughout CCAFS to await disposal. Hazardous wastes are collected for up to ninety days at the accumulation or satellite stations before transfer to one of three CCAFS hazardous waste storage facilities. Wastes are stored at these locations for eventual shipment off-station to a licensed hazardous waste treatment/disposal facility.

3.1.2.2.5 Services (USAF, 1986). The Range Contractor conducts all police services on base. However, CCAFS will loan support to the local police departments if necessary. A mutual agreement for fire protection services exists between the City of Cape Canaveral, Kennedy Space Center, and the Range Contractor at CCAFS.

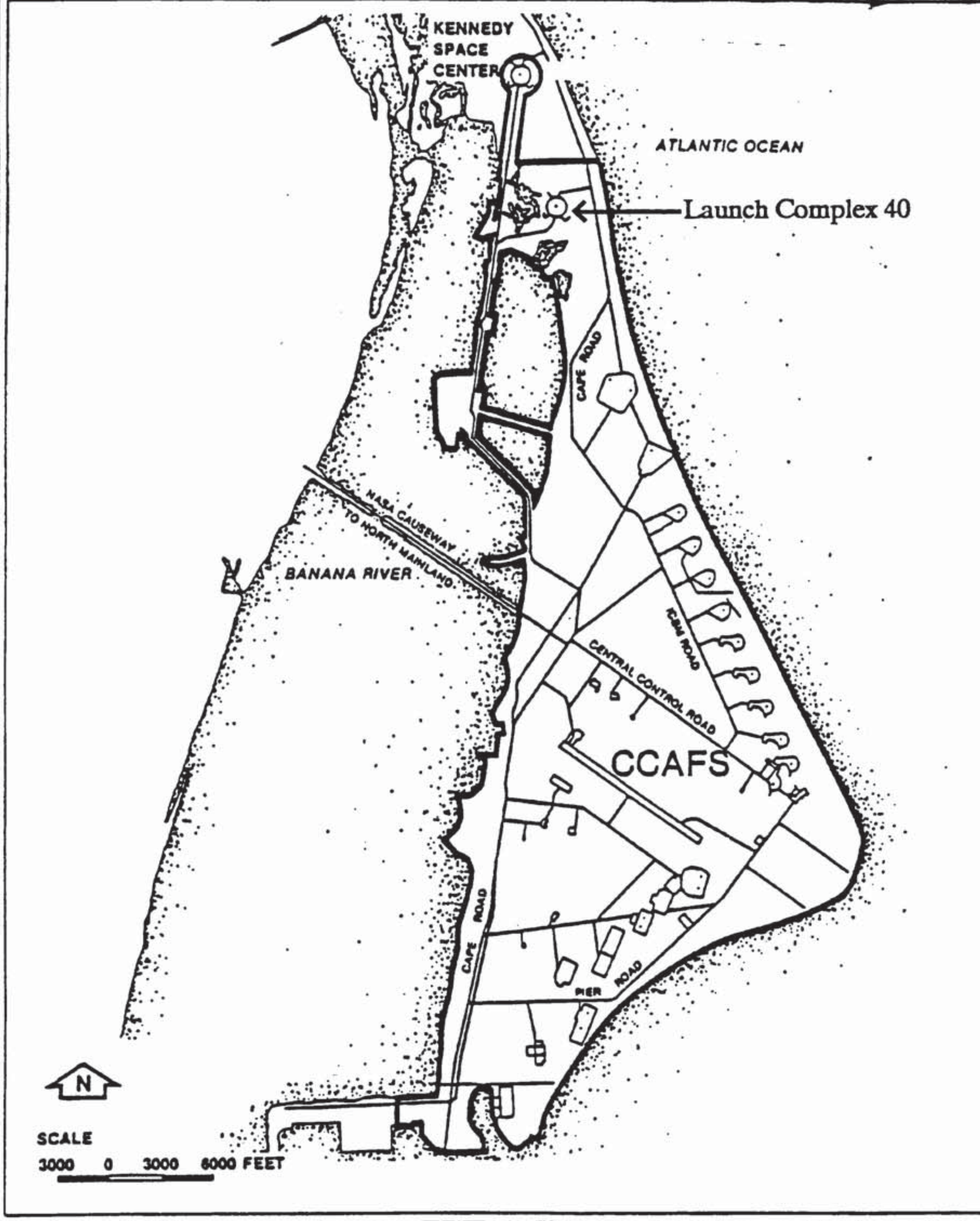

Figure 3-2
Transportation Network

Cape Canaveral Air Force Station

CCAFS is equipped with a dispensary under contract to NASA. The dispensary is staffed during all phases of missile launches, but otherwise works on a forty-hour work week. If medical service cannot be provided by the dispensary, hospitals at Patrick Air Force Base and in Cocoa, Titusville, and Melbourne are used.

3.1.2.2.6 Archaeological and Cultural Resources (USAF, 1986). An archaeological/historical survey of CCAFS was conducted in 1982. The survey consisted of literature and background searches and field surveys. It was determined that Cape Canaveral had been inhabited for 4,000 to 5,000 years. The survey located thirty-two prehistoric and historic sites and several uninvestigated historic localities. Site studies were conducted according to a sensitivity rating system devised by resources analysts, Incorporated. The initial results of the field survey indicated that many of the archaeological resources had been severely damaged by construction of roads, launch complexes, powerlines, drainage ditches and other excavation. The survey identified thirty-two sites and recommended eleven for further evaluation to determine eligibility for the National Register of Historic Places. None of these sites are located in the vicinity of Launch Complex 40.

The protection and interpretation of significant resources associated with the space program are underway by the Department of the Interior, National Park Service, and USAF through the Man in Space National Historic Landmark Program. Areas designated landmark sites include the Mission Control Center and Complexes 5/6, 26, 34, 13, 14, 19, which were used during the Mercury and early Gemini manned space flights.

3.2 NATURAL ENVIRONMENT

3.2.1 Air Resources

3.2.1.1 Meteorology (USAF, 1986). The climate in Brevard County is characterized by long, relatively humid summers and mild winters. Rainfall is heaviest in summer--approximately sixty-five percent of the annual total falls from June through October in an average year.

Temperatures in both summer and winter are moderated by the waters of the Indian and Banana Rivers and the Atlantic Ocean. Maximum temperatures in summers show little day-to-day variation, and temperatures as high as 95 degrees Fahrenheit are not uncommon. Minimum temperatures in winter vary considerably from day to day, largely because periodic invasions of cold, dry air move southward from across the continent. In many areas, particularly near the water, temperatures rarely drop below freezing.

Most rainfall in summer occurs as afternoon and evening showers and thundershowers. Day-long rains in summer are rare and generally associated with tropical storms. Rainfall in fall, winter, and spring is seldom as intense as in summer. Hail falls occasionally during thunderstorms, but hailstones are usually small and seldom cause much damage. Snow is rare in Brevard County; when it occurs, it melts as it hits the ground.

Tropical storms can affect the area from early in June through mid-November. The possibility for winds to reach hurricane force in Brevard County in any given year is approximately 1 in 20. Tornadoes may occur but are a rare occurrence.

The spring and summer months at CCAFS are characterized by southerly and easterly winds. During the winter, the predominant winds are north and northwesterly. The average wind rose for October is presented in Figure 3-3 (USAF, 1986). The seabreeze and land breeze phenomena occur commonly during summer and infrequently in winter.

3.2.1.1.1 Air Quality (USAF, 1986). Air quality at CCAFS is considered good, primarily because its distance from major sources of pollution. Air quality at CCAFS is influenced primarily by industrial and private sources located outside of CCAFS. There are no Class I or nonattainment areas for ozone, nitrous oxides, sulfur dioxide, lead, carbon monoxide and nonattainment area for ozone.

3.2.2 Land Resources (USAF, 1990)

3.2.2.1 Geology. Cape Canaveral lies on a barrier island composed of relict beach ridges formed by wind and wave action. This island parallels the shoreline separating the Atlantic Ocean from the Indian River, Indian River Lagoon, and Banana River. The island is approximately four and one-half miles wide at the widest point. The land surface ranges from sea level to twenty feet about mean sea level at its highest point. The complex is underlain by more than 320 feet of mainly carbonate strata belonging to the Floridan Aquifer, 160 feet of confining beds, and 100 feet of upper Miocene to recent age unconsolidated carbonate sands, silts, and shell fragments belonging to the near-surface aquifer.

3.2.2.2 Soils (USAF, 1986). The soils primarily are highly permeable, fine-grained sediments typical of beach and dune deposits. The native soil is highly permeable and not suitable for agricultural use. Based on examination of well and soil boring logs from CCAFS, the near-surface stratigraphy is fairly uniform, consisting of Pleistocene Age sand deposits that underlie the installation to depths of approximately 100 feet.

3.2.3 Hydrology

3.2.3.1 Surface Water (USAF, 1990). Major inland water bodies near CCAFS are the Banana River and Indian River to the west and the Mosquito Lagoon to the north (Figure 3-4). These are shallow lagoons except for the portions that are maintained as part of the Intracoastal Waterway between Jacksonville and Miami. The Indian and Banana rivers have a combined area of 150,000 acres in Brevard County; the combined drainage area is 540,000 acres. The Indian River is

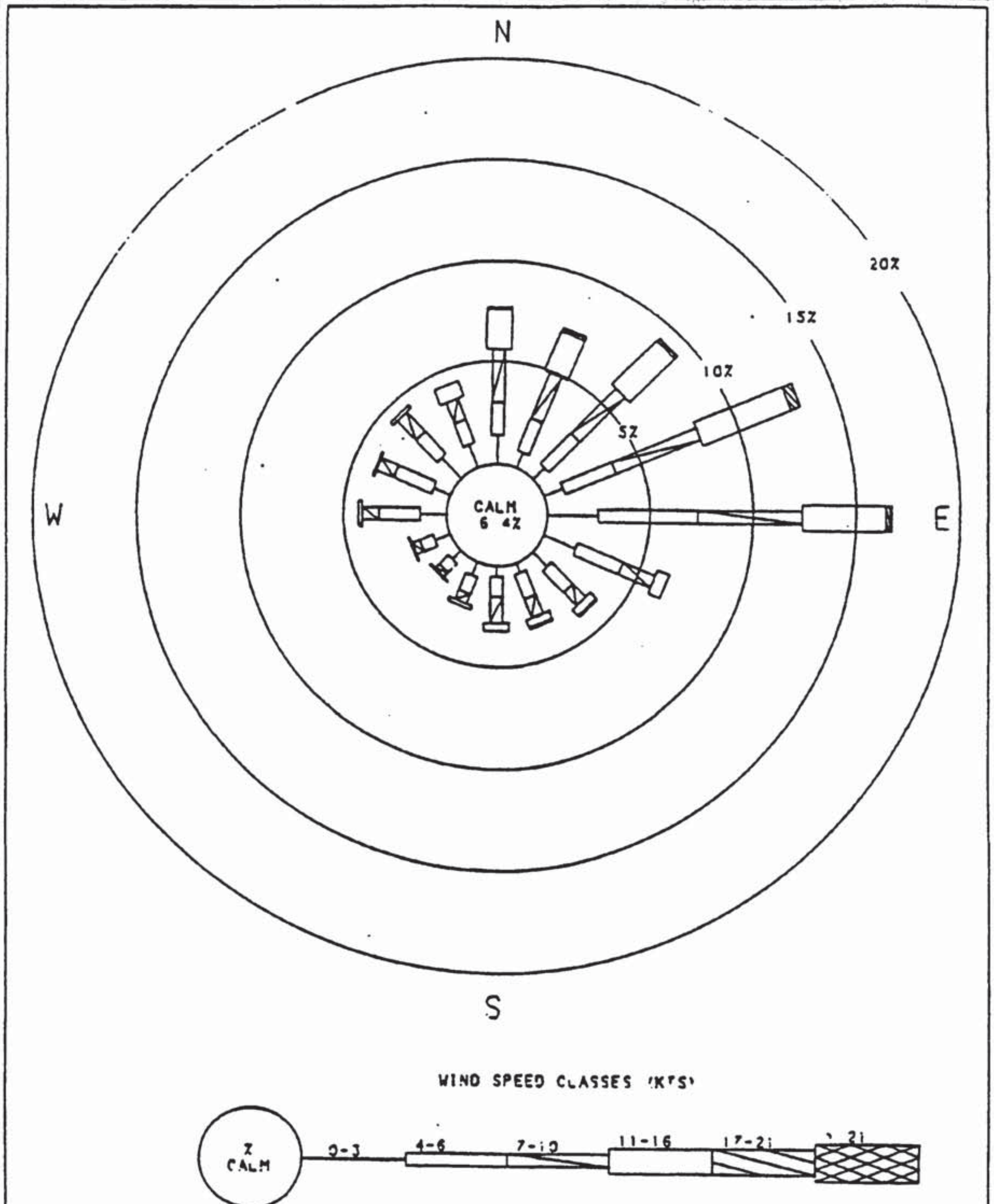

Figure 3-3
Wind Rose - Cape Canaveral
October 1968 - 1977

Cape Canaveral Air Force Station

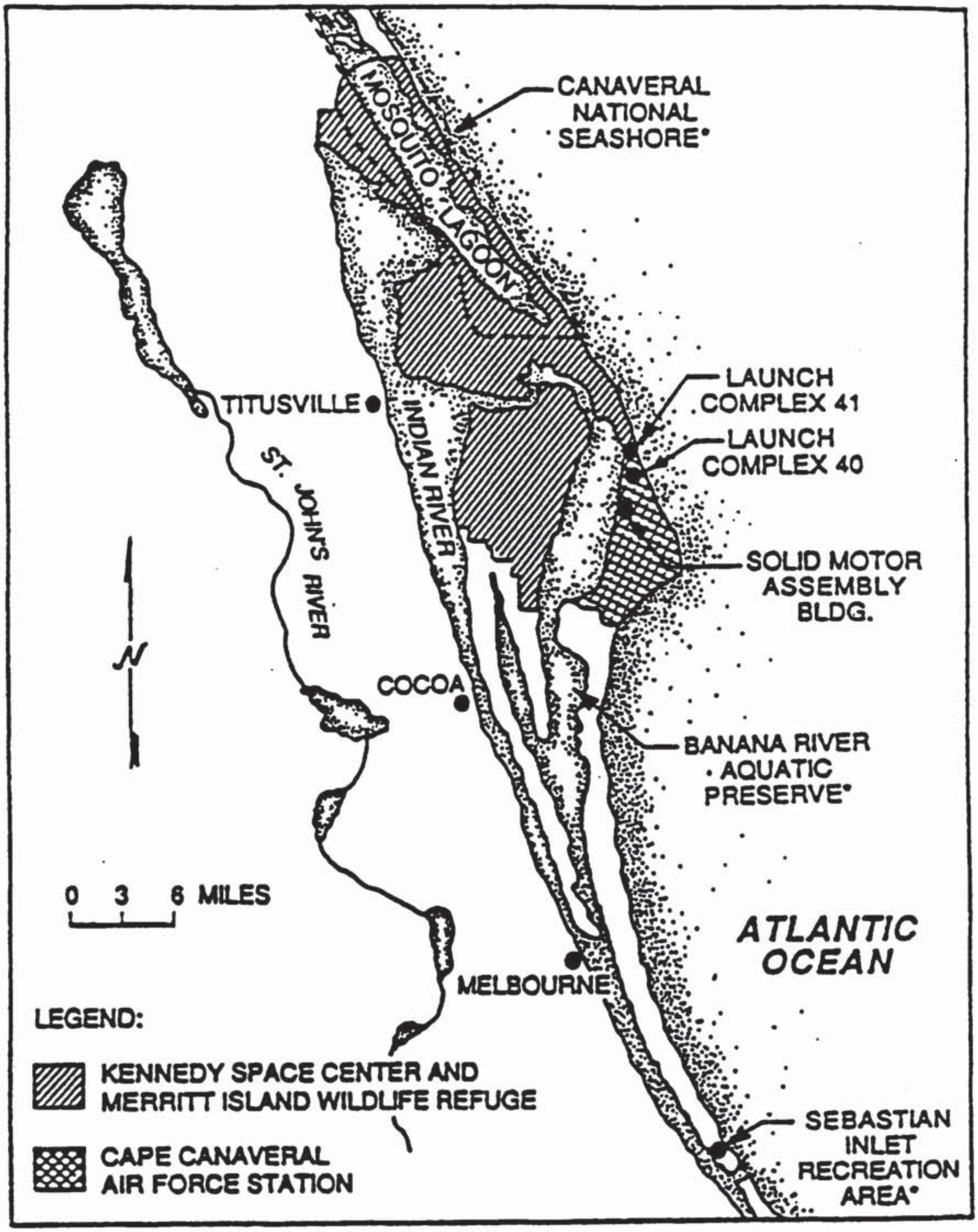

Figure 3-4. Outstanding Florida Water Near Cape Canaveral Air Force Station. (Marked with asterisks.)

connected to the Atlantic Ocean to the south of CCAFS by Sebastian Inlet and to the north through Haulover Canal to the Mosquito Lagoon and subsequently through Ponce de Leon Inlet.

Launch Complex 40 is located on a barrier island between the Atlantic Ocean and the Banana River. Because of the porous nature of the soil in the area and high percolation rate, most of the surface runoff from the complex percolates into the soil; any remaining surface flows toward the Banana River.

Ocean currents in the Cape Canaveral area are to the north with an east reversal when winds blow out of the south. The ocean current speed from the Cape sixteen miles offshore, the current flows north the majority of the time and is identified as the Florida Current of the Gulf Stream.

3.2.3.1 Ground Water (USAF, 1986). Groundwaters of the deeper Floridan and near-surface aquifers are hydraulically isolated from one another; hence any contamination of the upper aquifer would not impact the deeper aquifer. The Floridan Aquifer is under artesian pressure, whereas the near-surface aquifer is not. Although good quality water may be obtained from much of the Floridan Aquifer throughout the state, water from this formation on CCAFS is highly mineralized and is not used for domestic or commercial purposes.

Water for domestic and commercial use in this area is primarily from a shallow unconfined aquifer composed of Recent and Pleistocene Age surface deposits typically zero to five feet below land surface. The unconfined aquifer is recharged by rainfall along the coastal ridges and dunes, with little recharge occurring in the low swampy areas. Once the water reaches the saturated zone, it moves laterally toward the Atlantic Ocean or Banana River.

Shallow groundwater monitor wells have recently been installed at Launch Complex 40 (USAF, 1990). Water use at Launch Complex 40 will be limited to deluge water, launch complex washdown and fire suppressant water, and potable water.

3.2.3.2 Water Quality

3.2.3.2.1 Surface Water (USAF, 1990). The waters of the Merritt Island Wildlife Refuge and Canaveral National Seashore to the north, Sebastian Inlet State Recreational Area to the south, and the Banana River Aquatic Preserve are classified as Class III Outstanding Florida Waters (Environment Reporter 1988). Class III waters are considered suitable for recreation and for the propagation and maintenance of fish and wildlife and as such are afforded the highest degree of protection by the Florida Department of Environmental Regulation. The Banana River is also designated as an Outstanding Florida Water (Chap 17-3.041(4)(h), Florida Administrative Code), which affords it the highest degree of regulatory protection. Activities near or discharges into Outstanding Florida Waters, including activities related to drainage, flood control, or dredging and filling, are permitted only if management practices and suitable technology approved by the Florida Department of Environmental Regulation are utilized (Chap. 17-4.242 (1)(b)).

Surface runoff from Launch Complex 40 flows to the west into the Banana River Aquatic Preserve. The Florida Department of Environmental Regulation samples the Banana River on a monthly basis. At the sampling station nearest the launch complex, water temperatures ranged from 50 to 87 degrees Fahrenheit and salinity from 15 to 36 parts per thousand between 1981 and 1986. Dissolved oxygen concentrations were normally greater than 5.5 milligrams per liter, although values as low as 4 milligrams per liter were observed. Other parameters monitored included pH, biological oxygen demand, turbidity, chlorophyll, and nutrients. Results of the Florida Department of Environmental Regulation water quality analyses of the Banana River are given in Table 3-1.

3.2.3.2.2 Ground Water (USAF, 1990). The Floridan Aquifer contains nonpotable and brackish water that exceeds most secondary drinking water standards whereas groundwater from the near-surface aquifer is potable and exceeds only the secondary drinking water standard for iron. Table 3-2 compares the chemical compositions of these aquifer waters with Florida primary and secondary drinking water regulations (FDER 1989a; FDER 1989b).

3.2.4 Floodplains and Wetlands (USAF, 1990)

Three wetland community types (mangrove swamp, saltwater marsh, and freshwater marsh) occur at CCAFS. The wetland at Launch Complex-40, which is separated from the complex by a narrow band of wax myrtle/Brazilian pepper vegetation to the west, consists of white/mixed mangrove with scattered areas of mixed salt-tolerant grass marsh areas interspersed. The wetlands near Launch Complex 40 probably receives some surface runoff from the site; however, most of the water entering them is assumed to come from groundwater. NASA has determined that the proposed action will not be located in a wetland.

Launch Complex 40 is not on a floodplain, however portions of the launch facilities have been filled to elevate them above the base (100-year) and critical action (500-year) floodplains (USAF, 1990).

3.2.5 Biotic Resources (USAF, 1990)

The vegetation types found at CCAFS have been mapped and described (George, 1987; Provancha, Schmalzer, and Hinkle 1986). The complex is dominated by three community types: coastal scrub (9,400 acres), coastal stand (2,300) and coastal dune stands or secondary growth indigenous to the Florida coastal strand. Consequently, CCAFS offers excellent habitat for a wide variety of wildlife species, including some rare and endangered species.

3.2.5.1 Terrestrial Biota. Figure 3-5 depicts the vegetation near Launch Complex 40. The Complex is an industrial area containing ruderal vegetation and largely surrounded by coastal scrub. Coastal dune, coastal strand, and all three wetlands community types intermixed occur within 1,000 feet of Launch Complex 40. Following is an excerpt from George (1987) describing the major vegetation community types and their associated fauna in the Titan IV facilities.

Table 3-1: Surface Water Quality Characteristics of the Banana River Adjacent to the Cape Canaveral Air Force Station[a]

Parameter	Values[a]
Secchi depth (meters)	1.2
Color platinum-Cobalt color units)	12.5
Specific conductance (μmhos/cm)	28,700
Dissolved oxygen	5.6
5-day biological oxygen demand	2.3
pH	(8.3,8.4)[b]
Total alkalinity [as calcium carbonate]	164.0
Salinity (ppt)[c]	17.8
Total Kjeldahl nitrogen (as N)	1.55
NO_3 + NO_2 (as N)	0.01
Total Phosphorus (as P)	0.04
Chlorophyll a (μg/L)[d]	2.7
Turbidity (NTU)[e]	6.6

[a] All values were expressed in mg/L unless otherwise noted and are the mean of two samples, one in November 1983 and one in May 1984

[b] Measured values

[c] ppt = parts per thousand

[d] μg/L = micrograms per liter

[e] NTU - nephelometric turbidity unit

Table 3-2: Water Quality Characteristics of the Deeper, Confined Floridan Aquifer and the Near-Surface, Unconfined Aquifer Compared with Florida Primary and Secondary Drinking Water Standards

Parameter	Deeper, Confined Floridan Aquifer[a,b]	Near-Surface Unconfined Aquifer[a,c]	Maximum Contaminant Level[a,d]
			Secondary Standards
Chloride	540	8.50-21.4	250
Copper	<0.01	<0.03	1
Iron	0.02	0.73-1.5	0.3
Manganese	<0.001	0.03	0.05
Sulfate	85	13.88-19.33	250
TDS[e]	1425	194-258	500
Zinc	<0.01	<0.01-0.166	5
pH[f]	7.6	6.92-7.78	6.5-8.5
			Primary Standards[g]
Arsenic	<0.01	<0.01-0.166	0.05
Barium	0.02	<0.15	1.0
Cadmium	<0.001	<0.01	0.01
Chromium	0.001	<0.04	0.05
Fluoride	NA	0.45-0.48	2.0
Lead	<0.001	<0.05	0.05
Mercury	0.0005	<0.002	0.002
Nitrate (as N)	<0.01	<0.02-0.14	10
Selenium	0.006	<0.01	0.01
Silver	<0.001	<0.03	0.05
Sodium	1400	16.12-10.76	160

[a] Concentrations in mg/L except for pH, reported in pH units

[b] CCAFS facility 1717 well; June 1984

[c] CCAFS landfill monitoring station; range of values in 1986

[d] Florida Department of Environmental Regulations Maximum Concentration Levels-Rule 17-550.320 (FDER Secondary Drinking Water Standards
Florida Department of Environmental Regulations Maximum Concentration Levels-Rule 17-550.310 (FDER Primary Drinking Water Standards).

[e] TDS - total dissolved solids

[f] Negative log of the hydrogen ion concentration; the pH must not vary more than one unit above or below natural background of predominant freshwater and coastal waters or more than 0.2 units above or below natural background of open water (Florida Water Quality Standards, FDER 1989b).

[g] Water quality data available only formetals,fluoride, nitrate, and selenium.
Sources: USAGF 1989a; FDER 1989a; FDER 1989b.

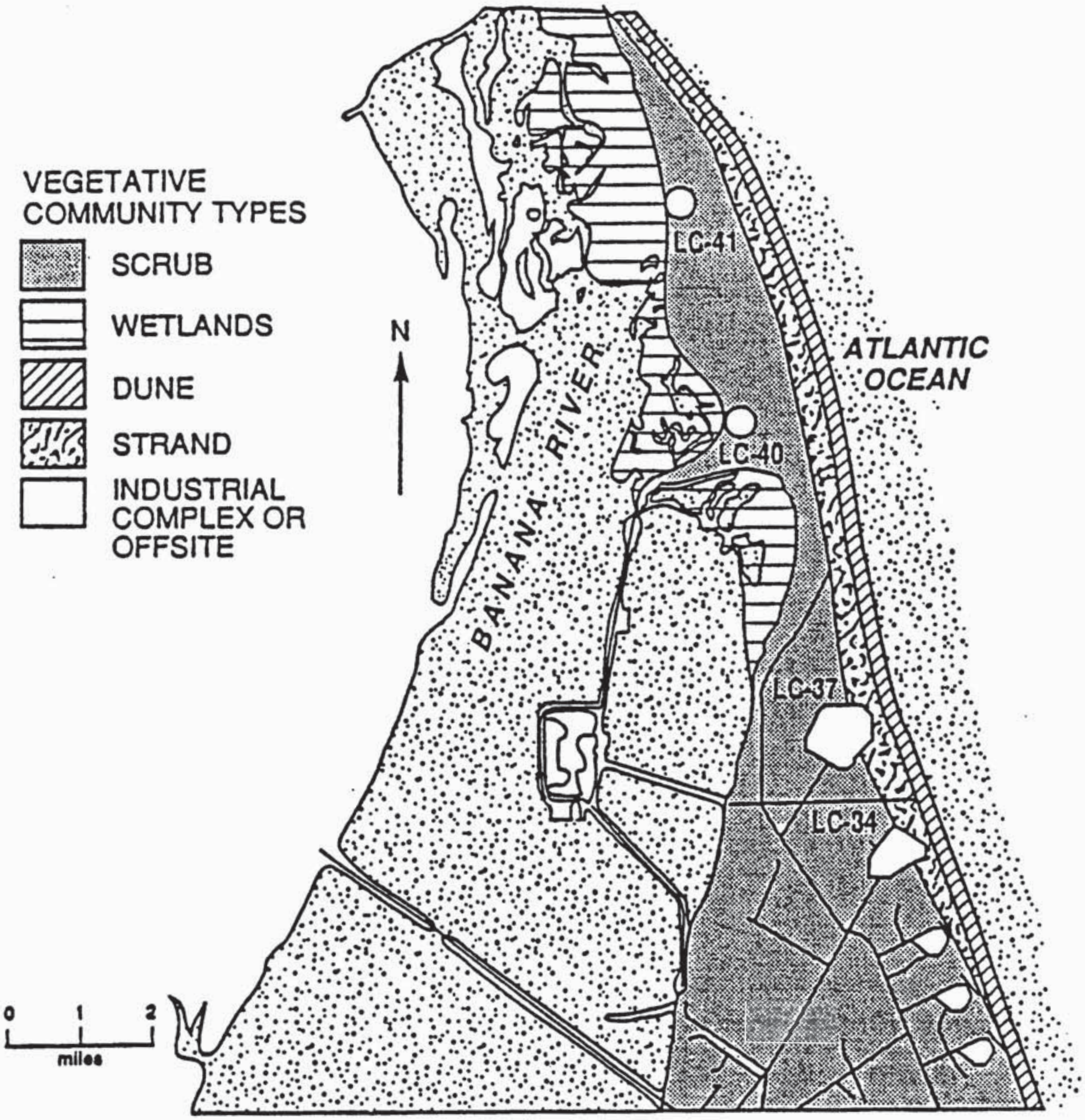

Figure 3-5. Vegetation at Cape Canaveral Air Force Station.

3.2.5.1.1 Coastal Scrub. This community varies in height from three to twenty feet tall. It is characterized by short trees and shrubs such as the introduced Brazilian pepper tree cabbage palm, Hercules Club, a variety of oaks, wax myrtle, and wild mulberry. The understory is very limited and there are often openings in the shrub-tree canopy. The community provides habitat for ten species of mammals including Florida white-tailed deer, armadillo, bobcat, feral hogs and the Southeastern beach mouse (federally designated threatened species); fourteen bird species including red-tailed hawk, red-headed woodpecker, and the Florida scrub jay (federally designated threatened species); and five reptile species including the Eastern indigo snake (federally designated threatened species), and the gopher tortoise.

3.2.5.1.2 Coastal Strand. This community occurs immediately inland of the coastal dunes and is composed of a dense thicket of woody shrubs three to thirteen feet tall, including such species as cabbage palm, saw palmetto, and tough buckthorn. An understory of prickly pear, partridge pea and grasses is typical. The community provides habitat for eight mammal species including Florida white-tailed deer, raccoon, Florida mouse (state-designated threatened species), and the Southeastern beach mouse. Fourteen bird species utilize this community (the same species that inhabit the coastal scrub), while only two reptiles--the gopher tortoise (a candidate 2 species) and the eastern diamondback rattlesnake--are found here.

3.2.5.1.3 Coastal Dune. This community includes the area from the high tide line to about halfway between the primary and secondary dune crest or the beginning of the coastal strand community type. It is characterized by a single layer of grass, herbs, and dwarf shrubs including such species as sea grape, cabbage palm, partridge pea, sea oat, and beach grass. Florida Statute 370.41 prohibits the disturbance or removal of sea oats (George, 1987). The community provides habitat for seven mammal species, including the Southeastern beach mouse. Most notable are raccoons, which feed on the trash, fish, and food items washing ashore. Four bird species are found here, including the Florida scrub jay. The dune areas at CCAFS and the adjacent KSC are important for sea turtle nesting which occurs from early May until the end of October. Raccoons are a primary predator of the nests. The nesting of the sea turtles, a federally designated endangered species has been the subject of ongoing study for several years (NASA 1984; NOAA 1987; George 1987; USAF 1988).

3.2.5.2 Aquatic Biota (USAF, 1990). The Cape Canaveral region is a transition zone between temperate and tropical climates; consequently, the aquatic biota found in the area is representative of both climates. The surface water habitats at and near CCAFS include marine (Atlantic Ocean), estuarine (Banana and Indian rivers), and freshwater (St. Johns River to the west of the Indian River).

No freshwater is found at or near Launch Complex 40 and no information concerning aquatic species in the nearby Banana River and wetlands adjacent to the launch complex is available. Aquatic vegetation, abundant in the Banana River, stabilizes the substrate and serves as a source of food and habitat for many fish and invertebrate species. Seagrasses, including turtle grass, manatee grass, and Cuban shoal grass, are the most common vegetation in the Banana River.

3.2.5.3 Endangered and Threatened Species (USAF, 1990). To comply with the requirements of Section 7c of the Endangered Species Act of 1973, as amended, (16 - U.S.C. 1531 et. seq.) and with the Marine Mammals Protection Act of 1972, as amended, (16 - U.S.C. 1631 et. seq.) the USAF has consulted with the Fish and Wildlife Service and the National Marine Fisheries Service for information and comment on the potential for adverse impacts to protected species and habitat at CCAFS. No federally designated threatened or endangered flora exist at CCAFS. Two species of plants at CCAFS, Verbena maritima and Hymenocallus latifolia (a dune species and coastal stand species, respectively) are currently listed as Type 2 candidate species and, as such are under consideration for threatened status.

Table 3-3 (USAF, 1990) lists threatened and endangered animal species at CCAFS and in the vicinity, and Figure 3-6 (USAF, 1990) shows the locations of their habitats. No threatened or endangered aquatic species are known to exist in the surface waters near the launch sites or support facilities. An endangered marine mammal, the manatee, inhabits the Indian and Banana rivers; a manatee sanctuary has been designated in the Banana River (Provancha and Provancha, 1988; Shane 1983). Protected marine species found in coastal waters adjacent to CCAFS include the finback, humpback, right, sperm, and sei whales.

Loggerhead, Atlantic green, and leatherback turtles nest on the ocean beaches of CCAFS between May and October each year. The beaches of CCAFS and KSC are critical habitat for Atlantic Coast populations of both the loggerhead and green sea turtle. Aerial surveys indicate that loggerhead densities are greater in the vicinity of Cape Canaveral in the spring and summer than anywhere else along the entire Atlantic coast. Each year 1,200 to 1,500 loggerhead and 10 to 20 green sea turtle nests occur on the thirty kilometer stretch of CCAFS beach (NOAA, 1987).

The dune habitat at CCAFS is used as a wintering area by Arctic peregrine falcons (George, 1987) and a wood stork rookery is found on a mangrove island northwest of Launch Complex 41 (USAF, 1990). Florida scrub jays extensively use the scrub vegetation surrounding the perimeter fences at Launch Complexes 40 and 41 (Figure 3-5) (USAF, 1990). The population of scrub jays within a 0.4-mi (0.6-km) radius of the Launch Complexes was estimated using scrub jay density and habitat and territory data from studies at the adjacent Kennedy Space Center. This distance was used because it includes the near-field zone that extends about 600 feet (182 M) from the pad. An estimated range of 60-199 jays was predicted within a 0.4 mile radius. Between 920 to 1840 scrub jays have been estimated at CCAFS (Breininger, 1989) which is about 10% of the estimated state population (Cox, 1984; Cox 1987). Therefore, the estimated maximum populations at Launch Complexes 40 and 41 ranges between 3% to 11% of the estimated CCAFS population, or a range of 0.3% to 1% of the state population.

The southeastern beach mouse inhabits sand dunes mainly vegetated by sea oats (Uniola paniculata) and dune panic grass (Paspulum amarulum) and adjoining scrub, characterized by oaks (Quercus sp.), sand pine (Pinus clausa),

Table 3-3: Listed and Proposed Threatened and Endangered Animal Species and Candidate Animal Species in Brevard County and their Status on Cape Canaveral Air Force Station[a]

Species[b]	Federal Status[c]	Cape Canaveral Air Force Station[d]
Loggerhead [sea turtle]	T	Occurs on beach/nests
Green sea turtle	E	Occurs on beach/nests
Leatherback [sea turtle]	E	Occurs on beach/nests
Kemp's ridley [sea turtle]	E	Occurs on beach/no nests
Hawksbill [sea turtle]	E	Occurs offshore/no nests
Eastern indigo snake	T	Resident
American alligator	T(S/A)	Resident
Atlantic salt marsh snake	T	Not observed
Gopher tortoise	C2	Resident
Gopher frog	C	Not observed
Alligator snapping turtle	C2	Not observed
Florida scrub jay	T	Resident
Wood stork	E	Resident
Bald eagle	E	Visitor
Piping plover	T	Visitor
Arctic peregrine falcon	T	Transient
Audubon's caracara	T	Not observed
Red-cockaded woodpecker	E	Not observed
Kirtland's warbler	E	Not observed
Backman's sparrow	C2	Visitor
Reddish egret	C2	Visitor
West Indian manatee	E	Resident in waters
Southeastern beach mouse	T	Resident
Finback whale	E	Offshore waters
Humpback whale	E	Offshore waters
Right whale	E	Offshore waters
Sperm whale	E	Offshore waters
Sei whale	E	Offshore waters
Florid mouse	C2	Resident
Round-tailed muskrat	C2	Possible resident

[a] Source: USAF, 1990

[b] Scientific names of federally listed threatened or endangered species are found in FWS (1989).

[c] E - endangered; S/A - similarity of appearance; T - threatened; C2 - Candidate (proposed for listing as threatened.

[d] Resident - a species that occurs on CCAFS year-round; Visitor - a resident bird species that occurs on CCAFS but does not next there; Transient - a bird species that occurs on CCAFS only during season of migration; Not observed - species occurs either as a resident or as a visitor in Brevard County but has not been observed on CCAFS.

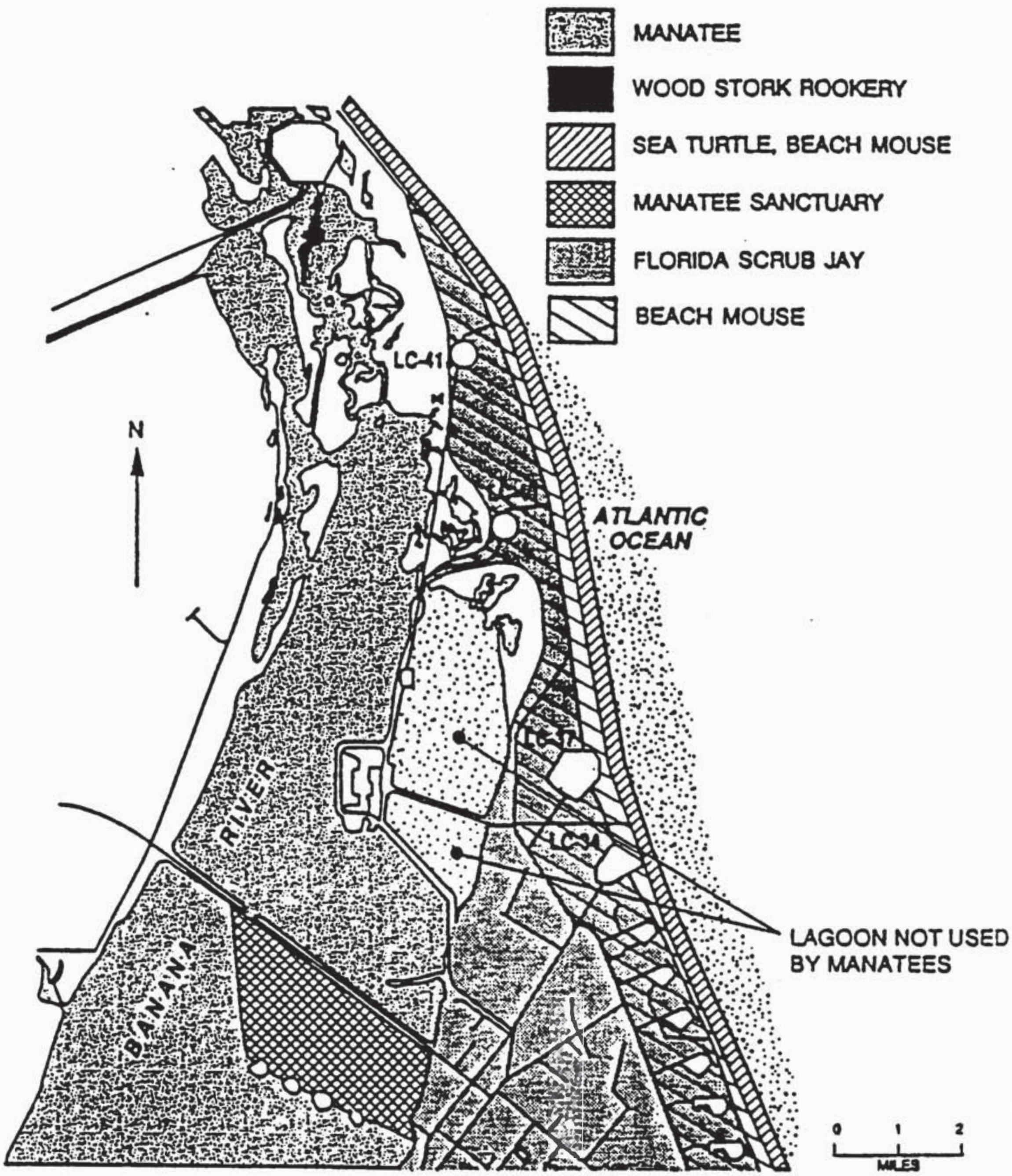

Figure 3-6. Habitats of Threatened and Endangered Species at Cape Canaveral Air Force Station.

and palmetto (Serenoa repens) (Extinct and Stout, 1987). The dune occurs either as a resident or as a visitor in Brevard County but has not been observed on CCAFS.grassland at CCAFS is excellent, extensive habitat for beach mice, and the population density there is high. Northward, the habitat narrows to a single dune in Canaveral National Seashore, where population density appears to be lower. Data obtained from trapping in dune, strand, and scrub vegetation at Launch Complex 40 suggest a beach mouse population range of 11,024 to 15,199 for all suitable habitats (USAF, 1989). The estimated population of beach mice wit in the disturbed coastal scrub, which is primarily found within a 0.4 mile rad us, is 5,732 for Launch Complex 40.

SECTION 4

ENVIRONMENTAL IMPACTS OF PROPOSED ACTION

The U.S. Air Force launched its first Titan booster from Cape Canaveral in 1964 (TRW, 1988). During the 70's and early 80's, Titan III's (including the titan 34D) were the primary Titan boosters launched from the site. In 1985, the Complementary Expendable Launch Vehicle program was initiated at Cape Canaveral to supplement the Space Shuttle Program (USAF, 1986) and launch the more powerful Titan 34D7.

The potential environmental impacts of launching the Titan 34D and the 34D7 are discussed in the U.S. Air Force's Environmental Assessment for the Complementary Expendable Launch Vehicle Program (USAF, 1986).[1] The type and quantity of propellants used by the Commercial Titan were discussed in Section 2.3.2. In terms of propellant quantities, the Commercial Titan is larger than the Titan 34D and smaller than the Titan 34D7 discussed in the Air Force 1986 Environmental Assessment (Table 4-1).

The following sections summarize the environmental impacts of normal vehicle flight and the effects of possible abnormal spacecraft operations or flight conditions for the launch of the Mars Observer Spacecraft.

Table 4-1: Propellant Quantity Comparisons for Titan Vehicles

TITAN EXPENDABLE LAUNCH VEHICLE	STAGE	PROPELLANT	QUANTITY OF PROPELLANTS LB (KG)
34D[1] (Air Force Titan)	0	Solid	929,400 (421,570)
	1	N_2O_4/Aerozine 50	295,000 (133,810)
	2	N_2O_4/Aerozine 50	68,000 (30,390)
Commercial Titan (Mars Observer)[2]	0	Solid	945,544 (421,249)
	1	N_2O_4/Aerozine 50	294,000 (133,360)
	2	N_2O_4/Aerozine 50	76,800 (34,840)
Titan 34D7[1]	0	Solid	1,183,384 (536,770)
	1	N_2O_4/Aerozine 50	341,000 (154,670)
	2	N_2O_4/Aerozine 50	77,000 (34,927)

[1] Source: USAF, 1986
[2] Source: MMC, 1990

[1]. Environmental impacts for similar launch vehicles are also discussed in the Department of Transportation's Programmatic Environmental Assessment of Commercial Expendable Launch Vehicle Programs (DOT, 1986) and in the National Aeronautic and Space Administration's Final Environmental Statement for Launch Vehicles and Propulsion Programs (NASA, 1973).

4.1 SUMMARY OF ENVIRONMENTAL IMPACTS ASSOCIATED WITH A SINGLE NOMINAL LAUNCH

This section summarizes normal vehicle flight air quality impact projections for the Titan 34D and the 34D7. Because the Commercial Titan is intermediate between the two launch vehicles in terms of propellant quantities, the range of impacts discussed bounds the potential emissions and environmental impacts associated with the launch of the Mars Observer Spacecraft.

4.1.1 Air Quality

Emissions of air pollutants from spacecraft and launch vehicle operations may arise from prelaunch operations, including bulk propellant transfer and system check out, launch operations, post-launch operations involving fuel system purging, scheduled and unscheduled propellant loading system component changeout and filter changes, on-pad accidents, or in-flight accidents in which propellants are burned or released to the environment. The hazardous materials and operational procedures utilized in processing the spacecraft and launch vehicle were discussed in Chapter 2. No radioactive materials or hazardous noise sources have been identified associated with the spacecraft or ground processing operations. For the nominal case, the actual launch and flight of the Commercial Titan is the major activity that will cause some temporary perturbation in the environment.

Various ground-support activities associated with the launch would cause relatively minor emission of volatile organic compounds used in coating, fabrication, and cleaning operations for launch vehicle components, the servicing towers and the ground support equipment. Small amounts of hydrazines, nitrous oxides, nitrogen tetroxide and carbon monoxide would be released during liquid fueling operations for the launch vehicle. Emissions of hydrazine (fuel) and nitrogen tetroxide (oxidizer) vapors would be minimized by the use of a fuel vapor incineration system and an oxidizer vapor scrubber system. Diesel-fired backup electrical generators and miscellaneous transport vehicles would periodically emit nitrous oxides, carbon monoxide, volatile organic carbons, sulfur dioxide and respirable particulates. Emissions would slightly degrade local air quality near support facilities, but impact would be temporary and are not expected to be measurable off-site (USAF, 1990).

Release of small[2] concentrations of fuel and oxidizer may occur as a result of scheduled post launch maintenance when fuel and oxidizer filters are replaced. These releases occur only after the propellant lines have been purged with nitrogen gas to reduce emissions to the lowest practical level. There is no way to completely eliminate these small releases as the system must be opened to change the filters. These small releases are not expected to result in a significant adverse impact to the environment.

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[2] Assuming worst case concentrations for the oxidizer and fuel, the Air Force estimates emissions would amount to 0.05 pounds of fuel and 0.10 pounds of oxidizer for each filter change (USAF, 1988).

The majority of air emissions will be produced during the launch of the spacecraft. The launch vehicle relies on the two SRMs for lift-off and a first liquid stage that will not be ignited until approximately 108 seconds into the flight, the vehicle will be well away from the launch complex and most of the solid fuel will have already been burned. Thus, local air emissions will be produced only by ignition of the SRMs.

4.1.1.1 Lower Atmosphere.

4.1.1.1.1 Solid Propellant Emissions. Table 4-2 (USAF, 1975) shows the products and percentage by weight of combustion products expected to be produced from ignition of the Titan III solid fuel stages. Products of combustion include compounds or molecular fragments which are not stable at ambient conditions or which react with ambient oxygen leaving only the starred combustion products detectable in significant quantities.

Table 4-2: Products of Combustion at Nozzle Exit Plane Solid Rocket Motors

PRODUCTS OF COMBUSTION	PERCENTAGE (By Weight)
Aluminum Oxide (Al_2O_3)*	30.10
Carbon Monoxide (CO)	27.75
Hydrogen Chloride Acid (HCL)*	20.55
Nitrogen (N_2)*	8.27
Water (H_2O)	7.11
Carbon Dioxide (CO_2)*	2.48
Hydrogen (H_2)	2.44
Aluminum Chloride ($AlCl_3$)	0.89
Carbon Anion (C^-)	0.22
Hydrogen Cation (H^+)	0.02
Ionized Hydrocarbon (CH^-)	0.02

* Source: USAF, 1975

Of the major detectable exhaust products produced, aluminum oxide, carbon monoxide and hydrogen chloride are recognized as air pollutants presenting potential hazards. In a nominal launch, the exhaust products will be distributed along the vehicle trajectory. Due to the rate of acceleration of the vehicle and the staging process, the quantities emitted per unit length of trajectory are greatest at ground level and decrease continuously. The quantity of exhaust gases in the first 2500 feet of the atmosphere is most likely to be detectable and has the potential for local short-term measurable polluting of the atmosphere with hydrogen chloride near ground level.

Figures 4-1, 4-2 and 4-3 illustrate predicted peak ground level concentrations of carbon monoxide, hydrogen chloride and aluminum oxide particulates from the Titan III (C and D) and the 34D7 as a function of downwind distance from the launch complex (USAF, 1986). Because the solid motors used by the Commercial Titan contain a larger quantity of propellants than the Titan III and a smaller quantity than the Titan 34D7 emissions depicted in the graph, the two curves bound the emissions releases that will occur with the launch of the Mars Observer spacecraft. The predicted concentrations are considered to represent peak ground level values occurring along a narrow path as the ground cloud moves downwind from the launch pad; the actual duration of the exhaust cloud over any given ground point is on the order of minutes. Carbon monoxide concentrations are not predicted to exceed the National Ambient Air Quality Standards of 35 parts per million (one-hour average) (Figure 4-1). Except for brief excursions during lift-offs, the carbon monoxide concentration is expected to be below 9 parts per million, the National Ambient Air Quality Standard (NAAQS) eight-hour time weighted average.

Hydrogen chloride in SRM exhaust clouds tends to partition between gaseous and aerosol phases (Cofer et. al) and can be toxic above certain concentrations. Although hydrogen chloride concentrations along the path of the ground cloud could reach as high as 11 parts per million for five minutes at approximately five kilometers downwind (Figure 4-2), they would not exceed the National Research Council's (NRC) recommendation that one-hour average hydrogen chloride concentrations "in connection with community exposure during space-shuttle launches" not exceed a level of one part per million (NRC, 1987).[3]

The peak concentrations of particulate aluminum oxide are expected to be between 28 and 38 milligrams per cubic meter at five kilometers from the site (Figure 4-3) but would be present for only two to fifteen minutes in any location depending on wind conditions. Aluminum oxide, which exists as a crystalline dust in SRM exhaust clouds, is quite inert chemically and is not toxic. However, many of the dust particles are small enough to be retained

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[3] The Air Force has recently published the results of an assessment of the effects of SRM exhaust products from the launch of upgraded Titan IVs downwind of the Cape Canaveral Air Force Station using the Rocket Effluent Exhaust Dispersion Model (REEDM)(USAF, 1990). This model was developed specifically to predict air quality impacts of space vehicle launches and has been enhanced over the past two decades by NASA and the Air Force. For the analysis, the REEDM model was executed with four expected worst-case meteorological conditions to estimate maximum one-hour hydrogen chloride concentrations as a function of distance for each scenarios. For upgraded Titan IV launches, the maximum one-hour hydrogen chloride concentrations beyond the distance of the nearest site boundary were predicted to be well below the NRC recommended one-hour short-term public emergency guidance level for all meteorological scenarios. Because the Commercial Titan uses less solid propellant than the Titan IV, less hydrochloric acid will be released into the exhaust cloud than in the case of Titan IV launches.

in the lung (Cofer et al., 1985). Thus, it is appropriate to compare aluminum oxide concentrations to NAAQS for suspended particulates smaller than ten microns (PM-10). The shortest averaging time for which a PM-10 NAAQS exists is a 24-hour average of 150 micrograms per cubic meter. This will not be exceeded during the launch.[4]

[4] The REEDM predictions for the launch of upgraded Titan IV's predicted a maximum twenty four hour aluminum oxide concentration of 25 micrograms per cubic meter beyond the distance of the nearest property boundary. In 1986, the maximum measured total suspected particulates concentration in the Titasville and Merritt Island was 104 micrograms per cubic meter (FDER 1987) Combining the two worst case scenarios would still be below the twenty four hour NAAQS for PM-10 of 150 micrograms per cubic meter.

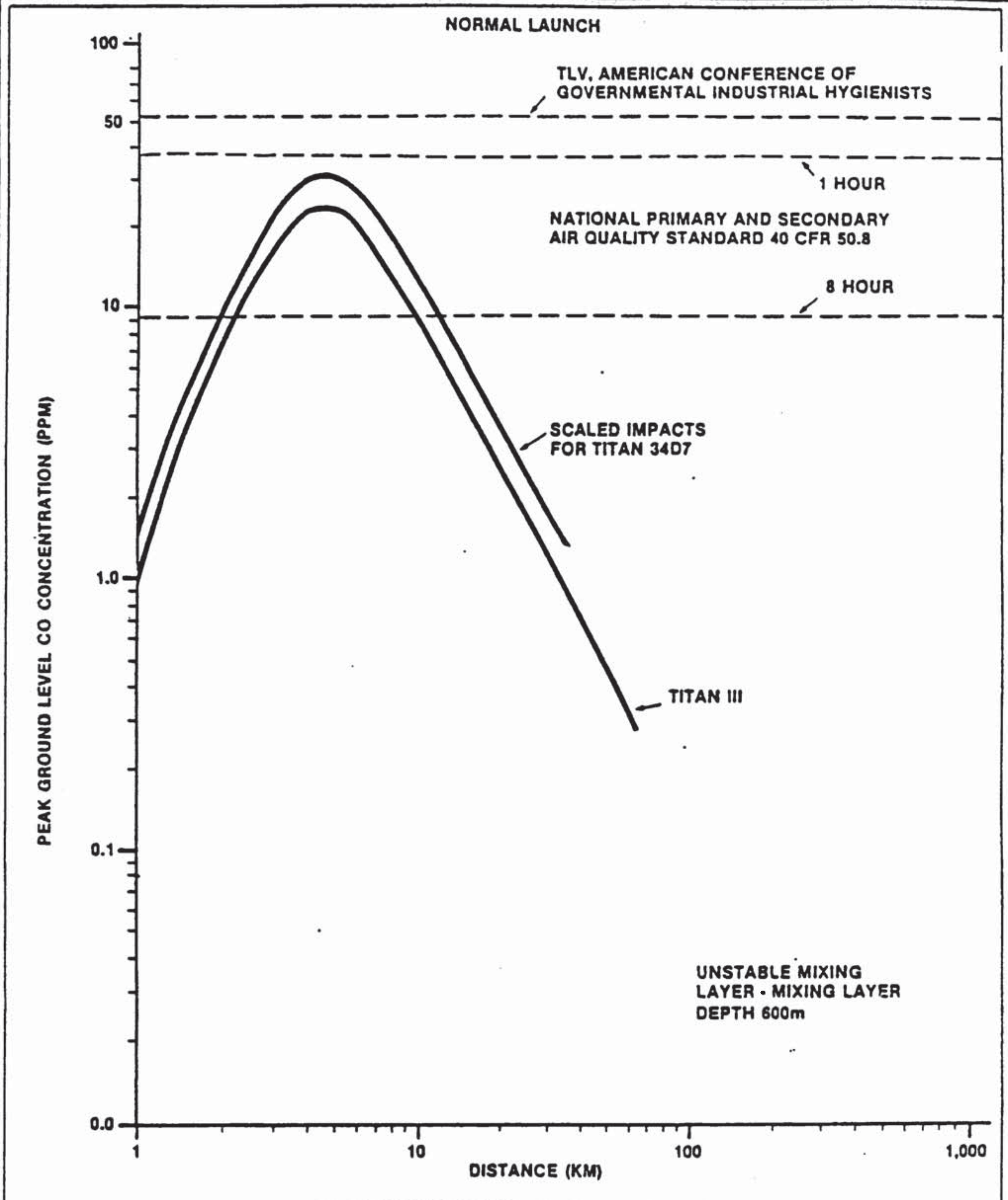

Figure 4-1
Estimated Peak Ground Level Carbon Monoxide Concentration Downwind from Launch Site.

Cape Canaveral Air Force Station

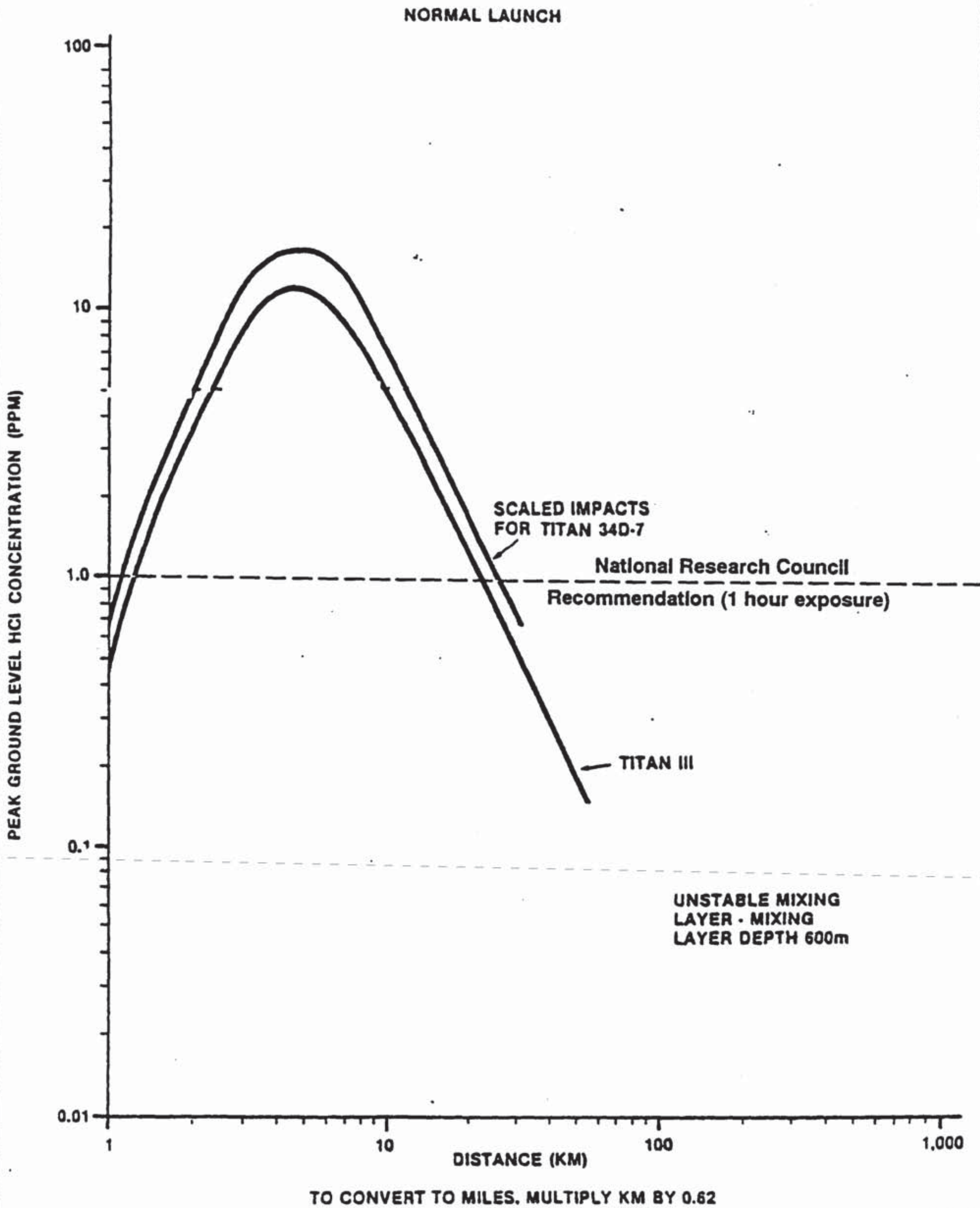

Figure 4-2 Estimated Peak Ground Level Hydrogen Chloride Concentration Downwind from Launch Site.	Cape Canaveral Air Force Station

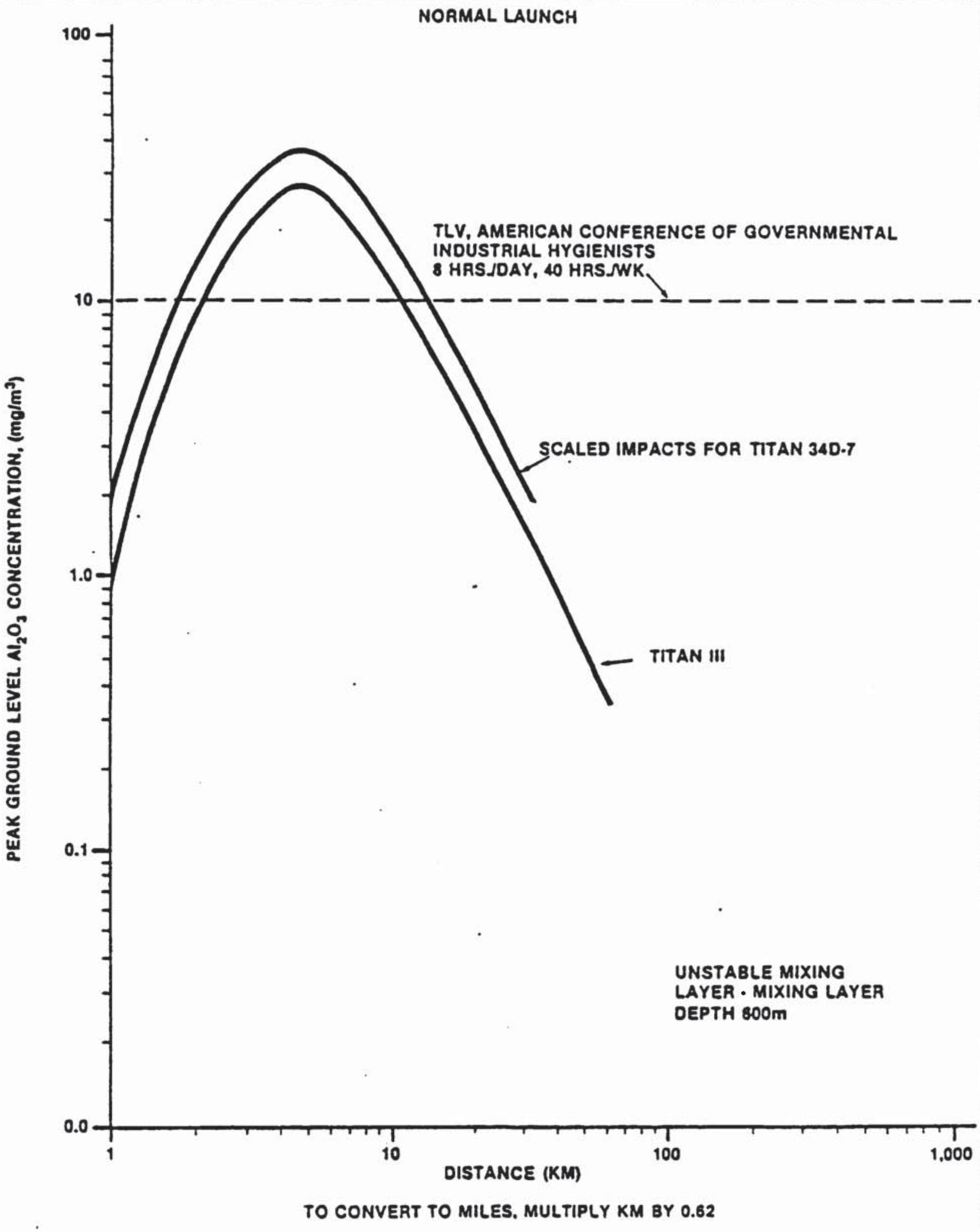

Figure 4-3
Estimated Peak Ground Level Aluminum Oxide Particulate Concentrations Downwind from Launch Site.

Cape Canaveral Air Force Station

4.1.1.1.2 Liquid Propellant Emissions. Table 4-3 (USAF, 1975) shows the products and percentage by weight of combustion products expected to be produced from ignition of the Titan III liquid fuel stages. Products of combustion include compounds or molecular fragments which are not stable at ambient conditions or which react with ambient oxygen leaving only the starred combustion products detectable in significant quantities.

Table 4-3: Products of Combustion at Nozzle Exit Plane Solid Rocket Motors

PRODUCTS OF COMBUSTION	PERCENTAGE (By Weight)
Nitrogen (N_2)*	41.1
Water (H_2O)*	35.0
Carbon Dioxide (CO_2)*	18.1
Carbon Monoxide (CO)	2.5
Hydrogen (H_2)*	2.0
Nitrous Oxides (NO_x)	1.9
Oxygen Molecule (O_2)	0.7
Hydroxide Ion (OH_-)	0.4

* Source: USAF, 1975

Of the major detectable exhaust products produced, carbon monoxide and the nitrous oxides are recognized as air pollutants presenting potential hazards; however, because the launch vehicle will be well away from the launch complex before ignition of the liquid stages, the relatively small emissions of these criteria pollutants will have little incremental impact in an area that presently meets air quality standards with ambient concentrations well below the NAAQS.

4.1.1.2 Upper Atmosphere. The past two decades have been marked by increasing concern about the effects of human activities on the upper atmosphere. The ozone layer is mostly contained within the stratosphere, a region of steady or increasing temperature with height, which extends from roughly ten kilometers to fifty kilometers above the earth's surface. The vertical distribution of ozone within the stratosphere varies substantially, depending on the time of year and on latitude. Ozone in the stratosphere partially absorbs ultraviolet radiation and protects biological organisms from excess levels which may cause sunburn and skin cancer.

With regard to potential ozone layer effects, the SRM emissions, particularly hydrogen chloride, are the main concern. Photochemical reactions involving chlorine are thought to be very important in the destruction of stratospheric ozone. In order to evaluate the cumulative impact of the Titan launches, the Air Force conservatively estimated an indefinite launch rate of eight of the largest Titan vehicles per year (USAF, 1990). They concluded that the net decrease in ozone due to launch of these vehicles could be as high as 0.02%. This perturbation is small compared to solar variability increases and decreases of between 7% to 20% in total ozone (Gille, 1982). The single launch of the Commercial Titan would have a significantly smaller impact and would be indistinguishable from effects caused by other natural and man-made causes.

4.1.2 Water Quality

Water use at Launch Complex 40 will be limited to potable water and deluge water to suppress acoustic levels and dissipate excess heat from the launch platform area. No withdrawal of ground water will be required from wells located on Cape Canaveral Air Force Station. All of the water used during each launch comes from municipal sources.

During vehicle launch, a large volume of water will be used in the deluge process and subsequent launch complex washdown. Most of the deluge water and launch complex washdown and fire suppressant water will be collected in the launch duct sump, which drains to percolation ponds at the Launch Complex 40, preventing release of this deluge and washdown water to surface water bodies. The remaining would be blown by the exhaust onto uncontrolled areas of the launch facility, where it would either percolate into highly permeable soils or vaporize and disperse into the atmosphere.

4.1.2.1 Surface Water. Potential nominal sources of surface water contamination include surface water impacts from exhaust cloud deposition of hydrochloric acid and aluminum oxide particulates and the impact of spent, suborbital stages and jettisoned hardware into the ocean.

During the early stages of formation and transport, the ground clouds generated during the launch will contain SRM effluent in both gaseous and aerosol form. For the most part, the aerosols will be water droplets continuing dissolved hydrogen chloride and particulate aluminum oxide from SRM exhaust. The larger aerosols tend to settle out of the cloud near the launch pad, therefore, the greatest deposition will be near the pad with rapidly decreasing amounts downwind. The mass of aerosol deposited will be influenced by the quantity of deluge water used, the amount of water produced by combustion, and the water content and temperature of the ambient air that mixes with the ground cloud. Ground clouds from the more powerful Titan launches contain substantially greater amounts of water than from the Commercial Titan because of the larger SRMs and greater deluge water requirements.

The impact of the exhaust cloud on surface water quality will be a function of the composition of the exhaust cloud, duration of contact with the water, wind speed and directions, and other atmospheric conditions. Due to atmospheric diffusion of the exhaust cloud, impacts to surface waters will likely be restricted to the area adjacent to the Launch Complex. Although it will be less so than for the launch of larger Titan vehicles, the launch of the Mars Observer Spacecraft may result in short-term acidification of surface water from direct contact with the exhaust cloud and through deposition of hydrochloric acid in the form of dryfall. A significant portion may drift toward the Banana River or the Atlantic Ocean, depending on wind direction. Immediate deposition due to wet precipitation will not occur because launch constraints do not allow liftoff during rain or storm conditions. As a result of the extensive bicarbonate buffering capacity of ocean water, no significant impact due to hydrochloric acid deposition will occur in waters east of the Launch Complex. Under certain atmospheric conditions, portions of the Banana River and adjacent marshes could potentially experience a short-term increase in acidity due to acid deposition.

Deposition of aluminum oxide particulates in surface waters will also depend on wind direction and speed. It is possible that they could be deposited in the coastal marsh and the Banana River as a result of easterly winds during vehicle launch. Tidal flushing in the marsh areas will prevent accumulation of significant quantities of aluminum oxide and is not expected to significantly impact surface water quality around the Launch Complex.

Under normal flight conditions, vehicle stages which do not go into orbit have trajectories which result in ocean impact. Stages that reach initial orbit will re-enter the atmosphere as a result of orbital decay, and may enter the water. Relatively small amounts of residual propellant may be released into the ocean along with the various spent stages. Corrosion of stage hardware will contribute various metal ions to the water column. Due to the slow rate of corrosion in the marine environment and the large quantity of water available for dilution, toxic concentrations of metals are not likely to occur. Relatively small amounts of propellant may also be released into the ocean along with the various spent stages. Release to the water column will be slow, with toxic concentrations occurring only within a few feet of the propellant, if they occur at all. Concentrations in excess of the maximum acceptable concentration for marine organisms will be limited to the immediate vicinity of the spent stage. Due to the large volume of water available for dilution, no significant impacts are expected to be caused by the re-entry of spent stages.

4.1.2.2 <u>Ground Water</u>. Although there is no water supply wells within 500 feet of the percolation ponds (USAF, 1990), the potential exists for contamination of groundwater in the surficial aquifer by deluge and washdown water as it infiltrates into permeable soils underlying the percolation ponds. One of the effects of disposal of wastewater through percolation ponds would be slight groundwater mounding beneath the launch complex. Although mixing with natural groundwater is expected to dilute contaminates released by a given launch to acceptable levels, a groundwater monitoring program has been established to provide regulatory control, allowing appropriate and timely mitigative actions should the need arise.

4.1.3 Floodplains and Wetlands

Impacts to wetlands from the launch would not exacerbate impacts from other Cape Canaveral Air Force Station activities or launches. Depending on meteorological conditions, deposition of hydrogen chloride and aluminum hydroxide from the ground cloud during the launch could affect the biota and water quality in these areas. Impacts would result from decrease in pH associated with the hydrogen chloride deposition. The wetlands to the west of the launch complex are lagoon with recharge occurring from groundwater, rainfall, and gate access from the Banana River. The only organisms that might be affected would be those occurring in the upper 0.5 to 1 meter of the wetland area (USAF, 1990). Natural buffering should raise the pH to normal levels within a few hours after deposition occurred. Deposition of aluminum hydroxide should be minimal and nontoxic because of its insolubility at the normal pH of the receiving waters.

4.1.4 Land Quality

The probable environmental effects on land quality imposed by the launch of the Mars Observer mission will be the disposal or treatment of solid wastes and material storage areas. No facilities will be modified for the launch of this mission.

4.1.4.1 Waste Treatment and Disposal. Based on the estimated number of personnel located at Launch Complex 40, the wastewater treatment plant capacity is adequate to provide sanitary wastewater treatment. No adverse impacts are expected associated with the launch.

The solid waste landfill on Cape Canaveral Air Force Station still has over half its life expectancy remaining. Processing and launch of the Mars Observer Mission is not expected to add any unusual additional load to normal operations. The same is true for hazardous waste storage facilities and disposal procedures.

4.1.4.2 Hazardous Materials Transportation. The quantity of hazardous materials that will be used to launch the Mars Observer mission is small relative to existing activities at Kennedy Space Center and Cape Canaveral Air Force Station. Existing safety precautions and procedures are discussed in Chapter 2.

4.1.4.3 Material Storage Areas. Materials storage and handling will be in accordance with existing Cape Canaveral Air Force policies and procedures for Titan launches. No additional impact is expected associated with preparation for the launch of the Mars Observer spacecraft.

4.1.4.4 Coastal Zone. A consistency determination conducted for the Complementary Vehicle Program at Cape Canaveral concluded that the program was consistent to the maximum extent practicable with State Coastal Management Programs, based on compatible land use, absence of significant environmental impacts and compliance with applicable regulations (USAF, 1986). Processing and launch of the Mars Observer spacecraft would add little impact beyond those associated with that program.

4.1.5 Noise Sources and Impacts

The major noise source in the immediate vicinity of the launch pad is the combination of noise in the combustion chamber, the interaction of the exhaust jet with the atmosphere, and the post-burning of fuel-rich combustion products in the atmosphere. The nature of the noise may be described as intense, of relatively short duration, composed predominantly of low frequencies, and occurring infrequently. Table 4-4 (USAF, 1975) shows approximate overall sound pressure levels for the Titan III space launch vehicle versus distance from the source.

Table 4-4: Estimated Maximum Ground-Level Sound Levels and Duration of Titan III

ESTIMATED MAXIMUM SOUND PRESSURE LEVEL (dB re: 2×10^{-5} N/m^2)	DISTANCE	DURATION OF SOUND WITHIN RANGE OF 20 dB OF MAXIMUM (seconds)
182	0	7
136	0.5	
129	1	10 to 40
122	2	
112	5	20 to 80

Source: USAF, 1975

Near the launch pad, workers are routinely protected from launch noise by evacuation and by wearing protective devices when inside launch operations buildings that are acoustically designed to reduce noise levels below acceptable levels. Road blocks are provided on access roads at a minimum of two miles away from the launch pads to exclude on base personnel from hazardous areas at launch time. The predicted maximum sound pressure level at this distance is 122 decibels for forty seconds; less than the 125 decibels for eight minutes allowed daily without exceeding the OSHA requirements.

The noise impact of the Mars Observer Spacecraft launch will be limited due to the rapid ascent of the vehicle, distance to uncontrolled areas, and flight path over the ocean. The nearest uncontrolled location where the public could be exposed to launch noise is about four miles away at Kennedy

Space Center. The nearest communities are about ten miles away. Because the launch of the Commercial Titan would involve very short exposure duration (one to two minutes), no significant adverse public health impacts would be expected from launch noise. Launch noise is usually perceived in nearby communities as a rumble in the distance. Infrequent launch noise is a commonly accepted part of the ambient environment in these communities surrounding Cape Canaveral Air Force Station.

During lift-off and during re-entry of suborbital and orbital stages, sonic booms are generated by space launch vehicles. These sonic booms are an inevitable effect of flight speeds in excess of that of sound. For the launch of the Mars Observer Mission, sonic booms will occur over the Atlantic Ocean, and will not impact developed coastal areas of Brevard County.

4.1.6 Biota

4.1.6.1 Terrestrial Impacts. Launch activities could impact vegetation and wildlife in three ways: fire, acidic deposition on vegetation and fauna, and noise. Occasionally small brush fires are sometimes associated with launches, and vegetation within 20 meters (66 feet) of the perimeter of the launch pads could be singed. Brush fires are usually successfully contained and limited to the ruderal vegetation within the launch complexes. Past singeing has not permanently affected the vegetation near the pads. Wildlife transients that do not flee the area within the perimeter fence could be injured or killed; however, mortality from such incidences is historically reported in post-launch inspections summaries to be very low (USAF, 1990).

Local wildlife will not be exposed to hazardous or toxic chemicals as a result of activities at Launch Complex 40. Containment provisions at the launch site will prevent spilled propellants or contaminated water from being released to the surrounding environment. Wildlife in the direct path of the ground level exhaust cloud may experience short-term elevated levels of hydrochloric acid; however, in studies of Titan III launches at Cape Canaveral Air Force Station, hydrogen chloride has not been detected within the ground cloud in toxic concentrations (USAF, 1975).

Elevated noise levels associated with the launch event could possibly cause a temporary hearing loss in sensitive wildlife living near the launch pad. Brattstrom and Bondello (1983) found that fringe-toed lizards, desert kangaroo rats, and Couch's spadefoot toad all suffered immediate hearing loss when exposed to off-road vehicle sounds of 95 decibels (acoustic) for less than nine minutes. No other reports are known to document wildlife hearing losses associated with short-term exposures to loud (95 to 120-decibels (acoustic)) noises. After the June 1989, Titan IV launch at Cape Canaveral Air Force Station, Florida scrub jays did not respond to alarm calls (USAF, 1990). In contrast, following the Shuttle mission-34 launch, scrub jays west of the pad displayed normal behavior and responded to calls. Wildlife that are heavily dependent on sound information could be more susceptible to predations because of a short-term hearing loss.

4.1.6.2 Aquatic Impacts. Because no surface water bodies receive direct runoff from the site during deluge water discharge, there should be no impacts to surface waters or their associated biota.

Deposition from the ground clouds associated with the launch could occur into the wetlands and Banana River to the west of the launch complex. The impact of the exhaust cloud on aquatic biota will be a function of the composition of the exhaust cloud, duration of contact with the water, wind speed and direction, and other atmospheric conditions. Aquatic resources including fish and insects that occur in the area receiving the heaviest deposition of hydrogen chloride from the ground cloud could be adversely affected by deposition. Hawkins, Overstreet, and Provancha (1984) have reported adverse effects of deposition associated with Space Shuttle launches. The concentration of hydrogen chloride in the ground cloud associated with a Commercial Titan launch should be considerably less than that associated with the Space Shuttle; however the potential does exist for temporarily increased acidity to affect biota in adjacent wetlands and the Banana River.

In addition, deposition of aluminum hydroxide from the exhaust cloud may occur over surface waters, depending on wind speed and direction during vehicle launch. Some of the aluminum hydroxide entering the aquatic environment may solubilize as a result of the temporary acidification of the Banana River; however the ambient pH of 8.0-8.5 would be quickly restored due to water flow and mixing. At this pH, aluminum is insoluble and nontoxic to most aquatic organisms. Localized fish kills in the Banana River are not expected to occur as a result of the launch due to the distance of the Launch Complex from the Banana River and the relatively small exhaust cloud produced by the Commercial Titan.

Overall, no significant long-term adverse impacts to aquatic biota are expected to occur as a result of the ground level exhaust cloud from launch of the Mars Observer spacecraft.

4.1.6.3 Threatened and Endangered Species.

4.1.6.3.1 Facility Lighting Impacts (USAF, 1990). The impacts of security and operations lighting at the Launch Complex and Integrated Titan Launch Area on endangered sea turtle nesting is a major concern associated with all Cape Canaveral launch programs. Lights that emit in the ultraviolet, violet-blue, and blue-green wavelengths, such as high-pressures sodium lights, disorient endangered sea turtle hatchlings. If these illuminate sea turtle nests on the beach, hatchlings move inlands rather than seaward and subsequently suffer increased mortality (USAF, 1988).

Light surveys have been completed for Launch Complex 40 and a light management plan designed to reduce beach lighting is being developed. With the implementation of this and other light management plans, impacts to endangered sea turtle populations would not be expected associated with the processing and launch of the Mars Observer spacecraft.

4.1.6.3.2 Habitat Destruction or Disturbance. There is no designated critical habitat for the Florida scrub jay or the southeastern beach mouse at Cape Canaveral Air Force Station.

Acidic deposition from hydrogen chloride in the ground cloud that forms following ignition and combustion of the SRMs may injure or destroy vegetation very near the launch pads and along the path of the ground cloud; however, habitat or forage will not be altered to the extent that populations of threatened species will be adversely affected.

A high-risk zone exists within the perimeter fence of the launch complex, extending out to about 600 feet (182 meters) out from the launch pad. During launch, this area will experience intense heat and pressure and toxic gases. The zone is industrial in nature, and areas where structures or pavement are not present are covered with only grass. There is little if any suitable habitat for either the scrub jay or the beach mouse within the high-risk zone.

In consultation with the Fish and Wildlife Service regarding impact of protected species, the Air Force has established a monitoring plan to measure the effects of the ground cloud and noise from the Titan III launch vehicle on surrogate species of a rodent and bird. The Fish and Wildlife Service will use these results to estimate the effects of launches on beach mice and scrub jays.

4.1.7 Community Impacts

Launch of the Mars Observer Mission will not require additional operational personnel; operational personnel will be from the current employment pool at CCAFS. No impact on housing is expected as no additional permanent personnel are expected beyond those currently employed at CCAFS.

Because Launch Complex 40 is already being used for space launches and the land area has been disturbed no additional adverse impacts on existing land uses are expected.

4.1.8 Archaeological and Cultural Resources

No significant archaeological and/or historical sites are expected to be affected by the launch of the Mars Observer Mission (see section 5.1).

4.2 ACCIDENTS AND LAUNCH FAILURES

In the event of a Commercial Titan anomaly early in flight, public safety could be affected by the blast effect, release of toxic fumes or by the impact of the launch vehicle.

4.2.1 Blast Effect

The blast effect as a function of distance from the explosion site is estimated by determining TNT equivalent blast yields (USAF 1983). The TNT equivalent is composed of the solid propellant within the solid rocket motors used on the Commercial Titan and the liquid propellant contained in the core launch vehicle. The total Commercial Titan blast yield is estimated to be approximately 408,678 pounds and the radial distance the which the blast pressure wave falls below 3.4 pounds per square inch (adequate for creating an eardrum rupture rate of 1% within the affected area) (Richmond and Fletcher,1971) is 1336 feet. This distance is within the Integrated Titan Launch boundaries and will not pose a hazard to other launch complexes.

4.2.2 Liquid Propellant Handling

Liquid propellant spills can result in the generation of a cloud or plume of toxic vapor. The liquid propellants used in large quantities are nitrogen tetroxide and aerozine-50. Previous studies have indicated that for a given amount of propellant, nitrogen tetroxide has greater potential than the hydrazines for toxic air quality effects (USAF 1989b). Although the hydrazines have lower recommended exposure limits than nitrogen tetroxides (NRC 1985a, NRC 1985b), the latter evaporates much faster at typical ambient temperatures. Thus, for spills of comparable mass, the plume of nitrogen tetroxide would travel farther downwind before atmospheric dispersion reduced the concentrations below recommended safety limits.

Spills during on-pad transfer operations have the potential to generate hazardous concentrations at distances of several kilometers or more from the spill site (USAF, 1986). For these reasons, a number of safety procedures are employed to minimize exposure of unprotected populations to hazardous concentrations. First the propellant loading systems are designed with redundant safety features, including meters and automatic shutoff valves, that would cause propellant flow to be stopped in the event of a leak. Second, if a propellant spill occurred, it would be contained in a catch basin and diluted with water to reduce the evaporation rate and allow prompt cleanup. Finally, before any operations involving hazardous propellants are conducted, meteorological and dispersion model forecasts are employed to determine the size and orientation of the potential hazardous condition. If the potential hazardous condition would overlay uncontrolled areas, the nearest of which are about eight miles away from Launch Complex 40, or unprotected Cape Canaveral Air Force Station or Kennedy Space Center populations, the propellant handling operations would be postponed until more favorable meteorological conditions were expected.

In the immediate vicinity of propellant transfer operations, personnel are provided with protective clothing and breathing equipment. All persons not involved in the propellant transfer operations are excluded from the area.

4.2.3 Launch

An accident shortly before or during launch of a Commercial Titan vehicle has the most potential for adverse air quality impacts, as compared with other accident hazards related to vehicle assembly and liquid propellant handling. Air quality impacts could occur from the combustion of solid or liquid fuel.

The worst-case air quality impacts would be from a solid fuel accident at the launch pad either before or shortly after launch which involved the burning of large solid fuel fragments that have become dislodged from the SRM casing. The rate at which the solid fuel burns would depend on the size of the solid fuel fragments and on the air pressure. When ignited within an SRM, the solid fuel burns very rapidly at the high pressures generated by the exhaust gases. However, if the solid fuel were to break into large chunks and ignite, it would burn more slowly. The air contaminant of primary concern in this scenario is hydrogen chloride.

A worst-case liquid propellant spill would involve the rapid, explosive combustion of the hypergolic liquid propellants in the fully fueled vehicle on the launch pad or shortly after liftoff. In this scenario, the SRMs would also be affected by the event. If the explosion were cause by a properly functioning command destruct, the SRMs would likely disintegrate into relatively small chunks, which would be more widely dispersed and burn more quickly than in the event described above. If the command destruct did not work, the solid fuel would probably break into larger fragments and burn as described above. Thus, hydrogen chloride impacts for this scenario would be less than or equal to the event described above.

The U.S. Air Force has been utilizing the Rocket Effluent Exhaust Dispersion Model to estimate ground-level concentrations of the solid and liquid propellants and combustion products downwind of the Air Force launch pads (USAF, 1990). In order to estimate the impacts of a Titan Solid Rocket Motor Upgrade accident, the model was enhanced to simulate the scenarios described above based on an analysis of the 1986 Titan 34D vehicle destruct at Vandenberg Air Force Base. For the worst-case scenarios described above, only the maximum concentration of nitrogen dioxide (formed by the dissociation of nitrogen tetroxide in ambient air) barely exceeded short-term public emergency guidance levels recommended by the National Research Council (NRC 1987, NRC 1985a, NRC 1985b) beyond the nearest uncontrolled areas.

Because the Commercial Titan uses a significantly smaller quantity of propellants than in the scenarios analyzed, no adverse exposures to people would be expected in a worst-case accident. Furthermore, as is done with other potentially hazardous operations, the Air Force meteorological forecasting staff will use dispersion models to forecast potentially hazardous conditions before launch operations are conducted . The forecasts are used to determine whether to launch, in order to prevent adverse exposures to people on and off-site in case of an accident.

The occurrence of fire and/or the explosion of the Commercial Titan vehicle during operation could result in the loss of some vegetation and wildlife. These impacts should generally be contained within the launch complex, which supports only limited numbers of both plant and animal species.

A worst-case accident would be for an early inflight termination if the vehicle destruction system failed to destroy the vehicle. If such a worst-case accident occurred, it is possible that some liquid propellant would enter the surface waters. The degree of impact would depend upon the amount of propellant released and the depth of the water receiving the propellant input. Such an accident would cause short-term impacts to water quality and aquatic resources in the immediate vicinity of the impact.

SECTION 5

REGULATORY REVIEW

5.1 AIR QUALITY

The Florida Department of Environmental Regulation regulates air pollutant emission sources in Florida and requires permits for construction, modification, or operation of many sources (FDER, 1986). Emissions from mobile sources, such as aircraft and space launch vehicles, are exempted from permit requirements. Stationary ground-based sources associated with space vehicle launch programs are subject to review and permitting by the Florida Department of Environmental Regulation. Because no new stationary sources will be constructed for the launch of the Mars Observer spacecraft, no new air quality permits will be required. Correspondence with the Florida Department of Environmental Regulation is included in Appendix A.

5.2 WATER QUALITY

5.2.1 Stormwater Discharge

Florida's stormwater discharge permitting program is designed to prevent adverse effects on surface water quality from runoff. A stormwater discharge permit will not be required for the launch of the Mars Observer spacecraft because no modifications of existing facilities are planned that would increase stormwater runoff rates or reduce the quality of the existing runoff.

5.2.2 Sewage Treatment

The facilities being used to assemble the spacecraft and launch vehicle as well as Launch Complex 40 already have potable water and sanitary waste disposal permits (USAF, 1990). No new permits will be required for the assembly or launch of the spacecraft.

5.2.3 Industrial Wastewater Discharge

Wastewater from the spacecraft launch at Complex 40 will include deluge and washdown water discharged during launch activities. An application has been filed with the Florida Department of Environmental Regulation to permit discharge from Launch Complex 40 (USAF, 1990). The permit would be issued based on demonstration that discharge would not significantly degrade surface water or groundwater.

5.2.4 Floodplains and Wetlands

Launch Complex is not on a floodplain. Impacts to wetlands from the launch of the Mars Observer spacecraft wold not exacerbate impacts from other

Cape Canaveral Air Force Station activities or launches. Therefore, no new permits would be required to launch the mission.

5.3 HAZARDOUS WASTES

Cape Canaveral Air Force Station was issued a RCRA Part B Hazardous Waste Operations permit in January 1986 (USAF, 1986). Several small hazardous waste accumulation areas are located throughout the launch complex for the collection of hazardous wastes produced from processing and launch operations. Hazardous wastes will be accumulated at these areas for up to ninety days, before being transferred to a hazardous storage area on the base. These wastes will eventually be transported to an off-station licensed hazardous waste treatment/disposal facility.

5.4 SPILL PREVENTION (USAF, 1990)

A Spills Prevention, Control, and Countermeasures Plan (SPCCP) is required by the Environmental Protection Agency under its Oil Pollution prevention regulation to prevent any discharges of oil or petroleum products into U.S. waters. Cape Canaveral Air Force Station has integrated a SPCCP into OPLAN 19-01, the Oil and Hazardous Substance Pollution Contingency Plan.

Spills of oil/petroleum products that may be federally listed hazardous materials will be collected and removed for proper disposal by a certified contractor in accordance with IAW OPLAN 19-4, Hazardous Substance Pollution Contingency Plan.

5.5 COASTAL MANAGEMENT PROGRAM

The Coastal zone Management Act of 1972 declared that national policy is to preserve, protect, develop, restore, and/or enhance the resources of the nation's coastal zone. While the Act defines the "coastal zone" as that which extends inland from the shoreline only to the extent necessary to control shore lands, it also excludes coastal zone lands that are used solely at the discretion of, or held in trust by, the federal government. The Act requires that federal agencies that conduct or support activities that directly affect the coastal zone do so, to the maximum extent practicable, in a manner that is consistent with approved state coastal zone management programs.

A consistency determination conducted for the Complementary Vehicle Program at Cape Canaveral concluded that the program was consistent to the maximum extent practicable with State Coastal Management Programs, based on compatible land use, absence of significant environmental impacts and compliance with applicable regulations (USAF, 1986). Processing and launch of the Mars Observer spacecraft would add no significant impact beyond those associated with that program.

5.6 ARCHAEOLOGICAL AND CULTURAL RESOURCES

In accordance with the procedures contained in 36 C.F.R.Part 800, the Florida Department of State, Division of Historical Resources has reviewed the planned launch of the Mars Observer Spacecraft for possible impact to archaeological and historical sites or properties listed, or eligible for listing, in the National Register of Historic Places. Their review indicates no significant archaeological and/or historical sites recorded or likely to be present in the Florida Master Site File. Because of the project location and/or nature, the agency considers it unlikely that any such sites will be affected by the Project (see Appendix A).

NASA has determined that the proposed action will have no effect on property listed, or eligible for listing, in the National Register of Historic Places.

5.7 CORRESPONDENCE WITH FEDERAL AGENCIES

5.7.1 United States Air Force

Correspondence with Patrick Air Force Base is included in Appendix A.

5.7.2 United States Department of Transportation

Correspondence received from the U.S. Department of Transportation (DOT) is included in Appendix A. The DOT noted that the vehicle being used to launch the Mars Observer spacecraft appears to be the same as for other launches licensed for Martin Marietta by the Office of Commercial Space Transportation. Based on previous findings of no significant impact for these launches, and their current understanding of the vehicle to be used to launch the Mars Observer spacecraft, the Office of Commercial Space Transportation believes there would be a similar finding for that launch.

5.7.3 United States Department of the Interior

The Endangered Species Act of 1973, as amended (16 USC 1531 et seq.) is intended to prevent the further decline of endangered and threatened plant and animal species in the United States and to help restore populations of these species and their habitats. The Act, which is jointly administered by the U.S. Departments of Commerce and the Interior, requires that each federal agency consult with the Fish and Wildlife Service to determine whether endangered and threatened species are known to occur or have critical habitats on or in the vicinity of the site of a proposed action. Correspondence with the Fish and Wildlife Service is included in Appendix A. Suggested revisions have been incorporated into the text of the impact analysis.

NASA has determined that the proposed action is not likely to jepardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat.

5.7.4 United States Environmental Protection Agency

Correspondence with the United States Environmental Protection Agency is included in Appendix A. Revisions have been incorporated into the text of the draft in accordance with initial comments received.

SECTION 6

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APPENDIX A

CORRESPONDENCE WITH STATE AND FEDERAL AGENCIES

NOTE: Where no agency written response is provided in this appendix, none was received

JAN 10 1991

SL

Mr. Buck Owen
Department of Environmental Regulation
2600 Blair Stone Road
Twin Towers Office Building
Tallahassee, FL 32301

Dear Mr. Owen:

During September 1992, NASA plans to launch the Mars Observer (MO) spacecraft for an extended orbital study of the Martian surface, atmosphere, and gravitational and magnetic fields. The spacecraft will be launched by a Commercial Titan Launch Vehicle (CTLV) from the launch complex 40 at the Eastern Test Range, Cape Canaveral Air Force Station, Florida. In accordance with National Aeronautics and Space Administration (NASA) and National Environmental Protection Act (NEPA) regulations, NASA is conducting an environmental assessment to evaluate any payload-specific environmental impacts associated with the launch of the mission.

The Mars Observer spacecraft structure is based on the RCA Satcom-K communications satellite. Instrument power will be provided by articulated solar arrays. The propulsion system will consist of a bipropellant system used for large velocity maneuvers and a monopropellant system used for orbit maintenance and reaction wheel unloading maneuvers. The CTLV will launch the spacecraft into a low Earth parking orbit. The launch vehicle is a modified Titan 34D consisting of two solid rocket motors attached to a two stage liquid propellant core vehicle. From the parking orbit, the spacecraft will be placed into a Mars trajectory by the Transfer Orbit Stage (TOS), which is a solid propellant motor propulsive stage. After spacecraft separation, the TOS will perform an evasive maneuver and fire its thrusters to change direction and preclude subsequent spacecraft recontact.

Prelaunch spacecraft testing and loading operations at the Kennedy Space Center will utilize the Payload Processing Facility, Payload Hazardous Servicing Facility, and the MIL-71 Deep Space Network Facility. After processing, the spacecraft will be transferred to the launch pad 40 for mating with the launch vehicle and upper stage (see enclosure). No requirements for new or modified Government or contractor facilities have been identified, and no new facilities or modifications are planned.

The Mars Observer environmental assessment being prepared will address the planned Federal action to integrate, launch and transfer the Mars Observer mission to an interplanetary trajectory. The effects associated with the launch vehicle are discussed in "Programmatic Environmental Assessment of Commercial Expendable Launch Vehicle Programs" (February 1986). The environmental assessment will address the proposed action, alternative launch vehicles and the no action alternative. On-going activities to monitor or protect endangered and protected species from the impacts of Titan launches will be discussed. Hazards and potential environmental effects associated with damage to the spacecraft during processing, launch and pre-planetary injection will be discussed. The potential effects include the impact on air and water quality, as well as land area; biotic resources; safety impact; wetland areas or areas containing historical sites; and socioeconomic impact.

The environmental assessment is expected to be released for review in February 1991. If you have specific comments concerning the environmental impact of this launch in the region, please let us know.

Please send your response within thirty (30) days to Dr. William L. Piotrowski, NASA Headquarters, Code SL, 600 Independence Ave., S.W., Washington, DC 20546. If you need any further information or wish to discuss this project, please contact Kenneth Kumor at NASA Headquarters at 202-453-1956.

Sincerely,

/s/ [signature]

Wesley T. Huntress, Jr.
Director
Solar System Exploration Division
Office of Space Science and Applications

Enclosures

Jet Propulsion Laboratory
California Institute of Technology
4800 Oak Grove Drive
Pasadena, California 91109
818 354-4321

JPL

April 24, 1991

Mr. Larry George
Department of Environmental Regulation
2600 Blair Stone Road
Twin Towers Office Building
Tallahassee, FL 32301

Dear Mr. George,

Thank you for your comments concerning the need for a discussion of the impacts of solid rocket motor emissions on local air and water quality in the environmental assessment for the launch of the Mars Observer Mission. Our current draft discusses the U. S. Department of Air Force's projection of hydrogen chloride and aluminum oxide particulate emissions that were discussed in their 1986 Environmental Assessment for the Complementary Expendable Launch Vehicle Program at Cape Canaveral Air Force Station. Additionally, the draft briefly mentions a recently published analysis completed by the Air Force for a much larger launch vehicle, the Titan IV with the Solid Rocket Motor Upgrade. This worst-case analysis predicts lower concentration emissions than predicted in the 1986 assessment.

I will let you know when we begin the next review cycle. In the meantime, if you have any questions, please feel free to call me at (818) 354-1249 or send me a fax at (818) 393-6734.

Sincerely,

Rebecca Wheeler

Rebecca Wheeler
Launch Approval Planning Group

JAN 10 1991

SL

Mr. Louis Tesar
State Historical Preservation
Division of Archives, History & Records
Department of State
R.A. Gray Building
Tallahassee, FL 32301

Dear Mr. Tesar:

During September 1992, NASA plans to launch the Mars Observer (MO) spacecraft for an extended orbital study of the Martian surface, atmosphere, and gravitational and magnetic fields. The spacecraft will be launched by a Commercial Titan Launch Vehicle (CTLV) from the launch complex 40 at the Eastern Test Range, Cape Canaveral Air Force Station, Florida. In accordance with National Aeronautics and Space Administration (NASA) and National Environmental Protection Act (NEPA) regulations, NASA is conducting an environmental assessment to evaluate any payload-specific environmental impacts associated with the launch of the mission.

The Mars Observer spacecraft structure is based on the RCA Satcom-K communications satellite. Instrument power will be provided by articulated solar arrays. The propulsion system will consist of a bipropellant system used for large velocity maneuvers and a monopropellant system used for orbit maintenance and reaction wheel unloading maneuvers. The CTLV will launch the spacecraft into a low Earth parking orbit. The launch vehicle is a modified Titan 34D consisting of two solid rocket motors attached to a two stage liquid propellant core vehicle. From the parking orbit, the spacecraft will be placed into a Mars trajectory by the Transfer Orbit Stage (TOS), which is a solid propellant motor propulsive stage. After spacecraft separation, the TOS will perform an evasive maneuver and fire its thrusters to change direction and preclude subsequent spacecraft recontact.

Prelaunch spacecraft testing and loading operations at the Kennedy Space Center will utilize the Payload Processing Facility, Payload Hazardous Servicing Facility, and the MIL-71 Deep Space Network Facility. After processing, the spacecraft will be transferred to the launch pad 40 for mating with the launch vehicle and upper stage (see enclosure). No requirements for new or modified Government or contractor facilities have been identified, and no new facilities or modifications are planned.

The Mars Observer environmental assessment being prepared will address the planned Federal action to integrate, launch and transfer the Mars Observer mission to an interplanetary trajectory. The effects associated with the launch vehicle are discussed in "Programmatic Environmental Assessment of Commercial Expendable Launch Vehicle Programs" (February 1986). The environmental assessment will address the proposed action, alternative launch vehicles and the no action alternative. On-going activities to monitor or protect endangered and protected species from the impacts of Titan launches will be discussed. Hazards and potential environmental effects associated with damage to the spacecraft during processing, launch and pre-planetary injection will be discussed. The potential effects include the impact on air and water quality, as well as land area; biotic resources; safety impact; wetland areas or areas containing historical sites; and socioeconomic impact.

The environmental assessment is expected to be released for review in February 1991. There were no unique archaeological or historical resources identified in the 1986 environmental assessment previously mentioned. We would appreciate information on any sites, listed or eligible for listing in additions or proposed addition to the National Register of Historic Places, that may be affected by this launch.

Please send your response within thirty (30) days to Dr. William L. Piotrowski, NASA Headquarters, Code SL, 600 Independence Ave., S.W., Washington, DC 20546. If you need any further information or wish to discuss this project, please contact Kenneth Kumor at NASA Headquarters at 202-453-1956.

Sincerely,

/McConnell/

Wesley T. Huntress, Jr.
Director
Solar System Exploration Division
Office of Space Science and Applications

Enclosures

FLORIDA DEPARTMENT OF STATE
Jim Smith
Secretary of State
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R.A. Gray Building
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Telecopier Number (FAX) (904) 488-3353

January 30, 1991

Wesley T. Huntress, Jr.
Director
Solar System Exploration Division
Office of Space Science and Applications
National Aeronautics and Space Administration
Washington, D . C. 20546

In Reply Refer To:
Susan M. Herring
Historic Sites Specialist
(904) 487-2333
Project File No. 910123

RE: Cultural Resource Assessment Request
NASA Launch of Mars Observer Spacecraft
Cape Canaveral Air Force Station
Brevard County, Florida

Dear Mr. Huntress:

In accordance with the procedures contained in 36 C.F.R., Part 800 ("Protection of Historic Properties"), we have reviewed the above referenced project(s) for possible impact to archaeological and historical sites or properties listed, or eligible for listing, in the National Register of Historic Places. The authority for this procedure is the National Historic Preservation Act of 1966 (Public Law 89-665), as amended.

A review of the Florida Master Site File indicates that no significant archaeological and/or historical sites are recorded for or considered likely to be present within the project area. It is the opinion of this agency that because of the project location and/or nature, it is considered unlikely that any such sites will be affected. Therefore, it is the judgement of this office that the proposed project will have no effect on any sites listed, or eligible for listing, in the National Register of Historic Places, or otherwise of national, state, regional, or local significance. The project is consistent with the historic preservation aspects of Florida's coastal zone program, and may proceed without further involvement with this agency.

If you have any questions concerning our comments, please do not hesitate to contact us. Your interest and cooperation in helping to protect Florida's archaeological and historical resources are appreciated.

Sincerely,

George W. Percy, Director
Division of Historical Resources
and
State Historic Preservation Officer

GWP/smh

SL JAN 10 1991

Ms. Karen MacFarland
Director
Florida State Clearing House
Executive Office of the Governor
Office of Planning and Budgeting
The Capital
Tallahassee, FL 32399-0001

Dear Ms. MacFarland:

During September 1992, NASA plans to launch the Mars Observer (MO) spacecraft for an extended orbital study of the Martian surface, atmosphere, and gravitational and magnetic fields. The spacecraft will be launched by a Commercial Titan Launch Vehicle (CTLV) from the launch complex 40 at the Eastern Test Range, Cape Canaveral Air Force Station, Florida. In accordance with National Aeronautics and Space Administration (NASA) and National Environmental Protection Act (NEPA) regulations, NASA is conducting an environmental assessment to evaluate any payload-specific environmental impacts associated with the launch of the mission.

The Mars Observer spacecraft structure is based on the RCA Satcom-K communications satellite. Instrument power will be provided by articulated solar arrays. The propulsion system will consist of a bipropellant system used for large velocity maneuvers and a monopropellant system used for orbit maintenance and reaction wheel unloading maneuvers. The CTLV will launch the spacecraft into a low Earth parking orbit. The launch vehicle is a modified Titan 34D consisting of two solid rocket motors attached to a two stage liquid propellant core vehicle. From the parking orbit, the spacecraft will be placed into a Mars trajectory by the Transfer Orbit Stage (TOS), which is a solid propellant motor propulsive stage. After spacecraft separation, the TOS will perform an evasive maneuver and fire its thrusters to change direction and preclude subsequent spacecraft recontact.

Prelaunch spacecraft testing and loading operations at the Kennedy Space Center will utilize the Payload Processing Facility, Payload Hazardous Servicing Facility, and the MIL-71 Deep Space Network Facility. After processing, the spacecraft will be transferred to the launch pad 40 for mating with the launch vehicle and upper stage (see enclosure). No requirements for new or modified Government or contractor facilities have been identified, and no new facilities or modifications are planned.

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The environmental assessment is expected to be released for review in February 1991. If you have specific comments concerning the environmental impact of this launch in the region, please let us know.

Please send your response within thirty (30) days to Dr. William L. Piotrowski, NASA Headquarters, Code SL, 600 Independence Ave., S.W., Washington, DC 20546. If you need any further information or wish to discuss this project, please contact Kenneth Kumor at NASA Headquarters at 202-453-1956.

Sincerely,

/M^c Connell/

Wesley T. Huntress, Jr.
Director
Solar System Exploration Division
Office of Space Science and Applications

Enclosures

Executive Office of the Governor
The Capitol
Tallahassee, FL
32399-0001

JAN '91 US POSTAGE 0.15

PLACE POST CARD POSTAGE HERE

NASA HEADQUARTERS - CODE SL
ATTN: DR. WILLIAM PIOTROWSKI
300 INDEPENDENCE AVE, SW
WASHINGTON, DC 20546-

SAI: FL9101140901
PROJECT: LAUNCHING OF THE MARS OBSERVER (MO) SPACECRAFT FOR AN EXTENDED ORBITAL STUDY OF THE MARTIAN SURFACE, ATMOSPHERE, AND GRAVITATIONAL & MAGNETIC FIELDS
RECEIVED: 01/14/91

under its intergovernmental coordination and review process ... respondence requesting review ... This correspondence has been assigned a **State Application Identifier (SAI) Number**, shown above, which should be used in all communications with this office concerning the application or project.

The State Clearinghouse will coordinate a review of the application or project pursuant to Presidential Executive Order 12372; Gubernatorial Executive Order Number 83-150; section 216.212, Florida Statutes; the National Environmental Policy Act; the Florida approved coastal management program; the Outer Continental Shelf Lands Act; and other federal or informational review requirements.

The review begins on the date the correspondence is received by the State Clearinghouse and normally is completed in 30 days, although longer review periods of 45 and 60 days are permitted by federal law for specific types of applications or projects. Completion of the review may be delayed if additional information is needed by reviewing agencies, in which case you will be notified. Please send three (3) copies of your application or project to the appropriate Regional Planning Council (RPC), if applicable.

FLORIDA STATE CLEARINGHOUSE
Executive Office of the Governor/OPB
Growth Management and Planning Policy Unit
The Capitol, Tallahassee, Florida 32399-0001
(904) 488-8114; (SunCom) 278-8114

JAN 10 1991

SL

Mr. Olin Miller
Chief, Environmental Planning
1040th CES-DEEV
Patrick Air Force Base, FL 32925

Dear Mr. Miller:

During September 1992, NASA plans to launch the Mars Observer (MO) spacecraft for an extended orbital study of the Martian surface, atmosphere, and gravitational and magnetic fields. The spacecraft will be launched by a Commercial Titan Launch Vehicle (CTLV) from the launch complex 40 at the Eastern Test Range, Cape Canaveral Air Force Station, Florida. In accordance with National Aeronautics and Space Administration (NASA) and National Environmental Protection Act (NEPA) regulations, NASA is conducting an environmental assessment to evaluate any payload-specific environmental impacts associated with the launch of the mission.

The Mars Observer spacecraft structure is based on the RCA Satcom-K communications satellite. Instrument power will be provided by articulated solar arrays. The propulsion system will consist of a bipropellant system used for large velocity maneuvers and a monopropellant system used for orbit maintenance and reaction wheel unloading maneuvers. The CTLV will launch the spacecraft into a low Earth parking orbit. The launch vehicle is a modified Titan 34D consisting of two solid rocket motors attached to a two stage liquid propellant core vehicle. From the parking orbit, the spacecraft will be placed into a Mars trajectory by the Transfer Orbit Stage (TOS), which is a solid propellant motor propulsive stage. After spacecraft separation, the TOS will perform an evasive maneuver and fire its thrusters to change direction and preclude subsequent spacecraft recontact.

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The environmental assessment is expected to be released for review in February 1991. If you have specific comments concerning the environmental impact of this specific launch, please let us know.

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Sincerely,

/McConnell/

Wesley T. Huntress, Jr.
Director
Solar System Exploration Division
Office of Space Science and Applications

Enclosures

Jet Propulsion Laboratory
California Institute of Technology
4800 Oak Grove Drive
Pasadena, California 91109
(818) 354-4321

JPL

April 19, 1991

Mr. Olin Miller
Chief, Environmental Planning
1040th CES-DEEV
Patrick Air Force Base, FL 32925

Dear Mr. Miller,

Thank you for referring me to Mr. Bob Ellis in response to NASA's January 10, 1991 letter concerning the environmental assessment being prepared for the launch of the Mars Observer Mission. I faxed a copy of the letter to Mr. Ellis so he wouldn't have to search through his files. I told Mr. Ellis that we would soon release a draft of the assessment for agency and public review and that the document was primarily based on environmental assessments already prepared by the air force for expendable launch vehicles. Mr. Ellis didn't expect your office to have comments at this point, but would likely comment during the next review cycle.

I will let you know when we begin the next review cycle. In the meantime, if you have any questions, please feel free to call me at (818) 354-1249 or send me a fax at (818) 393-6734.

Sincerely,

Rebecca Wheeler

Rebecca Wheeler
Launch Approval Planning Group

JAN 10 1991

SL

Mr. Norman Bowles
Director of Licensing Program
Office of Commercial Transportation
400 Seventh Street, S.W.
Washington, DC 20590

Dear Mr. Bowles:

During September 1992, NASA plans to launch the Mars Observer (MO) spacecraft for an extended orbital study of the Martian surface, atmosphere, and gravitational and magnetic fields. The spacecraft will be launched by a Commercial Titan Launch Vehicle (CTLV) from the launch complex 40 at the Eastern Test Range, Cape Canaveral Air Force Station, Florida. In accordance with National Aeronautics and Space Administration (NASA) and National Environmental Protection Act (NEPA) regulations, NASA is conducting an environmental assessment to evaluate any payload-specific environmental impacts associated with the launch of the mission.

The Mars Observer spacecraft structure is based on the RCA Satcom-K communications satellite. Instrument power will be provided by articulated solar arrays. The propulsion system will consist of a bipropellant system used for large velocity maneuvers and a monopropellant system used for orbit maintenance and reaction wheel unloading maneuvers. The CTLV will launch the spacecraft into a low Earth parking orbit. The launch vehicle is a modified Titan 34D consisting of two solid rocket motors attached to a two stage liquid propellant core vehicle. From the parking orbit, the spacecraft will be placed into a Mars trajectory by the Transfer Orbit Stage (TOS), which is a solid propellant motor propulsive stage. After spacecraft separation, the TOS will perform an evasive maneuver and fire its thrusters to change direction and preclude subsequent spacecraft recontact.

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The environmental assessment is expected to be released for review in February 1991. If you have specific comments concerning the environmental impact of this specific launch, please let us know.

Please send your response within thirty (30) days to Dr. William L. Piotrowski, NASA Headquarters, Code SL, 600 Independence Ave., S.W., Washington, DC 20546. If you need any further information or wish to discuss this project, please contact Kenneth Kumor at NASA Headquarters at 202-453-1956.

Sincerely,

/ M^c Connell /

Wesley T. Huntress, Jr.
Director
Solar System Exploration Division
Office of Space Science and Applications

Enclosures

U.S. Department of Transportation
Office of the Secretary of Transportation

400 Seventh St., S.W.
Washington, D.C. 20590

FEB - 8 1991

Dr. William L. Piotrowski
NASA Headquarters
Code SL
600 Independence Ave., S.W.
Washington, D.C. 20546

Dear Dr. Piotrowski:

This letter is in response to your request for comments on the environmental impact of the Mars Observer launch. The vehicle described in the letter appears to be the same as for other launches we have licensed for Martin Marietta.

To date, our office has overseen three licensed launches of the Titan. The Martin Marietta Titan and Titan/Centaur are covered in our publication, "Programmatic Environmental Assessment of Commercial Expendable Launch Vehicle Programs". Based on information provided to us by Martin Marietta, in accordance with section 415.33 of Subpart D, 14 CFR Chapter III, and our own independent analysis, all have had findings of no significant impact. Based on what we currently understand about the vehicle proposed to be used for the Mars Observer, we believe there would be a similar finding for that launch.

Should you have any additional questions, please call me on (202) 366-2929.

Sincerely,

Norman C. Bowles
Associate Director
for Licensing Programs
Office of Commercial Space
Transportation

Wiesnet

SL JAN 10 1991

Mr. David Westley
Field Supervisor
U.S. Fish & Wildlife Service
31000 University Blvd., South Suite 120
Jacksonville, FL 32216

Dear Mr. Westley:

During September 1992, NASA plans to launch the Mars Observer (MO) spacecraft for an extended orbital study of the Martian surface, atmosphere, and gravitational and magnetic fields. The spacecraft will be launched by a Commercial Titan Launch Vehicle (CTLV) from the launch complex 40 at the Eastern Test Range, Cape Canaveral Air Force Station (CCAFS), Florida. In accordance with National Aeronautics and Space Administration (NASA) and National Environmental Protection Act (NEPA) regulations, NASA is conducting an environmental assessment to evaluate any payload-specific environmental impacts associated with the launch of the mission.

The Mars Observer spacecraft structure is based on the RCA Satcom-K communications satellite. Instrument power will be provided by articulated solar arrays. The propulsion system will consist of a bipropellant system used for large velocity maneuvers and a monopropellant system used for orbit maintenance and reaction wheel unloading maneuvers. The CTLV will launch the spacecraft into a low Earth parking orbit. The launch vehicle is a modified Titan 34D consisting of two solid rocket motors attached to a two stage liquid propellant core vehicle. From the parking orbit, the spacecraft will be placed into a Mars trajectory by the Transfer Orbit Stage (TOS), which is a solid propellant motor propulsive stage. After spacecraft separation, the TOS will perform an evasive maneuver and fire its thrusters to change direction and preclude subsequent spacecraft recontact.

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The environmental assessment is expected to be released for review in February 1991. Enclosed is the list of endangered and threatened species residing or seasonally occurring on CCAFS and adjoining waters identified in the 1986 environmental assessment previously mentioned. We request an update to this list as well as any proposed threatened and endangered species and an identification of designated or proposed critical habitat that may be present in the vicinity of launch complex 40. In addition, please advise us of any present concerns you may have related to possible effects of launching this mission from launch complex 40 on such species or critical habitat, as well as any other wildlife concerns.

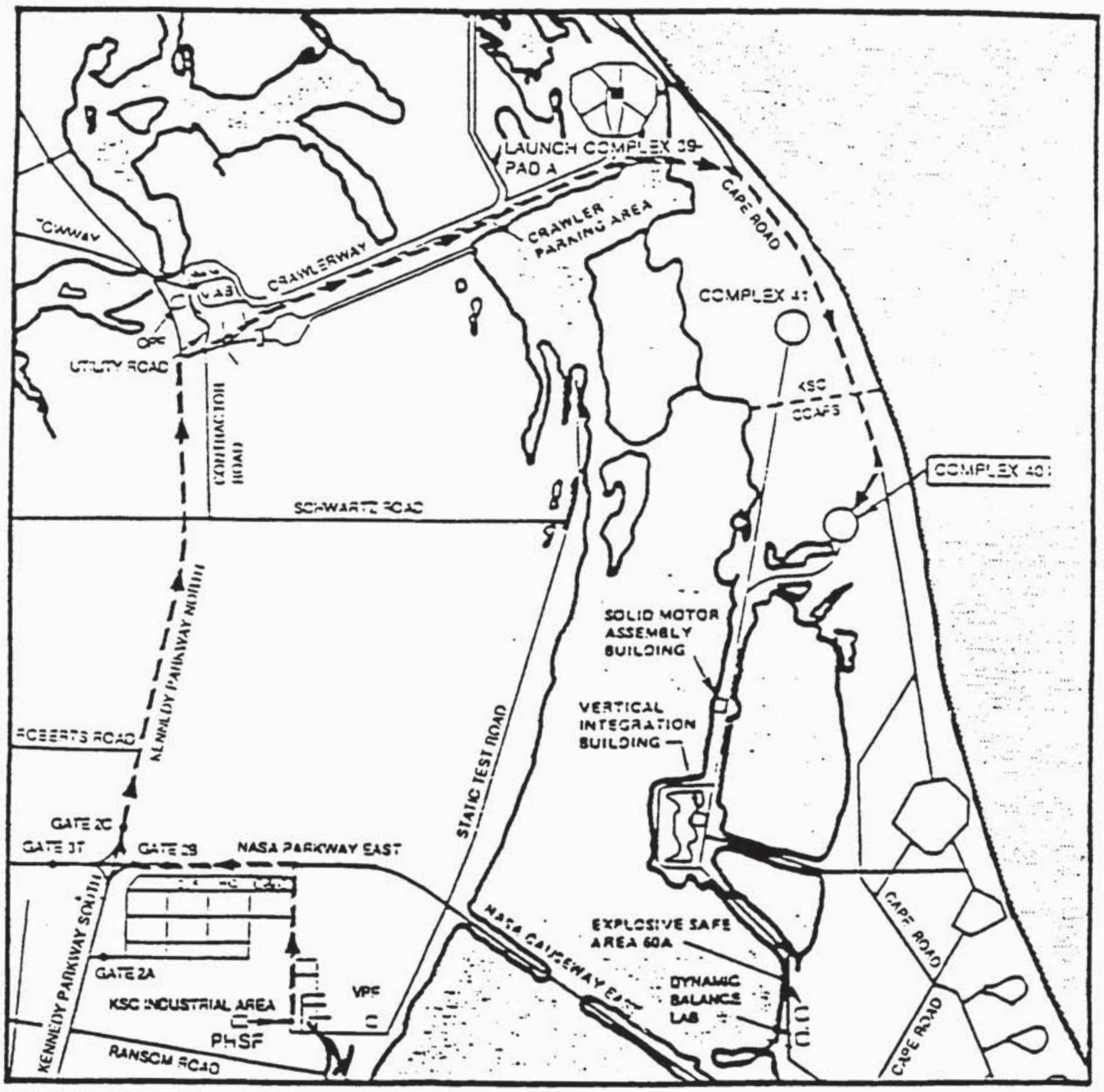
Please send your response within thirty (30) days to Dr. William L. Piotrowski, NASA Headquarters, Code SL, 600 Independence Ave., S.W., Washington, DC 20546. If you need any further information or wish to discuss this project, please contact Kenneth Kumor at NASA Headquarters at 202-453-1956.

Sincerely,

/ McConnell /

Wesley T. Huntress, Jr.
Director
Solar System Exploration Division
Office of Space Science and Applications

Enclosures



Mars Observer/TOS Transport Route

Endangered and Threatened Species Residing or Seasonally Occurring on CCAFS and Adjoining Waters[1]

	Species	
Species	USFWS[2]	FGFWFC[3]
Mammals		
Caribbean manatee (*Trichechus manatus*)	E[4]	E
Birds		
Wood stork (*Mycteria american*)	E	E
Bald eagle (*Haliaeetus leucocephalus*)	E	T[5]
Peregrin falcon (*Falco peregrinus*)	T	E
Southeastern kestrel (*Falco sparverius*)	-	T
Red-cockaded woodpecker (*Picoides borealis*)	E	T
Florida scrub jay (*Aphelocoma coerulesens*)	-	T
Dusky seaside sparrow (*Ammospiza maritima*)	E	E
Reptiles		
Atlantic green turtle (*Chelonia mydas*)	E	E
Atlantic ridley turtle (*Lepidochelys kemi*)	E	E
Atlantic loggerhead turtle (*Caretta caretta*)	T	T
Eastern indigo snake (*Drymarchon corais*)	T	T

[1] Source: Environmental Assessment Complementary Expendable Launch Vehicle, Cape Canaveral Air Force Station, Florida, June 1986

[2] U.S. Fish and Wildlife Service

[3] Florida Game and Fresh Water Fish Commission

[4] Endangered

[5] Threatened

United States Department of the Interior

FISH AND WILDLIFE SERVICE
3100 UNIVERSITY BLVD. SOUTH
SUITE 120
JACKSONVILLE, FLORIDA 32216

January 17, 1991

25 1991

Mr. Wesley T. Huntress, Jr.
Director
Solar System Exploration Division
Office of Space Science and Applications
National Aeronautics and Space Administration
Washington, D.C. 20546

Dear Mr. Huntress, Jr.:

This responds to your letter of January 10, 1990, requesting an up-dated list of Federally threatened and endangered species adjacent to Launch Complex 40 on Cape Canaveral Air Force Station, Florida, and other information related to possible impacts to listed species from the proposed Mars Observer project.

With reference to the list of species provided in your letter, under **Mammals**, add southeastern beach mouse (Peromyscus polionotus niveiventris), Threatened; **Birds**, delete the Dusky Seaside sparrow, extinct; and add the Florida scrub jay as a Federally listed threatened species.

As a result of a previous Section 7 consultation with the Air Force regarding the upgrading of Launch Complexes 40 and 41 and the possible impact of the new Titan IV program on the Florida scrub jay and southeastern beach mouse, the Air Force committed to undertake monitoring studies on the affect of the launch plume and noise on the biology of these species. These studies are ongoing, and no definitive conclusions have been reached. For further information regarding these studies, we refer you to Mr. Olin Miller, Acting Chief, Engineering and Environmental Planning Branch at Patrick Air Force Base (407-494-7288).

We look forward to working with NASA on this project, and if you have a question, please contact Don Palmer in this office.

Sincerely yours,

David J. Wesley
Field Supervisor

JAN 10 1991

SL

Mr. Heinz Mueller, Chief
Environmental Policy Section
Federal Activities Branch
Environmental Protection Agency, Region IV
345 Courtland Street
Atlanta, GA 30365

Dear Mr. Mueller:

During September 1992, NASA plans to launch the Mars Observer (MO) spacecraft for an extended orbital study of the Martian surface, atmosphere, and gravitational and magnetic fields. The spacecraft will be launched by a Commercial Titan Launch Vehicle (CTLV) from the launch complex 40 at the Eastern Test Range, Cape Canaveral Air Force Station, Florida. In accordance with National Aeronautics and Space Administration (NASA) and National Environmental Protection Act (NEPA) regulations, NASA is conducting an environmental assessment to evaluate any payload-specific environmental impacts associated with the launch of the mission.

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Sincerely,

McConnell /

Wesley T. Huntress, Jr.
Director
Solar System Exploration Division
Office of Space Science and Applications

Enclosures

Jet Propulsion Laboratory
California Institute of Technology
4800 Oak Grove Drive
Pasadena, California 91109
(818) 354-4321

JPL

May 15, 1991
Refer to: 311-RW:fm

Mr. Gerald Miller
Environmental Policy Section
Federal Activities Branch
EPA, Region IV
5th Floor Tower Building
345 Courtland Street
Atlanta, Georgia 30365

Dear Mr. Miller,

Thank you for your comments concerning the need for a discussion of the impacts of solid rocket motor emissions on air quality in the Environmental Assessment for the launch of the Mars Observer Mission. Our current draft discusses the U.S. Department of Air Force's projection of hydrogen chloride and aluminum oxide particulate emissions that were discussed in their 1986 Environmental Assessment for the Complementary Expendable Launch Vehicle Program at Cape Canaveral Air Force Station. Additionally, the draft briefly mentions a recently published analysis completed by the Air Force for a much larger launch vehicle, the Titan IV with the Solid Rocket Motor Upgrade. This worst-case analysis predicts lower concentration emissions than predicted in the 1986 assessment.

I will let you know when we begin the next review cycle. In the meantime, if you have any questions, please feel free to call me at (818) 354-1249.

Sincerely,

Rebecca Wheeler

Rebecca Wheeler
Launch Approval Planning Group

cc: Cunningham, G.
Dawson, S.
Evans, D.
Kumar, K. (NASA/NXG)
McConnell, D. (NASA/SL)
Piotrowski, W. (NASA/SL)
Sola, L.
Wilcox, R.

APPENDIX B

FINDING OF NO SIGNIFICANT IMPACT (FONSI)
COMPLEMENTARY EXPENDABLE LAUNCH VEHICLE PROGRAM
CAPE CANAVERAL AIR FORCE STATION

FINDING OF NO SIGNIFICANT IMPACT (FONSI)
COMLEMENTARY EXPENDABLE LAUNCH VEHICLE PROGRAM
CAPE CANAVERAL AIR FORCE STATION, FLORIDA

DESCRIPTION OF THE PROPOSED ACTION

INTRODUCTION

To support the Department of Defense (DOD) Space Program, and to ensure access to space through a secondary launch capability using expendable launch vehicles, the U.S. Air Force (USAF) proposes to renovate and modify Launch Complex 41 at Cape Canaveral Air Force Station (CCAFS), Florida, to accommodate the proposed Complementary Expendable Launch Vehicle (CELV) program.

PROPOSED ACTION

The proposed action calls for the renovation and modification of an existing launch complex (Launch Complex 41) located on the northernmost extension of CCAFS. This action is required to support the USAF's CELV program utilizing modified Titan 34D space boosters known as Titan 34D7. The CELV program is designed to provide additional space launch capability for USAF launches in support of DOD programs. The payload capacities of the Titan 34D7 are compatible with those of the Space Shuttle.

Launch Complex 41, which was used to launch Titan space boosters until 1977, retains skeleton structures of the umbilical and mobile service towers, in-place fuel storage areas, and a launch pad. The renovations and modifications to the complex include tearout and refurbishment of structural, mechanical, and electrical systems; and modification of transport and fuel systems, including the installation of air pollution control devices for the fuel and oxidizer systems.

Following renovation and modification of Launch Complex 41 facilities, systems and space vehicles will be tested to validate their performance against design requirements. Initial Launch Capability (ILC) for the proposed CELV is October 1988.

SUMMARY OF ENVIRONMENTAL IMPACTS

NATURAL ENVIRONMENT

Air Quality

The proposed CELV program will not significantly impact air quality of CCAFS or surrounding areas. Primary constituents of the ground level exhaust cloud produced by the solid rocket motors (SRMs) of the Titan 34D7 will be carbon monoxide (CO), hydrogen chloride (HCl), and aluminum oxide (Al_2O_3). Because the nearest uncontrolled area is 16 kilometers (km) from the launch site, it is expected that the general population will not be exposed to HCl concentrations greater than the current Occupational Safety and Health Administration (OSHA) permissible limit of 5 parts per million (ppm). In addition, concentrations of CO and Al_2O_3 are predicted not to exceed the National Ambient Air Quality Standards (NAAQS), anywhere beyond the immediate area adjacent to the launch complex. As part of the renovation of Launch Complex 41, air pollution control devices will be installed to control the emissions of Aerozine 50 and nitrogen tetroxide (N_2O_4). In addition, spill control and containment facilities are sufficient to retain emergency or accidental spills and prevent release of hazardous fumes to the atmosphere.

Soils

Implementation of the CELV program, including the refurbishment of Launch Complex 41, will not involve new excavation and will not impact soils on CCAFS.

Hydrology

No significant impacts to ground water or surface water hydrology will result from the CELV program. All water use for the CELV program will come from municipal water supplies and will be stored prior to use in a 1,000,000-gallon tank located on CCAFS. Some ground water recharge will occur as the result of deluge water and fire suppressant and launch complex washdown water flowing directly off the pad and discharging to grade. All water discharged to grade will percolate into the surficial water table and flow toward the Banana River.

Water Quality

No significant long-term adverse impacts to water quality will occur as a result of the CELV program. All deluge water and fire suppressant water collected in the flame bucket will be analyzed prior to discharge to grade. If this water is contaminated, it will be removed and disposed of offsite in an appropriate manner. Spill control and containment facilities are provided for all fuel tank areas to prevent the accidental release of propellants to the environment. The potential exists for a short-term, localized impact on water quality in the unlikely event of an early inflight failure of the Titan 34D7 vehicle. Due to the hypergolic nature of the liquid fuels, and the activation of the vehicle destruct system following a near-pad flight failure, minimal contamination of surface waters is expected following such an event.

Surface water quality will not be significantly impacted by deposition of HCl or Al_2O_3 from the ground cloud produced during liftoff of the Titan 34D7 vehicle. Any HCl deposited in surrounding surface waters will be rapidly neutralized by the extensive buffering capacity of the Banana River and adjacent marshes. In addition, any Al_2O_3 deposited in surface waters will remain insoluble and will not be toxic to aquatic life.

Biota

No significant impacts to the biota of CCAFS and surrounding areas are expected to result from the CELV program. No additional habitat will be lost or permanently disturbed due to the proposed activities. No critical habitat for threatened or endangered species will be lost due to the CELV program. Aquatic organisms will not be significantly impacted due to deposition of HCl or Al_2O_3 from the ground level exhaust cloud.

MAN-MADE ENVIRONMENT

Population

The renovation and modification of Launch Complex 41 and the subsequent launch program of the CELV will have no significant impacts on population and housing on CCAFS or surrounding communities. The CELV program will utilize existing personnel available at CCAFS, Patrick Air Force Base (PAFB), or surrounding communities.

Socioeconomics

Launch Complex 41 was established in the mid-1960s. The proposed CELV program is compatible with the surrounding land use, will not require additional acreage outside the boundaries of the complex, and will not require new utility services, new transportation access, or additional employment. No significant impacts to the socioeconomics of CCAFS or Brevard County, Florida, are anticipated.

Safety

Safety aspects of prelaunch, launch, and postlaunch phases of the proposed CELV program have been addressed in the T34D7 Accident Risk Assessment Report (ARAR) (see Appendix A). This report addresses the Titan 34D7 flight vehicle, support equipment, and Launch Complex 41 facilities. All procedures during prelaunch, launch, and postlaunch phases of the CELV program will be carried out according to the ARAR to ensure optimal safety for all onbase personnel.

Noise

Noise pollution associated with the CELV program will not significantly affect the general public due to the distance between the launch site and the nearest unregulated area (i.e., 16 km). Noise produced during the launch will be of short duration and at worst will be an infrequent nuisance rather than a health hazard.

Archaeology and Cultural Resources

Launch Complex 41 or the surrounding area does not contain any unique archaeological or historical resources. No new construction is required offsite. As a result, the CELV program will have no adverse impacts to archaeological or cultural resources.

FINDINGS

Based upon the above, a finding of no significant impact is made. An Environmental Assessment of the proposed action, dated June 1986, is on file at:

HQ Space Division
P.O. Box 92960
Worldway Postal Center
Los Angeles, CA 90009
ATTENTION: Mr. Robert C. Mason, SD/DEV