Environmental Impact Analysis Process

ENVIRONMENTAL ASSESSMENT

U.S. AIR FORCE
TITIAN IV/SOLID ROCKET MOTOR UPGRADE PROGRAM
Cape Canaveral Air Force Station, Florida
Vandenberg Air Force Base, California

February 1990

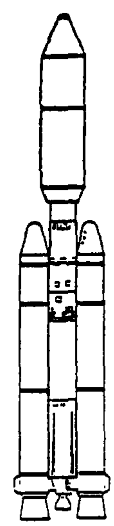
DEPARTMENT OF THE AIR FORCE

ENVIRONMENTAL ASSESSMENT

TITAN IV/SOLID ROCKET MOTOR

UPGRADE PROGRAM

Cape Canaveral Air Force Station, Florida
Vandenberg Air Force Base, California



Department of the Air Force
Headquarters, Space Systems Division
Los Angeles Air Force Station, California

February 1990

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS SPACE SYSTEMS DIVISION (AFSC)
LOS ANGELES AIR FORCE BASE, PO BOX 92960
LOS ANGELES, CA 90009-2960

February 23, 1990

To: Governmental Agencies, Public Officials, Public Groups and Interested Individuals

Attached for thirty (30) days of public and governmental agency notification, in compliance with the National Environmental Policy Act and the regulations of the President's Council on Environmental Quality, is the Finding of No Significant Impact and the Environmental Assessment for the Titan IV/Solid Rocket Motor Upgrade Program and operations at Vandenberg Air Force Base, California and Cape Canaveral Air Force Station, Florida.

The Finding of No Significant Impact and the Environmental Assessment address the environmental consequences associated with the construction and modifications to existing launch complexes and certain support facilities at Vandenberg AFB, California and Cape Canaveral AFS, Florida and construction of a second Solid Motor Assembly Building(SMAB) and a Payload Fairing Cleaning Facility (PFCF) at Cape Canaveral AFS, Florida to support a maximum launch rate of 37 Titan launch vehicles from 1991 through 1995 and will also provide for the launching of a larger launch vehicle known as the Titan IV - Type 2 or Solid Rocket Motor Upgrade (SRMU) from Vandenberg AFB, California and Cape Canaveral AFS, Florida.

The thirty (30) day public and agency notification period begins on February 26, 1990, and continues until March 28, 1990. Copies of the Finding of No Significant Impact and the Environmental Assessment may be obtained by writing to:

Department of the Air Force
Headquarters Space Systems Division/DEV
Attn: Mr. Dan Pilson
P. O. Box 92960
Los Angeles, CA 90009-2960

or by calling: Mr. Dan Pilson at (213) 643-1409.

Sincerely,

Donald R. Simmons

Donald R. Simmons, Lt Colonel, USAF
Acting Director, Acquisition Civil Engineering

FINDING OF NO SIGNIFICANT IMPACT

TITAN IV/SRMU PROGRAM

CAPE CANAVERAL AIR FORCE STATION, FLORIDA AND VANDENBERG AIR FORCE BASE, CALIFORNIA

1. PROPOSED ACTION

In support of the U.S. Department of Defense (DOD) space program, the U.S. Air Force (USAF) proposes to expand its existing Titan IV launch program at Cape Canaveral Air Force Station (CCAFS), Florida, and Vandenberg Air Force Base (VAFB), California. The proposed action is to increase the launch rate to a maximum of 37 Titan IV vehicles from 1991 through 1995 and to increase payload capacity for Shuttle-class payloads with a larger solid rocket motor known as the Titan IV-Type 2 or the Solid Rocket Motor Upgrade (SRMU). To support the expanded Titan IV program, the USAF proposes to modify existing launch complexes (LCs) and certain support facilities at CCAFS and VAFB and to construct a second Solid Motor Assembly Building (SMAB) and a Payload Fairing Cleaning Facility (PFCF) at CCAFS.

The Titan IV program has evolved rapidly since 1985 when the USAF began the Complementary Expendable Launch Vehicle (CELV) program to provide launch capability to supplement the Space Shuttle. The CELV program developed the Titan 34D7 launch vehicle, an expanded version of the Titan 34D. The USAF initially planned to launch 10 CELVs from CCAFS. An Environmental Assessment (EA) for this program, which evaluated the impacts of modifications to LC-41 and 10 launches of the CELV, also supported a Finding of No Significant Impact (FONSI).

In mid-1986, the USAF expanded the CELV program to 24 launches (total) from CCAFS and VAFB. At that time, the Titan 34D7 was renamed Titan IV. A supplemental EA addressed the increased number of launches and modifications to facilities at CCAFS, and a separate EA was prepared for the Titan IV launches from VAFB. FONSIs were also supported by these EAs.

The expanded Titan IV program will provide increased launch frequencies and greater lift capacity to ensure adequate launch capability for DOD payloads. For some launches, the SRMU will be used to provide increased thrust for the Titan IV vehicle so that it can launch Shuttle-class DOD payloads. The SRMU will increase payload capacity 25 to 35% above that of the Titan IV-Type 1 vehicle. To achieve the increased launch rates proposed for the Titan IV program and to process the larger SRMU, new facilities and modifications to existing facilities are needed at CCAFS and VAFB.

Alternative actions considered for the Titan IV program include no action, alternative sites, and alternative launch vehicles. Alternatives were eliminated from detailed consideration in this environmental assessment (EA) because they were incapable of meeting the mission requirements of the Titan IV program.

1.1. Project Location

Cape Canaveral Air Force Station

CCAFS is located along the eastern coast of Florida near the city of Cocoa Beach in Brevard County. The base is about 15 mi north of Patrick AFB and adjacent to the National Aeronautics and Space Administration's (NASA's) Kennedy Space Center (KSC). CCAFS occupies about 15,800 acres (25 mi^2) of a barrier island that is bounded on the east by the Atlantic Ocean and on the west by the Banana River.

The facilities at CCAFS that would be affected by the proposed action are located in the northwest portion of the base. These include LCs 40 and 41 and the Titan Integrate-Transfer-Launch (ITL) Area immediately south of the LCs. A new facility, the SMAB, is proposed to be constructed at a site near the ITL Area on narrow man-made causeway in the Banana River.

The ITL Area is located on a man-made island in the Banana River; the LCs are located on previously disturbed land and are industrial in character. LCs 40 and 41 were constructed in 1963-64. LC-41 was used by the USAF from 1964 to 1977 for Titan launches; it was reactivated in 1986 and renovated to support Titan IV launches. LC-40 has been used for

Titan launches from 1964 to the present. The site for the proposed new SMAB is currently vacant except for a railroad spur on which rail cars containing rocket fuel and oxidizer are stored.

Vandenberg Air Force Base

VAFB, occupying 98,400 acres (154 mi^2) along the south central coast of California, is located 140 mi northwest of Los Angeles and about 5 mi west of Lompoc in Santa Barbara County. VAFB is bounded by the Pacific Ocean to the west and south. VAFB is bisected by Ocean Avenue, which runs from Lompoc to a public beach at Surf.

The facilities at VAFB that would be affected by the proposed action are located on South AFB and include Space Launch Complex (SLC) 4E, from which Titan IV vehicles would be launched, and the Solid Rocket Subassembly Facility (SRSF) (Bldg. 398), located at SLC-6.

1.2 Project Description

The proposed action consists of (1) an increase in the Titan IV launch rate from CCAFS and VAFB from 24 to 37 through 1995, (2) the development and use of an enhanced Titan IV vehicle having larger solid rocket motors (SRMUs) capable of carrying Shuttle-class payloads, and (3) the expansion and renovation of Titan launch and support facilities at CCAFS and VAFB to process and handle the increased launch rates and larger Titan IV-Type 2 (SRMU) vehicles.

Existing facilities at CCAFS are not capable of processing solid rocket motors or the proposed SRMUs at a rate that could support the higher launch frequencies. Launch frequencies are also limited at present, because only one launch pad (LC-41) is available and because solid rocket motor assembly and inspection must be completed on the pad. The proposed action will provide a second SMAB that could accommodate a three-segment SRMU or a seven-segment solid rocket motor, thereby eliminating on-pad assembly and increasing the pre-launch processing rate. Because the existing Payload Fairing Cleaning Facility is incapable of handling the proposed launch frequencies, an additional PFCF will be built. An additional launch site (LC-40) will be renovated to support the launch of Titan IV-Type 1 and Type 2

(SRMU). LC-40 will require a new Mobile Service Tower, a new Umbilical Tower, and an overpressure suppression system (OSS). LC-41 will undergo structural modifications to accommodate the SRMU and will also have an OSS installed. Other minor renovations of structural, mechanical, and electrical systems will be made at the existing SMAB, the Vertical Integration Building, the Motor Inert Storage building and the Receipt, Inspection, and Storage building at CCAFS.

The existing facilities at VAFB are adequate to support the proposed launch rates; however, modifications are needed at Bldg. 398 for processing and storage of the larger SRMU segments and at SLC-4E to accommodate the Titan IV-Type 2 (SRMU) vehicle.

2. SUMMARY OF ENVIRONMENTAL IMPACTS

2.1 Cape Canaveral Air Force Station

Air Quality

Construction, pre- and post-launch processing, and launch activities during the Titan IV program will not significantly impact air quality.

Modelling results indicate that particulate matter (PM-10) emissions from earthwork and excavation would be about 5% and 1% of the 24-hr and annual National Ambient Air Quality Standard (NAAQS) for PM-10. Background levels in the CCAFS area are well below the NAAQS, therefore, the incremental increase from construction activities of the Titan IV program would not result in standards violations. In addition, PM-10 increases would be temporary, lasting only for the construction period.

During construction and pre- and post-launch processing, vehicles and equipment will emit nitrogen oxides (NO_x), sulfur dioxide (SO_2), hydrocarbons, carbon monoxide (CO), and PM-10. Emissions will be sporadic and concentrated near the source, and ambient air quality outside the immediate vicinity of operation will not be adversely affected.

Ground support activities and launch vehicle fueling will also result in emissions of trace quantities of volatile organic compounds (VOCs), hydrazines, nitrogen tetroxide, NO_x, and CO. Emissions of hydrazine and nitrogen tetroxide will be minimized by pollution control devices and will conform to all required regulatory permits.

Combustion of solid rocket motors at launch will produce a ground level exhaust cloud containing aluminum oxide particulates, hydrogen chloride vapor or droplets, and carbon monoxide gas. The CO will rapidly oxidize to carbon dioxide (CO_2) in the atmosphere, therefore, it will not adversely affect ambient air quality. Modelling results indicate that the maximum 1-hr hydrogen chloride concentration at the nearest off-base location would be 0.22 parts per million (ppm), well below the National Research Council-recommended short-term public emergency guidance level (SPEGL) of 1 ppm. Similarly, the maximum 24-hr aluminum oxide particulate concentration off-base was predicted to be about 25 micrograms/m^3, well below the NAAQS of 150 micrograms/m^3. Adverse air quality impacts would not be expected, because even when this increment is added to the highest historical background PM-10 concentration, the NAAQS will not be violated. In addition, the probability of maximum background concentration occurring coincidentally with launch is very low.

The incremental effects of Titan IV launches on stratospheric ozone and hence, ground-level ultraviolet-B radiation, will be much less than effects attributable to other natural and man-made causes.

Water Resources

Adverse impacts to surface waters and groundwater will not result from the Titan IV program. During construction, control measures, such as straw barriers and berms, will be implemented to minimize erosion and sedimentation. New wastewater streams will discharge to the Banana River from the stormwater runoff retention pond and the sewage plant at the proposed SMAB. Discharges will be in accordance with the effluent limitations defined by state permits, and will not adversely affect the water quality of the Banana River.

During launch, about 400,000 gallons of deluge water will be required. About 320,000 gallons will be collected in a sump, then drained to percolation ponds at LCs 40 and 41 in accordance with a state industrial wastewater discharge permit for the facilities. The remaining 80,000 gallons will be dispersed by the force of the vehicle exhaust into the atmosphere and to grade near the launch pad.

Percolation through the soil to groundwater will prevent the release of deluge water to nearby surface waters, therefore, no adverse surface water impacts will result. Percolation will likely cause slight groundwater mounding beneath the LCs. Based on local groundwater velocity, it would take a minimum of eleven years for the mound to reach the wetlands that are one-quarter mile west of the complexes. Groundwater quality will not be adversely affected by percolation because dilution by natural groundwater would be expected. An existing groundwater monitoring program at the LCs will continue during the Titan IV program, and will enable quick detection of contamination and appropriate mitigative action, if needed.

The deluge water dispersed by the exhaust will contain hydrogen chloride vapor or droplets and aluminum oxide particulates. Depending on prevailing winds, deposition from the cloud would be on land, in the Banana River, or in the Atlantic Ocean. No adverse impacts will result because both water bodies have sufficient buffering capacity to neutralize the acidic character of the hydrogen chloride. The aluminum oxide is insoluble and will not affect water quality.

Ecology

No significant impacts to the biota of CCAFS and surrounding areas will result from the expanded Titan IV program. Habitat will not be lost or permanently disturbed, and populations of resident species will not be significantly changed. Hydrogen chloride and aluminum oxide in the ground cloud formed from SRM exhaust would have minor impacts on populations of wildlife and vegetation outside the perimeter fence of each pad. Noise from Titan IV launches exceeding 95 dBA could result in a temporary hearing loss in sensitive wildlife near the launch pads. Wildlife that are heavily dependent on auditory (as opposed to visual) information may be more susceptible to predation if they experience short-term hearing loss. However, because no more than six Titan IV launches would occur per year, launch noise will not significantly contribute to wildlife hearing loss. Because the sonic boom from the Titan IV launches will occur over open ocean waters, it will not significantly impact terrestrial wildlife. Sea birds and mammals may exhibit startle responses.

Aquatic biota in a 0.3-ha (0.8-acre) wetland will be displaced by construction of the new SMAB. There will be no dredging or alteration of aquatic habitat in the Banana River. With the implementation of erosion and sedimentation control, no significant adverse impacts to the aquatic ecosystem will occur as a result of construction.

Depending on prevailing winds, acid deposition from the ground cloud may occur in the wetlands and Banana River to the west of both LCs or the Atlantic Ocean to the east. Fish and insects in the areas of heaviest HCl deposition could be adversely affected by a decreased pH. For the most part, the buffering capacity of the Banana River will be sufficient to prevent significant impacts to aquatic biota.

Deluge water would discharge to grassy percolation areas at the LCs, and gate valves would prevent water movement off-site. Therefore, deluge water discharge will not adversely affect aquatic ecosystems.

Threatened and Endangered Species

The impacts of security and operations lighting at the LCs and ITL Area on endangered sea turtles is a major concern associated with all CCAFS launch programs. Lights that emit in the ultraviolet, violet-blue, and blue-green wavelengths disorient sea turtle hatchlings in nests on the beach. When hatchlings are disoriented, they move inland rather than seaward and subsequently suffer increased mortality. Light management plans designed to reduce beach lighting are being developed for all existing facilities at CCAFS. With the approval of the U.S. Fish and Wildlife Service (FWS) and the implementation of these plans, significant impacts to endangered sea turtle populations will not result.

Consultation between the USAF and the FWS regarding the effects of the launch vehicle's ground cloud and launch noise on two federally listed threatened species, the Florida scrub jay and the southeastern beach mouse, resulted in a Biological Opinion issued by the FWS that stated that "the operational phase of the Titan IV program is not likely to jeopardize the continued existence of the scrub jay or southeastern beach mice." The FWS issued an incidental take exemption to the USAF for losses of either species in the vicinity of the launch complexes.

Floodplains and Wetlands

The low-lying areas at the new SMAB site will be elevated with fill (loamy sand with shell) to 9 ft above mean sea level (MSL). This elevation is above both the base (100-year) and critical action (500-year) floodplains. Because of the small area affected by the proposed construction relative to the floodplain of this lagoon system, the action would have no effect on flood potential in the drainage basin. A Sect. 404 dredge-and-fill permit has been obtained from the U.S. Army Corps of Engineers.

Construction of the SMAB will require the removal of about 0.8 acre of wetland vegetation (primarily woody shrubs) along the southern causeway portion of the site. The total area of vegetation, both wetland and non-wetland, on the SMAB site is about 14 acres. All vegetation on the site is secondary growth with no unique plant communities and no habitat for protected species; therefore, significant adverse impacts will not occur. To compensate for wetlands disturbance, a new 1.6-acre wetland will be created on the western boundary of the site.

Man-made Environment

New construction and proposed modifications for the Titan IV program are compatible with the existing industrial nature of land use at CCAFS.

The projected population increase during construction would be about 650, which represents 0.1% of Brevard County's projected 1990 population. About 160 additional persons would be expected to migrate into the area for the Titan IV launch operations period. Many of these employees would locate in Cape Canaveral and Cocoa Beach. The estimated increase represents about 0.6% of the combined projected 1990 populations of these communities. The population increase expected from construction and operation will have a negligible impact on the local infrastructure, services, and economy.

An estimated 600 vehicles might be added by the Titan IV program to the existing traffic volume entering CCAFS access points. Given the existing levels of service, there is little probability of a major reduction of speed or flow rate.

The Florida State Historic Preservation Officer (SHPO) has provided official comment on the proposed project and has indicated that no significant archaeological or historical sites are recorded or considered likely to be present within the project areas, and that no adverse impacts to cultural, archaeological, or historic resources will occur as a result of the proposed action.

Hazardous Waste

The small increases in hazardous wastes generated at CCAFS as a result of the Titan IV program will be mitigated by management practices, as stipulated by applicable federal and state regulations. The Titan IV program is being evaluated under the USAF hazardous waste minimization program; measures will be implemented to reduce the production of hazardous wastes, where feasible, and recycling will be encouraged. Therefore, hazardous waste from the Titan IV program will not have a significant impact on the environment.

Safety

The Titan IV program will not result in an unreasonable or increased risk to the public. Potential impacts to public safety will be prevented by the safety and disaster preparedness plans for the program and for CCAFS.

Cumulative Impacts

The Titan IV program is one of many under development in the Brevard County region. Others include military-related projects and urban/industrial development.

The proposed Titan IV program is a successor to the Titan 34D program, which is being phased out. The environment is not expected to be impacted to a greater intensity than by previous Titan launch programs.

2.2 Vandenberg Air Force Base

Air Quality

Construction activities at VAFB will involve minimal earthmoving operations; therefore, fugitive dust emissions will be small, and significant air quality impacts are not expected. Vehicle and equipment emissions at VAFB will be the same as those described for CCAFS, and will not result in significant adverse impacts.

Modelling results indicate that combustion products from launch would result in a maximum 1-hr HCl concentration at the nearest off-base location equal to the SPEGL of 1 ppm. As is the case with all potentially hazardous launch-related activities, VAFB meteorological forecasting staff will conduct dispersion modeling before launch to ensure that adverse concentrations do not occur over populated areas on-base or off-base.

The maximum 24-hr aluminum oxide particulate concentration off-base was predicted to be ~105 micrograms/m^3, which is below the 24-hr NAAQS of 150 micrograms/m^3 but greater than the California Ambient Air Quality Standard of 50 micrograms/m^3. However, the predicted PM-10 concentration is quite conservative, because maximum background and launch impacts are assumed to coincide in time. Because of the unlikelihood of such an occurrence, significant PM-10 impacts will not be expected.

Water Resources

Construction at VAFB will not require the disturbance of land, therefore, erosion and sedimentation impacts to surface waters will not occur.

Water quality in Spring Canyon Creek (an intermittent stream) reflects the cumulative impacts of deposition from ground clouds and deluge discharge from previous Titan launches at SLC-4E and SLC-4W. Deposition reduces the pH and alkalinity upstream of the site, and aluminum oxide accumulates in streambed sediments. With future launches, water quality will continue to be degraded by the ground cloud. Uncontrolled deluge water discharge will not occur, however, during future Titan IV launches; wastewater will be collected and treated on-site. Because only two launches per year are planned, impacts from the ground cloud deposition will not be significant.

A surface water monitoring plan will be implemented as part of the Titan IV program. If significant water quality changes are evident, the California Regional Water Quality Control Board will advise the USAF of appropriate mitigation measures.

Surface water supplies in the region will not be utilized by the Titan IV program; therefore, adverse impacts will not occur. The groundwater supply at South VAFB will not be significantly impacted by Titan IV launches at SLC-4E. Based on launch requirements and a launch rate of two per year, annual groundwater withdrawn for deluge and washdown water will be about 0.3% of annual groundwater supplies currently consumed at South VAFB. Because about 80% of deluge and washdown water will be collected and treated, adverse impacts to groundwater quality will not occur during normal operation.

Ecology

Construction activities associated with the proposed action will have negligible impacts on terrestrial vegetation.

Launches will temporarily increase noise and will produce acid deposition on vegetation and fauna. Because only two Titan IV launches per year are planned, impacts of acid deposition will not be significant.

Certain launch trajectories of Titan IV vehicles will produce sonic booms that may intersect the surface on or near the Channel Islands near VAFB, which are important breeding grounds for several protected species of marine mammals and sea birds. Based on previous studies of the potential sonic boom effects expected of Space Shuttle launches from VAFB, the Titan IV launch would generate a sonic boom of a substantially lower magnitude. (This determination is based on the size and shape of the vehicle and the size of its exhaust plume relative to the Shuttle). Significant adverse impacts to marine species during previous launches from VAFB over the past 25 years have not been observed during field studies, therefore, it is projected that future Titan IV launches, at a rate of two per year, will not significantly impact threatened or endangered species of the Channel Islands.

Deposition onto Spring Canyon Creek and its watershed from the ground cloud would to reduce the pH and alkalinity upstream of the site and maintain the existing poor aquatic habitat in the creek. Because only two launches are planned per year, impacts to aquatic habitat will not be significant. Deluge water discharge at SLC-4E will be collected and treated; therefore, adverse impacts to the wetlands in Spring Canyon will not occur.

Man-made Environment

A maximum of 15 construction and 21 operations workers will be needed for the expanded Titan IV program. No impacts to regional and local community resources are expected from this small increase in labor requirements.

The proposed action involves modifications to existing structures at SLC-4E and internal modifications to Bldg. 398, thus, no historic or archaeological sites would be affected by the proposed action. Consultation with the California SHPO has resulted in a determination of no adverse effect from the proposed action.

Hazardous Waste

The small increases in hazardous wastes generated at VAFB as a result of the Titan IV program will be mitigated by management practices, as stipulated by applicable federal and state regulations. The Titan IV program is being evaluated under the USAF hazardous waste minimization program; measures will be implemented to reduce the production of hazardous wastes, where feasible, and recycling will be encouraged. Therefore, hazardous waste from the Titan IV program will not have a significant impact on the environment.

Safety

The Titan IV program will not result in an unreasonable or increased risk to the public. Potential impacts to public safety will be prevented by the safety and disaster preparedness plans for the program and for VAFB.

Cumulative Impacts

The Titan IV program is one of many under development in the Santa Barbara County region. Others include military-related projects, oil and gas development projects, and urban/industrial development.

The proposed Titan IV program is a successor to the Titan 34D program, which is being phased out. The environment is not expected to experience any significant impacts of greater intensity than that of previous Titan programs. Therefore, cumulative impacts to the environment are not expected to be significant.

3. FINDINGS

Based upon the above, a Finding of No Significant Impact is made. Copies of the Environmental Assessment on the proposed action, dated February 1990, can be obtained from:

Headquarters, Space Systems Division, SSD/DEW
Attn: Mr. Daniel Pilson
P.O. Box 92960, Worldway Postal Center
Los Angeles, CA 90009-2960

CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABBREVIATIONS AND ACRONYMS

A/C	air conditioning
ACHP	Advisory Council on Historic Preservation
AFB	Air Force Base
AFR	Air Force Regulation
AFSC	Air Force Systems Command
AGE	Aerospace Ground Equipment
Al_2O_3	aluminum oxide
App.	Appendix
CCAFS	Cape Canaveral Air Force Station
CAAQS	California Ambient Air Quality Standards
CELV	Complementary Expendable Launch Vehicle
CFR	Code of Federal Regulations
cfs	cubic feet per second
CO	carbon monoxide
COE	(U.S. Army) Corps of Engineers
dBA	decibels (A-weighted)
DCE	dichloroethylene
DOD	(U.S.) Department of Defense
EA	environmental assessment
EDS	exhaust duct sump
EPA	(U.S.) Environmental Protection Agency
ESMC	Eastern Space and Missile Center
FDER	Florida Department of Environmental Regulation
FDOT	Florida Department of Transportation
FPL	Florida Power and Light
ft	foot
FVIS	Fuel Vapor Incineration System
FWS	(U.S.) Fish and Wildlife Service
gal	gallon
gpd	gallons per day
GEO	geosynchronous orbit
GN_2	gaseous nitrogen
gpm	gallons per minute
hr	hour
HCl	hydrochloric acid
in.	inch
ITL	integrate-transfer-launch
IUS	Inertial Upper Stage
km	kilometer
KSC	Kennedy Space Center
lb	pound
LC	Launch Complex
LEO	low earth orbit
LRB	liquid rocket booster

m	meter
MEK	methyl-ethyl-ketone
mg/L	milligrams per liter
mi	mile
mi^2	square mile
min	minute
MIS	Motor Inert Storage (Building)
MLV	Medium Launch Vehicle
MOA	Memorandum of Agreement
mph	miles per hour
MSL	mean sea level
MST	Mobile Service Tower
MVA	megavolt/ampere
MW	megawatt
NAAQS	National Ambient Air Quality Standards
NASA	National Aeronautics and Space Administration
NDE	nondestructive examination
NEPA	National Environmental Policy Act
N_2O_4	nitrogen tetroxide
N_2H_4	hydrazine
NO_x	nitrogen oxides
NO_2	nitrogen dioxide
NMFS	National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System
NRC	National Research Council
NUS	no upper stage
O_3	ozone
ORNL	Oak Ridge National Laboratory
OSS	overpressure suppression system
OVSS	Oxidizer Vapor Scrubber System
Pb	lead
PFCF	Payload Fairing Cleaning Facility
PHC	Potential Hazard Corridor
PM-10	particulate matter less than 10 microns in diameter
REEDM	Rocket Effluent Exhaust Dispersion Model
RIS	Receipt, Inspection, and Storage
RO	reverse osmosis
RWQCB	Regional Water Quality Control Board
s	second
SCS	Soil Conservation Service (U.S. Department of Agriculture)
SHPO	State Historic Preservation Officer
SLC	space launch complex
SO_2	sulfur dioxide
SMAB	Solid Motor Assembly Building
SPCCP	Spills Prevention Control and Countermeasures Plan
SPEGL	Short-Term Public Emergency Guidance Level
SRM	solid rocket motor (manufactured by United Technologies)

SRMU	Solid Rocket Motor Upgrade (manufactured by Hercules, Inc.)
SRSF	Solid Rocket Sub-Assembly Facility
STS	Space Transportation System
TCE	trichloroethylene
TSP	total suspended particulates
UDMH	unsymmetrical dimethylhydrazine
USAF	U.S. Air Force
UT	Umbilical Tower
μg/L	micrograms per liter
$\mu g/m^3$	micrograms per cubic meter
μm	micron
UV	ultraviolet
UVB	ultraviolet radiation in the 290–310 nm wavelength range
VAFB	Vandenberg Air Force Base
VIB	Vertical Integration Building
VOC	volatile organic compound
SR	state route

1. PROPOSED ACTION AND ALTERNATIVES

1.1 PROPOSED ACTION

In support of the U.S. Department of Defense (DOD) space program, the U.S. Air Force (USAF) proposes to expand its existing Titan IV launch program at Cape Canaveral Air Force Station (CCAFS), Florida, and Vandenberg Air Force Base (VAFB), California. The proposed action would be to launch a maximum of 37 Titan IV vehicles from 1991 through 1995 and to increase payload capacity for Shuttle-class payloads with a larger solid rocket motor known as the Solid Rocket Motor Upgrade (SRMU). To support the expanded Titan IV program, the USAF proposes to modify existing launch complexes and certain support facilities at CCAFS and VAFB and to construct a second Solid Motor Assembly Building (SMAB) and a Payload Fairing Cleaning Facility (PFCF) at CCAFS.

1.1.1 Purpose of and Need for the Action

The expanded Titan IV program would provide increased launch frequencies and greater lift capacity to ensure adequate launch capability for DOD payloads. Over the past 5 years, DOD has directed its space program toward the use of unmanned, expendable launch vehicles to allow the Space Shuttle to be used primarily for those payloads that require manned spacecraft. Also during the past 5 years, the design of the Titan vehicle has evolved to enable it to carry a greater weight of payloads.

The expanded Titan IV program will provide increased launch frequencies and greater lift capacity to ensure adequate launch capability for DOD payloads. For some launches, the SRMU will be used to provide increased thrust for the Titan IV vehicle so that it can launch Shuttle-class DOD payloads. The SRMU will increase payload capacity 25 to 35% above that of the Titan IV-Type 1 vehicle. To achieve the increased launch rates proposed for the Titan IV program and to process the larger SRMU, new facilities and modifications to existing facilities are needed at CCAFS and VAFB.

1.1.2 Project Location

1.1.2.1 Cape Canaveral Air Force Station

CCAFS is located along the eastern coast of Florida near the city of Cocoa Beach in Brevard County (Fig. 1.1). The base is 15 mi north of Patrick AFB and adjacent to the National Aeronautics and Space Administration's (NASA's) Kennedy Space Center (KSC). CCAFS occupies 15,800 acres (25 mi^2) of a barrier island that is bounded on the east by the Atlantic Ocean and on the west by the Banana River.

The facilities at CCAFS that would be affected by the proposed action are located in the northwest portion of the base, as indicated in Fig. 1.2. These include Launch Complexes (LCs) 40 and 41 and the Titan Integrate-Transfer-Launch (ITL) Area immediately south of the LCs. A new facility, the SMAB, is proposed to be constructed at a site near the ITL area on narrow man-made causeway in the Banana River. The relative locations of these facilities are shown in Fig. 1.3.

The ITL Area is located on a man-made island in the Banana River; the LCs are located on previously disturbed land and are industrial in character. LCs 40 and 41 were constructed in 1963-64. LC-41 was used by the USAF from 1964 to 1977 for Titan launches; it was reactivated in 1986 and renovated to support Titan IV launches. LC-40 has been used for Titan launches from 1964 to the present. The site for the proposed new SMAB is currently vacant except for a railroad spur on which rail cars containing rocket fuel and oxidizer are stored.

1.1.2.2 Vandenberg Air Force Base

VAFB, occupying 98,400 acres (154 mi^2) along the south central coast of California, is located 140 mi northwest of Los Angeles and about 5 mi west of Lompoc in Santa Barbara County (Fig. 1.4). VAFB is bounded by the Pacific Ocean to the west and south. VAFB is bisected by Ocean Avenue, which runs from Lompoc to a public beach at Surf (Fig. 1.5). VAFB was formed in 1957 when Camp Cooke Army Post was transferred to the

ORNL-DWG 89-10581R

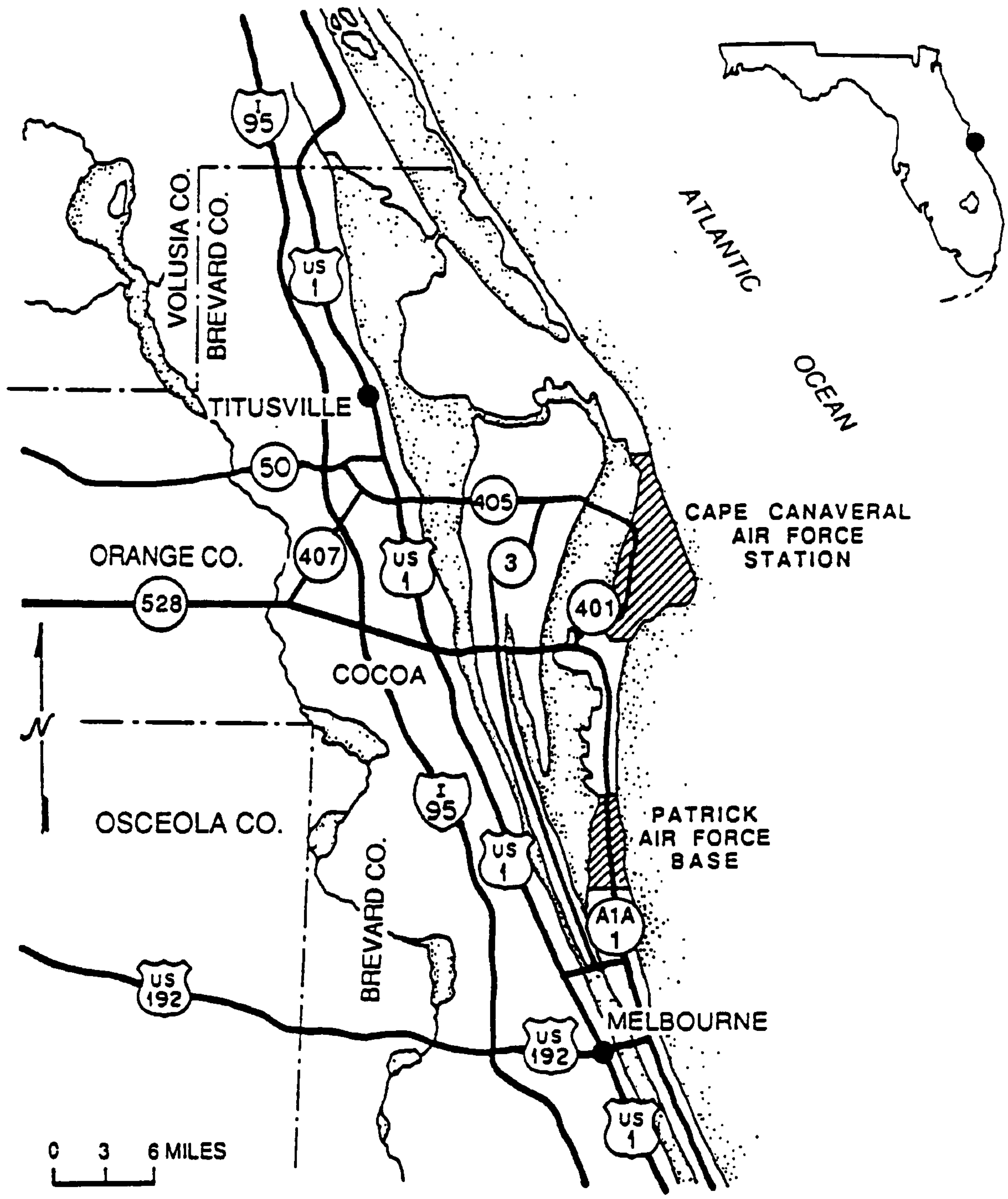


Fig. 1.1. Regional location of Cape Canaveral Air Force Station, Florida.

ORNL-DWG 89-10582R

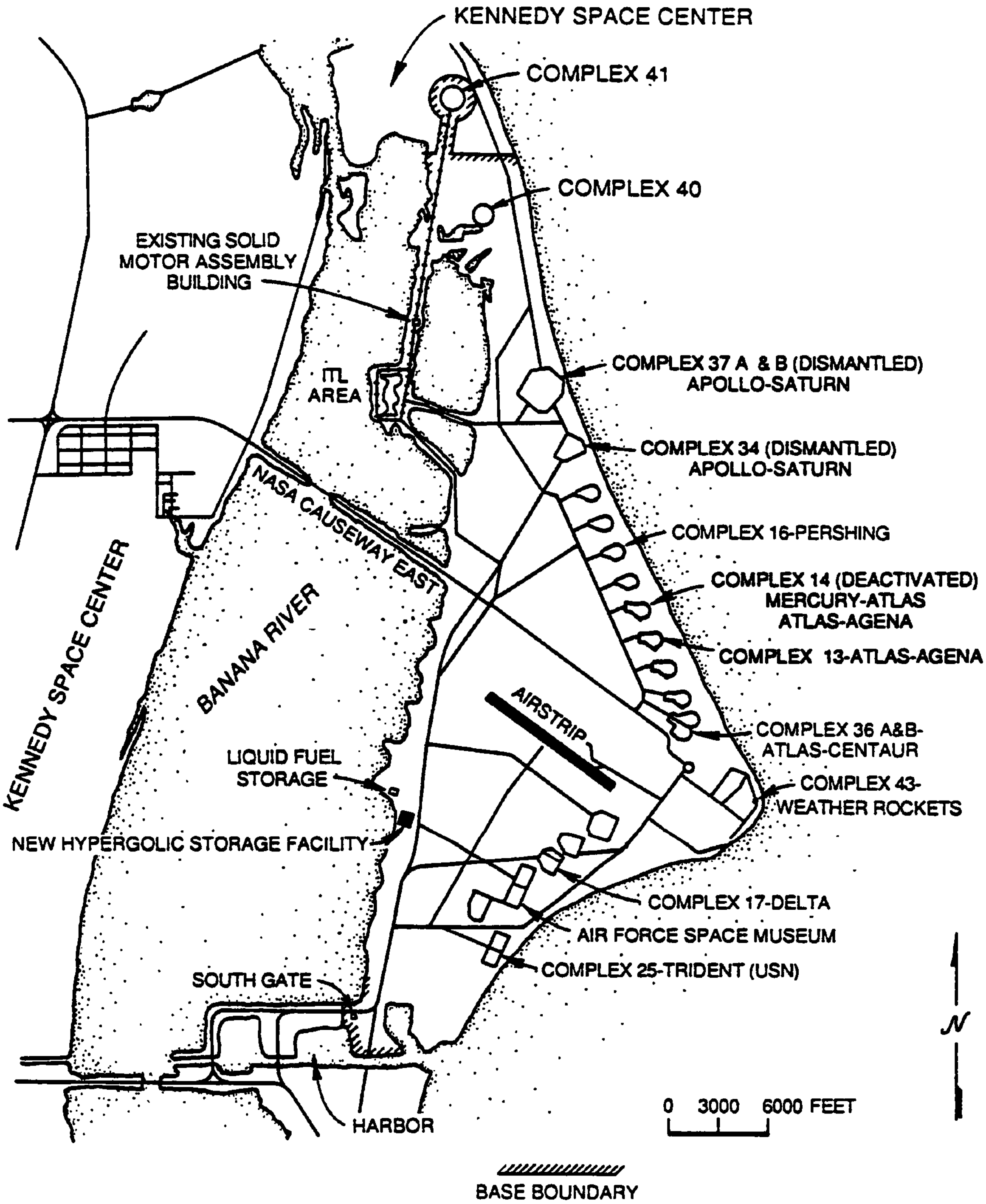


Fig. 1.2. Launch complexes and support facilities at Cape Canaveral Air Force Station, Florida.

ORNL-89-10583R2

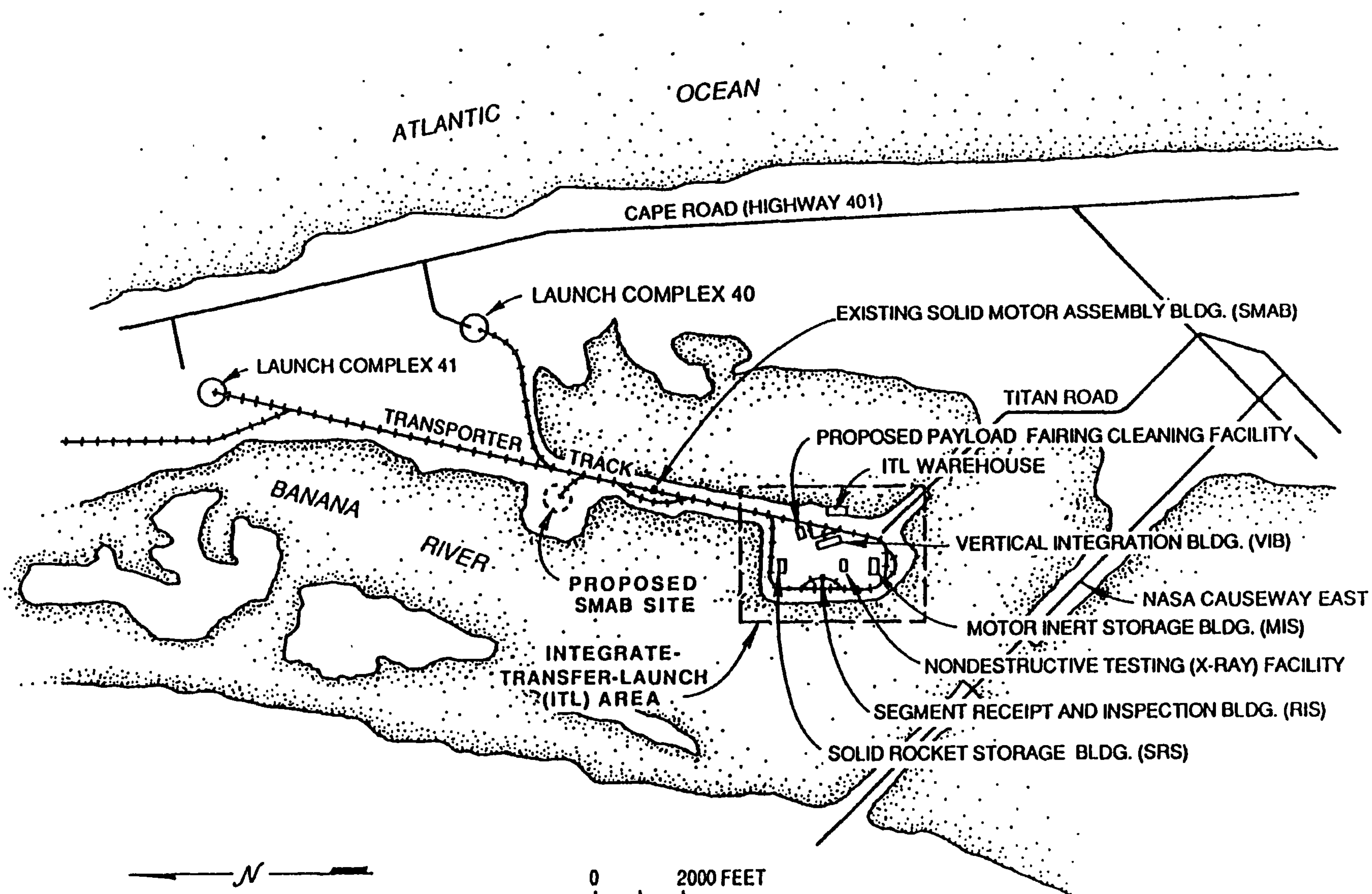


Fig. 1.3. Locations of existing and proposed Titan IV program facilities at Cape Canaveral Air Force Station, Florida.

ORNL-DWG 89-10584

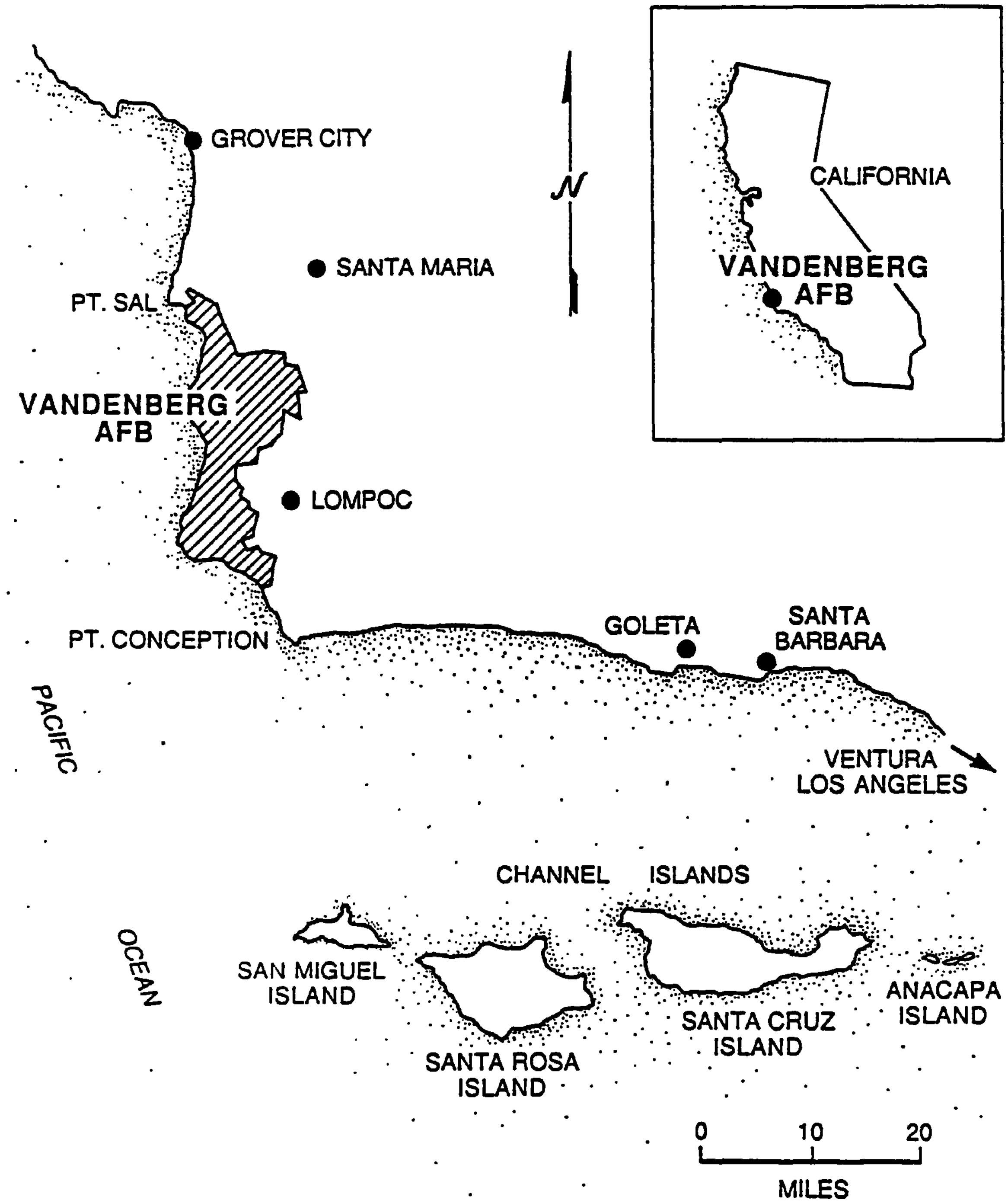


Fig. 1.4. Regional location of Vandenberg Air Force Base, California.

ORNL-DWG 89-12014R3

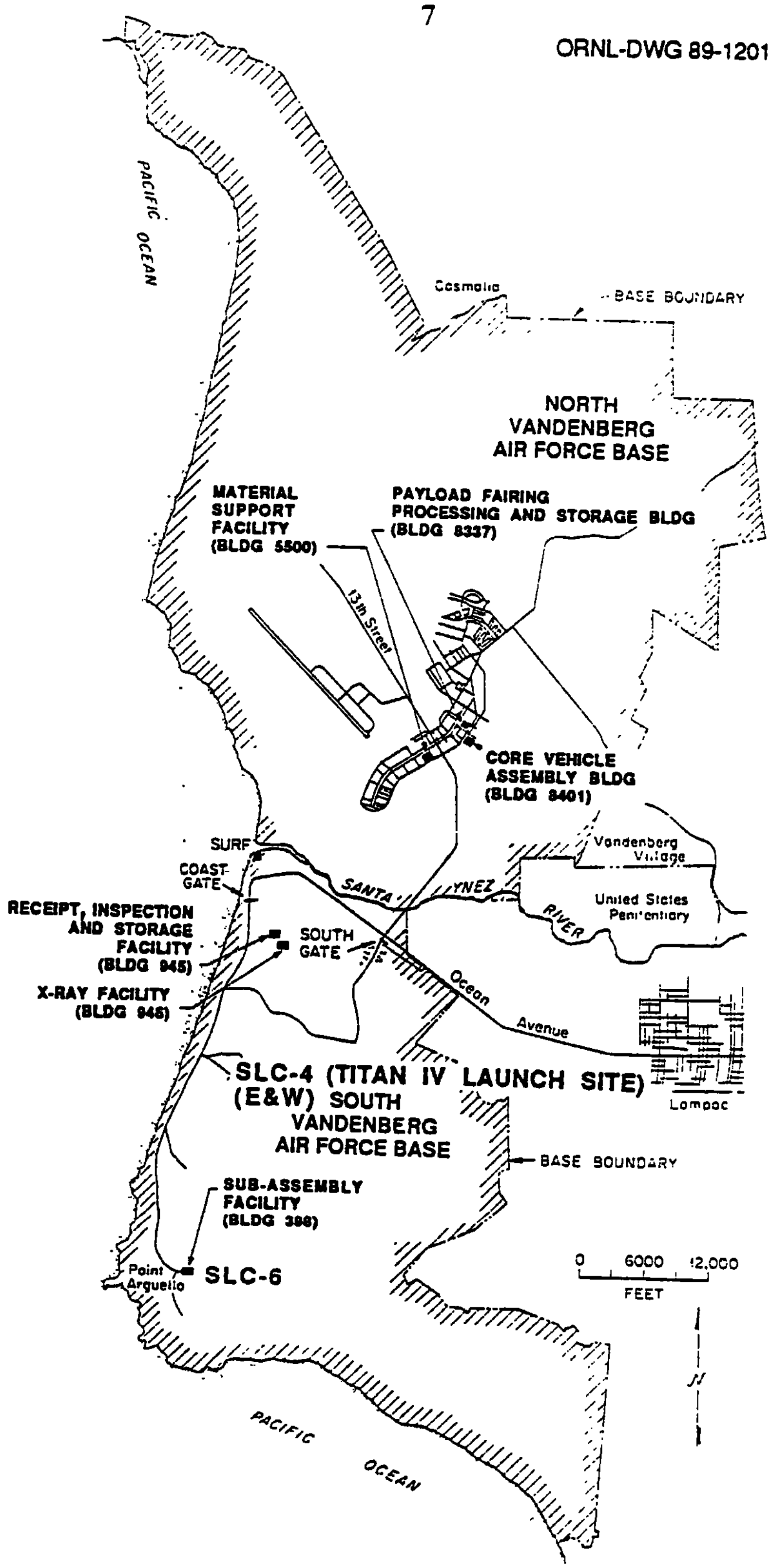


Fig. 1.5. Location of existing Titan IV program facilities, Vandenberg Air Force Base, California.

USAF; the south portion of the base (South VAFB), originally the Naval Missile Facility at Point Arguello, came under USAF control in 1962.

The facilities at VAFB that would be affected by the proposed action are located on South VAFB. These include the Space Launch Complex (SLC) 4E, from which the Titan IV vehicles would be launched, and the Solid Rocket Sub-Assembly Facility (SRSF), located at SLC-6.

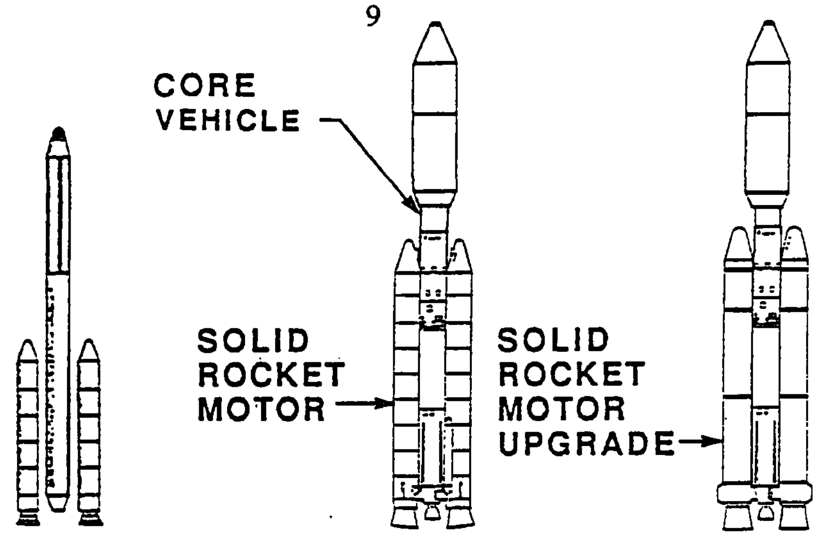
1.1.3 Background

1.1.3.1 Evolution of the Titan IV program

The Titan IV program has evolved rapidly since 1985 when the USAF began the Complementary Expendable Launch Vehicle (CELV) program to provide launch capability to supplement the Space Shuttle. The CELV program developed the Titan 34D7 launch vehicle, an expanded version of the Titan 34D (Fig. 1.6). The USAF initially planned to launch 10 CELVs from CCAFS. An Environmental Assessment (EA) for this program evaluated the impacts of modifications to LC-41 and 10 launches of the CELV (USAF 1986). That EA supported a Finding of No Significant Impact (FONSI), which is included in App. A of this document.

In mid-1986, the USAF expanded the CELV program to 23 launches (total) from CCAFS and VAFB. At that time, the Titan 34D7 was renamed Titan IV. A supplement (USAF 1988a) to USAF (1986) addressed the increased number of launches and modifications to facilities at CCAFS, and a separate EA was prepared for the Titan IV launches from VAFB (USAF 1988b). FONSIs for these EAs are also provided in App. A.

In October 1987, the USAF began developing the SRMU, a larger, modified solid rocket motor (SRM) intended to increase the payload capacity of the Titan IV by 25-35%. The USAF prepared an EA to evaluate the impacts of test facility modifications and testing of the SRMU at Edwards AFB (USAF 1988c; see App. A for FONSI).



Space launch vehicle	Titan 34D (predecessor to the Titan IV)	Titan IV—Type 1, originally called the Complementary Expendable Launch Vehicle or Titan 34D7	Titan IV/Solid Rocket Motor Upgrade, or Titan IV—Type 2
Launch sites and dates	Launched 1983-89 from Space Launch Complex 4 East, Vandenberg Air Force Base (VAFB) and from Launch Complexes 40 and 41 at Cape Canaveral Air Force Station (CCAFS)	First launched June 1989 from CCAFS. Launches planned from VAFB and CCAFS from 1989 through 1995	To be launched from CCAFS and VAFB 1992–1995
Height	161 ft	204 ft	204 ft
Number of solid rocket motor segments	5-1/2	7	3
Capacity (design specification)	4,200 lb to geosynchronous orbit 27,500 lb to low earth orbit	10,000 lb to geosynchronous orbit 32,000 lb to low earth orbit	12,700 lb to geosynchronous orbit 40,000 lb to low earth orbit

Fig. 1.6. Evolution of the Titan IV launch vehicle.

1.1.3.2 Description of the Titan IV launch vehicle

The typical Titan IV launch vehicle (designated Type 1) consists of the following components: (1) a two-stage core vehicle, which uses liquid propellants, nitrogen tetroxide (N_2O_4) oxidizer, and Aerozine 50 fuel [equal parts hydrazine (N_2H_4) and unsymmetrical dimethylhydrazine (UDMH)]; (2) two SRMs, each with seven segments of solid fuel consisting primarily of ammonium perchlorate and aluminum powder in an organic binder; (3) an upper stage, either a Centaur or an Inertial Upper Stage (IUS); and (4) a payload fairing (a protective shield) with the same 15 × 60 ft capacity as the Space Shuttle Orbiter's payload bay. An alternative configuration for Titan IV has no upper stage. The performance specification for the Titan IV–Type 1 is 10,000 lb from CCAFS to geosynchronous orbit (GEO) and 32,000 lb from VAFB to a polar low earth orbit (LEO) with an altitude of about 100 nautical miles.

The SRMU consists of three segments instead of seven, and its diameter (126 in.) is 5% larger than the existing SRM (120 in.) (see Fig. 1.6). The performance specification for Titan IV/SRMU (designated Type 2) is 12,700 lb to GEO and 40,000 lb to LEO. Figure 1.7 shows two configurations of the Titan IV-Type 2 (SRMU), one with a Centaur upper stage, the other, no upper stage (NUS).

1.1.3.3 Pre-launch processing

The processing of launch vehicles at CCAFS and VAFB includes receipt of components, inspection, storage, assembly, testing, and transport to the launch pad. The present processing steps and facilities at CCAFS and VAFB are shown in Figs. 1.8 and 1.9.

At CCAFS, the core vehicle is assembled and inspected at the Vertical Integration Building (VIB) located in the ITL Area. The solid fuel segments of the SRM are transported to the Receipt, Inspection, and Storage (RIS) Facility and, after preparation and inspection, stored in the Solid Rocket Storage Facility. The inert segments of the SRM (nose cone, aft skirt, nozzle, and exit cone) are processed in the Motor Inert Storage Facility, where the payload fairings are also prepared. In the assembly of an SRM for a

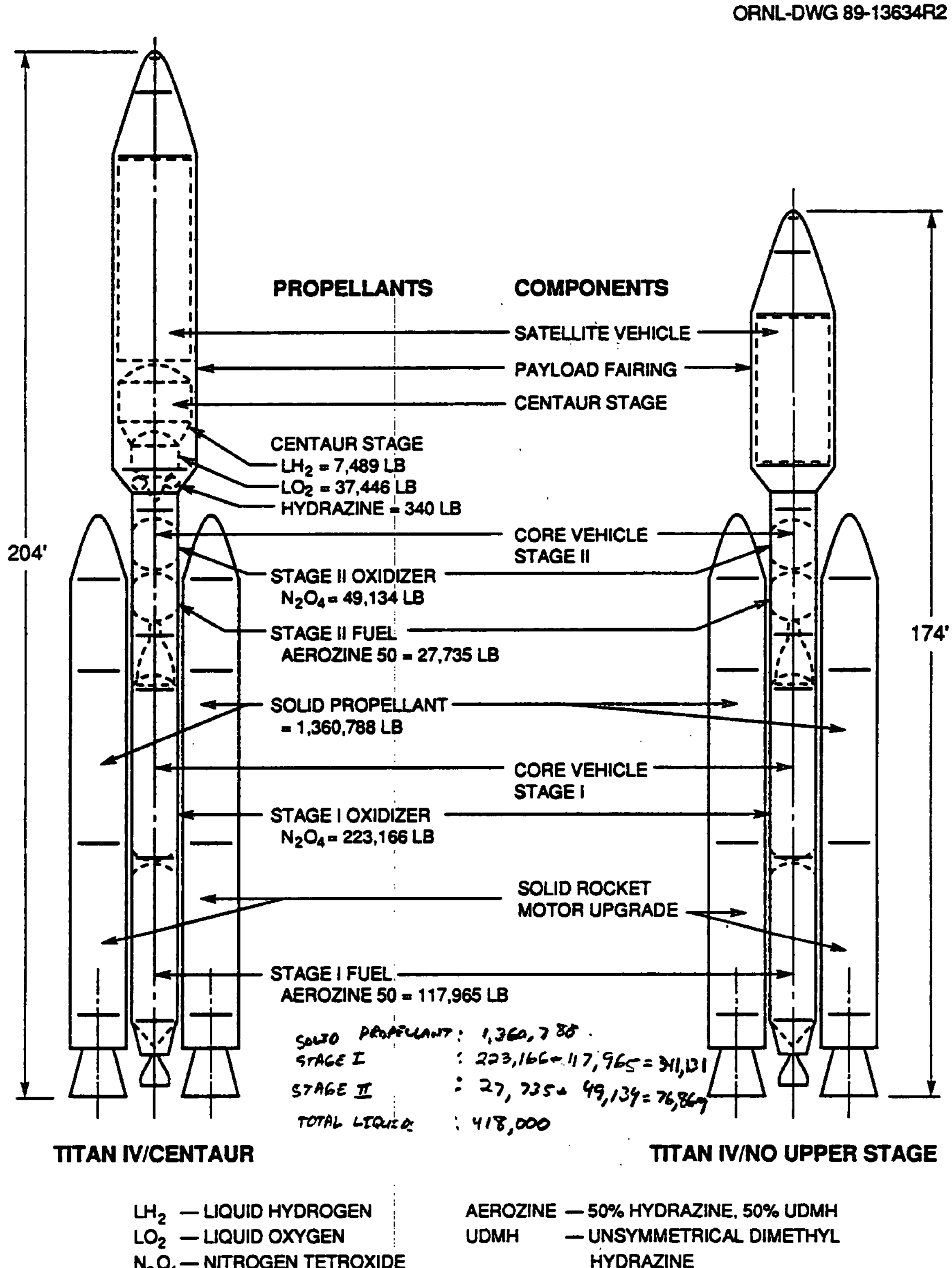


Fig. 1.7. Titan IV/Solid Rocket Motor Upgrade (SRMU) launch vehicle. Two configurations are shown, with the Centaur upper stage (left) and no upper stage (NUS) (right).

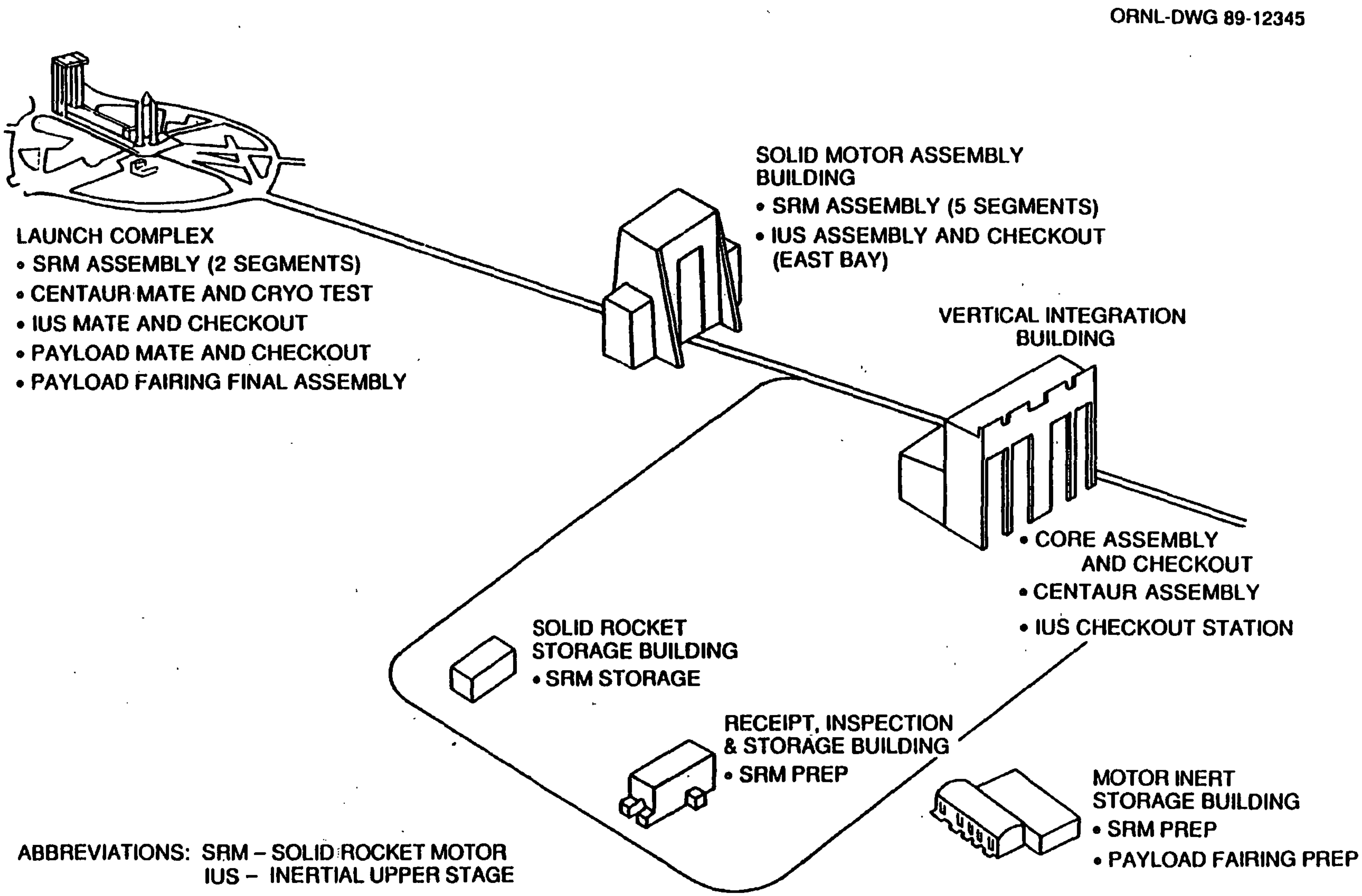


Fig. 1.8. Existing processing facilities for Titan IV launch vehicles, Cape Canaveral Air Force Station, Florida.

ORNL-DWG 89-13636R

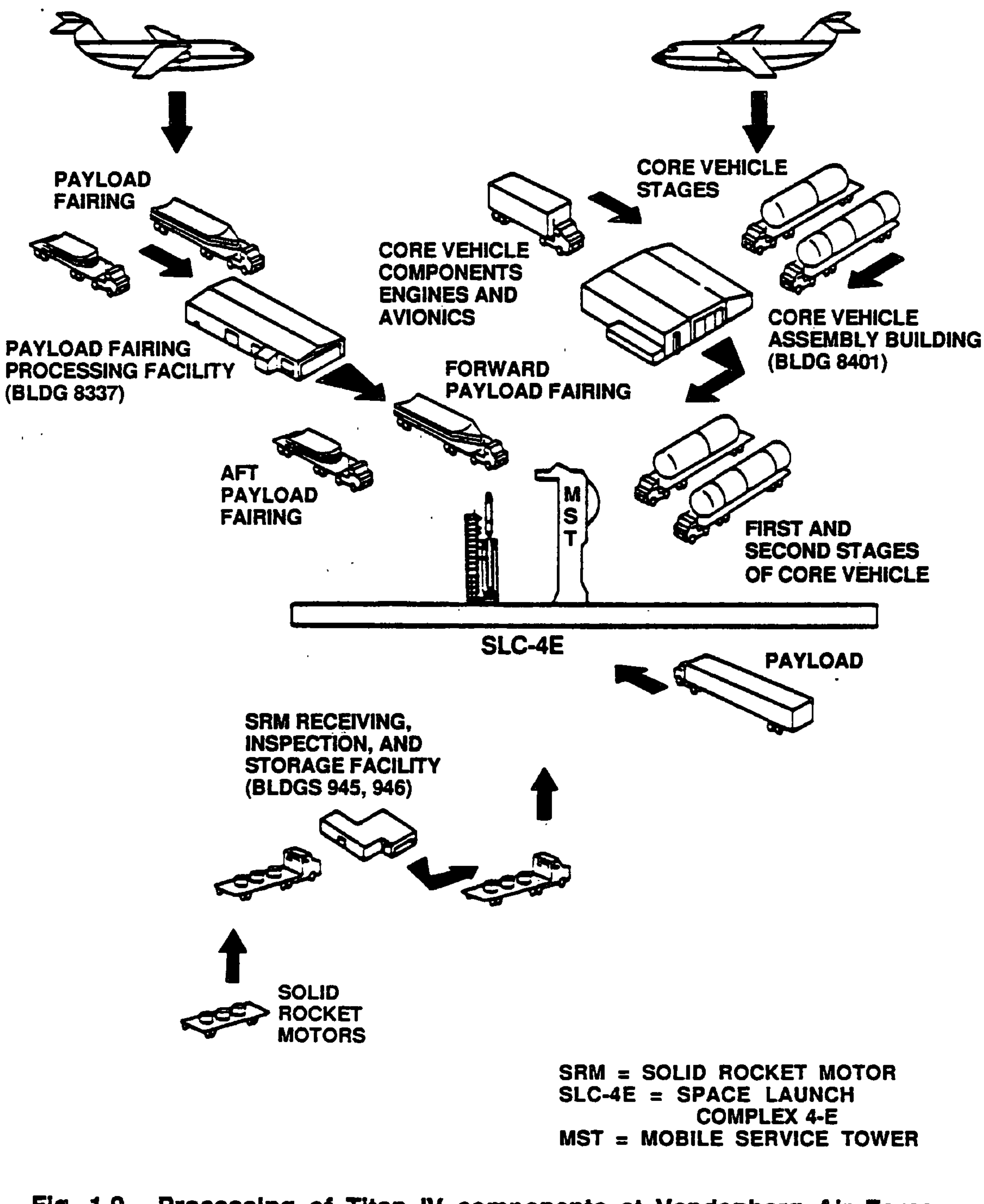


Fig. 1.9. Processing of Titan IV components at Vandenberg Air Force base, California.

Titan IV vehicle, five of the fuel segments and the bottom inert segments are moved by rail moved by rail to the existing SMAB and stacked. The SMAB was designed for assembly of the five-segment SRM for the Titan 34D. Because of limitations in the lifting capability and location of the 305-ton crane in the SMAB, all seven segments of a Titan IV SRM cannot be stacked there. The remaining two fuel segments and the inert nose cone are added at the LC. The core vehicle is moved from the VIB on the rail transporter to the SMAB, where the partially completed (five-segment) SRMs are attached to it. The launch vehicle, minus two solid fuel segments and the nose cone, is transported to the LC where stacking of SRMs is completed. Finally, the upper stage, payload, and payload fairing are integrated with the launch vehicle on the launch pad. The core vehicle then undergoes final combined system tests, is loaded with liquid fuel, and is ready to be launched.

At VAFB, the core vehicle is assembled at Bldg. 8401 on North VAFB (Fig. 1.5). Payload fairings are cleaned, coated, painted, and stored at Bldg. 8337, North VAFB. The SRM fuel segments are transported by truck to the RIS Facility on South VAFB (Bldg. 945) for subassembly, inspection, weighing, and storage. The SRMs are also examined at the X-ray Facility (Bldg. 946) adjacent to the RIS. All the components of the launch vehicle are brought by truck to SLC-4E and assembled on the pad.

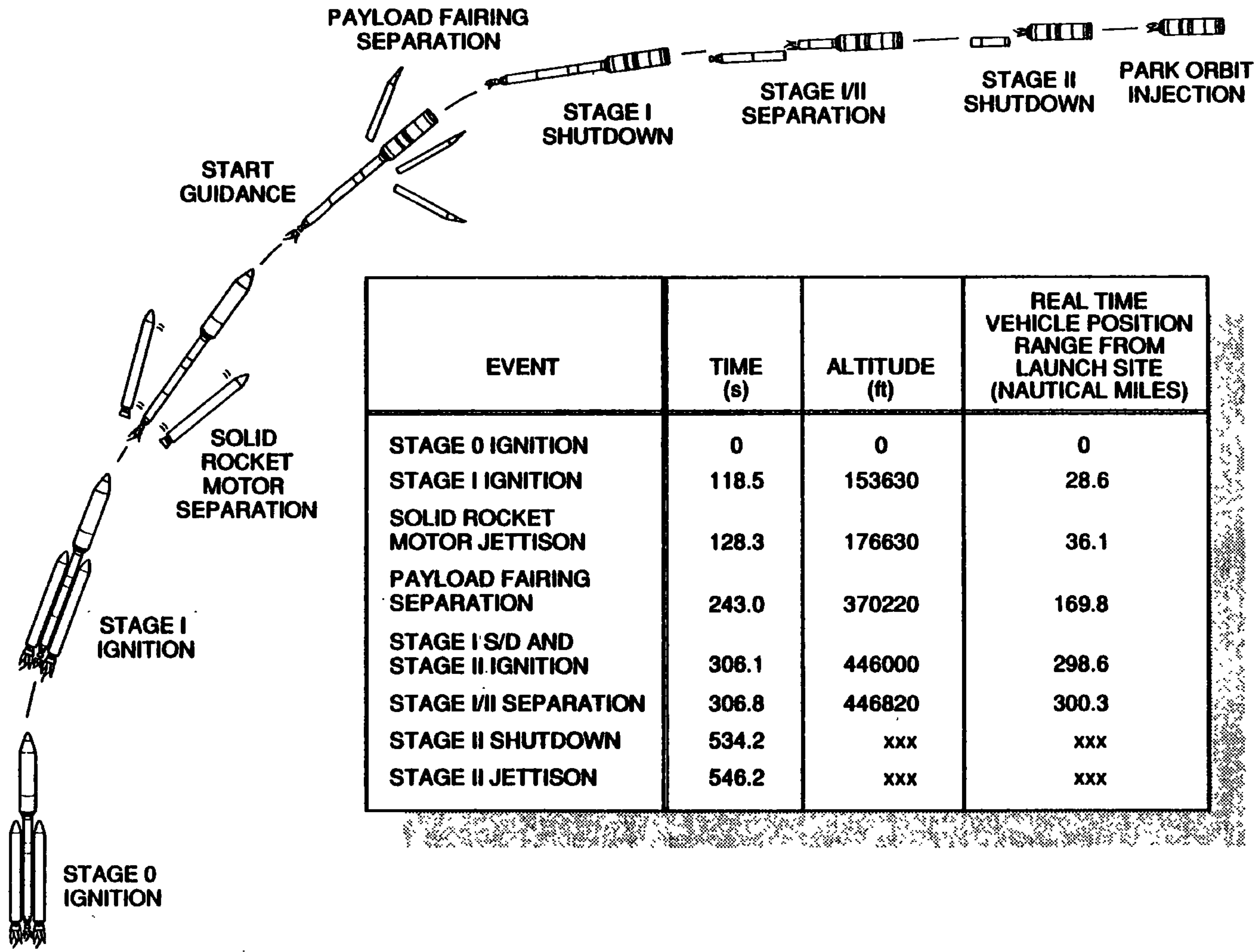
1.1.3.4 Launch and flight

The launch and flight of a Titan IV (Fig. 1.10) begin with ignition of the SRMs, which burn for about 2 min. At 29 mi above the earth, the Stage 1 motors ignite, quickly followed by jettison of the SRMs. The payload fairings are jettisoned after about 4 min of flight, and Stage 1 shutdown/Stage 2 ignition occurs after about 5 min. In less than 9 min from liftoff, Stage 2 is shut down and jettisoned and the payload is in a low earth "parking" orbit.

1.1.4 Project Description

The proposed action consists of (1) an increase in the Titan IV launch rate from CCAFS and VAFB from 24 to 37 through 1995, (2) the development and use of an

ORNL-DWG 89M-13635



EVENT	TIME (s)	ALTITUDE (ft)	REAL TIME VEHICLE POSITION RANGE FROM LAUNCH SITE (NAUTICAL MILES)
STAGE 0 IGNITION	0	0	0
STAGE I IGNITION	118.5	153630	28.6
SOLID ROCKET MOTOR JETTISON	128.3	176630	36.1
PAYLOAD FAIRING SEPARATION	243.0	370220	169.8
STAGE I S/D AND STAGE II IGNITION	306.1	446000	298.6
STAGE I/II SEPARATION	306.8	446820	300.3
STAGE II SHUTDOWN	534.2	xxx	xxx
STAGE II JETTISON	546.2	xxx	xxx

Fig. 1.10. Reference mission for the Titan IV-Type 1, no upper stage.

Table 1.1. Planned launches of Titan IV vehicles

Fiscal year	Launch site LC-40	LC-41	SLC-4E	Total
1991	0	3	2	5[a]
1992	3	3	2	8[b]
1993	3	3	2	8[c]
1994	3	3	2	8[c]
1995	3	3	2	8[c]
Total	12	15	10	37

[a]All Titan IV, Type 1.
[b]50% Type 1, 50% Type 2 (SRMU).
[c]All Type 2 (SRMU).

enhanced Titan IV vehicle having larger solid rocket motors (SRMUs) capable of carrying Shuttle-class payloads, and (3) the expansion and renovation of Titan launch and support facilities at CCAFS and VAFB to process and handle the increased launch rates and larger Titan IV-Type 2 (SRMU) vehicles. The planned launch schedule for the Titan IV, Types 1 and 2, is given in Table 1.1 From 1991 to 1995, there would be a transition from the use of Type 1 vehicles to Type 2.

Proposed construction and operations at CCAFS are described in Sect. 1.1.4.1. Existing facilities at CCAFS are not capable of processing SRMs and SRMUs at a rate that could support the proposed launch frequencies. Launch frequencies are also limited at present, because only one launch pad (LC-41) is available and because SRM assembly and inspection must be completed on the pad (see Sect. 1.1.3.3). The proposed action would provide a second SMAB that could accommodate a three-segment SRMU or a seven-segment SRM, thereby eliminating on-pad assembly and increasing the pre-launch processing rate. An additional launch site (LC-40) would be renovated to support the launch of Titan IV–Type 1 and Type 2 (SRMU).

The existing facilities at VAFB are adequate to support the proposed launch rates. However, modifications are needed at Bldg. 398 for processing and storage of the larger SRMU segments and at SLC-4E to accommodate the larger SRMU. Details of the proposed actions at VAFB follow in Sect. 1.1.4.2.

1.1.4.1 CCAFS proposed activities

Construction and operation of a new SMAB

The proposed SMAB (Fig. 1.11) would provide an additional facility for processing SRMs, thus facilitating increased launch rates of the Titan IV from CCAFS. Operation of the facility would involve assembly-line stacking of the SRMU segments, nondestructive testing and checkout of SRMUs, storage of assembled SRMUs, and mating of assembled SRMUs with core vehicles.

Construction of the new SMAB would commence with the demolition of existing fuel storage facilities at the proposed site and the removal of an existing rail spur, water lines, and storm drainage culverts. The existing rail car storage area would not be relocated. In the future, fuel and oxidizer would be stored in a hypergolic storage facility now under construction on the west side of CCAFS 2 mi south of NASA Causeway East (Fig. 1.2). The site has been evaluated to determine if fuel and oxidizer storage there has resulted in groundwater contamination; no evidence of contamination was found (Morton 1989).

The new SMAB would cover 59,600 ft^2 and would be 240 ft high. The building would be supported by a deep pile foundation and a reinforced concrete floor slab. The vertical construction would consist of a structural steel frame with an 8 ft high, hardened reinforced concrete exterior wall at ground level and aluminum siding above. Two interior overhead cranes would be installed in the new SMAB; load capacities would be 500 tons and 220 tons, with 60-ton and 25-ton auxiliary crane capacities, respectively. The project would also include construction of a guardhouse and a double-track transporter spur from the existing tracks into the assembly building. Double perimeter fencing, security lighting, and other security requirements would be provided. Access drives and paving would be installed around the building, and a 75-space parking area would be located outside the perimeter fence. A packaged sewage treatment plant with a drain field and a storm drainage system with a retention pond would be installed. Electrical, water, and communications utilities would be connected to the new facility from existing systems at CCAFS. The proposed layout of the new SMAB, associated facilities, utilities, and the railroad spur is shown in Fig. 1.12.

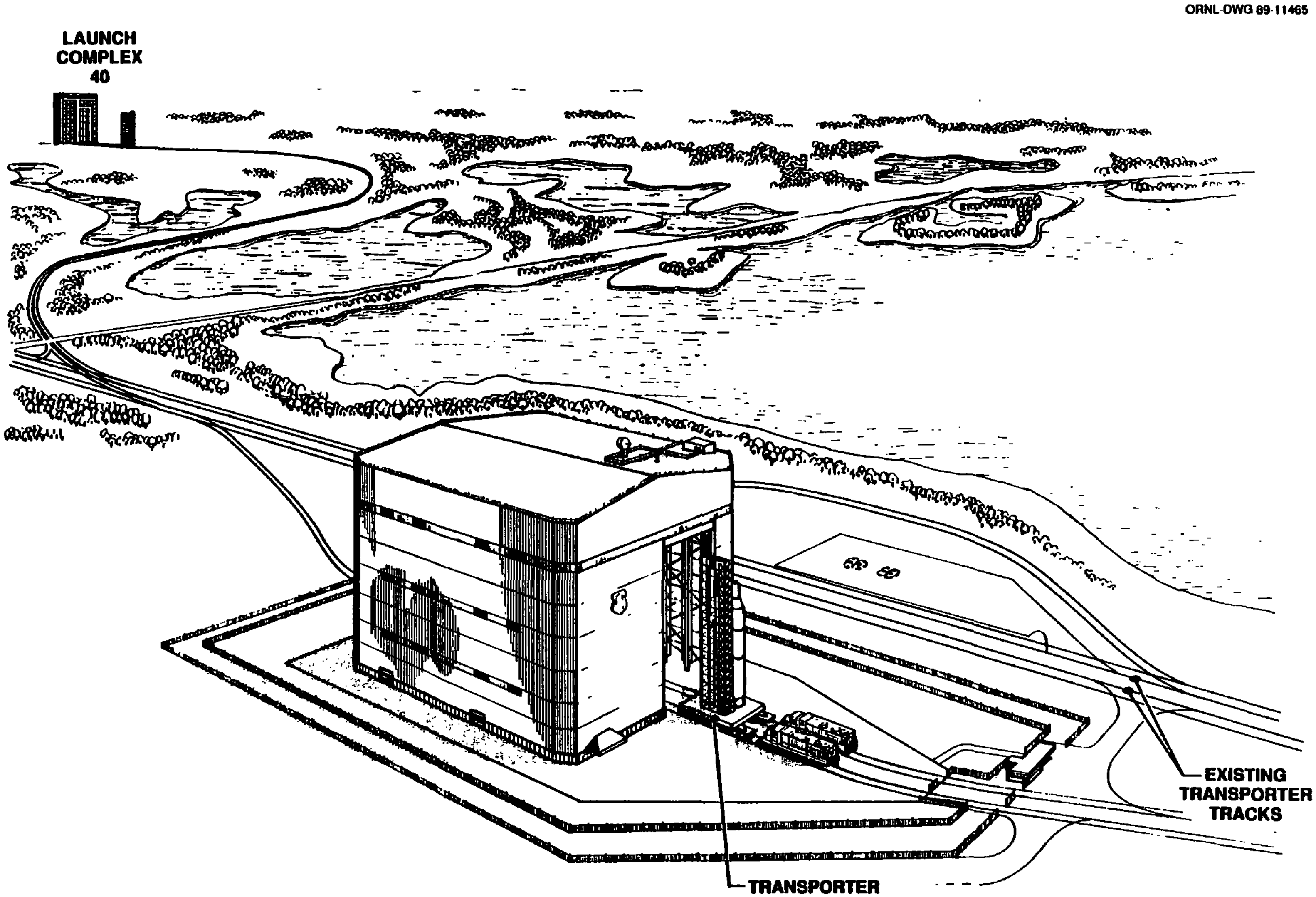


Fig. 1.11. Architectural drawing of the proposed Solid Motor Assembly Building.

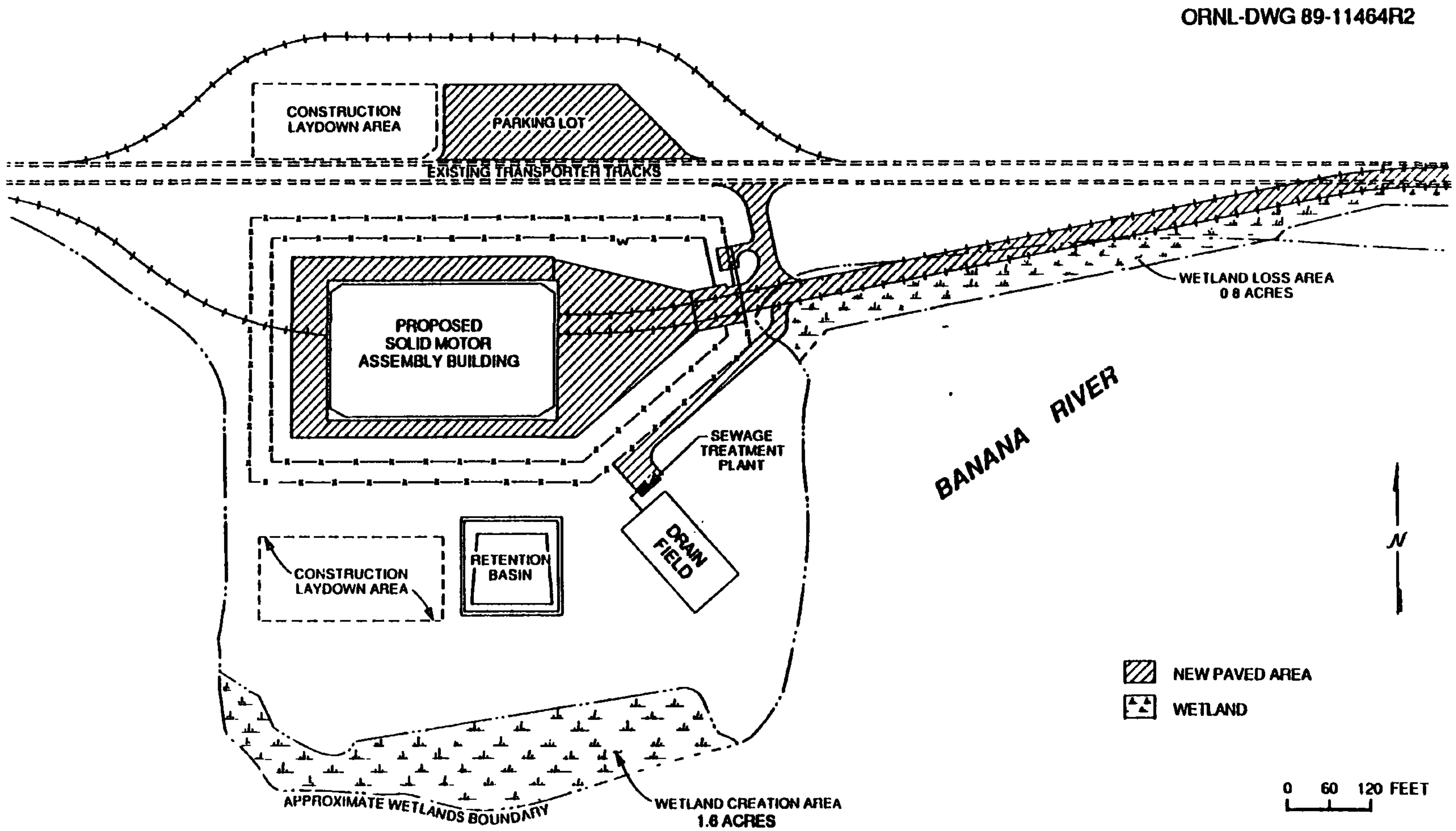


Fig. 1.12. Proposed layout of the new Solid Motor Assembly Building site.

The new SMAB would support the following Titan IV operations:

1. Receiving and inspecting solid-fuel motor segments and components. This function within the new SMAB would consist primarily of mechanical handling of segments with large cranes and ultrasonic examination of the SRMU to ensure that the solids have not been damaged.
2. Handling, storage, and environmental control of solid-fuel motor segments and stacked SRMUs. The new SMAB would be able to store one flight set (two aft, two center, and two forward segments) before stacking; two flight sets fully assembled in storage stands; two flight sets in various stages of assembly; and one set on the transporter with the core vehicle.
3. Assembly of all components of solid motor segments. Nose cones would be received by truck and moved to a designated area where cables, boxes, batteries, solid stage separation rockets, and the controlled high energy firing unit would be installed. Cable raceways and cables would be installed in all three segments of the SRMU at another area, and cork-type insulation would be attached with an ambient-cure adhesive to the forward segment and attachment and the aft segment and skirt.
4. Stack buildup (complete) for one pair of SRMUs, including installation and checkout of the destruct systems. The final assembly of the SRMU would be performed in the vertical position in the stacking cell area of the new SMAB.
5. Integration of the stacked SRMUs with the Titan IV core vehicle, to be performed in the transporter area of the new SMAB.
6. Preparation for transporter roll-out of the totally integrated launch vehicle minus the upper stage, payload fairing, and space vehicle (payload).
7. Processing of up to eight Titan IV vehicles per year.
8. Stacking and destacking of one pair of SRMs.

Construction of the new SMAB would result in typical construction-related emissions from vehicle exhaust and earthwork activities. Installation of the transporter spur at the new SMAB would require filling 0.8 acre of wetlands south of the proposed site along the western edge of the causeway (Fig 1.12). To compensate for this loss of wetlands, a new 1.6-acre wetlands area would be created along the Banana River at the western edge of the

SMAB site. Creation of the wetlands area would involve removal of soil to lower the grade of the designated area so that it would be intermittently flooded and would support wetland vegetation. Details on wetlands creation are provided in Sect. 3.1.8.

Operation of the new SMAB would consist of mechanical handling and assembly activities, with no atmospheric emissions expected under normal circumstances, other than vehicle and equipment exhaust. Liquid effluents from the new SMAB would include stormwater runoff and treated sanitary sewage. Stormwater runoff would be discharged to the Banana River, after retention in a settling pond (see Fig. 1.12), in accordance with a permit from the Florida Department of Environmental Regulation (FDER). Treated wastewater from the sewage plants would be discharged to a drainage field (Fig. 1.12) in accordance with a separate FDER permit.

Solid nonhazardous wastes from construction of the new SMAB would include spoils from excavation, vegetation debris, and conventional construction wastes such as wood and metal scrap. Hazardous wastes would include paint wastes, oils and grease, and solvents. During operation, nonhazardous solid wastes would consist of ordinary trash and sludge from a sewage treatment plant. Hazardous wastes from operations might include rags contaminated with cleaning solutions and wastes associated with the sealing adhesives used in the assembly of the SRMUs.

Construction and operation of new Payload Fairing Cleaning Facility

The existing ITL facilities at CCAFS are not capable of cleaning and storing Titan IV payload fairings to meet the launch frequency of the Titan IV program. Because of the proposed increased launch rate, further processing capability is needed. A 12,750-ft^2 PFCF would be constructed on the northeast corner of the VIB in the ITL area. The structure would consist of an airlock high bay, two cleaning booths, and miscellaneous floor space for lockers and a control room. Two overhead cranes would be installed to service the high bay area and cleaning booths.

The PFCF would be used for final cleaning of the fairing. The fairing trisectors would be cleaned for gross contamination in the existing facility and the exterior surface would be painted. The trisector would then be moved to a clean room in the new facility.

Final cleaning would be done by placing Freon-113 on a lint-free cloth and wiping the fairing interior surfaces. Methyl-ethyl-ketone (MEK) may be needed to clean small areas. The estimated quantities required for each fairing are 5 gal of Freon and 1 gal of MEK. After the fairing is properly cleaned, the acoustic blankets would be installed on the inside surface. The fairing would then be wrapped with plastic for storage or transfer to the launch pad. One fairing processing period would take about 30 days. Waste Freon-113 and MEK would be collected and stored at a permitted hazardous waste accumulation area at the VIB until disposal off-site by an approved contractor.

Modifications to LC-40

Modifications to LC-40 to support the launch of the Titan IV-Types 1 and 2 would include (1) construction of a new Mobile Service Tower (MST), (2) construction of a new Umbilical Tower (UT), (3) construction of a trailer shed north of the Aerospace Ground Equipment (AGE) building, (4) construction of a new air conditioning (A/C) shelter, and (5) installation of an overpressure suppression system (OSS) at the center of the launch pad. The layout of LC-40 and the location of proposed new facilities are shown in Fig. 1.13. New facilities would be located on previously disturbed land. The new UT would be erected in the parking position of the existing MST, which would provide services during the construction period. The annex to the AGE building and the A/C shelter would be constructed to the structural, mechanical, and electrical specifications of the existing AGE and A/C facilities at LC-41. The design criteria for LC-40 will incorporate Centaur requirements in all necessary facilities.

The OSS would use pressurized gaseous nitrogen (GN_2) to inject water directly into the SRM/SRMU exhaust to reduce the shock wave that occurs at SRM ignition as a result of the interaction between SRM exhaust and the launch pad exhaust duct. The system would consist of a water distribution manifold for each SRM, nozzles for injecting about 5000 gal water into the SRM plume, and a high-pressure GN_2 system to control delivery of water to the exhaust duct. The OSS would supplement the deluge water system used to reduce noise and provide cooling at the pad during launch.

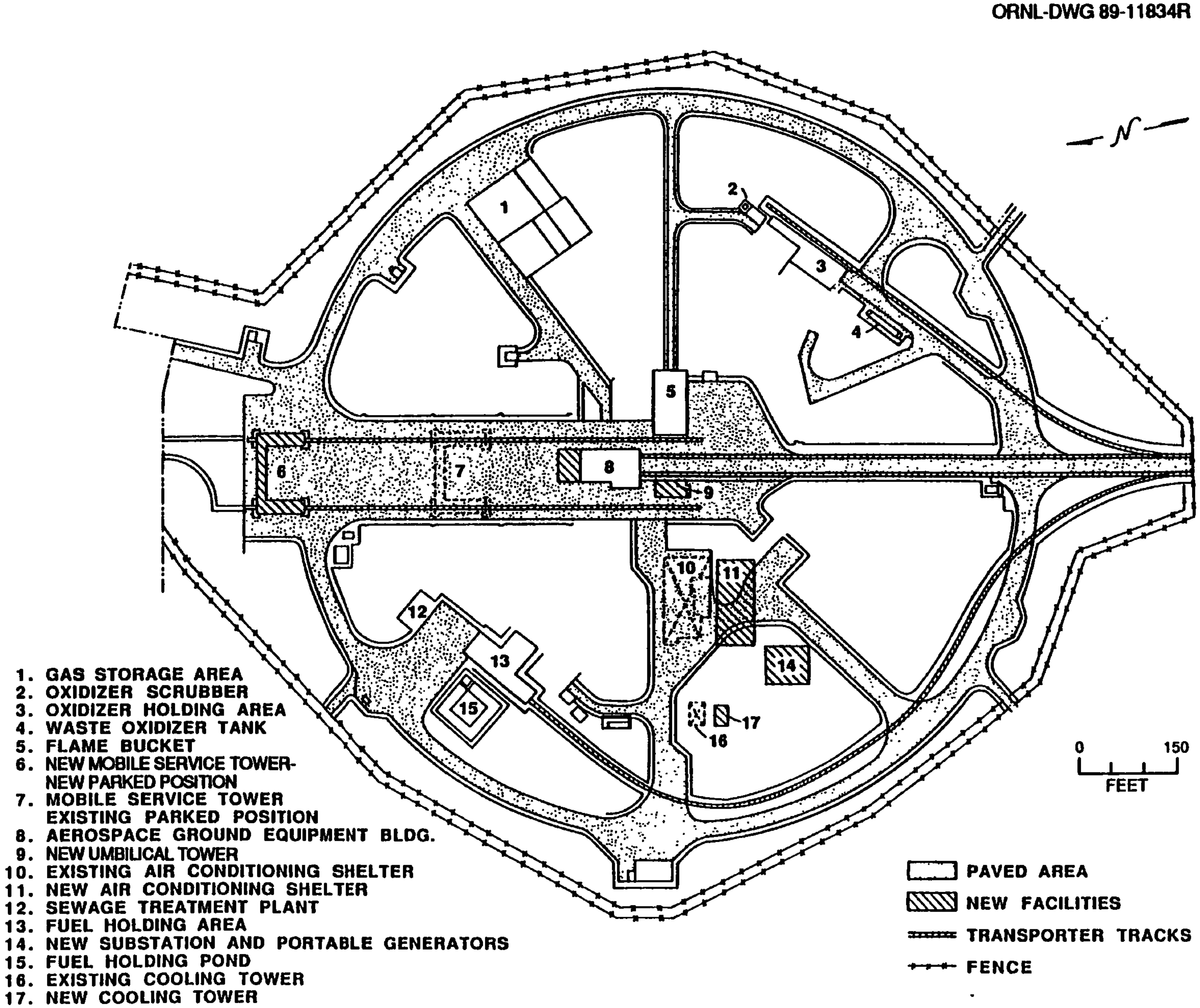


Fig. 1.13. Existing and proposed layout of Launch Complex 40 at Cape Canaveral Air Force Station, Florida.

The MST would be constructed at either LC-34 or 37, which have been dismantled (see Fig. 1.2 for location). It is anticipated that steel and materials would be delivered to CCAFS by over-the-road trailers. The steel would be placed at the proposed construction site at LC-34 or 37. The modules would be fabricated and then delivered to LC-40 by over-the-road vehicles for final erection. Operations to be conducted at the module fabrication site would be welding, sandblasting, grinding, and painting. Portable power units would be required for lighting and equipment operation. Existing CCAFS roads would be used but may need improvements and widening at some locations.

Atmospheric emissions during the proposed modifications would include fugitive dust and vehicle and equipment exhaust. No liquid effluents other than sanitary sewage would be generated. Solid wastes would consist of nonhazardous conventional construction wastes (wood and metal scrap) and hazardous wastes such as paint waste, oils, grease, and solvents.

Other modifications

LC-41, which has a layout identical to that of LC-40 (Fig. 1.13), would require structural, mechanical, and electrical modifications to the MST and UT to make them capable of supporting the Titan IV–Types 1 and 2. The AGE building and A/C shelter would be evaluated to determine their capability of withstanding the pressure, force, and temperature from the firing of the SRMU. The launch platform would be modified to support the SRMU. An OSS would be installed as described previously for LC-40 and would function in the same manner.

The existing SMAB would undergo the following changes to accommodate the SRMU: (1) modification of the northeast and southeast stacking cell platforms; (2) modification of the SRM sling support platform, installation of a new SRMU 220-ton bar sling support platform, modification of the SMAB structure to accommodate the new sling configuration as well as the new 220-ton bar sling; (3) modification, as required, of the SRM frame supports in the northeast and southeast stacking cells; (4) modification of four removable support piers and foundations; (5) removal of eight concrete piers and replacement with eight removable support piers and foundations; and (6) modification of existing foundation as necessary to support railcar hardcovers. Modifications would allow alternation of Titan IV–Type 1 and Titan IV–Type 2 (SRMU) assembly with a minimum of effort and parts handling.

Atmospheric emissions during the proposed modifications of LC-41 and the SMAB would include fugitive dust and vehicle and equipment exhaust. No liquid effluents other than sanitary sewage would be generated. Solid wastes would consist of nonhazardous conventional construction wastes (wood and metal scrap) and hazardous wastes such as paint waste, oils, grease, and solvents.

Minor interior modifications to platforms and workstands would be made to **Cell 4 of the VIB.** Utilities would be provided to (1) the **RIS building** for the ultrasonic inspection system, and raceway and cork installation area and (2) the **MIS building** for inspection, assembly, and storage of raceway cables, and the nozzle, exit cone, nose cone, forward attachment ring and aft skirt of the SRM.

Launch operations at CCAFS

Processing of the Titan IV launch vehicles (Type 1 and Type 2) is described in Sect. 1.1.3.3. Both the existing and the new SMAB would have the facilities required to assemble both Type 1 and Type 2 SRMs. The new SMAB would allow complete assembly, inspection, and storage of Type 1 and Type 2 SRMs. The existing SMAB would still allow only partial SRM assembly; final assembly of the SRMs would be completed on the pad, as would SRM checkout. Liquid propellants would be delivered to the pad by truck and loaded to the core vehicle. Propellants are stored in the Hypergolic Storage Facility shown in Fig. 1.2.

During launch, potable water would be used for the deluge, washdown, and the OSS. Approximately 400,000 gal would be required per launch. Wastewater would be collected in a sump during launches at LCs 40 and 41, then discharged to percolation ponds in accordance with an FDER industrial wastewater discharge permit.

Light management planning

The U.S. Fish and Wildlife Service (FWS) has determined that security and operations lighting at the LCs at CCAFS decreases the survival rate of hatchling sea turtles on the ocean beach (Sect. 3.1.6.1). Consequently, all existing and proposed facilities at CCAFS must develop a light management plan in consultation with the FWS (see App. B). All lights within a facility are surveyed to determine whether they shine directly or indirectly on the beach or shoreline. Corrective actions are then planned for lights that illuminate beaches. These may include (1) eliminating unnecessary lighting, (2) redirecting lights, (3) shielding lights, (4) using low-profile rather than pole/building lamps, (5) changing to low-pressure sodium vapor lights that do not emit in the critical wavelengths (ultraviolet to blue-green), (6) installing low-light cameras, (7) erecting shades over nests that are lit, or (8) erecting barriers around nests to channel hatchlings toward the sea. The measures that would be adopted for the Titan IV facilities would depend on the type and location of existing or proposed lights and the facility's operational and security requirements. Further discussion of light management at CCAFS is presented in Sect. 3.1.6.

1.1.4.2 VAFB proposed activities

The 1988 EA for Titan IV launches at VAFB (USAF 1988b) described the modifications to SLC-4E and the adjacent area, the Payload Fairing and Processing Facility (Bldg. 8337), and the Vehicle Assembly Building (Bldg. 8401). It also evaluated a maximum launch rate of four vehicles per year to allow for the possibility that launch rates might increase in the future. The following sections describe new proposed actions for the Titan IV program necessary to support the SRMU at VAFB, including modifications at SLC-4E and the SRSF, Bldg. 398. The launch of Titan IV–Type 2 (SRMU) vehicles is also discussed, as well as the disposal of the wastewater from Titan IV launches.

Modifications at SLC-4E

To accommodate the SRMU, the following internal modifications are needed at SLC-4E: (1) structural modifications to launch mounts, frames, posts, heads, pressure baffle, stage one access platforms, and launch stand platforms; (2) modification of the GN_2 distribution system used for checkout of the Thrust Vector Control system; (3) installation of new electrical service to support aerospace ground equipment; and (4) modifications in the design of the MST. In addition, an oxidizer vapor scrubber system (OVSS) would be installed at SLC-4E to replace an existing oxidizer vapor burner. No land will be disturbed by any of these actions.

Modifications to the SRSF, Bldg. 398

The SRSF, which was constructed near SLC-6 for use in the Space Shuttle program, would be internally modified to accommodate SRMU segment and component receipt, inspection, testing, buildup, and storage. The proposed modifications are as follows: remove and replace or relocate three doors and add two new doors; raise a 25 × 80 ft section of the roof by 3 ft; provide a foundation for the verticalization fixture; anchor permanently installed equipment; provide an environmentally controlled control room with utilities; relocate the air handling unit on the roof; and provide utilities for aft skirt buildup, ultrasonic testing, cork insulation, raceway installation, segment buildup, and storage of components and segments. In addition, a 20 × 100 ft paved extension of an existing paved apron at Bldg. 520 (adjacent to Bldg. 398) is planned for SRMU transporter storage.

Launch operations at VAFB

The analysis in this EA focuses on changes in launch operations in the Titan IV program at VAFB. The USAF would launch two Titan IVs per year from VAFB between 1991 and 1995 (Table 1.1); this represents no change in the projected launch rate evaluated in USAF 1988b.

The processing and launch procedures for Titan IV vehicles at VAFB would be as described in Sect. 1.1.3, with the exception that Bldg. 398 will be used for SRMU processing rather than Bldgs. 945 and 946, which will continue to process SRMs.

The Titan IV-Type 2 (SRMU) vehicles would use 15% more solid propellant than the Titan IV-Type 1. Because of this difference, launch impacts could differ from those described in USAF (1988b).

The Titan-Type 2 (SRMU) would require the same quantity of deluge and washdown water per launch as the Titan IV-Type 1 (about 220,000 gal per launch). In previous Titan launch operations, the procedure was to discharge all deluge water to grade. Because of a change in regulatory requirements, this will not be allowed for future Titan IV launches. Instead, wastewater collected from launch operations, consisting primarily of post-launch washdown water, would be temporarily stored in the SLC-4E retention basin and subsequently trucked to SLC-6 for treatment. Because this procedural change would affect the environment differently than operations described in USAF (1988b), it is evaluated in this EA as part of the proposed actions. The proposed wastewater treatment for Titan IV launches at SLC-4E is as follows.

Prior to treatment, wastewater would be analyzed for hydrazine compounds. If hydrazine compounds are detected, they would be removed in an ultraviolet/ozone treatment facility. The pH would be adjusted and metals would be removed by precipitation. Dissolved solids would be removed in a reverse osmosis (RO) unit. Reject water (brine) from the RO unit would be stored in evaporation ponds. Treated water from the RO unit would either be released to appropriately lined evaporation ponds or reused as process water. The wastewater treatment facility will be designed and operated in accordance with the requirements of Regional Water Quality Control Board (RWQCB) and other regulatory agencies with jurisdiction.

1.2 ALTERNATIVES TO THE PROPOSED ACTION

1.2.1 No-Action Alternative

No action would mean that no modifications or new construction would occur for the Titan IV program at CCAFS and VAFB, the SRMU would not be brought into the USAF inventory of launch vehicles, and the increased number of launches planned for the program would not be carried out. As a result, the larger DOD payloads that require the SRMU would not be supported, and such payloads would have to be launched by the Space Shuttle, which already has an extensive backlog of satellites awaiting launch. If no action were taken, launches of the heavier payloads might be delayed or cancelled and DOD mission requirements to place national security satellites in orbit would not be met. Launch delays or cancellations would amount to a corresponding loss of defense capabilities. Environmental impacts associated with the proposed action would not occur if no action were taken.

1.2.2 Alternatives Eliminated from Detailed Consideration

The following alternatives to the proposed action were identified during planning for the Titan IV missions but have been eliminated from detailed consideration in this EA for reasons outlined below.

1.2.2.1 Programmatic alternatives

Alternative launch vehicles

Selection of a space launch vehicle depends upon two primary factors: the specific payload to be supported and the availability of existing launch vehicles to meet the payload and mission requirements. Payload requirements such as the weight, the specific orbit the payload is to be placed in, and the size of the payload must be considered. The Titan IV-Type 2 (SRMU) vehicle is essential to the DOD space program because it can launch payloads as heavy as those carried by the Space Shuttle without the need for a manned spacecraft.

The alternative of using the Space Shuttle to launch the satellites of the Titan IV program was eliminated because the launch rate and payload capacity of the Shuttle are limited. Although DOD satellites could be placed back on the Shuttle inventory, the current Shuttle launch schedule and payload priorities of greater national significance would delay the Titan IV program mission unacceptably.

Alternative launch sites

Selection criteria for a suitable launch site included economics, the ability to meet the technical requirements of the Titan IV vehicle, environmental factors, and the availability of a site for launching the mission on schedule. The use of sea platforms or construction of a new launch site (i.e., other than VAFB and CCAFS) was discounted for all four of the above reasons. No space launch sites other than VAFB and CCAFS exist at DOD facilities; therefore, consideration of alternative sites was eliminated from detailed consideration.

Alternative launch complexes at VAFB and CCAFS

Launch complexes are designed and constructed for a specific launch vehicle or family of launch vehicles. Only those LCs at CCAFS and VAFB that have previously launched the Titan vehicle (these include SLC-4E and SLC-4W at VAFB and LCs 15, 16, 19, 20, 40, and 41 at CCAFS) were considered for use in the Titan IV program because of economic, environmental, technical, and scheduling reasons. Of these, LCs 40 and 41 at CCAFS and SLC-4E at VAFB were the only suitable complexes. LCs 15, 16, 19, and 20, developed to support the Titan II vehicle, have been deactivated; in addition, these LCs are not served by the existing Titan rail transporter system. Other complexes at CCAFS were designed for launch vehicles other than Titan, and those that have not been deactivated support other missions. These include LCs 36A and 36B, which support the Atlas vehicle; LC-17, which supports the Delta vehicle; and LC-39, which supports the Space Shuttle. At

VAFB, SLC-4 is the only complex that has supported Titan launches. SLC-4W supports launches of Titan II vehicles and is not available to support Titan IV. SLCs 2, 3, and 5 support launches of the Delta, Atlas, and Scout vehicles, respectively, and SLC-6 was designed to support Space Shuttle launches. The use of LCs other than LC-40, LC-41, and SLC-4E would involve displacement of other launch vehicles and/or substantial costs for modification.

Alternatives other than launch

No alternate means of deploying satellites for use in defense and national security missions are available. Discontinuation of the use of space satellites in the defense network would be a counterproductive step that could negate the advances made in recent decades and could adversely impact national security.

1.2.2.2 Site-specific alternatives

Alternatives to constructing the new SMAB

The crane in the existing SMAB cannot handle the weight of the SRMU fuel segments (Sect. 1.1.3). New handling equipment would be installed at the existing SMAB as part of the planned modifications at CCAFS; however, the existing SMAB alone would still not have sufficient capacity to process SRMs and SRMUs to meet the increased frequency of Titan IV launches. Furthermore, other operations within the existing SMAB, which include the loading of hazardous propellants on payloads and the processing of various upper stage vehicles, frequently preclude SRM assembly operations for safety reasons. Consequently, the existing SMAB would not be capable of supporting the Titan IV program as planned because it could not accommodate the required throughput of SRMs and SRMUs and would delay the Titan IV launch schedule.

Alternative sites for the new SMAB

Consideration was given to the use of alternate sites at CCAFS and off-base for location of the new SMAB. The criteria used in the evaluation of potential sites included (1) proximity to LCs 40 and 41 and the ITL Area, (2) availability of an adequate rail system for transport of assembled vehicles to the launch pad, (3) ability to satisfy the quantity-distance requirements (AFR 127-100) for explosive materials, and (4) potential for environmental impact. No other on-base or off-base site met these criteria as well as the proposed site. Because the Titan IV vehicle is processed and assembled in the ITL Area, the proposed site for the new SMAB (between the ITL Area and the LCs) is almost ideal.

Alternatives considered included (1) creating a new man-made island in the Banana River (2) expanding the ITL Area, or (3) building the new SMAB in the vicinity of LC-40 or LC-41. These options were eliminated from detailed consideration because of explosive materials quantity-distance requirements or economic or obvious environmental reasons. Constructing a new dual track rail system from other sites at CCAFS to the LCs would be expensive and would require a construction period that would negatively impact the mission schedule for Titan IV. Development of a new island in the Banana River could involve significant environmental impacts and possible regulatory delays that would be unacceptable. Siting a facility such as the SMAB off-base also would require the construction of a new rail system, with the associated economic, environmental, and scheduling impacts. In addition, the potential risk to the public from accidental ignition of the solid-fuel rockets during assembly or transport would be greater for an off-base facility.

Assembly of SRMUs at the manufacturing facility in Utah is infeasible for similar reasons. The segments are assembled vertically and would have to be transported in this manner. In addition, existing rail transportation systems would be incapable of handling the weight of the SRMUs and the tandem or dual track hauling capabilities required.

Alternatives to VAFB modifications

SLC-4E was designed to launch the Titan vehicle, so it is the logical launch site for the Titan IV, Types 1 and 2. There are no alternatives to modifying SLC-4E to render it capable of supporting the Titan IV-Type 2 (SRMU) except to choose not to use the Type 2 vehicle (no action; see Sect. 1.2.1).

Bldg. 398 has the capability to process the SRMU with only interior modifications. It was determined to be more economical to use Bldg. 398 rather than to construct a new SRMU processing facility or modify the existing SRM RIS facilities at VAFB. In addition, having separate facilities to process SRMs and SRMUs would expedite pre-launch processing.

1.3 SCOPE OF THIS ENVIRONMENTAL ASSESSMENT

This EA was prepared to satisfy the environmental review requirements set forth in the National Environmental Policy Act of 1969 (NEPA, Public Law 91-190). It was prepared in accordance with the President's Council on Environmental Quality regulations implementing NEPA (40 CFR, Parts 1500-1508) and Air Force Regulation (AFR) 19-2. The objective of the EA is to provide the basis for a determination of the significance of environmental impacts of the proposed action. If impacts are potentially significant, an environmental impact statement will be prepared. If not, the USAF will issue a Finding of No Significant Impact (FONSI) for the proposed action.

This EA focuses primarily on those aspects of the Titan IV program that have not been addressed in previous NEPA documents (USAF 1986 and 1988a,b,c). The Titan IV program, however, has evolved and expanded rapidly. This EA, in its consideration of cumulative impacts, provides an integrated review of the entire Titan IV program as planned and as currently being pursued at VAFB and CCAFS. For a worst-case analysis in this EA, it is conservatively assumed that all launches would be Titan IV-Type 2 (SRMU)s, which would result in 15% more exhaust emissions than the Titan IV-Type 1.

2. AFFECTED ENVIRONMENT

2.1 CAPE CANAVERAL AIR FORCE STATION

2.1.1 Man-Made Environment

2.1.1.1 Socioeconomic resources

Population distribution and trends

Military personnel at CCAFS and Patrick AFB live in Brevard County, ~57% of them on Patrick AFB. About 95% of Air Force civilian and contractor personnel live in Brevard County; the remainder live in Orange County, Indian River County, and other counties. The base is easily accessed from northern and central Brevard County. Orlando, ~45 mi west of CCAFS in Orange County, and the communities of south Brevard County (Melbourne, West Melbourne, Melbourne Village, Palm Bay, and Malabar), about 25–30 mi away, are within commuting distance from CCAFS.

Population 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 levels in the space program dropped to their lowest point in 1976 but recovered after 1979 because of a new emphasis on space launch events (Edward E. Clark Engineers-Scientists, Inc. 1986). 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 and 3.2% from 1990 to 1995. The projected 1990 and 1995 populations are 407,200 and 473,000, respectively. Projected growth through 1995 is expected to be highest on the mainland in southern Brevard County (4.4% annually, 1990-1995) and lowest on the mainland in central Brevard County (2.6% annually, 1990-1995) (Brevard County Research and Cartography Division 1988).

Land use

CCAFS is Station 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 30% of CCAFS is developed with LCs and support facilities (Fig. 1.2). The remaining 70% is undeveloped land. The developed land on the base consists of more than 40 LCs along the eastern edge, many of which have been dismantled or deactivated. Support facilities are located in the central and western portions of the base (Fig. 1.2).

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 (Brevard County Research and Cartography Division 1988). 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. Communities located near CCAFS are Cape Canaveral (0.5 mi south), Cocoa (7 mi southwest), Cocoa Beach (8 mi south), Titusville (12 mi northwest), and Patrick AFB (15 mi south) (see Fig. 1.1).

Employment and economy

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 179,421 in October 1988, yielding an unemployment rate of 4.7% (Brevard County Job Service 1988). The unemployment rate rose in the last quarter of 1988 to 5.1%, exceeding 9,000 persons for the first time since the third quarter of 1987 but decreased to 4.3% in the first quarter of 1989.

Employment in the construction industry in Brevard County has remained steady in recent years, even though nonagricultural employment rose at a rate of 6.4%/year. The construction work force was 9,300 in January 1988, 9,000 in January 1989, and 9,300 in March 1989 (personal communication from C. Johnson, Brevard County Job Service, to Janice Morrissey, SAIC, May 16, 1989). A relatively high percentage of Brevard County employment is in manufacturing; in 1987, 19.7% of employees covered by unemployment compensation law were in manufacturing, in contrast to 10.9% in Florida as a whole (University of Florida 1988).

Housing

Brevard County's housing industry has fluctuated with shifts in employment within the space program. From 1986 to 1989, building activity declined from its 1984 peak, partially because of layoffs following the Space Shuttle disaster.

In 1987, there were 148,280 housing units in Brevard County, of which 61% were single-family dwellings, 27% were multi-family dwellings, and 12% were mobile homes. As of 1980, 25.6% of total units were renter occupied, 64.5% were owner occupied, and 9.9% were vacant. Vacancy rates were lowest in the Melbourne area (7.0%), Titusville (6.8%) and Cocoa (7.3%) (Brevard County Research and Cartography Division 1988). In 1980, the vacancy rate of rental units was 12% in Brevard County as a whole, 6.7% in Cocoa and Rockledge, and 7.4% in Titusville. Vacancy rates on the beaches for 1987 ranged from a low of 8.5% at Satellite Beach to a high of 25.4% at Cape Canaveral. The seasonal availability of temporary housing can be roughly estimated based on local studies of tourist and part-time resident or winter resident population. Occupancy rates for hotel/motel units are highest in February and March (81.0% and 85.3%, respectively) and lowest in September and October (52.5% and 51.3%, respectively). Part-time resident populations are highest in February and March and lowest in July, August, and September. The total part-time resident and tourist population in 1986 was estimated at 24,000 in March and 8,600 in September (Brevard County Research and Cartography Division 1988).

Facilities and services

Schools. Public schools in Brevard County are part of a countywide, single-district school system with 69 schools and over 50,000 students. The school system has been growing since 1982, and capacity has been exceeded in some districts of central Brevard County. Average growth in the district has been about 3%/year and is expected to exceed 6% by 1993. The major growth in the school district is at the elementary level. Two new elementary schools will open in the fall of 1989, one in Port St. John and another in Palm Bay. Seven more elementary schools are being planned over the next 5 years—five in the Palm Bay area and two between Cocoa and Titusville. The staffing plan is based on enrollment projections; teachers are hired to maintain an average pupil-teacher ratio of 22:1 at the elementary level (Jordan 1989).

Water. 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 (mgd), and average daily consumption is 26 mgd (Cocoa Beach Area Economic Development Council 1988). CCAFS receives its water supply from the City of Cocoa and uses 3 mgd. To support launches, the distribution system at CCAFS was constructed to provide up to 30,000 gal/min for 10 min.

Waste management. The cities of Cocoa, Cape Canaveral, Cocoa Beach, and Rockledge each are served by their own municipal sewer systems. Unincorporated areas of Central Brevard County are served by several plants. One county plant in Port St. John, south of Titusville, has reached capacity, and plans to build a new plant are uncertain. Other county systems are expected to resolve any capacity problems by mid-1990. Municipal systems in Cape Canaveral, Cocoa Beach, and Cocoa recently were expanded, and plans are under way to expand the Rockledge system (personal communication from D. Martens, Director of Water/Wastewater Division, Brevard County Utility Systems, June 21, 1989). CCAFS provides for its own sewage disposal with on-site packaged treatment plants.

Nonhazardous solid waste at CCAFS is managed according to the nature and quantity of the waste. The CCAFS sanitary landfill, which is located near the skid airstrip (see Fig. 1.2), accepts only construction debris. Debris from large construction projects is usually disposed of off-base by the contractor.

Hazardous wastes at CCAFS are managed by a joint USAF/NASA contractor certified to conduct hazardous waste disposal. For the Titan IV program, wastes not incinerated or recycled would be placed in interim storage at a designated accumulation area at the VIB for up to 90 days before being transported to a permitted storage site or off-site for disposal. The contractor would handle disposal in accordance with state and federal regulations and the Eastern Space and Missile Center (ESMC) Hazardous Waste Management Plan (OPLAN 19-14). Hazardous wastes generated in support of commercial launches would be disposed of by a certified contractor.

Power. Florida Power & Light (FPL) supplies electricity to Brevard County. CCAFS is serviced by FPL through a 240/138-kV switching station. The FPL net capacity in the summer of 1988 was 16,137 MW. The historical system peak of 12,533 MW occurred on January 22, 1985 (communication from M. Philo, FPL, to J. Morrissey, SAIC, June 6, 1989).

Public safety. The police departments in the 5 municipalities of the central Brevard area have 1 officer per 631 people, and fire protection has 1 full-time officer per 936 people (Cocoa Beach Area Economic Development Council 1988). Police and fire services at CCAFS are provided by the Launch Base Support Contractor and include mutual agreements with other jurisdictions, particularly the city of Cape Canaveral and KSC.

Health care. CCAFS is equipped with a dispensary operated under a joint contract (NASA/USAF) with EG&G, Inc., to handle accident cases, physical examinations, and emergencies involving the work force. Additional medical services are available at the Air Force Systems Command Hospital, Patrick AFB and at two hospitals in the Cocoa Beach Area. The two off-site hospitals have a total of 458 beds.

Transportation

Principal routes near CCAFS are Interstate 95, U.S. 1, and State Routes A1A, 401, 528, 3, 405, and 407 (Fig. 1.1). Bridges and causeways link the urban areas on the beaches, Merritt Island, and the mainland. Daily traffic loads on off-base roads fluctuate widely because of tourism in the beach resort areas.

Peak traffic on off-base roads is created by workers commuting to CCAFS and the beaches, out-of-town tourists year-round, and weekend tourists from Orlando and other areas on the mainland. The highest volumes of traffic occur on Saturdays. State Route (SR) A1A, a four-lane divided road that extends along much of Florida's east coast, has been experiencing congestion. Peak traffic on SR A1A occurs in the afternoon as well as on weekends. The Florida Department of Transportation (FDOT) has planned an engineering study to widen SR A1A to six lanes south of the SR 401 interchange for 6.5 mi through Cocoa Beach in the late 1990's. There is a major congestion problem on SR A1A south of SR 528 in Cocoa Beach (letter from R. Kamm, Asst. Director, Brevard County Traffic Management Division, to Janice Morrissey, SAIC, June 2, 1989).

All roads on CCAFS and KSC are federal property. Employee access to CCAFS is provided by the NASA Causeway from the west, SR 401 from the south, and the Cape Road from the north. Public access from the north is restricted because of its proximity to NASA's Shuttle launch pads 39A and 39B. The NASA causeway begins on the mainland at U.S. 1 south of Titusville and is a four-lane limited access facility. About 1.5 miles east of the intersection with N. Courtenay Parkway (SR 3) in the center of KSC and just east of the KSC operations complex, the causeway narrows to two lanes. The Causeway is, therefore, two lanes as it crosses the Banana River into CCAFS. The Causeway terminates at a "T" intersection with the north-south road that runs the length of CCAFS. This road, the Cape Road, is variously two or four lanes. It exits the south end of CCAFS on the north side of Port Canaveral. At this southern access point, the road is two lanes with a continuous center turn lane. Outside CCAFS, the road becomes SR 401. Problems are currently being experienced at the 401/528 interchange south of CCAFS by increased traffic related to the construction of a cruise ship terminal at Port Canaveral. Congestion and potential traffic hazards are caused by cross-traffic of construction vehicles travelling to the Port, unaided by traffic signals; increased traffic to Orlando from cruises; and back-ups caused by the priority of commercial vessels to use of the drawbridge.

Traffic frequently is backed up outside the South Gate of CCAFS during morning badge-checks. KSC also experiences frequent congestion during morning and afternoon peak hours on the 4-lane section of NASA Causeway from U.S. 1 to KSC (Capt. Bullington, Pan Am World Services Security Police, personal communication with Janice Morrissey, SAIC, September 22, 1989). A 24-hr traffic count on North Cape Road in the vicinity of LC-41 indicated 612 northbound vehicles and 649 southbound vehicles. During peak hours, there is a stable traffic flow, with no backups caused by traffic congestion. Because of its location between two major operational areas (LC 40/41 and LC-39), the North Cape Road experiences frequent, unscheduled closing due to operational requirements and thus is not a reliable access/egress route for CCAFS. When the North Cape Road is closed, commuters must go south on SR 3 to the two-lane NASA Causeway (Capt. Bullington, Pam Am World Service Security Police, personal communication with Janice Morrissey, SAIC, September 22, 1989). Traffic counts for a 24-hr period (in November 1988) on the NASA Causeway indicated 4,300 eastbound vehicles and 4,280 westbound vehicles.

On Cape Road in the vicinity of Gate 1 at the south end of CCAFS, a 24-hr count showed 6,172 northbound vehicles and 6,522 southbound vehicles. There is a stable traffic flow during peak hours, with minor backups (letter from Lt. Col. W. K. Penley, USAF, to Janice Morrissey, SAIC, July 10, 1989). In 1963, the South Gate typically handled 8,000 vehicles during a 24-hr period; however, severe back-ups resulted during morning rush hour (Capt. Bullington, Pam Am World Service Security Police, personal communication with Janice Morrissey, SAIC, September 22, 1989).

2.1.1.2 Cultural resources

Archeological and historical surveys of CCAFS were conducted in 1984 (Levy, Barton, and Riordan 1984; Barton and Levy 1984). The surveys identified 32 prehistoric and historic sites and several uninvestigated historical localities associated with the 4,000-5,000 years of human occupancy of the cape. The field survey indicated that many of the archeological resources had been severely damaged by construction of roads, LCs, powerlines, drainage ditches, and other excavation associated with the development of CCAFS. The survey recommended further evaluation for 11 sites to determine eligibility for the National Register of Historic Places.

Attempts are being made by the U.S. Department of the Interior, National Park Service, and USAF to protect significant resources associated with the *Man in Space* National Historic Landmark Program. Areas designated landmark sites include the Mission

Control Center and Complexes 5/6, 26, 34, 14, and 19, which were used during the Mercury and early Gemini manned space flights.

Facilities at LC-40 are located on previously disturbed land. LC-41 is located in a highly disturbed area that was not included in the archaeological survey. The closest recorded archaeological site (BR 221) is located 4 mi north of LC-41. LC-41 has been evaluated and determined not to be part of the *Man in Space* program. The survey located no known historic or archaeological resources at the proposed SMAB site, which lies on a man-made causeway covered by 15 ft of fill and no native soils. Similarly, the ITL Area is situated on a man-made island and is unlikely to contain native soils.

Consultation with the Florida State Historic Preservation Officer (SHPO) with regard to archaeological or historic resources that would be impacted by the Titan IV program activities has been completed (see App. B).

2.1.1.3 Ambient noise

Monitoring of ambient noise levels at CCAFS has not been performed. However, noise levels at the ITL Area, LC-40, and LC-41 would be expected to approximate those of an urban industrial area, or 60-80 dBA.

2.1.2 Natural Environment

2.1.2.1 Climate and air quality

Climatology

The climate at CCAFS is strongly influenced by its coastal setting. Annual variations in atmospheric temperature and moisture content are slight because of the moderating effects of the Atlantic Ocean. The annual average temperature at CCAFS is 71°F. Average daily minimum temperatures range from 51°F in February to 73°F in August. Average daily maximum temperatures range from 69°F in January to 88°F in July. Between 1968 and 1978, the lowest recorded temperature at CCAFS was 19°F; the highest was 98°F.

Surface-based temperature inversions are infrequent, occurring 2% of the time. Temperature inversions aloft caused by sea breeze circulations and by subsidence associated with the Bermuda high-pressure feature are much more common.

Relative humidity at CCAFS is usually between 70 and 100% because of the proximity of the ocean and inland waterways. Fog is uncommon during most of the year but occurs about 1 out of 4 days during the winter. Annual average precipitation in the CCAFS area is 45 in., with the monthly maximum occurring in September and the monthly minimum occurring in April.

The sea breeze and land breeze circulations, caused by uneven solar heating and surface radiation properties of the land and ocean, are very common in summer and less common in winter. The sea breeze (onshore or easterly winds) occurs during the daytime, while the land breeze (offshore flow) occurs at night. Figure 2.1 is a wind rose showing the frequency distribution of wind speeds and directions at CCAFS. Winds predominate from the southeast quadrant.

Air quality

The air quality at CCAFS is very good because there are few local pollutant sources. Air quality monitoring data for the CCAFS vicinity are limited. Recent (1986) ambient air quality data indicate that there were two monitoring sites operated at Titusville and two on Merritt Island but that these sites measured only total suspended particulate (TSP) matter. TSP concentrations measured at these sites in 1986 were well below the National Ambient Air Quality Standards (NAAQS) for TSP (FDER 1987).

Effective July 31, 1987, the U.S. Environmental Protection Agency (EPA) replaced the NAAQS for TSP (150 $\mu g/m^3$ 24-hr average and 75 $\mu g/m^3$ annual average) with NAAQS for particles less than 10 μm in diameter (PM-10). The new PM-10 standards were set at 150 $\mu g/m^3$ and 50 $\mu g/m^3$ for 24-hr and annual average concentrations, respectively. Even if all TSP measured at Titusville and Merritt Island in 1986 were under 10 μm in diameter, the new PM-10 NAAQS would still have been met.

No long-term measurements are available from the CCAFS vicinity for the other five criteria air pollutants: sulfur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO),

ORNL-DWG 89-11467

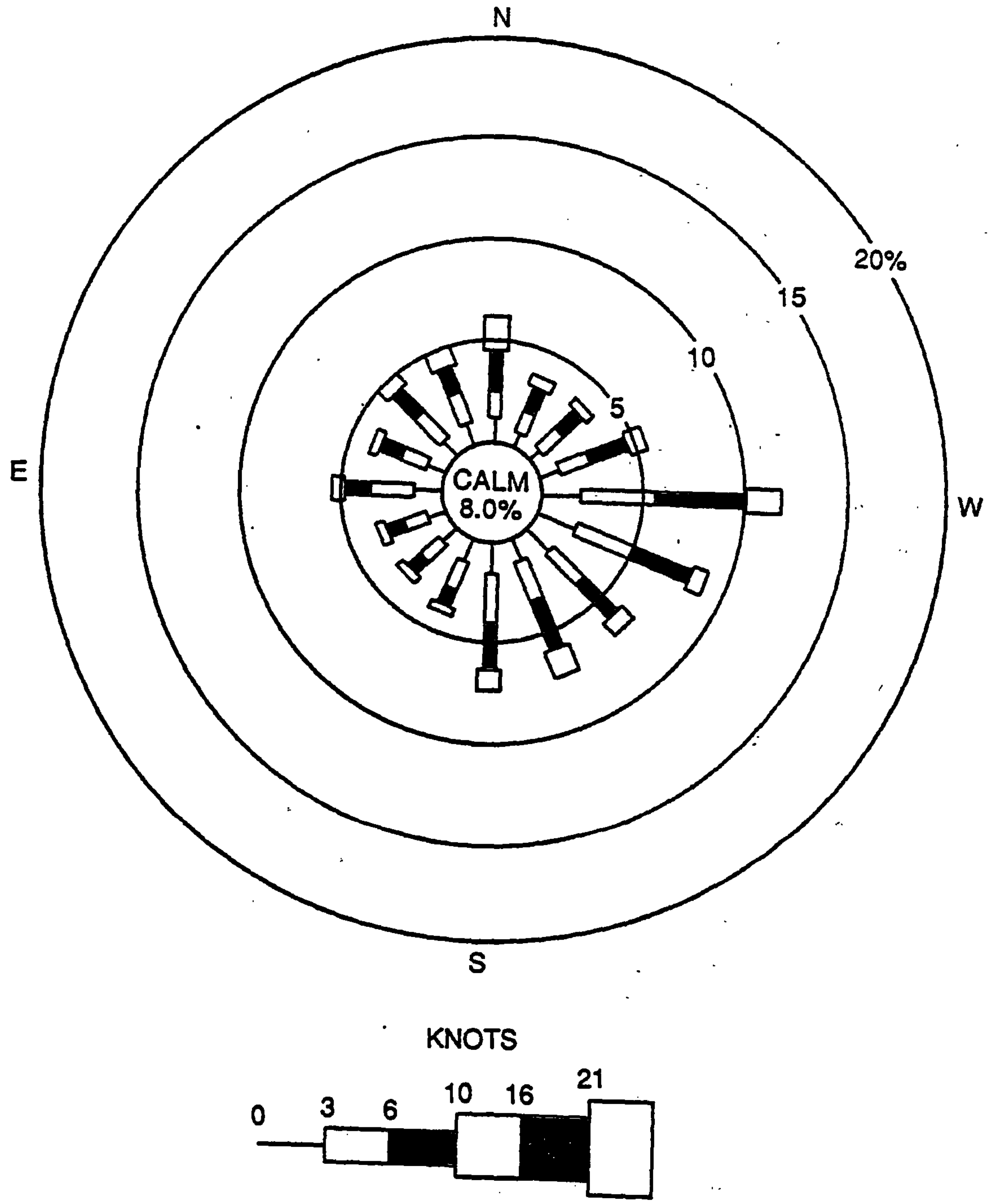


Fig. 2.1. Wind rose for Cape Canaveral for 1968-1978.

ozone (O_3), and lead (Pb). However, episodic measurements for some pollutants have been made in conjunction with space vehicle launches at CCAFS and KSC. CCAFS and the vicinity are considered by EPA to be either "in attainment" or "unclassifiable" with respect to NAAQS for criteria pollutants (40 CFR Pt. 81). There are no designated NAAQS "nonattainment" areas in Brevard County.

2.1.2.2 Surface water resources

Major inland water bodies near CCAFS are the Banana River and Indian River to the west and the Mosquito Lagoon to the north (Fig. 2.2). 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 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.

The existing SMAB and the ITL Area are located on a man-made causeway in the Banana River, a saltwater tidal lagoon (Fig. 2.2). Runoff from these areas (as well as most of the CCAFS) is to the Banana River either directly or via percolation to groundwater (USAF 1989a). The Banana and Indian Rivers merge to the south of the site and join the Atlantic Ocean about 80 km (50 mi) south of the SMAB site.

Both LC-40 and LC-41 are located on a barrier island between the Atlantic Ocean and the Banana River (Fig. 2.3). Because of the porous nature of the soil in the area and high percolation rate (greater than 20 in./hr), most of the surface runoff from the complexes percolates into the soil; any remaining surface runoff flows toward the Banana River.

Wetlands adjacent to both LC areas are discussed in Sect. 2.1.2.6. There are no freshwater resources at any of the Titan IV facilities sites.

The FDER samples the Banana River monthly at the four locations shown in Fig. 2.3. At NASA Causeway East, the station nearest the Titan IV facilities, water temperatures ranged from 52° to 87°F and salinity from 15 to 36 parts per thousand between 1981 and 1986. Dissolved oxygen concentrations were normally greater than

ORNL-DWG. 89-10581R2

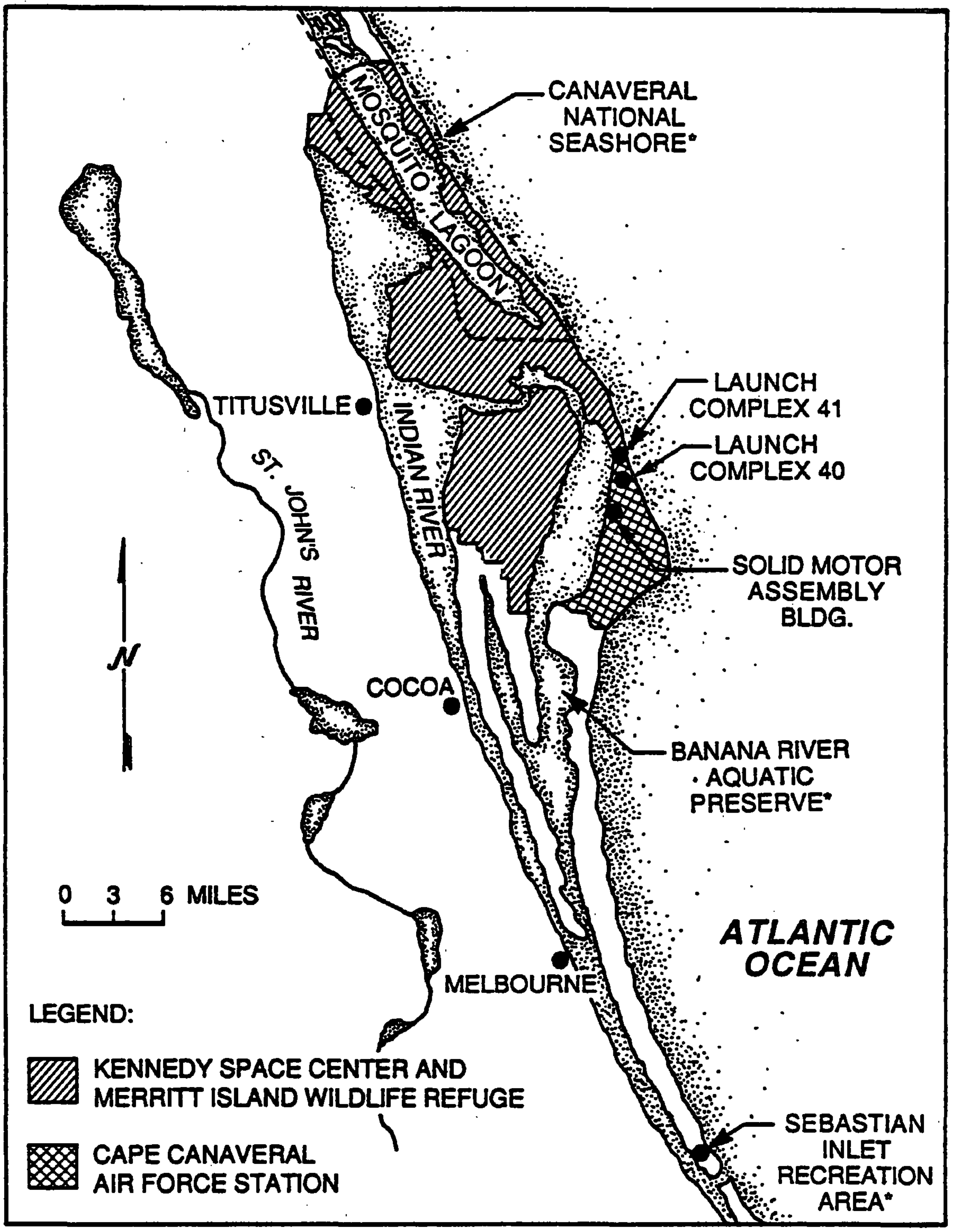


Fig. 2.2. Outstanding Florida waters near Cape Canaveral Air Force Station. Outstanding waters marked with asterisks.

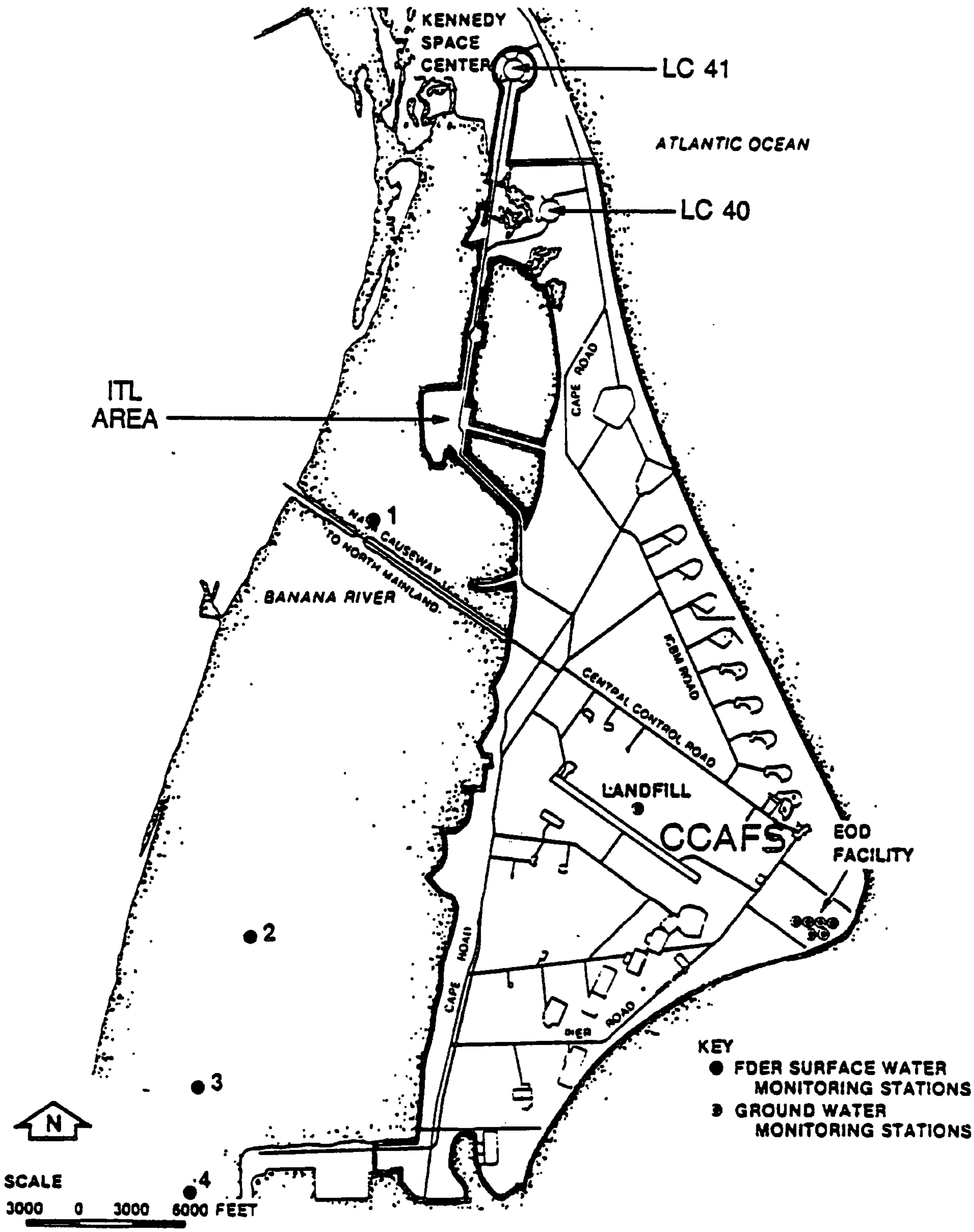


Fig. 2.3. Surface water and groundwater monitoring stations at Cape Canaveral Air Force Station, Florida.

5.5 mg/L, although values as low as 4 mg/L were observed. Other parameters monitored included pH, biological oxygen demand, turbidity, chlorophyll, and nutrients. Results of FDER water quality analyses of the Banana River are given in Table 2.1.

Table 2.1. Surface water quality characteristics of the Banana River adjacent to the Cape Canaveral Air Force Station[a]

Parameter	Concentration[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 (BOD_5)	2.3
pH	(8.3, 8.4)[b]
Total alkalinity [as calcium carbonate ($CaCO_3$)]	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, taken at site 1 on Fig. 2.3.
[b]Measured values.
[c]ppt = parts per thousand
[d]μg/L = micrograms per liter
[e]NTU = nephelometric turbidity unit

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 (Fig. 2.2) 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 FDER. 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 the developer implements management practices and suitable technology approved by the FDER [Chap. 17-4.242(1)(b)].

2.1.2.3 Geology, soils, and groundwater

CCAFS lies on a barrier island composed of relict beach ridges (remnants of an ancient beach) formed by wind and wave action. The island is 4.5 mi wide at its widest point. The land surface ranges from sea level to 20 ft above mean sea level. The island is underlain (in ascending order) by more than 320 ft of mainly carbonate strata belonging to the Floridan Aquifer, 160 ft of confining beds, and 100 ft of upper Miocene to recent age unconsolidated carbonate sands, silts, and shell fragments belonging to the near-surface aquifer.

Soils on the CCAFS were mapped by the U.S. Department of Agriculture Soil Conservation Service (SCS) (USAF 1989a). The site is underlain by the Canaveral-Urban Land Complex. The urban complex includes impermeable asphalt and concrete surfaces as well as permeable sands and shell fragments dredged from the Banana River. Native soils are highly permeable (greater than 20 in./hr). According to SCS, the soils at CCAFS are not suitable for agricultural use.

COE (1989) describes foundation conditions beneath the proposed SMAB site. Foundation bore holes varied in depth from 15 to 127 ft. The soil profile at SMAB consists of alternating layers of silty sand and well sorted sand. The density of sand layers ranges from loose to dense and appears to be unrelated to depth. Layers of very soft clayey silt were found at depths of 13.5 and 60 ft. The upper silt layer is believed to be the original ground surface prior to filling for an existing causeway. Shell fragments are found throughout the depth of bore hole drilling. Groundwater in the bore holes was generally encountered at a depth of 6 ft, fluctuating with rainfall and tides.

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, and the chemical composition of groundwater from the two aquifers is distinctly different (Table 2.2). The Floridan Aquifer contains nonpotable and brackish (TDS greater than 1000 mg/L) water that exceeds most secondary drinking water standards whereas groundwater from the near-surface aquifer is potable (TDS less than 500 mg/L) and exceeds only the secondary drinking water standard for iron. Table 2.2 compares the chemical compositions of these aquifer waters with Florida primary and secondary drinking water regulations (FDER 1989a; FDER 1989b).

Shallow (15-ft) groundwater monitor wells have recently been installed at the LC-40 and LC-41 sites, as shown in Fig. 2.4. Also shown in this figure are wastewater discharge points for the flame bucket and oxidizer scrubber and their associated percolation ponds. Table 2.3 provides recent (June 1988) groundwater data from wells at LC-41 (no data are available for wells at LC-40) for comparison with Florida primary and secondary drinking water standards. All wells at LC-41 exceed primary drinking water standards for cadmium. Several wells exceed secondary drinking water standards for iron and manganese, and water from well No. IV is brackish. Traces of 1,1,1-trichloroethane, benzene, and dimethylhydrazine were also found in water samples from well No. IV. Water samples from well No. IV were also turbid, suggesting that contaminants adsorbed on soil particles may have been solubilized during sample collection. More recent analyses of samples taken in November 1988 at both LC-40 and LC-41 wells did not reveal the presence of organic acids, base/neutral organics, or volatile organics at detection limits ranging from 5 to 100 parts per billion (ppb) in the November sample analyses. Most detection limits were 10 ppb.

2.1.2.4 Terrestrial ecology

Vegetation and fauna of CCAFS

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 strand (2,300 acres), and coastal dune

Table 2.2. 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	0.73–1.56	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	6.12–10.76	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 for metals, fluoride, nitrate, and selenium.
Sources: USAF 1989a; FDER 1989a; FDER 1989b.

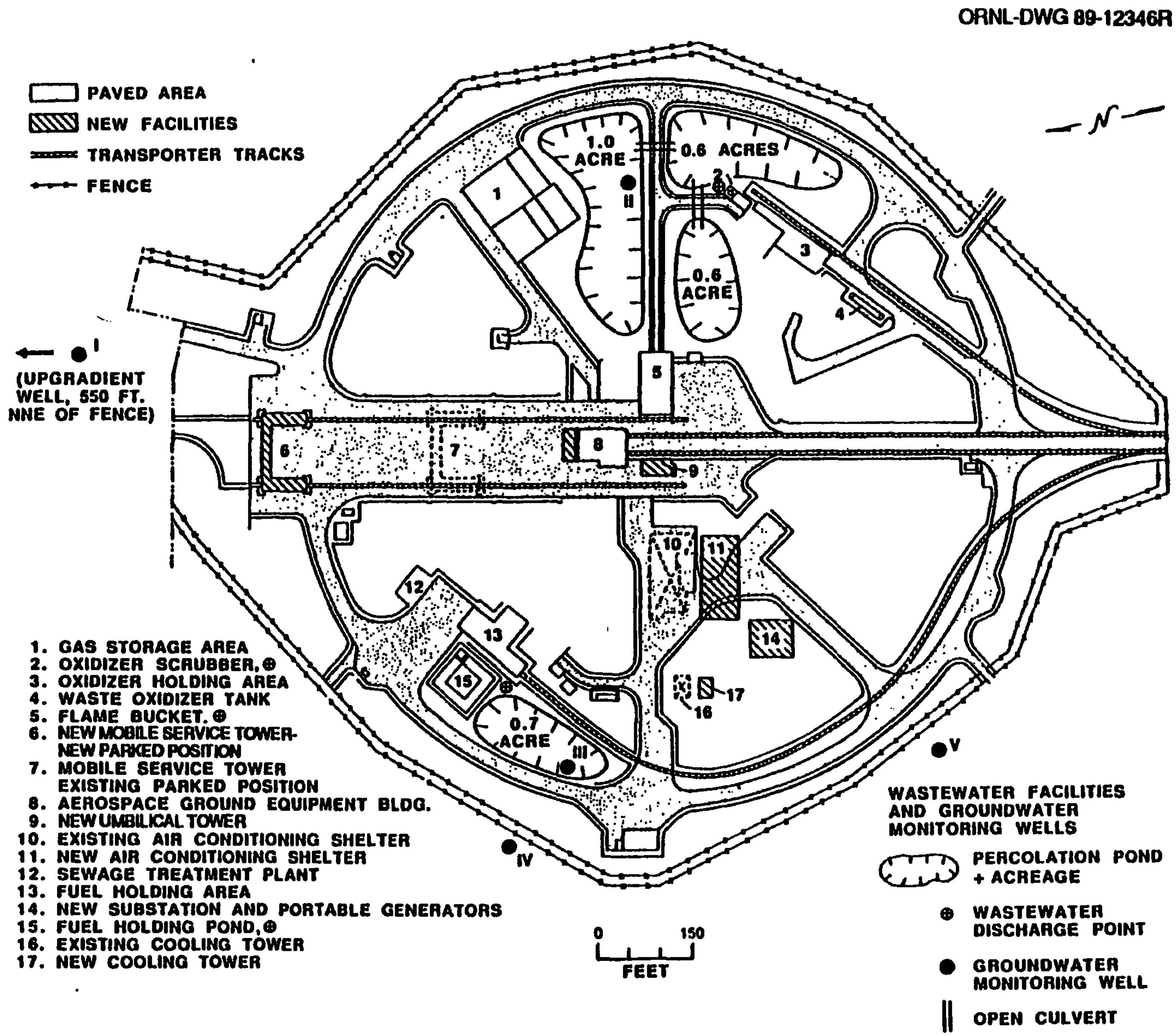


Fig. 2.4. Location of percolation areas and groundwater monitoring wells at Launch Complex 41.

Table 2.3 Groundwater quality of LC-41 monitor wells, June 1988[a]

Parameter	Well number 1	2	3	4	5	Maximum contaminant level
						Secondary standards[b]
Chloride	11	15	15	130	15	250
Copper	<0.03	<0.03	<0.03	<0.03	<0.03	1
Iron	0.11	1.19	0.95	12.1	0.22	0.3
Manganese	<0.02	0.06	<0.02	0.20	0.06	0.05
Sulfate	9	40	7	2	13	250
TDS	240	474	374	1388	274	500
Zinc	0.05	<0.01	<0.01	<0.01	0.05	5
pH	7.6	8	7.3	7.4	7.5	6.5-8.5
						Primary standards[c]
Arsenic	<0.05	<0.05	<0.05	<0.05	<0.05	0.05
Barium	<0.15	<0.15	<0.15	<0.15	<0.15	1
Cadmium	0.23	0.10	1.26	0.21	0.63	0.01
Chromium	<0.04	<0.04	<0.04	<0.04	<0.04	0.05
Fluoride	0.24	0.79	1.30	0.43	0.34	2
Lead	0.003	<0.003	<0.003	<0.003	<0.003	0.05
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.002
Nitrate	1.45	<0.02	0.04	0.04	0.03	10
Selenium	<0.01	<0.01	<0.01	<0.01	<0.01	0.01
Silver	0.04	<0.03	<0.03	<0.03	<0.03	0.05
Sodium	5	9	10	84	7	160

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

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

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

Source: Patrick AFB 1989.

(800 acres). Three minor but ecologically significant community types present on the complex are freshwater wetlands (20 acres), mangrove swamp (450 acres), and salt marsh (140 acres). Because of the restricted nature of its activities, the CCAFS has retained a near-natural condition on much of its land. The majority of the acreage remains as virgin

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.

Figure 2.5 depicts the vegetation on the portion of CCAFS potentially impacted by the activities considered in this assessment. The new SMAB would be located on the transporter causeway in the Banana River. The vegetation near the proposed facility is grass or bare soil, characteristic of highly disturbed sites. An area of wetlands is just south of SMAB, where the transporter tracks would cross (Sect. 2.1.2.6). LCs 34 and 37 are industrial areas containing ruderal vegetation surrounded on the east by coastal strand vegetation and on the west by coastal scrub vegetation. LCs 40 and 41 are industrial areas containing ruderal vegetation and largely surrounded by coastal scrub. Coastal dune, coastal strand, and all three wetlands community types intermixed occur within 1,000 ft of LC-40 and LC-41. Following is an excerpt from George (1987) describing the major vegetation community types and their associated fauna in the vicinity of the Titan IV facilities. No information is available on terrestrial invertebrate species.

Coastal scrub—This community varies in height from 3 to 20 ft 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 10 species of mammals including Florida white-tailed deer, armadillo, bobcat, feral hogs and the Southeastern beach mouse (federally designated threatened species); 14 bird species including red-tailed hawk, red-headed woodpecker, and the Florida scrub jay (federally designated threatened species); and 5 reptile species, including the Eastern indigo snake (federally designated threatened species), and the gopher tortoise.

Coastal strand—This community occurs immediately inland of the coastal dunes and is composed of a dense thicket of woody shrubs 3–13 ft 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 (a state-designated threatened species), and the Southeastern beach mouse. Fourteen bird species utilize this community

ORNL-DWG 89M-9559

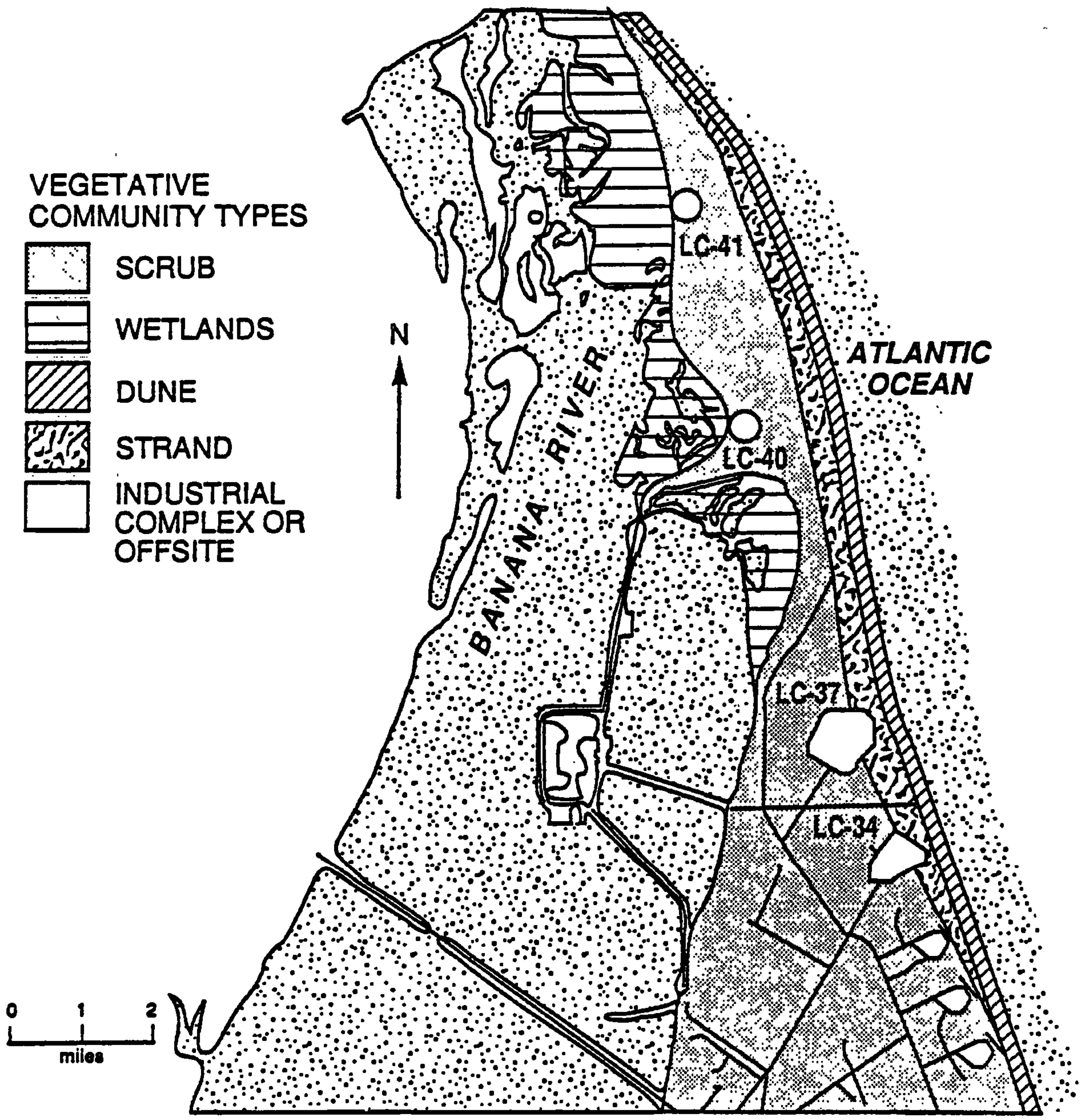


Fig. 2.5. Vegetation at Cape Canaveral Air Force Station, Florida.

(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.

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 and concern for several years (NASA 1984; NOAA 1987; George 1987; USAF 1988d) and is discussed in Sect. 3.1.7.

2.1.2.5 Aquatic ecology

CCAFS is located in a transition zone between temperate and tropical climates; consequently, the aquatic biota found in the area are 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) (see Fig. 2.2).

No freshwater is found at or near the Titan IV launch and support facilities at CCAFS. Aquatic species in the Titan IV facilities area would occur in the Banana River and in the wetlands adjacent to the LCs. No information is available concerning aquatic fauna in the wetlands. A description of wetlands vegetation follows in Sect. 2.1.2.6. 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.

The benthic macroinvertebrate community of the Banana River is dominated by polychaetes, molluscs, and crustaceans (Reish and Hallisey 1983). Numerous local marine fish species collected in the Banana River include redfish, mullet, snook, drum, and sheepshead (George 1987). The lagoons are considered to be productive habitats for fishes and also support numerous waterfowl, alligators, and some mammals.

2.1.2.6 Floodplains and wetlands

Three wetland community types (mangrove swamp, saltwater marsh, and freshwater marsh) occur at CCAFS (Fig. 2.5). The wetland adjacent to LC-41 is mixed salt-tolerant grass marsh with some black mangrove and sea oxeye vegetation areas. The wetland at LC-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 LC-40 and LC-41 probably receive some surface runoff from the sites; however, most of the water entering them is assumed to come from groundwater (see Sect. 2.1.2.3).

The wetlands at the proposed SMAB site are depressions consisting of woody vegetation typical of an upper (high) salt marsh community.

2.1.2.7 Threatened and endangered species

To comply with the requirements of Section 7c of the Endangered Species Act (Public Law 93-205) and with the Marine Mammals Protection Act, the USAF has consulted with the FWS and the National Marine Fisheries Service for information and comment on the potential for adverse impacts to protected species and habitat at CCAFS (see App. B and App. C). 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 strand species, respectively), are currently listed as Type 2 candidate species and, as such, are under consideration for threatened status (personal communication, Don George, Pan Am World Services, Inc., with R. L. Graham, ORNL, April 17, 1989).

Table 2.4 lists threatened and endangered animal species at CCAFS and in the vicinity, and Fig. 2.6 shows the location 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 (Fig. 2.6) (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 (NASA 1984; NOAA 1987; George 1987; USAF 1988d). The beaches of CCAFS and KSC are critical habitat for Atlantic Coast populations of both the loggerhead and green sea turtle. Aerial pelagic 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 30-km (21-mi) 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 LC-41 (see Fig. 2.6) (personal communication, Dave Breininger, Bionetics, Co., with R. L. Graham, ORNL, July 19, 1989). Florida scrub jays extensively use the scrub vegetation surrounding the perimeter fences at LCs 40 and 41 (Fig. 2.5), and nests have been observed within 660 ft (201 m) of LC-41. The population of scrub jays within a 0.4-mi (0.6-km) radius of the LC 40 and 41 launch pads was estimated using scrub jay density and habitat and territory data from studies at the adjacent Kennedy Space Center (USAF 1989e). This distance was used because it includes the near-field zone that extends about 600 ft (182 m) from the pad. An estimated range of 60-199 jays was predicted within a 0.4-mi radius (0.6-km radius) of LCs 40 and 41. Breininger (1989) estimated between 920 to 1,840 scrub jays at CCAFS (based on bird densities per hectare and hectares of available habitat), which is about 10% of the state population reported by Cox (1984, 1987). Therefore, the estimated maximum population at LCs 40 and 41 ranges between 3% to 11% of the estimated maximum CCAFS population, or a range of 0.3% to 1% of the state population.

Table 2.4. Listed and proposed threatened and endangered animal species and candidate animal species in Brevard County and their status on Cape Canaveral Air Force Station

Species[a]	Federal status[b]	Cape Canaveral Air Force Station[c]
	Reptiles and Amphibians	
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	C2	Not observed
Alligator snapping turtle	C2	Not observed
	Birds	
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

Table 2.4. (continued)

Species[a]	Federal status[b]	Cape Canaveral Air Force Station[c]
	Birds (continued)	
Bachman's sparrow	C2	Visitor
Reddish egret	C2	Visitor
	Mammals	
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
Florida mouse	C2	Resident
Round-tailed muskrat	C2	Possible resident

[a]Scientific names of federally listed threatened or endangered species are found in FWS (1989). The reader is referred to Banks, McDiarmid, and Gardner (1987) to obtain scientific names of other species.

[b]E = endangered; S/A = similarity of appearance; T = threatened; C2 = Candidate 2 (proposed for listing as threatened).

[c]Resident = a species that occurs on CCAFS year-round; Visitor = a resident bird species that occurs on CCAFS but does not nest 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.

Sources: USFWS 1989; USAF 1989a; George 1987 (personal communication, Dave Rininger, Bionetics Co., with Robin Graham, July 19, 1989).

ORNL-DWG 89-19548

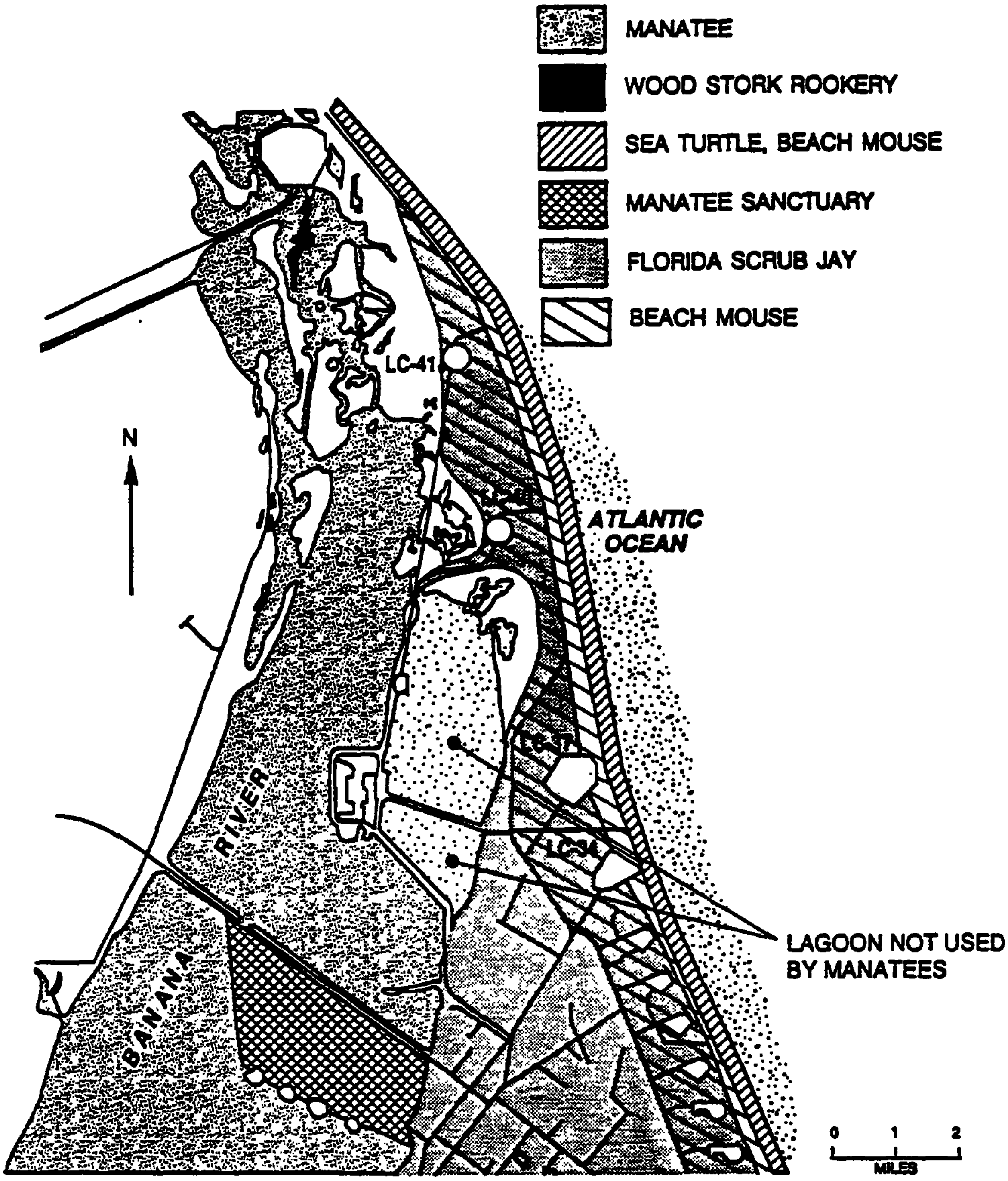


Fig. 2.6. Habitats of threatened and endangered species at Cape Canaveral Air Force Station, Florida.

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*), and palmetto (*Serenoa repens*) Extine and Stout (1987). The dune grassland at CCAFS is excellent, extensive habitat for beach mice (see Fig. 2.6), 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 LC 40 suggest a beach mouse population range of 11,024 to 15,199 for all suitable habitats (USAF 1989e). Assuming similar beach mice densities exist at LC 41 as for LC 40 and extrapolating those densities to all suitable habitat, a population range of 13,042 to 18,940 was estimated (USAF 1989e). The estimated population of beach mice within the disturbed coastal scrub, which is primarily found within a 0.4-mile radius, is 5,732 for LC-40 and 6,177 for LC-41.

2.2 VANDENBERG AIR FORCE BASE

2.2.1 Man-Made Environment

2.2.1.1 Socioeconomic resources

The commuting patterns for current VAFB workers generally indicate that the VAFB area of influence is the North County region of Santa Barbara County, which encompasses the area north of Lompoc (see Fig. 1.5). The area to the south is defined as the South Coast area. Within the North County, VAFB economic influence centers on the Lompoc and Santa Maria valleys.

Population distribution and trends

The total population of Santa Barbara County was 298,700 in 1980. The county's population grew at an average annual rate of 2.1% from 1975 to 1980. The estimated population increased to 334,600 in 1985 and is projected to reach almost 365,000 by 1990 (California Population Research Unit 1986). The population trend of cities in Santa Barbara County is shown in Fig. 2.7. In 1985, Lompoc had an estimated population of 29,100, and Santa Maria had an estimated population of 48,350.

Activities at VAFB have influenced population growth patterns in Santa Barbara County over the last 30 years. The working population at VAFB was 15,016 in 1986, an increase of more than 4,600 from a decade earlier but a substantial decrease from the mid-1960s, when the VAFB working population was above 18,000. Between 1960 and 1970, Lompoc grew by about 11,000 persons, or 75%, while Santa Maria increased its population by 13,000, a 69% growth rate. Growth continued between 1970 and 1980, although at a much slower rate, with the population of Lompoc increasing by 4% and that of Santa Maria increasing by 21%. Although total employment at VAFB has decreased, North County population growth has continued as a result of the development of offshore oil and gas resources. More than 80% of the oil-related growth is believed to have occurred in North County communities.

Land use

VAFB is located in northwest Santa Barbara County and comprises 98,400 acres, or 5.6% of the county. Urban uses account for about 3% of the total land area in the county. The populated areas of the county are primarily concentrated along the coast, in communities along U.S. 101 and Highway 1. Santa Maria is located 12 mi northeast of the main base complex, and Lompoc lies 5 mi to the southeast. Vandenberg Village and Mission Hills lie to the east in Lompoc Valley. Casmalia, Guadalupe, and Santa Maria-Orcutt are located north and east in the Santa Maria Valley. The Santa Barbara urban complex lies 50 mi to the southeast along U.S. 101. Large agricultural areas common throughout the region form a buffer between these urban centers and VAFB. The VAFB shoreline includes three public beach parks, one each immediately north and south of VAFB and one at Surf, which lies on the boundary of North and South VAFB (USAF 1988b).

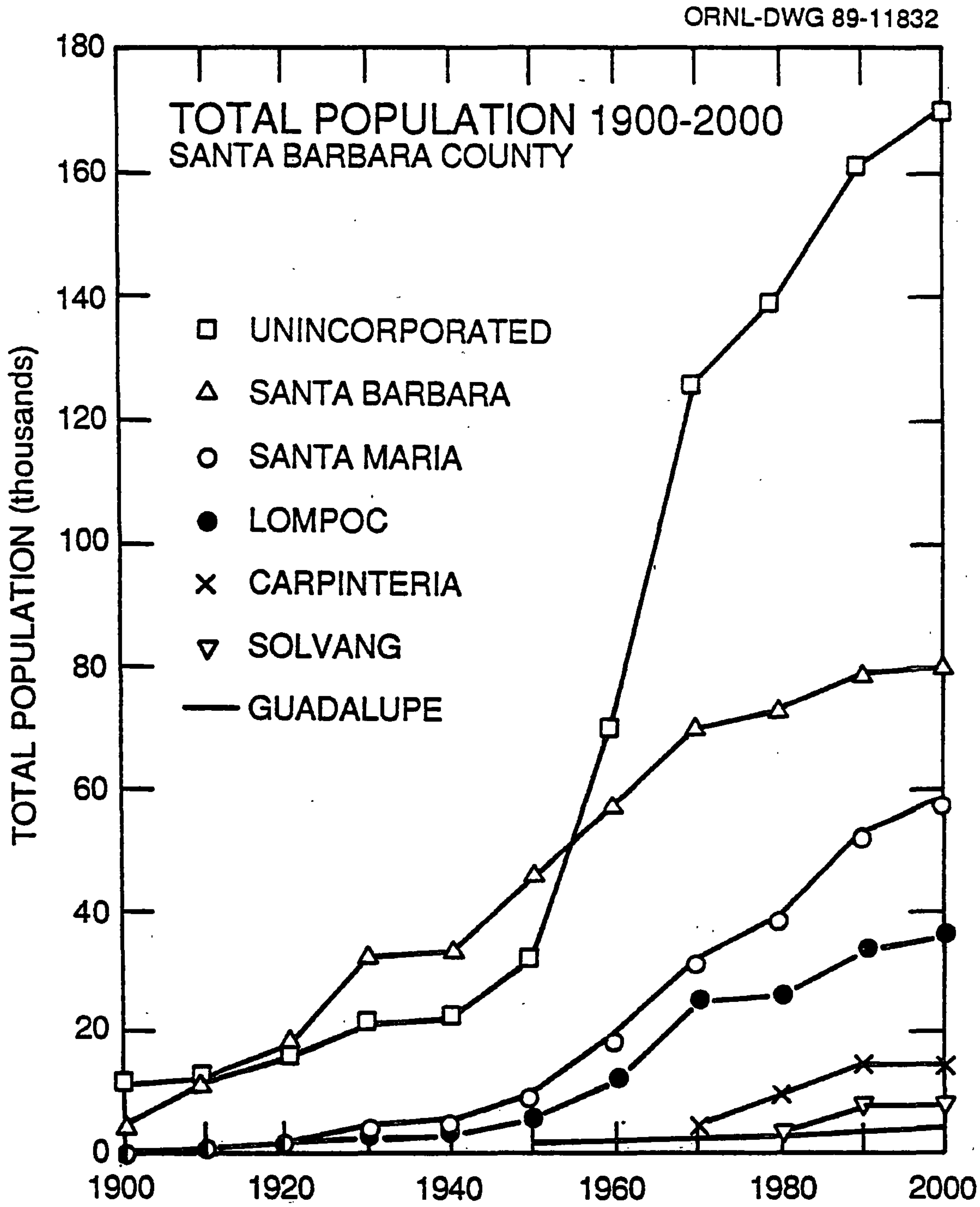


Fig. 2.7. Population trends in Santa Barbara County.

Employment and economy

VAFB is the major economic influence in northern Santa Barbara County and the Lompoc Valley. Approximately 40% of the Lompoc Valley and 9% of the Santa Maria Valley labor forces are employees at VAFB. VAFB employment decreased by 30% from 1985 to 1987, partly as a result of a 45% decline in the number of aerospace contract employees. Growth in the business sectors of Lompoc and Santa Maria occurred at rapid rates during the 1980s in association with construction of SLC-6 and other activities in preparation for the Space Shuttle Program at Vandenberg. The mothballing of the program following the Space Shuttle Challenger disaster resulted in a large surplus in the services economy, particularly in the restaurant and hotel/motel industries, where much of the new growth occurred (personal communication, T. Martin, Principal Planner, City of Lompoc, with Janice Morrissey, SAIC, June 15, 1989).

Much of the employment in Santa Barbara County has been related to the construction of oil facilities, which has helped to maintain a steady construction work force in the area in spite of space program fluctuations. Oil-related construction workers reside primarily in the Lompoc Valley.

Housing

The estimated number of housing units in Santa Barbara County in 1985 was 131,000, an increase of 20% from the 1980 level of 109,000 (USAF 1989d). The ownership housing stock in Lompoc is very strained. The price of single-family homes in Lompoc has risen 42% over a 12-month period. The large surplus of rental units and hotel rooms exists because of expansion to accommodate the construction of SLC-6 for the Space Shuttle. Vacancy rates in apartment units average 12% (personal communication, T. Martin, Principal Planner, City of Lompoc, with Janice Morrissey, SAIC, June 15, 1989).

Facilities and services

Facilities and services relevant to the possible influx of workers at VAFB include schools, utilities, and waste disposal.

Schools. The VAFB-related school population is concentrated in the Lompoc Unified School District, which includes two elementary schools, a middle school, and a high school located on VAFB. Enrollment in Lompoc Unified totalled about 9,000 during the 1986-87 school year (California Department of Education 1987). As of 1987, the Lompoc Unified district had ample capacity, as did the Orcutt Elementary and Santa Maria Joint Union High School districts.

Water. In 1986, VAFB supplied about 90% of its own water, purchasing the remainder from the adjoining Park Water Company. Water usage in many areas of Santa Barbara County exceeds the safe yield capacity of water sources. As of 1987, 75-80% of the county water supply was derived from groundwater sources, and the rest is from surface reservoirs, primarily along the Santa Ynez and Santa Maria Rivers. Current county-wide water deficits are 40,000 acre-ft/year.

Waste management. Sufficient wastewater treatment capacity exists in the North County communities of Santa Maria, Lompoc, and Guadalupe. The Lompoc system is at 60% capacity (personal communication, T. Martin, Principal Planner, City of Lompoc, with Janice Morrissey, SAIC, June 15, 1989). Wastewater from the VAFB administrative/ industrial area flows to the Lompoc publicly owned treatment works. Individual packaged treatment facilities serve the more remote support areas for VAFB launch facilities, including SLC-4.

Construction and expansion of facilities for the expanded Titan IV program would generate both industrial and hazardous wastes. Categories and definitions of hazardous waste are provided by the EPA in the Code of Federal Regulations (40 CFR 261) and by the California Department of Health Services in the California Code of Regulations (CCR), Title 22, Chapter 30. California recognizes more wastes as being hazardous than does the EPA. Industrial designated and nonhazardous solid wastes must be disposed of in Class II or Class III landfills. Specifications for such landfills are set forth in the CCR Title 23, Chapter 3, Subchapter 15, Article 5, sections 2532 and 2533, respectively. Hazardous wastes can be disposed of in a Class I landfill or, if disposal is not desired, an approved treatment facility can be used to treat and recycle the waste. After May 8, 1990, only hazardous wastes meeting certain specified treatment standards may be disposed of in a Class I landfill.

VAFB practices waste minimization by on-site and off-site recycling to reduce the total amount of waste it sends to Class I landfills. In 1987, the amount of waste recycled was about 436,640 lbs, or 28% of the total hazardous waste generated by VAFB (USAF 1989a).

Industrial waste in the region is primarily generated from manufacturing facilities in the city of Lompoc and the North VAFB industrial area. Although a Class II landfill exists in the city of Lompoc and can accept various domestic and industrial wastes, it is not utilized by VAFB for waste disposal. The North VAFB Class III landfill is currently used for disposal of some solid industrial waste generated on VAFB.

Hazardous wastes generated on North VAFB are transferred for temporary storage (less than 90 days) to a collection-accumulation point (CAP) on North VAFB. From the CAP, the hazardous waste is transferred to a central EPA RCRA (Part A) permitted hazardous waste storage facility on North VAFB. VAFB contracts the disposal of its hazardous wastes to privately owned firms. Once the wastes leave the storage facility, they are either hauled to a Class I landfill or recycled (USAF 1989a).

Transportation

The transportation system potentially affected by the proposed project would be the highways surrounding the city of Lompoc and VAFB and streets within the city of Lompoc. In 1985, the peak-month average daily traffic volumes on Ocean Avenue were 3,900 vehicles on the segment west of 13th Street and 4,850 vehicles immediately east of 13th Street, with peak-hour traffic volumes of 430 and 690 vehicles, respectively (Caltrans 1985). The volume of traffic entering and leaving VAFB was recorded in October 1986 by VAFB's Traffic Engineering Department. During a midweek, 24-hr period, 5,478 vehicles passed through the 13th Street Gate (13th Street near Ocean Avenue), 2,645 through the South Gate (Arguello Boulevard near Ocean Avenue), and 3,835 through the Coast Gate (Coast Road at the western terminus of Ocean Avenue). Most of this traffic occurred during daylight hours.

Traffic on Ocean Avenue west of 13th Street has declined significantly since 1986, largely because of cutbacks in the Space Shuttle program. In early 1988, the hours when the Coast Gate was open were cut back from 13.5 hr (5:30 a.m. to 7:00 p.m.) to 2.5 hr (6:00 to 8:30 a.m.).

2.2.1.2 Cultural resources

More than 600 archaeological sites are recorded within the boundaries of VAFB, and over 2,000 archaeological sites are recorded in Santa Barbara County. Extensive archaeological surveys and testing have been conducted recently for other programs on South VAFB. A survey by Greenwood and Associates (1987) documented numerous archaeological sites near SLC-4E. Consultation with the SHPO regarding present construction activity at SLC-4E resulted in a determination of no adverse effect (personal communication, Sarah Berry, 1 STRAD/ET, VAFB, with Andrea Campbell, ORNL, August 11, 1989). An historic site (CA-SBA-1148) (a ranch) is located about 1/4 mi southeast of Bldgs. 398 and 520 at SLC-6, and an archaeological site (CA-SBA 1678) is located about 1/4 mi to the southwest. The area at Bldg. 520 has been surveyed, and no archaeological resources were found (personal communication, Larry Spanne, 1 STRAD/ET, VAFB, with Andrea Campbell, ORNL, September 25, 1989). Recent consultation with the SHPO (see App. C) has indicated that future modifications to SLC-4E and Bldg. 398 as part of the proposed expansion of the Titan IV program at VAFB would also have no adverse effect (see App. C).

The National Park Service conducted an inventory of historic sites on VAFB in 1987. Although military use of the area, dating back to the early 1940s, is reflected in certain structures on VAFB, SLC-4 was not nominated as an historic landmark.

2.2.1.3 Ambient noise

Noise monitoring at VAFB and surrounding areas during 1984 and 1985 showed ambient average noise levels of 48–67 dBA, levels typical of residential or urban areas. Rural and isolated areas of VAFB, the Lompoc Valley, and north Santa Barbara have noise levels less than 45 dBA. Current space vehicle launches at VAFB generate high noise levels but because of their short duration and infrequent occurrence do not influence noise contours for the Lompoc Valley or Santa Maria.

2.2.2 Natural Environment

2.2.2.1 Climate and air quality

Climatology

The climate at VAFB is strongly influenced by its coastal setting. Annual variations in temperature and moisture content of the air are relatively small because of the moderating effects of the Pacific Ocean. The average annual temperature at VAFB is 55°F. Average daily minimum temperatures range from 43°F in January to 53°F in July. Average daily maximum temperatures range from 59°F in March to 68°F in October. Between 1958 and 1970, the lowest recorded temperature at VAFB was 26°F and the highest was 100°F.

Relative humidity at VAFB is usually in the 50-100% range because of the proximity of the ocean and the predominance of ocean-to-land air flow. Fog is common during the summer months, particularly at night and in the early morning. Annual average precipitation in the VAFB region is 12.7 in., the majority of which occurs in the winter months.

The terrain at VAFB causes wind speeds and directions to vary substantially across the base. Stronger winds tend to occur along the beaches and on higher terrain. The wind rose in Fig. 2.8 shows the frequency distribution of wind speeds and directions at a location just south of the VAFB airfield. This wind rose is based on 11 years of data (1967-70 and 1973-79). The spokes on the wind rose indicate a strong predominance of winds from the northwest quadrant at VAFB.

Temperature inversions of two types are fairly common at VAFB. A high-pressure system over the Pacific Ocean causes subsidence inversions at an elevation of about 1,000 ft frequently during the summer and less frequently during the rest of the year. Surface-based

ORNL-DWG 89-11466

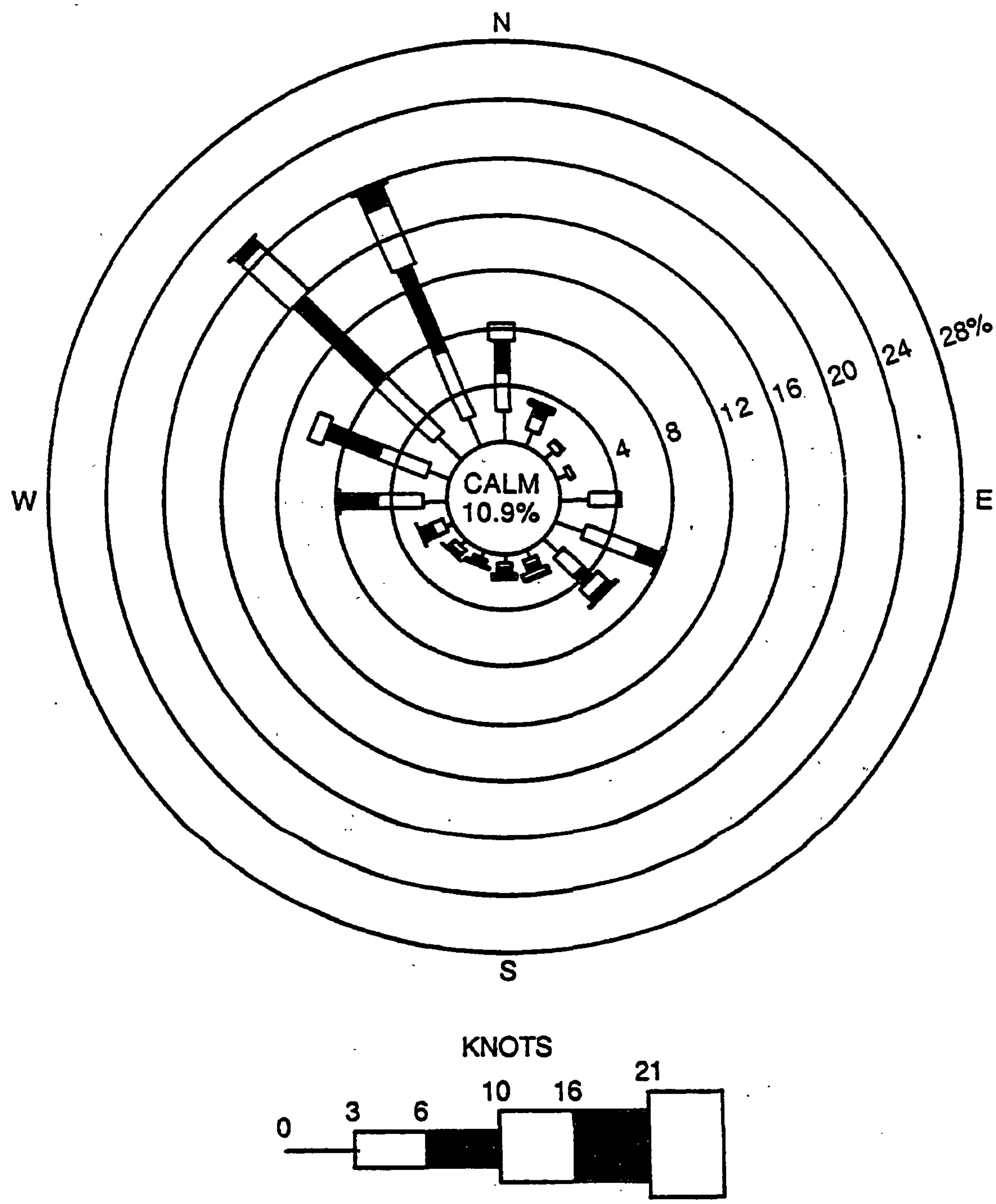


Fig. 2.8. Wind rose for Vandenberg Air Force Base for 1967-70 and 1973-79.

radiation inversions caused by nighttime cooling are frequent during autumn, winter and spring.

Air quality

The most recent air quality monitoring data (1986) obtained from the California Air Resources Board (CARB 1987) indicate that air quality at VAFB is quite good for most regulated air pollutants. The generally good air quality results from the predominance of northwest winds, bringing clean air from over the Pacific Ocean. The lack of major emission sources at VAFB is another reason for the good air quality. An inventory of 1981 emissions indicated that sources on VAFB accounted for less than 2% of the total emissions in Santa Barbara County.

Two monitoring sites at VAFB are included in the CARB report. One site was located in the vicinity of SLC-2, near Purisima Point. The other site was on the plateau about 1 mi southeast of the airfield. Each of these sites yielded measurements of six criteria pollutants during 1986: SO_2, NO_2, CO, O_3, Pb, and TSP. The data in Table 2.5 summarize the maximum concentrations measured at either of the two VAFB monitoring sites during 1986. With the exception of O_3, levels of all pollutants were less than half of the corresponding California Ambient Air Quality Standards (CAAQS) and NAAQS. Ozone levels at VAFB exceeded CAAQS several times in 1986 but did not exceed the NAAQS.

TSP levels at VAFB in 1986 were less than half of the 24-hr and annual NAAQS. There were no PM-10 data from VAFB in 1986 to compare with the California PM-10 standards or with the new PM-10 NAAQS implemented on July 31, 1987. However, based on recent PM-10 measurements in Santa Barbara County, the Santa Barbara County Air Pollution Control District (SBCAPCD) has designated northern Santa Barbara County, including VAFB, as non-attainment with respect to the CAAQS for PM-10 (personal communication, Larry Gordon, 1 STRAD/ET, VAFB, with E. J. Liebsch, ORNL, August 16, 1989). PM-10 was measured at two other sites in Santa Barbara County (in the cities of Santa Maria and Santa Barbara) in 1986. The ratio of PM-10/TSP at these other sites was roughly 0.5 for both 24-hr and annual average concentrations. Assuming that the same ratio of PM-10/TSP applies at VAFB, the PM-10 concentrations at VAFB for 1986 would have been well below the new PM-10 NAAQS and safely below the CAAQS for PM-10.

Table 2.5. Maximum air pollutant concentrations at two sites at Vandenberg Air Force Base in 1986

Pollutant[a]	Averaging period	Concentration	CAAQS[b]	NAAQS[c]
SO_2	1-hour	0.01 ppm	0.25 ppm	none
	3-hour	NA[d]	None	0.50 ppm
	24-hour	NA	0.05 ppm	0.14 ppm
	Annual	0.001 ppm	None	0.03 ppm
NO_2	1-hour	0.04 ppm	0.25 ppm	none
	Annual	0.003 ppm	None	0.05 ppm
CO	1-hour	2.0 ppm	20.0 ppm	35.0 ppm
	8-hour	NA	9.0 ppm	9.0 ppm
O_3	1-hour	0.10 ppm	0.10 ppm	0.12 ppm
Pb	30-day	0.02 $\mu g/m^3$	1.5 $\mu g/m^3$	none
	Calendar Quarter	0.01 $\mu g/m^3$	None	1.5 $\mu g/m^3$
TSP[e]	24-hour	69 $\mu g/m^3$	None	150 $\mu g/m^3$
	Annual[f]	32 $\mu g/m^3$	None	75 $\mu g/m^3$
PM_{10}	24-hour	No data[g]	50 $\mu g/m^3$	150 $\mu g/m^3$
	Annual	No data[g]	30 $\mu g/m^3$	50 $\mu g/m^3$

[a] SO_2 = sulfur dioxide; NO_2 = nitrogen dioxide; CO = carbon monoxide; O_3 = ozone; TSP = total suspended particulate matter; PM-10 = particulate matter less than 10 microns.

[b] CAAQS = California Ambient Air Quality Standards.

[c] NAAQS = National Ambient Air Quality Standards.

[d] NA = not available. These data were not provided in CARB (1987).

[e] The NAAQS for TSP were replaced by NAAQS for PM-10 effective July 31, 1987.

[f] Geometric mean concentration. All other annual averages in the table are arithmetic means.

[g] PM-10 data were not monitored at the two VAFB sites in 1986.

2.2.2.2 Surface water resources

Hydrology

The major streams that drain VAFB are the Santa Ynez River, San Antonio Creek, and Canada Honda Creek. None of these is near SLC-4. The Santa Ynez River, the closest, is 5.3 mi north, and Canada Honda Creek is 2 mi to the south (Fig. 2.9). Ephemeral and intermittent streams near SLC-4E and SLC-6 include Spring Canyon Creek, 0.1 mi south and directly downslope from SLC-4 and Bear Creek, 1 mi to the north.

Spring Canyon Creek, which originates 1.4 mi inland and flows toward the ocean, is the only receiving water that could be directly affected by the proposed action. The drainage at SLC-4E is toward Spring Canyon Creek, away from Bear Creek. Although the major portion of the flow in the creek is from direct runoff, several small seeps also feed into it. Flow varies seasonally between 0 and 0.5 cfs (Versar 1987). The creek flows into a seasonal pond behind the Coast Road embankment and percolates into the groundwater system rather than discharging directly to the Pacific Ocean. The water in the creek ultimately reaches the ocean via groundwater transport (Stearns Catalytic 1987).

Bear Creek, to the north of SLC-4, drains an area of only a few square miles. Like Spring Canyon Creek, Bear Creek does not discharge directly to the ocean. Canada Honda Creek, south of SLC-4, is more than 8 mi long and drains an area of 12 mi^2. Flow in the creek ranges from 0 to a measured peak of 2,120 cfs in February 1962. Summer flow comes from seeps and springs along canyon walls.

Water quality

Water quality of Spring Canyon Creek is summarized in Table 2.6 for the sampling locations indicated on Fig. 2.9. Water quality is generally poor to fair, with high concentrations of sodium, chloride, iron, aluminum, and total dissolved solids. Elevated concentrations of these elements are probably the result of past wastewater discharges and particulate deposition of Al_2O_3 and HCl in the ground cloud during previous Titan III launches from the SLC-4 site. Dissolved oxygen and pH vary in comparison with

ORNL-DWG 89-11833R

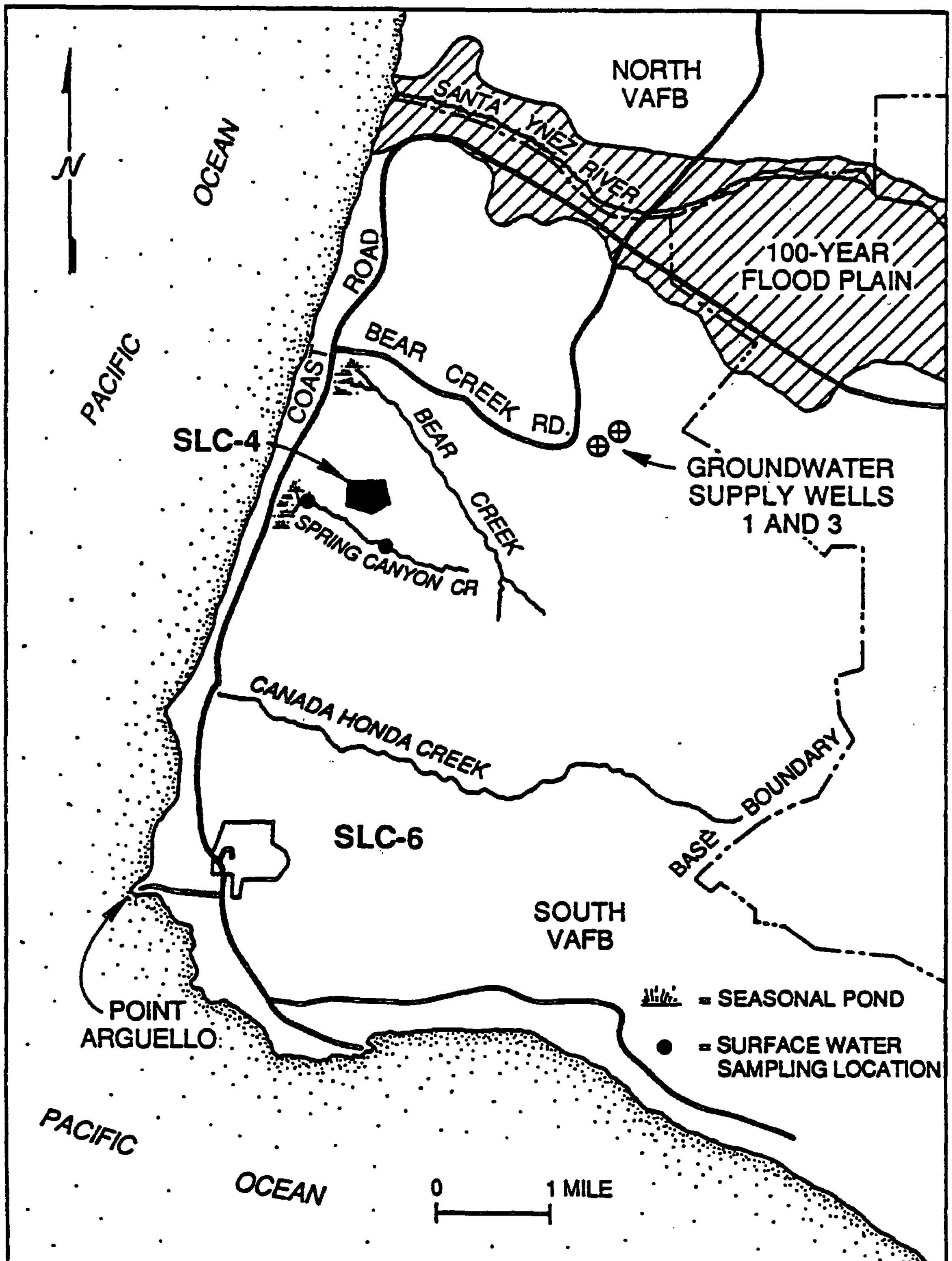


Fig. 2.9. Surface waters in the vicinity of Titan IV launch and support facilities, South Vandenberg Air Force Base, California. Surface water sampling locations and groundwater supply wells are also indicated.

Table 2.6. Surface water quality data for Spring Canyon Creek at Vandenberg AFB, California

	Sampling station above SLC-4[b]			Sampling station below SLC-4[c]			
Parameter[a]	1983	1984	1986	1983	1984	1985	1986
pH	6.42	6.00	6.00	6.99	7.50	7.68	6.67
Total organic carbon	24.50	23.00	31.00	25.00	35.60	34.70	18.00
Chemical oxygen demand	87.50	120.00	325.00	59.00	179.20	190.30	112.50
Dissolved oxygen	8.45	NA	NA	5.70	8.75	9.70	8.40
Chloride	280.00	NA	580.00	316.00	550.00	593.30	670.00
Nitrate	<0.10	0.40	<0.10	0.10	0.05	NA	0.10
Calcium	15.05	27.30	70.20	62.60	62.30	75.50	53.25
Magnesium	21.40	13.40	47.00	52.85	47.10	73.10	49.50
Sodium	173.90	24.70	296.00	206.45	303.20	367.60	306.54
Total dissolved solids	872.50	NA	1,220	879.50	550.00	593.30	1,407
Total hardness	125.50	123.00	369.00	373.50	349.60	489.70	373.00
Alkalinity	44.00	NA	162.00	148.50	193.20	143.30	157.70
Arsenic[d]	<10.00	NA	NA	502.50	<10.00	NA	NA
Copper[d]	<20.00	NA	NA	28.50	34.00	NA	NA
Iron[d]	7,822	3,728	48,640	512,751	26,952	7,272	4,680
Lead[d]	17.50	NA	NA	17.50	NA	NA	NA
Zinc[d]	<50.00	NA	NA	70.00	70.00	NA	NA
Aluminum[d]	3,602	38,700	805.00	35,520	1,157	108.7	250

[a]Units are shown in mg/L, except where noted.
[b]Sampling location is 1/4 mi upstream.
[c]Sampling location is 1 mi downstream.
[d]Units are μg/L.
Source: USAF 1988b, Table 2.1.5-3.

EPA-accepted levels of 5.0 mg/L and 6.5-8.5 units, respectively, for protection of aquatic life. High values of iron may exceed accepted safe levels for aquatic life based on toxicity bioassays.

2.2.2.3 Geology, soils, and groundwater

Detailed descriptions of the geology, groundwater, and soils of VAFB are provided in a previous Titan IV EA (USAF 1988b), but the impact of deluge water on groundwater was not included. This assessment reiterates the site geology in sufficient detail for understanding the impact of deluge water on local groundwater.

The SLC-4E site and its support facilities lie in the southern part of VAFB on soils of the Marina-Oceano association. These soils, mainly sand, are developed on nearly flat to moderately steep slopes and drain very rapidly (greater than 20 in./hr).

Soils are underlain by Pleistocene (ice age) dune sand and alluvium except where they are eroded out and replaced by Holocene (recent age) alluvium that fills the bottom of Spring Canyon. Stratigraphers refer to the Pleistocene unit as the Orcutt Sand. Both of these units lie directly on top of several tens of meters (perhaps 100 ft) of diatomite and diatomaceous clay shale (the Sisquoc Formation). In turn, the Sisquoc Formation overlies several thousand feet of diatomite and diatomaceous shale belonging to the Monterey Formation.

Groundwater movement adjacent to SLC-4E is restricted to the near-surface Orcutt Sand aquifer and the Holocene alluvial aquifer of Spring Canyon, as shown in Fig. 2.10. In the middle reaches of Spring Canyon (near SLC-4E), the water table lies 3 m (10 ft) beneath the surface, but downstream (near the ocean) the water table is up to 43 m (140 ft) deep. Groundwater in the Orcutt Sand discharges to the Holocene alluvium of Spring Canyon and then through the Holocene alluvium to the Pacific Ocean. Groundwater in Spring Canyon is apparently isolated from groundwater in Bear Creek by the fault shown in Fig. 2.9. Hence, groundwater north of the fault would not be impacted by contaminated groundwater beneath SLC-4E. The underlying diatomite (siliceous remains of tiny organisms) and shale are too fine grained to be considered aquifers.

Groundwater quality data in the Holocene aquifer of Spring Canyon near SLC-4E, collected from 1984 to 1986, are provided by Table 2.7. Groundwater quality fails to meet

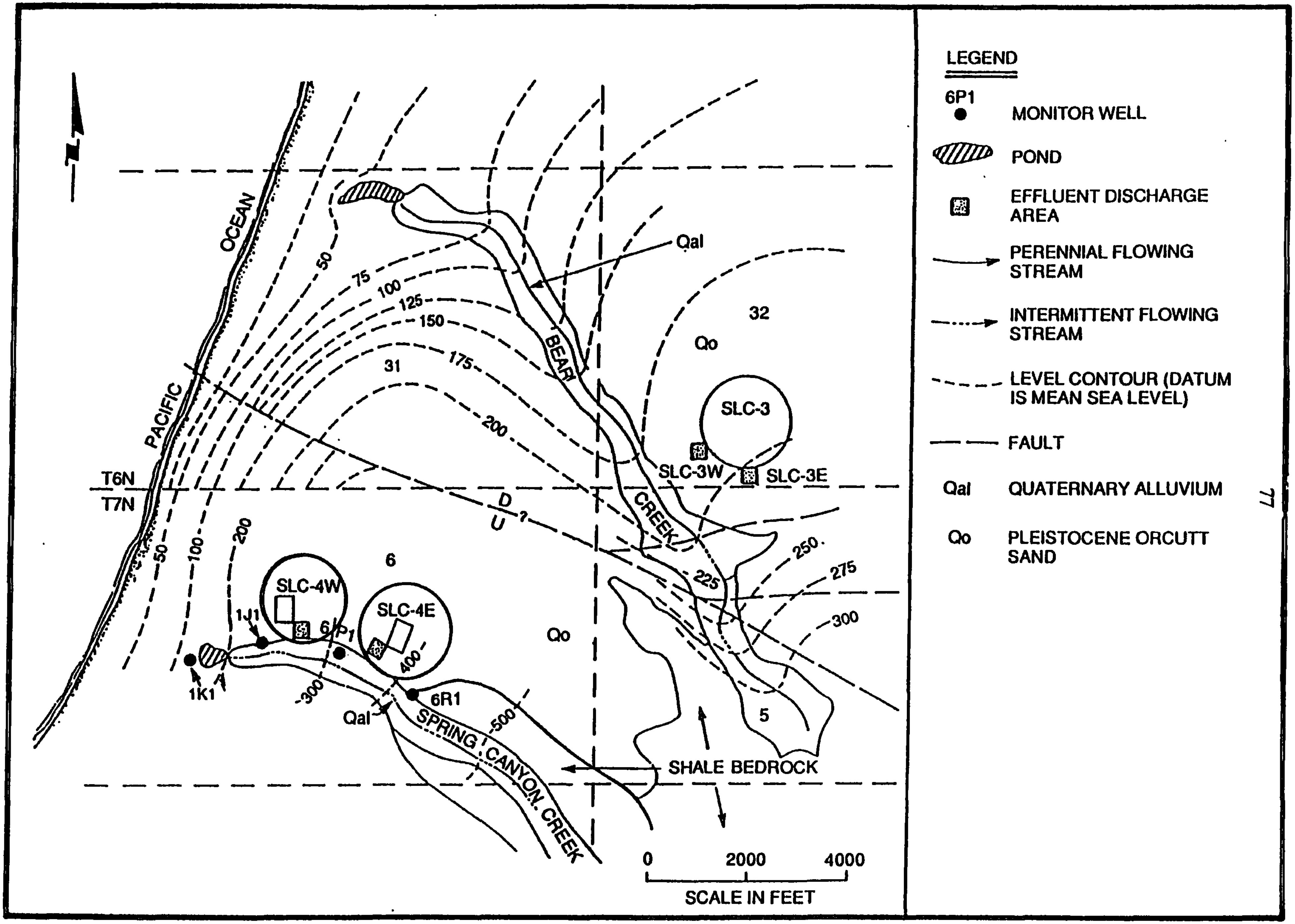


Fig. 2.10. Groundwater contour levels and sampling locations near SLC-4 E at Vandenberg Air Force Base, California.

Table 2.7. Groundwater quality data for Spring Canyon both upstream and downstream of SLC-4E compared with interim primary and secondary drinking water standards

Parameters[a]	Monitoring wells 6R1 1500 ft upstream	6P1 500 ft downstream	1J1 2000 ft downstream	1K1 4000 ft downstream	EPA maximum contaminant levels[b]
Samples	1	1	4	2	
Alkalinity	80	109	67	346	c
Boron	<0.5	<0.5	0.5	0.1	c
Calcium	25	38	73	95	c
Magnesium	20	27	76	43	c
Hardness	145	206	497	415	c
					Secondary Standards
Chloride	354	372	825	240	250
Copper	<0.02	<0.02	0.016	0.005	1
Iron	1.5	3.4	1.6	0.1	0.3
Manganese	0.09	0.22	0.52	1.30	0.05
Sodium	19	19	457	175	none
Sulfate	48	33	270	245	250
Total dissolved solids	664	842	1800	1050	500
Zinc	0.07	0.65	0.50	0.12	5
pH[d]	6.9	7.1	6.4	7.0	6.5-8.5
					Primary Standards
Arsenic	<0.01	<0.01	0.002	0.001	0.05
Barium	<0.2	<0.2	0.25	None	1
Cadmium	<0.01	<0.01	0.004	0.001	0.01
Lead	0.022	<0.02	0.002	0.001	0.05
Nitrate	<0.1	<0.1	None	None	10

[a]Units are shown in mg/L except as noted.

[b]40 CFR, Parts 141.11 and 143.3. U.S. Environmental Protection Agency Drinking Water Standards, Maximum Contaminant Levels for Inorganic Metals and Secondary Maximum Contaminant Levels.

[c]No standards.

[d]Negative log of the hydrogen ion concentration.

Source: USAF 1988b, Table 2.1.5-1.

most interim secondary drinking water standards but (based on limited data) apparently meets interim primary drinking water standards. As a result, it is highly unlikely that the Holocene aquifer would be an acceptable municipal water supply. Groundwater quality generally deteriorates downstream from an active launching pad. Downstream deterioration in water quality may be related to both launching activities and proximity to the sea. Slightly elevated levels of organic solvents [trichloroethylene (TCE) and trans-1,2-dichloroethylene (DCE)] were also observed. The presence of organic solvents is almost certainly related to VAFB activities.

2.2.2.4 Terrestrial ecology

Vegetation within and around VAFB has been well documented in previous studies (e.g., USAF 1978, 1988b). Eleven different community types are known to exist on the base. The three community types which would be affected by the proposed action are the dune scrub, the coastal scrub, and the ruderal vegetation communities (Fig. 2.11). The following is a brief description taken from USAF (1988b) of these three communities, the degree to which they have been disturbed by prior activities, and the wildlife inhabiting them.

Dune-scrub community—This community consists of a dense cover of shrubs 3 ft or more in height growing on gently sloping hills of loose sand. Dominant shrubs are dune lupine, mock heather, and California sagebrush. Common native herbs include curly-leaved monardella, cudweed aster, and Blochman's groundsel. The dune scrub community near the SLC-4 complex has been lightly invaded by a few introduced species such as hottentot fig and narrow-leaved iceplant.

The community type has been classified as a threatened and declining vegetation type in California. Because the sandy soil is unconsolidated, this community type is especially sensitive to off-road vehicles and other forms of mechanical disturbance. The dune scrub community in the vicinity of the SLC-4 complex has experienced little disturbance. Few animal species permanently inhabit this community.

Coastal scrub community—This community is dominated by a dense cover of shrubs 3–7 ft high. Dominant shrubs are California sagebrush, mock heather, black sage, California coffeeberry, coyote brush, and poison oak. Common native herbs include figworts, chaparral

ORNL-DWG 89M-9566

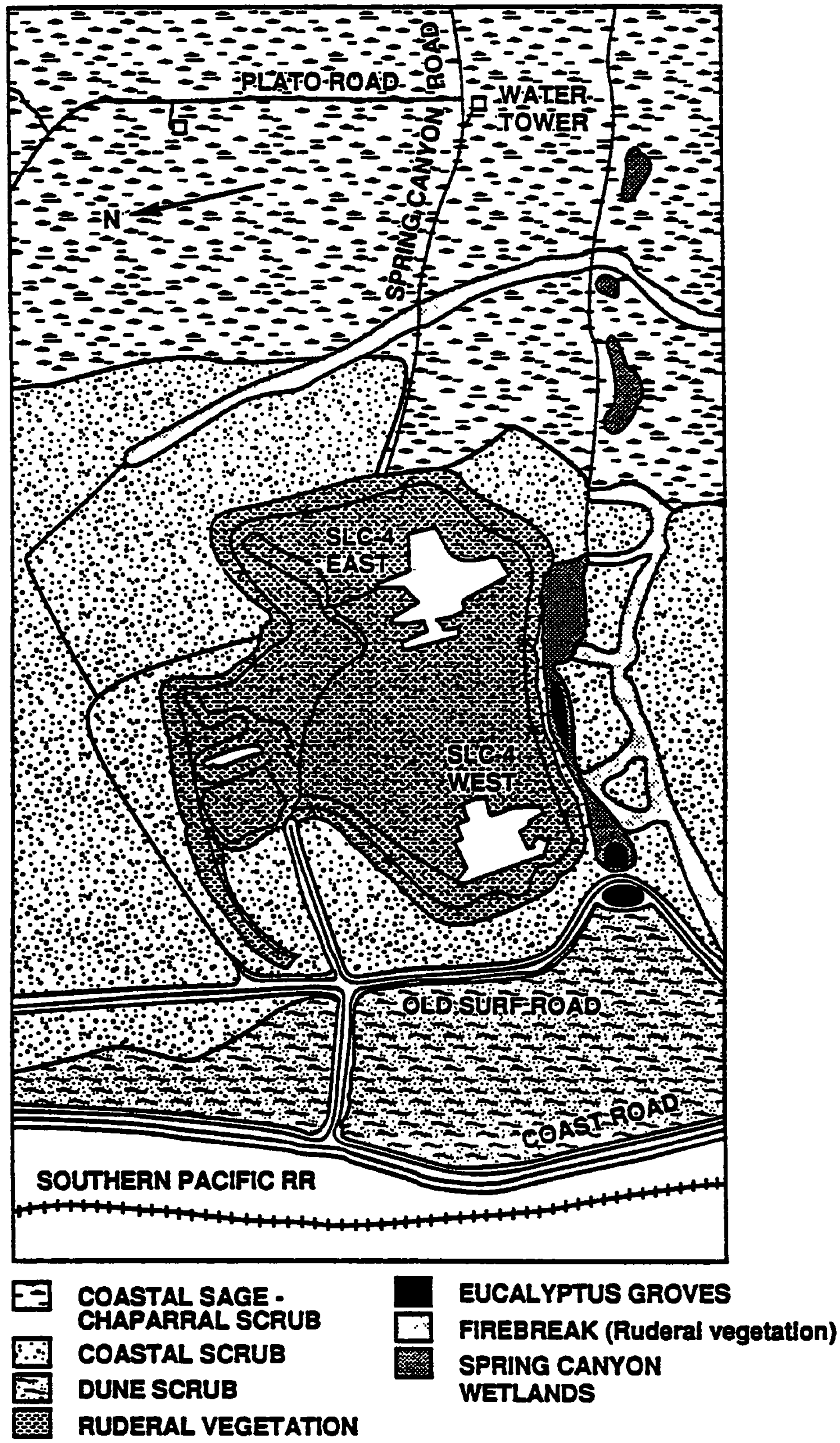


Fig. 2.11. Vegetation of Space Launch Complex 4 and surrounding area. *Source:* adapted from Versar 1987, Fig. 2.1-7.

morning glory, white yarrow, California croton, and branching phacelia. With the exception of a recently burned area near SLC-4, the community type is relatively undisturbed.

Many wildlife utilize the food and shelter afforded by the dense shrub cover of this community. Twelve species of reptile and two species of amphibians use this habitat type within VAFB, while fourteen bird species breed in the habitat. In addition, several regionally rare or declining bird species, including Cooper's hawk, northern harrier, merlin, short-eared owl, and burrowing owl are likely to forage in this habitat. Fourteen mammal species, including badger, also use this habitat.

Ruderal community—This highly disturbed community is dominated by introduced species, especially hottentot fig and iceplant, and supports a somewhat limited wildlife. Four species of reptile and two amphibians are expected to occur in this community near SLC-4. Seven grassland bird species might be expected to breed within this community, while regionally rare raptors such as the black-shouldered kite, northern harrier, and burrowing owl may use such sites for foraging. Small rodents are common and provide important prey for hawks, owls, and other carnivores. This habitat is also used by mule deer, feral pig, and badger.

The Channel Islands just south of Santa Barbara and VAFB represent a unique biological resource. Although the flora and fauna of the Channel Islands are generally similar to that of VAFB and the adjacent mainland areas (USAF 1988b), the islands are ecologically significant because they include some of the most important Californian breeding grounds for seals and sealions and migration areas for whales and porpoises. The islands also serve as breeding grounds for many seabird species including California's only nesting colonies of brown pelicans (USAF 1978).

2.2.2.5 Aquatic ecology

Because they are intermittent streams, Spring Canyon Creek and Bear Creek have no permanent aquatic fauna. The wetlands vegetation in Spring Canyon is described in Sect. 2.2.2.7. The aquatic biota of Canada Honda Creek is diverse because of good water quality, abundant plant life, and year-round flow (USAF 1988f). Fauna include invertebrates such as stoneflies, caddisflies, snails, and amphipod crustaceans.

The marine biota in the project vicinity from Point Arguello to the Santa Ynez River are described in detail in USAF (1983 and 1988b). This area has diverse species in both intertidal and subtidal zones. The biota north of Point Arguello are generally typical of the central California coast. In rocky habitats adjacent to SLC-4, the high intertidal zone commonly contains acorn barnacles, periwinkle snails, and limpets; the middle intertidal zone, in addition to these groups, contains brown and red algae. Slightly lower in the zone are sea anemones, black turban snails, shore crabs, polychaete worms, tidepool sculpins, and green and red algae. Mussels, gooseneck barnacles, starfish, and coralline red algae also are common, and red and black abalone occur.

The subtidal region offshore from SLC-4 varies greatly in habitat type and biotic composition. The inshore habitats support a variety of benthic plants, predominantly green and brown algae. The fauna vary with depth. Offshore, at depths of 50 to 75 ft, polychaete worms, speckled sanddabs, and dark-blotched rockfish are dominant. At least 297 species of marine fish appear in the Point Arguello region (USAF 1978). Three species of sea turtle are the only marine reptiles expected in the project region. South of Point Arguello are several haul-out and breeding areas for a large population of harbor seals and one haul-out area for California sea lions. Juvenile elephant seals occasionally haul out in these areas.

2.2.2.6 Threatened and endangered species

Several federal candidate threatened or endangered plant species occur in the dune scrub community—soft-leaved Indian paintbrush, crisp monardella, curly-leaved monardella, and black-flowered figwort. The same rare plant species are found in the coastal scrub community, although crisp monardella is absent. In addition, the federal candidate species, Hoffmann's sanicle, is also expected to occur in the coastal scrub community although it has not been observed there.

Threatened and endangered animal species and protected marine mammals that may occur on or near VAFB are listed in Table 2.8; candidate species are listed in Table 2.9. The portions of Canada Honda Creek that have year-round flow support an introduced population of the federally listed endangered unarmored three-spined stickleback (USAF 1988b).

Table 2.8. Threatened and endangered fauna and protected marine mammals near Vandenberg Air Force Base and their status

Species[a]	Federal status[b]	Status at Vandenberg Air Force Base
	Birds	
California least tern	E	Resident/nesting
Bald eagle	E	Rare winter visitor
Brown pelican	E	Visitor/foraging
American peregrine falcon	E	Visitor/foraging
	Marine Mammals	
Finback whale	E	Occasional sightings
Right whale	E	Occasional sightings
Northern elephant seal	E	Rookery/Channel Is.
Guadalupe seal	T	Visitor/Channel Is.
California sea otter	T	Occasional sightings
California gray whale	E	Occasional sightings
Blue whale	E	Occasional sightings
Humpback whale	E	Occasional sightings
Sperm whale	E	Occasional sightings
Harbor seal	--	Rookery/VAFB
Stellar sea lion	--	Visitor/Channel Is.
Northern fur seal	--	Visitor/Channel Is.
California sea lion	--	Rookery/VAFB
	Fish	
Unarmored three-spined stickleback	E	Resident

[a]Scientific names are given in FWS (1988).
[b]E = listed as endangered
T = listed as threatened.
Source: USAF 1988b.

Table 2.9. Candidate 2 species[a] at or near Vandenberg Air Force Base and their status

Species[b]	VAFB
Plant	
Black-flowered figwort	Observed
San Luis Obispo monardella	Observed
Soft-leaved Indian paintbrush	Observed
Beach spectacle pod	Observed
Surf thistle	Observed
Island wallflower	Observed
Crisp monardella	Observed
Aphanisma	Observed
Shagbark manzinita	Observed
Lilac (Nipomo Mesa ceanothus)	Not observed
Monterey spine flower	Observed
La Graciosa thistle	Observed
Gambel's watercress	Observed
Hoffmann's sanicle	Observed
Reptiles and Amphibians	
Western pond turtle	Resident
California red-legged frog	Resident
Arroyo toad	Not observed
Birds	
Western snowy plover	Resident/nesting
Long-billed curlew	Resident
Ferruginous hawk	Observed/no nesting
White-faced ibis	Visitor/observed
Tricolored blackbird	Observed
California black rail	Not observed

Table 2.9. (continued)

Species[b]	VAFB
Birds (continued)	
Elegant tern	Visitor/observed
Western yellow-billed cuckoo	Visitor
Mammals	
Spotted bat	Not observed
Towsend's western big-eared bat	Not observed
Western mastiff bat	Not observed
Fish	
Tidewater Goby	Observed
Invertebrates	
Morro blue butterfly	Observed
Globose dune beetle	Not observed
Wandering skipper butterfly	Not observed

[a]Candidate 2 species are proposed for federal listing.
[b]Scientific names are given in USAF (1989d).
Source: USAF (1988b); Schmalzer et al. 1988.

No other protected aquatic species have been identified in surface water bodies in the project vicinity. The California least tern nests at the mouth of the Santa Ynez River and on the beaches and dunes from Seal Beach north to Shoman Creek. Peregrine falcons are occasionally sited on South VAFB. Six endangered whale species have been sighted in the vicinity of the Channel Islands. Harbor seals use the beaches of Vandenberg for rookery habitat. California sea lions use the rocks at Pt. Arguello for haul-out areas, and elephant seals are also sometimes seen in this area. The Northern elephant seal, harbor seal, and California sea lion use the Channel Islands for rookery habitat.

In compliance with Sect. 7c of the Endangered Species Act, the FWS and National Marine Fisheries Service (NMFS) have been contacted for information about protected species that may be affected by the proposed action (see App. B and App. C).

2.2.2.7 Floodplains and wetlands

Spring Canyon contains unique wetland communities, including riparian forest, emergent wetlands, and arroyo willow scrub. These wetland communities are described in detail by USAF (1988b) and are summarized here.

The riparian forest occurs as two groves in the lower reaches of the canyon and is dominated by blue gum (*Eucalyptus globulus*), which provides habitat for wildlife, insects, and birds. These areas are used as winter roosting sites for monarch butterflies. Butterfly roosts are considered an environmentally sensitive habitat and are a protected resource within Santa Barbara County (USAF 1988b). The Spring Canyon roost supports a winter population of 2,000–4,000 individuals. In the vicinity of SLC-4, the perennially wet soil and partially open canopy have resulted in the formation of dense stands of bulrushes and rush. Arroyo willows also occur along the stream margins. Emergent wetland areas in Spring Canyon consist of areas of both broadleaf and narrowleaf cattails, coastal woodfern, western sword fern, braches fern, stinging nettle, giant horsetail, and sedge.

Many birds, mammals, amphibians, reptiles, and insects use the wetland area. Cooper's hawk and the western gray squirrel are the only regionally rare or declining wildlife species that are expected to frequent *Eucalyptus* woodlands in the vicinity of SLC-4 (USAF 1988b). No threatened or endangered species are expected to use the wetland area in Spring Canyon.

3. POTENTIAL IMPACTS AND MITIGATION MEASURES

3.1 CAPE CANAVERAL AIR FORCE STATION

3.1.1 Man-Made Environment

3.1.1.1 Regional and local impacts

Socioeconomic impacts at the regional and local levels depend largely on the influx of workers during the construction and operational phases of the project. The projected personnel requirements for the expanded Titan IV program are indicated in Table 3.1.

Table 3.1. Estimated construction schedules and personnel requirements for the expanded Titan IV Program at Cape Canaveral Air Force Station

Proposed activity	Construction start	Construction finish	Duration (months)	Approximate cost ($ million)	Peak number of additional workers
New Solid Motor Assembly Building	January 1990	October 1991	22	79	260
New Payload Fairing Cleaning Facility	April 1990	April 1991	12	10	35
Modifications to Launch Complex 40	April 1990	February 1992	22	135	435
Other modifications	January 1990	January 1991	12	15	80

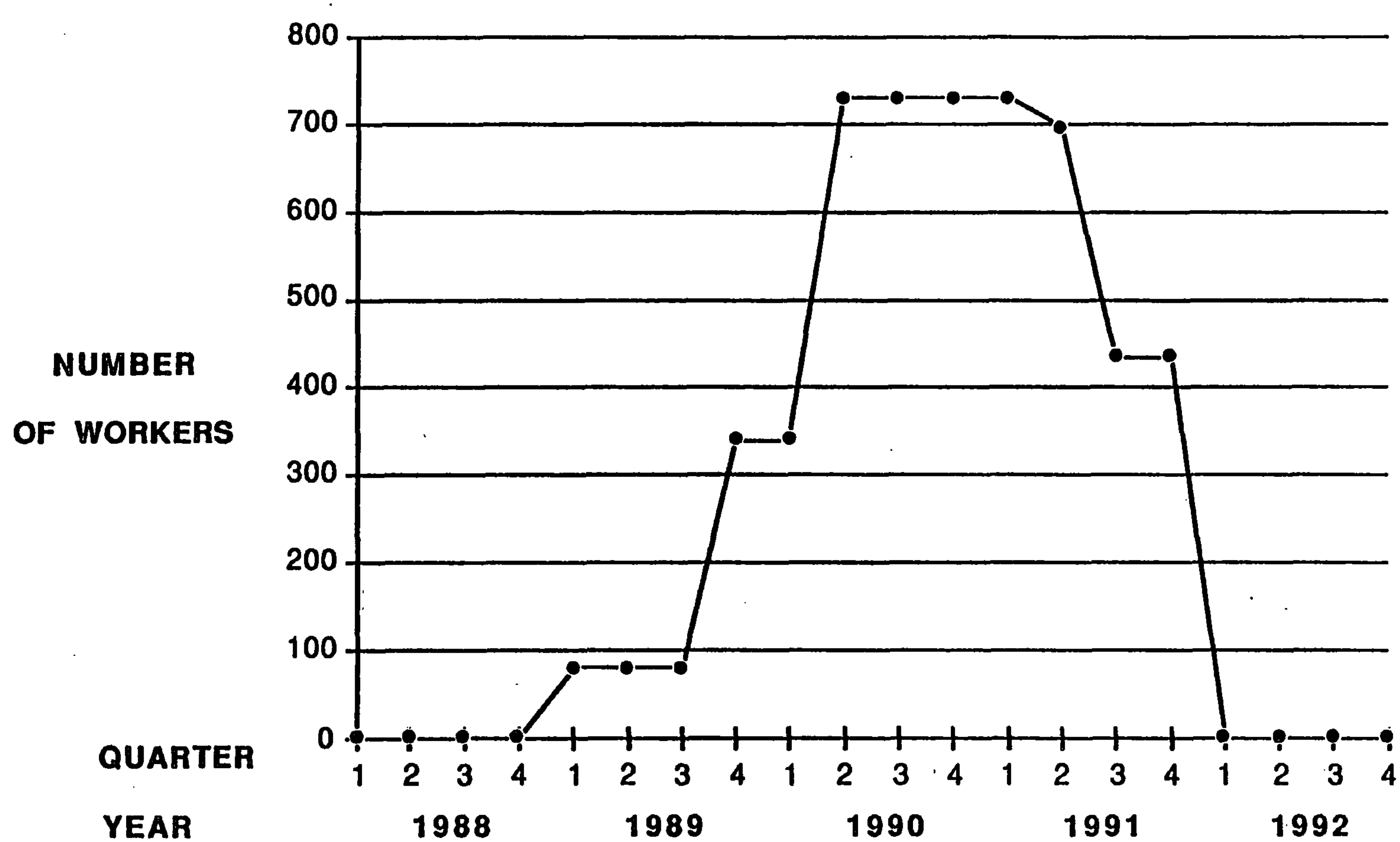
Based on planned schedules, the on-site construction work force for the new SMAB, the modifications to LC-40, and construction of the PFCF would be expected to peak in 1990 at a level of 730. Of these, the actual workers needed on the construction site are assumed to make up about 68% of the total; another 14% are management, quality control, and administrative personnel; and absentees and contingencies account for about 9% each.

The operations work force for the expanded Titan IV-Type 2 (SRMU) program would be expected to build to a level of 230 employees (200 contractor and 30 subcontractor) around July 1991, following the completion of construction. The peak work force requirements over time for construction and operation of the SRMU program are shown in Fig. 3.1. Total Titan IV activities (i.e., the expanded program and existing program) would involve a peak construction workforce of 820 in 1990 and a peak operational workforce of 630 in late 1991.

Population distribution and trends

Although construction labor is available within commuting distance of CCAFS, it is expected that up to 40% of the work force would be drawn from outside the vicinity, in part because highly specialized skills in high-rise steel work will be required. Thus, a maximum of 290 construction workers associated with the expanded Titan IV program would be expected to relocate to Brevard County from other regions. Approximately 60% of the workers' families, or 170 families, would relocate for the construction period (Malhotra and Manninen 1981). Assuming that each of the 170 construction workers is accompanied by an average of 2.1 family members (Malhotra and Manninen 1981), the population increase during the construction phase would be about 650 (including workers without families present), which represents only 0.1% of Brevard County's projected 1990 population or less than 1% of the central mainland's 1990 population of 65,650. Such an increase would have a negligible impact on the size and composition of the county population.

Of the expected operations work force of 230 associated with the expanded Titan IV-Type 2 (SRMU) program, about 23% (50) would be drawn from outside the local area and about 23% would be drawn from the Brevard County labor force. The remaining 54% would be expected to be available within the CCAFS, PAFB, and KSC employee pool (USAF 1989a). Assuming that the 50 in-migrating operations employees would be accompanied by their families, with a total household size of 3.1, 160 additional persons would be expected to migrate into the area in the operations phase. It is expected that many of these employees might locate in Cape Canaveral and Cocoa Beach. The estimated increase represents about 0.6% of the combined projected 1990 populations of these two communities. Because projected growth in Cocoa Beach and Cape Canaveral from 1985 through 1990 is in the range of 3.2 to 4.1%, the operations phase would have a negligible impact on the size and composition of either the regional or local population.



ORNL-DWG 89-15780

Fig. 3.1. Peak construction employment in the expanded Titan IV/SRMU program at Cape Canaveral Air Force Station.

Land use

The construction of the new SMAB and the proposed modifications to existing facilities are compatible with the existing industrial nature of land use at these sites and would not change present land use patterns. Because construction and operations activities would not be expected to result in a significant increase in the off-site population, no impacts to community land use patterns would occur.

Employment

Construction employment for the proposed expanded Titan IV-Type 2 (SRMU) program would peak at 730 employees, 290 of whom would be drawn from the labor force outside of Brevard County. These 290 workers would represent an increase of 0.1% in the Brevard County labor force and, assuming other factors remain constant, could lower the county's unemployment rate from 4.7 to 4.5%.

Housing

In-migrating construction workers would be expected to locate primarily on the mainland in either central or northern Brevard County. It is unlikely that a significant percentage of the workers would buy homes—many would seek temporary housing such as apartments, mobile homes, and hotel/motel rentals. Rental vacancy rates range from 6.7% to 7.4% in central and northern Brevard County and are higher elsewhere in the county. Temporary housing, such as hotel/motel units, can be expected to be readily available during the peak construction period in the summer months, when the part-time and tourist population is at its lowest level. No impact on the housing market would be expected from increased demand during the construction phase.

Many of the operations personnel might locate in Cape Canaveral, Cocoa Beach, or elsewhere in central Brevard County. The 50 new households expected during the operations phase represents only 0.1% of housing units in Brevard County and about 1.5% of housing units in Cape Canaveral and Cocoa Beach. The vacancy rate among total housing units in

Cape Canaveral and Cocoa Beach was 25% in 1980. No impact is expected as a result of increased housing demand from operations personnel.

Facilities and services

Schools. Assuming an average of 0.8 children per in-migrating family enrolled in elementary or high school (U.S. Bureau of the Census 1983), the estimated maximum potential increase in the Brevard County school district as a result of the proposed action would be 175 new students (0.8 × 220 families). This represents an increase of only 0.3% in the district and would have no effect on existing pupil-teacher ratios. This figure is well within projected growth rates and staffing plans for the school district and would have a negligible impact on enrollment in any area of the district.

Water. The maximum increase in potable water consumption resulting from an influx of population in the area is 53,000 gal/day (810 × 65 gal/day), which represents about 0.1% of the maximum daily capacity. The water supply has ample available capacity to accommodate this increase.

Implementation of the Titan IV program expansion would require an increase of 727,000 gal of deluge and washdown water over pre-SRMU launches, or about 121,000 gal per launch. The launch water would be drawn from the municipal supply. The water requirements for each launch are within the available daily capacity of the system.

Waste management. Because the increase in population expected from the proposed action is very small, it would not be expected to stress wastewater treatment and landfill capacity in the county, which are adequate for the existing and projected population.

Construction and expansion of facilities for the Titan IV program would generate conventional wastes (wood and metal scrap, excess concrete flashing, etc.), which would be disposed of either at the on-base site or at an approved off-base site (probably the Brevard County Solid Waste Disposal Facility) as prescribed by the USAF in the project specifications.

Nonhazardous solid waste generated during operation of the program would consist of domestic waste (e.g., trash from offices) and sludge from the VIB and SMAB sewage treatment plants. Domestic waste would be collected by a range contractor and disposed of off-base at the Brevard County Solid Waste Disposal Facility. Sludge from the sewage treatment plant would be analyzed to determine if it contains hazardous substances. If so, it would be treated as hazardous waste; if not, it would likely be spread over the on-base solid waste landfill.

Conventional hazardous wastes, such as paint wastes, solvents, and potentially contaminated oils, are anticipated to result from construction. These wastes would be managed by a certified contractor, and no significant impacts would be expected. If asbestos is encountered during refurbishment, it will be removed by a licensed contractor in accordance with National Emissions Standards for Hazardous Air Pollutants (40 CFR 61), which the state of Florida has incorporated into its regulations by reference, and disposed of at the CCAFS sanitary landfill in accordance with ESMC OPLAN 19-15. The quantities of hazardous waste from construction for the Titan IV program would not significantly impact landfill capacity.

Hazardous wastes generated during project operations would consist of trichloroethylene (TCE) from cleaning operations (50-100 gal per launch), MEK, and Freon-113. All would be temporarily stored in the VIB area for subsequent recycling or disposal. The TCE and MEK would either be recycled on-site or incinerated off-site, and waste Freon-113 would be collected and recycled by a KSC contractor. Because hazardous wastes would be recycled, incinerated, reused, or disposed of by a certified contractor, no significant impacts would be expected.

Power. Because FPL is a very large power producer with adequate available capacity, the peak population increase of 810 and the operational requirements of the Titan IV facilities would not impact the demand for power in the region.

Public safety. The expected population increase of 810, if concentrated in Central Brevard County, would only slightly change the ratio of police officers or firefighters to service area population. No impacts to public safety services would be expected.

Health care. An increase of 810 would not significantly change the availability of hospital beds in Central Brevard County. No impact on health care would be expected.

Transportation

Due to the variability in traffic volume attributed to tourism and beach traffic, increases in highway traffic from the influx of Titan IV/SRMU program workers commuting to CCAFS are not expected to result in a noticeable reduction of flow rate on off-base roads. However, the expected increase could exacerbate traffic problems near Port Canaveral.

Additional commuting traffic would be expected to occur in the third quarter of 1991. Assuming that 60% of the 730 construction workers would carpool with another person, and all others would drive alone (Malhotra and Manninen, 1981), the expanded Titan IV program could add an estimated 550-600 vehicles the existing traffic volume entering CCAFS access points. Workers who reside on the beaches and in Central Brevard County are likely to enter Gate 1 via SR 401 and travel north on the Cape Road. Existing traffic problems could be exacerbated in the vicinity of Port Canaveral. NASA Causeway on KSC and North Cape Road are likely to be travelled by persons commuting to CCAFS from Titusville area. The increase in traffic volume on either road would depend on where the workers locate in the county. Assuming a maximum increase of 400 vehicles entering from the Causeway or Gate 1 (south), the increases in traffic for a 24-hr period would be 9% and 6%, respectively. Given the existing levels of service, there is little probability of a major reduction of speed or flow rate. However, the increases could contribute to the frequency of back-ups during peak traffic periods. Thus, minor impacts during peak hours could occur on CCAFS and KSC roads. Traffic is expected to decline following peak construction, although traffic on the Cape Road south of CCAFS may continue to be heavier because of additional operations employees commuting from the beach communities.

Cultural resources

Proposed facilities modifications and new construction would occur on previously disturbed or man-made areas that are industrial in character. The SHPO has provided official comment on the proposed project, stating that no significant archaeological or historical sites are recorded or considered likely to be present within the project areas (App. C). Thus, no adverse impacts to cultural, archaeological, or historic resources would be expected to occur as a result of the proposed action.

3.1.1.2 Cumulative impacts

The assessment of cumulative impacts to socioeconomic resources includes actions in the existing Titan IV program that are already completed or under way and other major actions at and near CCAFS that are not part of the Titan IV program.

Other major activities under way at CCAFS include two Medium Launch Vehicle (MLV) programs and the commercial Titan program. It is not expected that sufficient excess processing and launch capacity at the Titan facilities would exist for there to be a significant number of launches by the commercial Titan program. The MLV program began in late 1988 with the MLV I, a Delta expendable space vehicle launched from LC-17 to place navigation satellites into orbit (USAF 1988g). The MLV II program, proposed to reach full operations in 1991, involves the modification of LC-36 and the nearby industrial area at CCAFS to support launches of expendable Atlas II vehicles to place satellites into orbit. The program will cover a 4-year period (USAF 1989a).

Because construction activities for MLV I have been completed, the activities assessed for cumulative impacts include the operations phases of the MLV I program, the construction and subsequent operations phases of the MLV II program, the construction and operations phases of the existing Titan IV program, and the construction and operations phases of the expanded Titan IV-Type 2 (SRMU) program. Table 3.2 shows the background and projected schedules of each phase and peak personnel requirements during each quarter through 1992.

Population distribution and trends

Figure 3.2 shows peak employment, which is expected to occur between the second quarter of 1990 and the third quarter of 1991. At that time, construction activity associated with LC-40 and new SMAB is expected to peak, the MLV II program would be continuing its construction activities and would have reached its operational level, and the Titan IV-Type 2 (SRMU) operations phase would be starting. The cumulative increase in new construction and operational employees during that time is estimated to be 1,700 (750 construction and 950 operation).

Assuming that 40% of construction workers and 23% of operational personnel are drawn from outside the local labor force (see Sect. 3.1.1.1), a peak increase in in-migration of 530 employees could be expected to occur in the second quarter of 1990. The peak levels of in-migration for each stage of the various programs are shown in Table 3.3. Assuming that 60% of in-migrating construction workers and 80% of operational personnel have families present (Malhotra and Manninen 1981), 350 families might be expected to relocate to the

Table 3.2. Peak employment estimates associated with USAF actions at Cape Canaveral Air Force Station by quarter through 1992

Action	Prior to 1989	1989				1990				1991				1992 and after
		1	2	3	4	1	2	3	4	1	2	3	4	
Expanded Titan IV/SRMU Program														
Construction	0		80	80	340	340	730	730	730	730	695	435	435	0
Operations	0								60	110	170	230	230	230
Existing Titan IV Program														
Construction	0			120	225	225	90	90						
Operations	400	400	400	400	400	400	400	400	400	400	400	400	400	400
Total Titan IV Activities														
Construction	0		80	200	565	565	820	820	730	730	695	435	435	
Operations	400	400	400	400	400	400	400	400	460	510	570	630	630	630
MLV I Program														
Construction	(Construction complete)													
Operations	100	100	100	100	100	100	100	100	100	100	100	100	100	100
MLV II Program														
Construction	175	240	300	220	110	45	45	25	25					
Operations					230	270	310	350	350	350	350	350	350	350
Cumulative Peak Employment														
Construction	175	240	380	440	675	610	865	845	755	730	695	435	435	0
Operation	500	500	500	500	730	770	810	850	910	960	1020	1080	1080	1080
Total	**675**	**740**	**880**	**940**	**1405**	**1380**	**1675**	**1695**	**1665**	**1690**	**1715**	**1515**	**1515**	**1080**

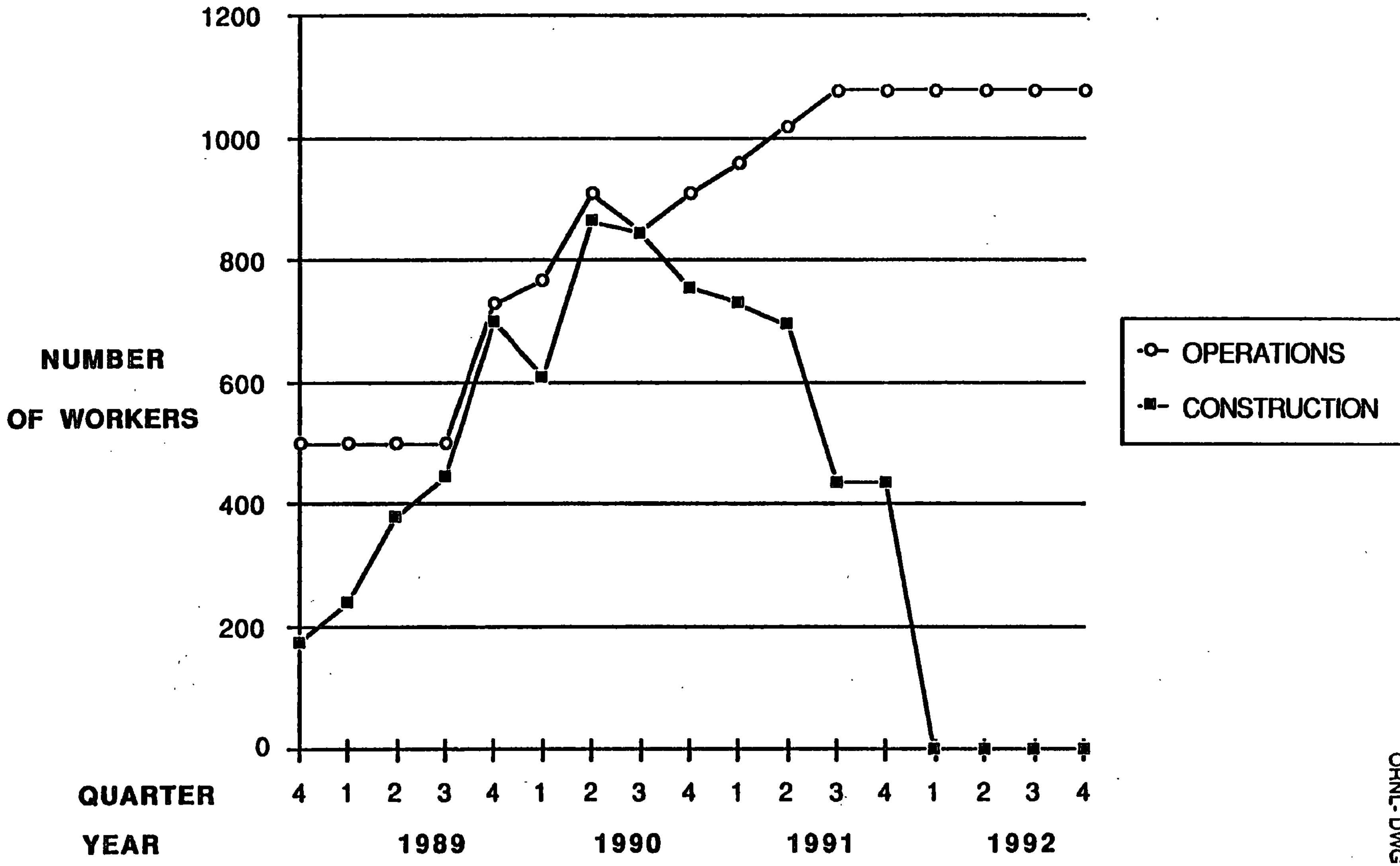


Fig. 3.2. Cumulative peak construction and operations employment in USAF programs at Cape Canaveral Air Force Station.

Table 3.3. Peak estimates of in-migrating employees associated with USAF actions at Cape Canaveral Air Force Station by quarter through 1992[a]

Action	Prior to 1989	1989				1990				1991				1992 and after
		1	2	3	4	1	2	3	4	1	2	3	4	
Expanded Titan IV/SRMU Program														
Construction	0		30	30	140	140	290	290	290	290	280	170	170	0
Operations	0								10	30	40	50	50	50
Existing Titan IV Program														
Construction	0			50	90	90	40	40						
Operations	90	90	90	90	90	90	90	90	90	90	90	90	90	90
MLV I Program[b]														
Operations	20	20	20	20	20	20	20	20	20	20	20	20	20	20
MLV II Program														
Construction	70	100	120	90	40	20	20	10	10					
Operations					50	60	70	80	80	80	80	80	80	80
Cumulative Peak In-Migration														
Construction	**70**	**100**	**150**	**170**	**270**	**250**	**350**	**340**	**300**	**290**	**280**	**170**	**170**	**0**
Operations	**110**	**110**	**110**	**110**	**160**	**170**	**170**	**190**	**200**	**220**	**230**	**240**	**240**	**240**
Total	**180**	**210**	**260**	**280**	**430**	**420**	**530**	**530**	**500**	**510**	**510**	**410**	**410**	**240**

[a]Based on estimates derived in another environmental assessment (USAF 1989a), approximately 54% of operations employees would be drawn from the employee pool at CCAFS, 23% from the Brevard County labor force, and 23% from outside the local area. This assessment assumes a similar distribution. Approximately 40% of the construction work force is assumed to be drawn from outside the local area due to specialized skills required; the remaining 60% are expected to be available within the Brevard County labor force. Numbers are rounded to the nearest 10.

[b]Construction has been completed.

area, in addition to 180 individuals not accompanied by families. Assuming each family has an average of 3.1 members, an estimated population increase of 1,270 could be expected during the peak employment stage. This represents an increase of 0.3% in Brevard County's estimated 1990 population.

The size and composition of the population is not expected to change significantly as a result of the cumulative USAF activities at CCAFS.

Land use

The construction and operations activities associated with the MLV programs and the Titan IV program would not result in impacts to community land use patterns because there would be no significant increase in the local population. The activities will not require new utility services, community facilities, or additional transportation access. The construction would not change the industrial nature of land use on CCAFS.

Employment and economy

Cumulative program activities are expected to reach a peak employment level of about 1,700 workers during the second quarter of 1990. Approximately half of the operations work force is expected to be drawn from personnel currently employed by contractors at KSC and CCAFS and military personnel stationed at CCAFS (USAF 1989a). The remaining half of peak operational employment of 1,080 workers (or 540 workers) would represent a 4.6% increase over the existing level of USAF and associated contractor employment in the area, which totalled 11,743 in September 1988 (PAFB 1988). The direct in-migrating work force of 530 associated with cumulative activities would amount to an increase of less than 0.3% in Brevard County's existing labor force. The peak increase in direct new employment, 1,700 jobs, could change the unemployment rate from 4.7% to 4.1%, if other factors remain constant.

Because the employment levels associated with the cumulative projects are small in Brevard County's overall economic context, adverse impacts to community employment would not be expected and economic benefits would be small.

Housing

Peak in-migration associated with construction for the cumulative programs is expected to require up to 350 temporary rental units during mid-1990. As described in Sect. 2.1.1.1, temporary housing in central Brevard County is expected to be readily available.

Employment of permanent employees associated with the MLV II and Titan IV programs is expected to reach its highest point in the latter part of 1991 (See Table 3.2). Approximately 240 new operating personnel remaining after 1991 will require permanent housing; these houses represent only about 0.2% of housing units in Brevard County. Vacancy rates are particularly high on the beaches, where permanent employees may be likely to locate. No cumulative impacts to the housing market are expected to occur.

Facilities and services

Schools. Assuming an average of 0.8 school-aged children per family (Malhotra and Manninen 1981) among the 350 in-migrating families during the peak employment stage in mid-1990, a maximum of 280 students would be expected to enter the Brevard County School District. These students represent less than 0.5% of the district's enrollment, and enrollment increases would be distributed over the central mainland and beach communities. No cumulative impacts to school capacity are expected.

Water. The maximum cumulative increase in water consumption due to in-migration would be 83,000 gal (1,270 × 65 gal/day), or about 0.2% of the system's capacity. No impacts to the provision of community water services are expected as a result of cumulative in-migration.

The deluge water used in the combined operations of the MLV I, MLV II, and Titan IV programs is not expected to exceed or stress the maximum daily capacity of the municipal water system.

Waste management. The peak cumulative population increase of 1,270 people is not expected to impact local wastewater treatment systems. Most systems in the area (with the possible exception of the Port St. John community) are expected to have sufficient capacity for new customers by 1990. Because a new county facility for solid waste disposal is expected to be in operation by early 1990, the cumulative population increase is not expected to strain existing waste disposal services.

Power. The maximum population increase of 1,270 is not expected to impact the provision of power by FPL. Adequate capacity is available (see Sect. 2.1.1.1) for all CCAFS activities.

Public safety. The peak cumulative population increase is expected to change only slightly the ratio of police and fire department personnel to population in central Brevard County. No impacts on public safety services are expected.

Health care. The cumulative population increase is expected to change the ratio of hospital beds to population in central Brevard County to 1:278 from 1:276. This change is not expected to affect the availability of health care services in the area.

Transportation

The cumulative employment increase of 1,700 workers during early 1991 could result in an increase of up to 1,000 additional vehicles entering and leaving CCAFS over a 24-hour period, in addition to trucks and other vehicles associated directly with construction. This estimate assumes that 60% of the construction workers would carpool with another worker and that all other workers would drive alone (Malhotra and Manninen, 1981). The increase on each access route would depend upon where workers locate. A maximum increase of 700 vehicles at either the NASA Causeway gate or the South Gate (on Cape Road) could be expected during a 24-hour period. Such increases may result in significant increased back-ups during morning badge checks at these points (Capt. Bullington, Pan Am World Services Security Police, personal communication with Janice Morrissey, SAIC, September 22, 1989). Traffic on the 2-lane section of NASA Causeway east of SR 3 would be particularly heavy when North Cape Road is closed. Badge checks conducted by KSC are honored by CCAFS; therefore, increased traffic on the NASA Causeway between the mainland and KSC could conflict with KSC rush-hour traffic congestion.

Due to the existing variability in off-base traffic caused by travel to and from the beaches, no significant impacts on off-base roads would be expected to occur, although some increase in rush hour traffic on roads closer to the base may be noticeable.

While significantly higher traffic levels have been handled by CCAFS access roads in the past, increased traffic flow and congestion on the NASA Causeway and on Cape Road near the main gate could occur during morning and afternoon peak hours as a result of cumulative actions at CCAFS. Off-base impacts could occur to the south of CCAFS in the area of Port Canaveral as increases in CCAFS traffic conflict with increasing traffic related to the new cruise ship terminal and related expansions at Port Canaveral.

Cultural resources

No cumulative impacts to cultural resources would be expected. Consultation with the Florida SHPO for the MLV and Titan programs at CCAFS has resulted in an official determination of no adverse effects on archaeological or historic resources at CCAFS.

3.1.1.3 Mitigation

Because adverse impacts on the economy, land use, or the provision of public services would not be expected to occur, no mitigation would be necessary. Impacts on the transportation network on CCAFS and KSC could be mitigated by effective programs designed to encourage employee carpooling, by employer-sponsored vanpools, or by staggering work schedules. While carpooling programs have met with limited success in the past, regulations provide for CCAFS to order staggered work schedules among its three largest contractors, Martin Marietta, General Dynamics, and McDonald Douglas (Lt. Col. Penley, Commander CCAFS, personal communication with Janice Morrissey, SAIC, September 25, 1989). Plans call for adding a third lane incoming to CCAFS on Cape Road at the south gate early in 1991. This would mitigate, but not eliminate, traffic impacts occurring after that date. Other mitigation measures include continuing double laning and 1-way traffic flow through the industrial area at North Cape Road and providing three lanes both inbound and outbound on Cape Road. A professional traffic study by military Traffic Management Command is needed to identify specific mitigation measures to alleviate cumulative impacts. Mitigation of impacts on off-base roads in the vicinity of Port Canaveral would fall under the jurisdiction of the Port Authority.

3.1.2 Noise

3.1.2.1 Regional and local impacts

Construction

Noise impact analysis focuses on the potential for loss of hearing in human and animal receptors, health and welfare effects on people, and structural damage.

Construction noise at the LCs and at the proposed sites for the new SMAB and PFCF would be generated by vehicles and equipment. Table 3.4 lists peak and attenuated noise levels expected from operation of construction vehicles and equipment.

The nearest location where the public could be exposed to noise from construction at CCAFS is about 4 mi to the west at KSC. Table 3.4 shows that noise from construction vehicles and equipment attenuates to between 54 to 89 dBA at 400 ft from the source. Extrapolating from this, at 4 mi from the source, increased noise from construction would be imperceptible. Therefore, significant adverse impacts to public health would not be expected from construction associated with the expansion of the Titan IV program.

Occupational exposure to unsafe noise levels nearer the source would be reduced to acceptable levels by the use of hearing protection equipment; therefore, significant impacts to occupational health and safety would not be expected.

Pre-launch processing

Noise would be generated in the launch vehicle assembly process by mechanical equipment, such as cranes, and by diesel locomotives and rail cars during transport of core vehicles, SRMs, and components. Typical locomotive noise levels at a distance of 50 ft are about 88 dBA (Canter 1977). Cranes produce about 100 dBA at the source, decreasing to 55-70 dBA at 400 ft. As with construction noise, the increase noise from operations in the ITL Area would be confined to the vicinity of the facilities, and would not affect off-site populations. Therefore, no significant noise impacts would be expected.

Table 3.4. Peak and attenuated noise levels expected from operation of vehicles and equipment during construction for the Titan IV program at Cape Canaveral Air Force Station, Florida[a]

Source	Noise level (Peak)	Distance from source			
		50 ft	100 ft	200 ft	400 ft
Heavy trucks	95	84-89	78-83	72-77	66-71
Pickup trucks	92	72	66	60	54
Dump trucks	108	88	82	76	70
Concrete mixer	105	85	79	73	67
Jackhammer	108	88	82	76	70
Scraper	93	80-89	74-82	68-77	60-71
Dozer	107	87-102	81-96	75-90	69-84
Paver	109	80-89	74-83	68-77	60-71
Generator	96	76	70	64	58
Shovel	111	91	85	79	73
Crane	104	75-88	69-82	63-76	55-70
Loader	104	73-86	67-80	61-74	55-68
Grader	108	88-91	82-85	76-79	70-73
Caterpillar	103	88	82	76	70
Dragline	105	85	79	73	67
Shovel	110	91-107	85-101	79-95	73-89
Dredging	89	79	73	66	60
Pile Driver	105	95	89	83	77
Ditcher	104	99	93	87	81
Fork Lift	100	95	89	83	77

[a]Noise levels given in decibels (A-weighted) (dBA).
Source: Golden et al. 1979.

Launch

Launch of Titan IV vehicles produces noise from the combustion of fuel and the interaction of the exhaust jet with the atmosphere. Although the Titan IV–Type 2 (SRMU) has been designed to generate an instantaneous thrust 8% greater than the Titan IV–Type 1, acoustic calculations indicate that because of design differences, the Titan IV–Type 2 (SRMU) would generate about the same amount of noise as the Titan IV–Type 1 (MMC 1988). The noise occurring at Titan IV launch would be intense, of relatively short duration, and at low frequencies. Near the launch pad, the maximum sound pressure would reach a sound level of about 170 dB, a level that can cause hearing damage. 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 115 dBA. At a distance of about 2 mi from the launch pad, a maximum sound pressure of 125 dB would be anticipated for about 30 seconds after liftoff. This noise level is roughly equivalent to the sound experienced at 200 ft from a jet takeoff. At distances of 5 and 10 mi from the pad, noise levels of about 110 and 100 dBA would be anticipated for about 2 min after launch.

The nearest uncontrolled location where the public could be exposed to launch noise is about 4 mi away at KSC. The nearest communities to the LCs are about 10 mi away. Because Titan IV launches would occur infrequently (six per year maximum) and would involve very short exposure duration (1-2 min), 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. Although some individuals might be annoyed at this, infrequent launch noise is commonly accepted as part of the ambient environment in these communities.

When launch vehicles reach supersonic speeds, they produce pressure waves known as sonic booms. The characteristics of the shock pattern depend on the size of the launch vehicle and its exhaust plume and its trajectory characteristics (altitude, speed, and curvature). Other factors such as air turbulence, winds, and temperature variations of the atmosphere affect the pressure wave and determine how the sonic boom sounds at the surface. Sonic booms of launch vehicles tend to be focused by the curvature of the flightpath produced by the pitchover maneuver necessary to place the vehicle into orbit. Focusing results from the accumulation and reinforcement of the pressure waves; this causes the sonic overpressure to be magnified in a small area. The impact of the focused sonic boom for a specific vehicle is based upon the magnitude of the focusing effect, the location where the focus boom intersects the earth's surface, and the frequency and timing of launches. At CCAFS, the ascent track for launch vehicles is over open ocean. No problems have ever been reported as a result of sonic booms from CCAFS launches; therefore, no impacts would be expected from the expanded Titan IV program.

3.1.2.2 Cumulative impacts

Construction activities for expansion of the Titan IV program would overlap other CCAFS construction projects; but, because of the distance from the nearest public receptor, significant public health impacts would not be expected and the ambience of local communities would be unchanged. The brief, infrequent but intense noise levels associated with the proposed launches of the Titan IV vehicles would correspond to the brief increase in noise resulting from other launches at CCAFS, but because launches would not occur simultaneously, a cumulative impact on noise intensity would not result at a given point in time. However, the Titan IV program in combination with other launches at CCAFS would increase the number of launches by up to 18 per year, or 1 every 3 weeks, thereby increasing the frequency of launch noise disturbances in the region per year. No significant public health impacts would be expected; however, annoyance would increase slightly among sensitive individuals.

3.1.2.3 Mitigation

Significant noise impacts to off-site receptors would not be expected from the proposed action; therefore, mitigation would be unnecessary. Occupational exposure to noise is regulated by the Occupational Safety and Health Administration (29 CFR 1910.95). Workers would wear ear protection or other noise-attenuating equipment and would be exposed to noise for only specified lengths of time. Vehicles would be equipped with mufflers and noise-abatement devices to minimize noise levels during operation.

3.1.3 Air Quality

3.1.3.1 Regional and local impacts

Potential air quality impacts of the expanded Titan IV program at CCAFS are discussed in the following sections according to the nature and timing of the activities causing the pollutant emissions. Emissions would result from (1) one-time construction activities, (2) periodic pre- and post-launch processing, and (3) periodic launches of the Titan IV-Type 1 and 2 vehicles.

Construction

The new SMAB would be built on a site that currently contains a fuel/oxidizer railcar storage facility, which would be dismantled. Construction of the new SMAB would result in emissions of PM-10 from site demolition, earthmoving, and structure erection. Construction would last 18 months. For typical construction activities, the EPA has estimated an average monthly TSP emission factor of 1.2 tons/acre (EPA 1985). A recent EPA report (EPA 1988) provides estimates of PM-10/TSP ratios for construction activities, based on measurements 50 m downwind of construction areas. The average PM-10/TSP ratios for various earthmoving operations ranged from 0.22 to 0.27. To be conservative, an average PM-10/TSP ratio of 0.3 was assumed for the new SMAB construction. Multiplying this value by the monthly TSP emission factor of 1.2 tons/acre, a PM-10 emission factor of 0.36 tons/acre•month was calculated.

The total area to be disturbed by construction of the new SMAB would be 16.5 acres. Conservatively assuming that the entire area is actively disturbed for the duration of the construction period and that no dust suppression measures are implemented, the total PM-10 emissions from construction were calculated to be:

$$\text{Total PM-10} = (0.36\ \text{ton/acre}\bullet\text{month})(16.5\ \text{acres})(18\ \text{months})$$
$$= 107\ \text{tons}$$

A dust suppression (watering) program would reduce PM-10 emissions by at least 50% (EPA 1985) to about 54 tons.

Modifications to LC-40 and construction of the PFCF would include structure demolition, modification, and new structure erection. The surface areas disturbed by these activities would be less than an acre; therefore, PM-10 emissions would be 1-2 tons/18 months, much less than for construction of the new SMAB. This would not have a measurable impact on off-site air quality.

The EPA Industrial Source Complex Short-Term (ISCST) dispersion model (EPA 1987) was used to estimate the increased atmospheric PM-10 loading from Titan IV program construction activities, using the above emissions rate without dust suppression measures. With conservative assumptions, the maximum predicted increase in PM-10 levels in uncontrolled areas (the nearest land areas outside CCAFS and KSC, over 10 km from the proposed SMAB site) would be 7 $\mu g/m^3$ on a 24-hr basis and 0.2 $\mu g/m^3$ on an annual basis. These increases would be less than 5% and 1% of the 24-hr (150 $\mu g/m^3$) and annual (50 $\mu g/m^3$) NAAQS, respectively. Since existing PM-10 concentrations in the area are well below the NAAQS, these minor increases would not threaten the continued attainment of NAAQS in the area. Also, these minor impacts would be temporary, lasting only for the duration of construction.

Other emissions associated with construction would be from various earthmoving and equipment engines, including pile driving hammers. The pollutants emitted would be NO_x, SO_2, hydrocarbons (which are precursors in the formation of ozone), CO, and PM-10. The amounts of these emissions would be very small compared with the construction-related PM-10 emissions estimated previously, and the impacts to uncontrolled areas would be insignificant.

Pre-launch processing

Various ground-support activities associated with each launch would cause relatively minor emissions of VOCs used in coating, fabrication, and cleaning operations for launch vehicle components, the MSTs and UTs, and ground support equipment. Small amounts of hydrazines, N_2O_4, NO_x, and CO would be released during liquid fueling operations for the launch vehicles. Emissions of hydrazine (fuel) and N_2O_4 (oxidizer) vapors would be minimized by fuel vapor incineration systems (FVIS) and oxidizer vapor scrubber systems (OVSS) at each LC. An FVIS and OVSS already exist at LC-41, and FVIS and OVSS units of the same design would be installed at LC-40 for the Titan IV-Type 2 (SRMU) program. Air pollution permits have been granted previously for the FVIS and OVSS units at LC-41. The new FVIS and OVSS units at LC-40 would require similar permits from the FDER (see Sect. 4.1.1). Diesel-fired backup electrical generators and miscellaneous transport vehicles would periodically emit NO_x, CO, VOCs, SO_2, and PM-10.

Quantitative estimates of NO_x, CO, VOCs, CO_2, and PM-10 emissions during pre-launch processing would be similar to previously calculated emissions for Titan programs (USAF 1986; USAF 1988a). (Estimates from these sources are not repeated here.) Emissions would slightly degrade local air quality near support facilities, but impacts would be temporary. The increased number of launches would increase the total annual emissions from pre-launch processing; however, the emissions per launch would remain constant. Because pre-launch processing would occur a maximum of six times per year, impacts of these emissions to regional air quality are not expected to be measurable off-site.

Launch

For both the Titan IV-Type 1 and Type 2 (SRMU), the dual SRMs (stage zero) would be ignited at liftoff and continue burning for slightly over 2 min, placing the launch vehicle at an altitude of roughly 50 km. At this point, the stage one engine would be ignited and the SRMs would separate from the core vehicle about 20 seconds later. Nitrogen (41% wt.), water (35% wt.), and carbon dioxide (18%), the stage one exhaust products, would be emitted to the atmosphere at an altitude of 29 miles.

The primary combustion products from the SRMs for both vehicle types are shown in Table 3.5. These data are based on thermochemical model calculations (App. D) and are effective at the nozzle exit plane of the SRMs. The solid propellants for Types 1 and 2 have slightly different chemical formulations, resulting in somewhat different effluent compositions. The elements and compounds in Table 3.5 comprise over 99.9% of the SRM effluent mass; other trace constituents would be emitted in quantities too small to be of concern with regard to air quality. The total (both SRMs) solid propellant weights for the Titan IV–Type 1 and Type 2 (SRMU) vehicles would be 1,180,000 lb and 1,360,000 lb, respectively. The SRMU solid propellant weight is about 15% greater than that of Type 1. As a comparison, the total solid propellant weight for a pair of Space Shuttle SRMs is 2,216,696 lb, 63% greater than for the SRMU.

The combustion products shown in Table 3.5 would be distributed along the vehicle trajectory to an altitude of roughly 50 km. However, because of the gradual acceleration of the vehicle off the launch pad, the emissions per unit length would be much greater near the ground, forming what is known as a "ground cloud." For Space Shuttle [Space Transportation System (STS)] and other large space vehicle launches, it is typical for the buoyant ground cloud to rise 1 km or more before stabilizing. Its height then remains relatively constant as it is transported and dispersed downwind.

Air pollutants in the combustion products that are of primary concern are HCl and Al_2O_3. The other combustion products (1) would be nontoxic, (2) would react rapidly to

Table 3.5. Combustion products at the nozzle exit plane for Titan IV–Type 1 and Titan IV–Type 2 (SRMU) stage zero boosters[a]

Combustion Product	Titan IV–Type 1		Titan IV–Type 2 (SRMU)	
	Wt. %	Wt. (tons)	Wt. %	Wt. (tons)
Al_2O_3	30.45	180.2	35.88	244.2
CO	27.50	162.7	21.93	149.3
CO_2	2.97	17.6	2.49	17.0
Cl^-	0.05	0.3	0.25	1.7
$FeCl_2$	0.39	2.3	0.00	0.0
HCl	20.67	122.3	21.14	143.9
H_2	2.48	14.7	2.21	15.1
H_2O	6.97	41.2	7.69	52.3
N_2	8.50	50.3	8.34	56.8

[a]Total emissions from two solid rocket motors; emissions would be distributed along a trajectory from ground level to an altitude of 50 km.

form nontoxic compounds, or (3) would be emitted in insignificant quantities. The HCl in SRM exhaust clouds tends to partition between gaseous and aerosol phases (Cofer et al. 1985) and can be toxic above certain concentrations. The National Research Council (NRC) recommends that 1-hr average HCl concentrations "in connection with community exposure during space-shuttle launches" not exceed a level of 1 ppm (NRC 1987).

Al_2O_3, 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 (PM-10) to be retained in the lung (Cofer et al. 1985). Thus, it is appropriate to compare Al_2O_3 concentrations with NAAQS for PM-10. The shortest averaging time for which a PM-10 NAAQS exists is 24 hr; a standard of 150 $\mu g/m^3$ is applicable.

During the early stages of formation and transport, the ground clouds generated by STS and Titan launches contain large amounts of SRM effluent in both gaseous and aerosol form. For the most part, the aerosols are water droplets containing dissolved HCl and particulate Al_2O_3 from SRM exhaust. The larger aerosols tend to settle out of the cloud near the launch pad, therefore, the greatest deposition is near the pad and amounts rapidly decrease downwind. The mass of aerosol deposited is 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 STS launches contain substantially greater amounts of water than Titan ground clouds, because of the vehicle's larger SRMs, main engine exhaust ($H_2 + O_2 \longrightarrow H_2O$), and greater deluge water requirements. Thus, Titan ground clouds are drier than STS ones, and produce generally smaller amounts and areal extent of acidic aerosol deposition.

In addition to the near-field acidic deposition which occurs with STS and Titan launches, there is a possibility of acid precipitation from naturally-occurring rain showers falling through the ground cloud. Such an event occurred after a 1975 Titan III launch at Cape Canaveral, and resulted in rain of pH 1 about 5 km (3 mi) from the launch pad and pH 2 about 10 km (6 mi) away (Pellett et al. 1983). For STS launches, model predictions have indicated the possibility of acid rain with pH ≤1 at distances up to 20 km (12 mi) from the launch pad and pH ≤2 up to 200 km (120 mi) away (NASA 1978).

In order to estimate ground-level concentrations of the SRM exhaust products downwind of the CCAFS launch pads, the Rocket Effluent Exhaust Dispersion Model (REEDM) was utilized. This model was developed specifically to predict air quality impacts of space vehicle launches and has been enhanced over the past two decades through the joint support of NASA and the USAF. The version of REEDM used for this analysis is currently used at VAFB in support of various launch activities. The VAFB REEDM version contains site-specific algorithms to handle the unique terrain and wind-field conditions at VAFB. For simulation of Titan IV effluent dispersion at CCAFS, the VAFB-specific terrain/wind algorithm was disengaged, so that REEDM was executed in a flat-terrain mode.

The REEDM model was executed with four expected worst-case meteorological conditions. The required meteorological input data for REEDM consist of vertical atmospheric profiles of wind direction, wind speed, temperature, and turbulent intensity. Four historical meteorological cases were selected for the CCAFS analysis, based on the judgement of Eastern Space and Missile Center (ESMC) staff experienced in running REEDM for CCAFS launch operations. Selected meteorological parameters for the four CCAFS cases are summarized in Table 3.6.

The REEDM model was executed for a Titan IV-Type 1 launch. Concentrations of HCl and Al_2O_3 discussed below are for a Titan IV-Type 2 (SRMU) launch, which would

Table 3.6. Cape Canaveral Air Force Station meteorological parameters for four typical worst-case dispersion conditions used as input to the Rocket Effluent Exhaust Dispersion Model

Case	Date	Local time	Wind speed (m/s)		Wind direction		Temperature inversions
			Surface	500 m	Surface	500 m	
Winter, cold morning	1/12/87	0739	4.1	11.3	310°	320°	200 m–500 m (moderate)
Summer, light wind	7/12/87	0715	2.1	5.1	220°	239°	Surface–200 m (weak)
Summer, on-shore flow	8/16/88	0615	1.0	6.2	153°	165°	Surface–200 m (weak)
Fall, sea breeze	11/11/88	1313	2.5	2.1	32°	319°	None below 10,000 ft (3,048 m)

generate more HCl and Al_2O_3 than a Type 1 launch. The concentrations for Type 2 (SRMU) were obtained by multiplying the Type 1 concentration predictions by the appropriate factors to account for the greater fraction of these constituents in the Type 2 (SRMU) exhaust (see Table 3.5) and for the greater (15% more) solid propellant weight for the Type 2 vehicle.

The results of the four REEDM runs for CCAFS are summarized graphically in Fig. 3.3. The four curves represent maximum predicted plume-centerline concentrations as a function of distance for the four meteorological scenarios. Because HCl and Al_2O_3 are assumed by REEDM to disperse identically, without deposition or chemical conversion, a single curve is used to represent concentrations of both compounds for each scenario. Maximum 1-hr HCl and 24-hr Al_2O_3 concentrations at a given distance can be obtained from the left and right scales, respectively.

Maximum 1-hr HCl concentrations beyond the distance of the nearest CCAFS property boundary were predicted by REEDM to be well below the NRC recommended 1-hr short-term public emergency guidance level (SPEGL) of 1 ppm for all meteorological scenarios. The highest predicted 1-hr HCl concentration beyond this distance was 0.22 ppm, which occurred for the summer, light wind scenario.

ORNL-DWG 89-13637R

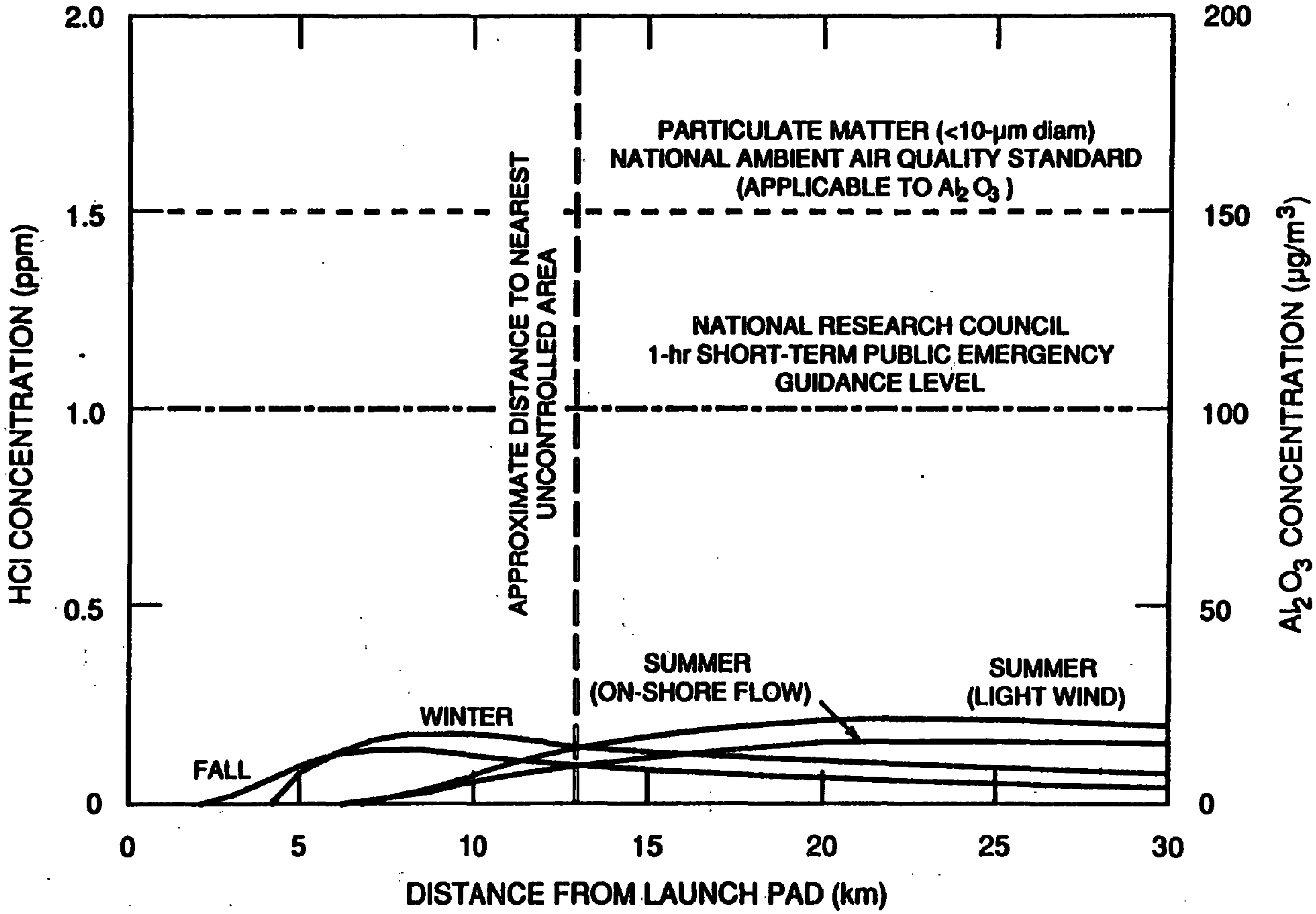


Fig. 3.3. Titan IV Solid Rocket Motor Upgrade maximum 1-hour hydrogen chloride (HCl) and 24-hour aluminum oxide (Al_2O_3) concentrations predicted by the Rocket Effluent Exhaust Dispersion Model (REEDM) for four meteorological scenarios at Cape Canaveral Air Force Station.

The maximum predicted 24-hr Al_2O_3 concentration beyond the distance of the nearest CCAFS property boundary was 25 $\mu g/m^3$, which is well below the 24-hr NAAQS for PM-10 of 150 $\mu g/m^3$. In 1986, the maximum measured 24-hr TSP concentration in the Titusville and Merritt Island area was 104 $\mu g/m^3$ (FDER 1987). Assuming that all the TSP generated by the Titan IV-Type 2 (SRMU) launch was in the PM-10 size range, the maximum predicted total PM-10 concentration would be 129 $\mu g/m^3$. This is quite a conservative estimate because it assumes that the highest yearly 24-hr particulate matter concentration attributable to other sources would occur on the same day as the highest estimated concentration from a normal launch.

3.1.3.2 Cumulative impacts

Lower atmosphere

Because of the brief and sporadic nature of atmospheric emissions associated with the Titan IV-Type 2 (SRMU) and other launch programs, the long-term cumulative air quality impacts of the combined launch programs at CCAFS are not expected to be significant. Short-term (24 hr or less) cumulative air quality impacts would not occur because launches for the various programs would not be conducted at the same time. The relatively small emissions of criteria pollutants associated with ground support operations would have little incremental impact in an area that presently meets air quality standards with ambient concentrations well below the NAAQS.

Upper atmosphere

The past two decades have been marked by increasing concern about the effects of man's activities on the upper atmosphere. In regard to space vehicle launches, this concern has focused on the potential cumulative role of exhaust constituents in depleting the ozone layer (Gille 1982), which tends to protect biological organisms from adverse levels of ultraviolet (UV) radiation. Sunburn and skin cancer can result from excess exposure to UV radiation in the 290-310 nm wavelength range (UVB), which is partially absorbed by the stratospheric ozone layer.

The ozone layer is mostly contained within the stratosphere, a region of steady or increasing temperature with height, which extends from roughly 10 km to 50 km above the earth's surface. The vertical distribution of ozone within the stratosphere varies substantially, depending on the time of year and on latitude. However, the bulk of the ozone is concentrated in the lower half of the stratosphere (Webb 1966).

With regard to potential ozone layer effects, the SRM emissions, primarily HCl, are the main concern. Photochemical reactions involving chlorine are thought to be very important in the destruction of stratospheric ozone. As stated earlier, the stage-one Titan IV–Type 2 (SRMU) engine would not be ignited until the vehicle reached an altitude of roughly 50 km, and would produce combustion products of less concern to the ozone layer. The total SRM burn time and SRM separation/stage-one ignition altitude for the Titan IV-Types 1 and 2 (SRMU) would vary somewhat, but for the purpose of ozone layer effects assessment, do not differ appreciably.

The potential effect of SRM exhaust on the ozone layer was studied extensively by NASA prior to STS launches (NASA 1978; Potter 1978). The latter reference contains a reassessment of stratospheric ozone depletion from STS launches, which was performed after new information became available regarding the rate constants for some chemical reactions important to ozone destruction. The reassessment of a hypothetical 60 STS launches/year, assumed to occur indefinitely, was conducted for NASA by five independent research groups. The revised model estimates for northern hemisphere ozone reduction from the five research groups ranged from 0.23% to 0.28% (Potter 1978).

A comparison of modeled ozone-layer effects by Gille (1982) found that even for a large number of shuttle launches, the decrease in total stratospheric ozone was much smaller than perturbations resulting from natural or anthropogenic causes. Gille has summarized estimates of the expected magnitudes and directions of the total ozone perturbations from these causes as follows:

1. Solar variability—increase or decrease from 7 to 20%.

2. Current and projected (1990) commercial supersonic and subsonic aircraft—increase from a few percent to 20%.

3. Continued chlorofluoromethanes released at the 1977 rate—decrease of 17%.

4. Space Shuttle launch rate of 60/year—decrease from 0.2 to 0.3%.

The reference cited for the finding in item (2) was a 1979 report by the U.S. Department of Transportation (DOT). A more recent DOT report in the same series (DOT 1981) revised these estimates, stating that the existing and projected 1990 commercial aircraft fleets would cause only a 1% increase in stratospheric ozone. The latter report also stated that model estimates were quite sensitive to the injection altitude of the aircraft emissions, with flights above 15 km (49,000 ft) causing stratospheric ozone depletion and lower altitude flights causing stratospheric ozone production.

Rosenberg and Newton (1983) indicate that an STS launch rate of 24 per year would decrease stratospheric ozone by 0.1% and increase UVB at the earth's surface by 0.2%. These figures are consistent with the estimate that a 1% decrease in stratospheric ozone results in a 1–2% increase in ground-level UVB (Gille 1982). A decrease in stratospheric ozone in the range of 0.1–0.25% is about two orders of magnitude smaller than the measured variations in total ozone that occur annually as well as variations predicted due to global chlorofluorocarbon emissions. These findings do not suggest that the slight decrease in ozone attributed to STS exhaust would not have an adverse effect on biological organisms—but rather that any effects would not be discernible because they would be masked by other larger-scale variations.

Although the proposed action would increase HCl emissions from the existing Titan IV program, the following discussion of ozone layer effects considers the Titan program as a whole, since the program has been and continues to be evolutionary. As indicated in Table 1.1, a total Titan IV launch rate (CCAFS and VAFB) of 8 per year is planned in the early 1990s. The annual HCl emission rate under this plan was compared with the annual STS HCl emissions at the hypothetical launch rate of 60 per year, which has been the case used for several modeling studies. Using the worst-case assumption that all Titan IVs launched are the slightly larger SRMU vehicle (60% of STS vehicle HCl emissions), the HCl emission rate for the Titan IV program would be 8% of the STS program at 60 launches per year. It might also be conservatively assumed that the Titan IV program was extended indefinitely, as was assumed for the STS modeling studies. Assuming that additional ozone depletion is approximately proportional to the additional HCl emissions represented by the entire Titan IV program, the net decrease in ozone for launching 8 Titan IV-Type 2 (SRMUs) per year would be 0.02%.

This perturbation would be indistinguishable from effects caused by other natural and man-made causes. However, the problem of stratospheric ozone depletion by man-made chemicals is global in nature; and the cumulative effects of many small sources, taken together, can add up to serious adverse effects, even though each individual source seems insignificant.

Given the desired payload weights for the Titan IV-Type 2 (SRMU) program, the only alternative vehicle is the STS. The Titan IV-Type 2 (SRMU) represents an environmentally favored alternative to the STS because the atmospheric HCl emissions per launch are only about 50–60% of those for the STS.

In summary, the incremental effects of the proposed action on stratospheric ozone and on ground-level UVB are expected to be far below the effects attributable to other natural and man-made causes. Still, the global nature of the ozone depletion problem implies that all sources of depletion must be weighed in considering control strategies. Rosenberg and Newton (1983) have discussed the benefits of liquid rocket boosters (LRBs), which would affect the ozone layer much less than the SRMs and also cost less. Rosenberg and Newton also indicated that NASA is funding studies that could lead to the development of LRBs to replace the SRMs currently used with the STS. If LRBs prove reliable, they may replace SRMs on future unmanned booster systems such as Titan IV-Type 2 (SRMU) as well.

3.1.3.3 Mitigation

Construction impacts

PM-10 emissions from grading, fill, and excavation activities associated with construction would be controlled by water application as soil moisture conditions warrant. It is expected that implementation of a watering program would reduce potential PM-10 emissions by at least 50% (EPA 1985). Other construction activities associated with the

Titan IV-Type 2 (SRMU) program would involve relatively little or no soil disturbance and PM-10 emissions.

Pre-launch processing impacts

Emissions from all routine fuel and oxidizer loading and transfer operations would be minimized through incineration and scrubbing of hazardous vapors. The potential for emissions from accidental spills would be minimized through the use of redundant systems for flow metering and cutoff in case of leaks. Propellant transfer systems would be situated over catch basins, where accidental spills could be quickly neutralized through water dilution where applicable, allowing for prompt cleanup in the event of a spill. Hazardous propellant handling operations are undertaken only if Potential Hazard Corridor (PHC) forecasts indicate that off-base or on-base populations would not be exposed to adverse vapor concentrations from accidental spills.

Launch impacts

Although no steps are taken specifically to reduce launch-related emissions, the deluge water, which is applied to the launch pad area and exhaust stream for cooling and overpressure suppression, does remove some air contaminants from the exhaust. However, the amount removed is probably a small fraction of the total exhaust emissions, because the exhaust is in contact with this water for only a brief period during SRM firing.

Mitigation of potentially adverse air quality impacts from the exhaust cloud is accomplished through dispersion forecasts which affect the decision whether to launch a vehicle at the scheduled time. CCAFS maintains extensive meteorological monitoring and forecasting facilities. One function of the meteorological facilities and staff is to provide forecasts of the PHC before launches and associated operations. The CCAFS meteorological forecasting staff uses site-specific dispersion models, together with real-time or forecast meteorological input data and potential source strength data, to predict the length and angular width of PHCs. The PHC forecast would be used to determine whether to launch, in order to prevent both off-base and on-base populations from being exposed to adverse effluent concentrations.

Mitigation of potential cumulative air quality impacts could take the form of controls on the type, number, and frequency of launches from the planned programs at CCAFS. However, given the currently planned launch rates of space vehicles from CCAFS and the transient nature of the associated emissions, mitigation of cumulative impacts on air quality is considered unnecessary.

3.1.4 Surface Water

3.1.4.1 Regional and local impacts

Construction

Soil that is exposed during construction of the new SMAB and PFCF would be subject to erosion by wind and rain; soil transport could increase the sediment load and turbidity of the Banana River. Proper erosion control measures, such as straw-barriers and berms, would be taken to minimize the movement of soil and contaminants (e.g., chemicals and construction materials such as oil and grease) into the Banana River.

Pre-launch processing

Effluents from the new SMAB would include stormwater runoff and treated sanitary sewage. Stormwater runoff from the SMAB and associated facilities (e.g., parking lots and storage areas) would be collected and diverted to a retention pond on the northwest side of the site in accordance with permit requirements established by the St. Johns River Water Management District. The retention pond would be designed to retain runoff long enough for suspended particulates to settle. Clarified runoff would then be discharged to the Banana River via a buried pipeline in accordance with limitations set in the permit.

Sanitary wastewater from a work force of less than 200 personnel would be treated on-site by a secondary waste treatment facility. Treated effluent from the facility would be discharged to a drainage field on the southwest side of the site. This discharge of treated domestic wastewater would be in accordance with USAF and state requirements (AFR 88-15, Florida Administrative Code 17-6, and FDER domestic wastewater permit conditions).

Effluents and/or stormwater runoff from other Titan IV program support facilities in the ITL area would not change because of the proposed action.

Launch impacts

Approximately 400,000 gal of deluge and washdown water would be required per Titan IV launch at LC-40 and LC-41. About 300,000 gal would be deluge water, some of which would be dispersed by the SRM/SRMU exhaust (MMSLS 1988). About 320,000 gal would be collected in the launch duct sump, which drains to percolation ponds at LC-40 and LC-41 (Fig. 2.4), preventing release of this deluge and washdown water to surface water bodies. The remaining 80,000 gal 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. Some deluge water also would be expected to fall directly into the Atlantic Ocean or Banana River.

In addition, 44,400 gal of coolant water from the new OVSS would be required for each launch. This wastewater also would drain to percolation ponds in controlled areas at the LC-40 and LC-41 sites. Three percolation ponds covering 1.2 acres are located near the flame bucket and oxidizer scrubber unit. These ponds are connected by open culverts; if 364,000 gal of wastewater were collected in them simultaneously, the water depth would be about 0.5 ft. No direct discharge to surface water would occur, and no direct impacts to surface waters would be expected.

Launch operations from LCs 40 and 41 would produce a ground cloud that could deposit Al_2O_3 or HCl in solid, aerosol, and/or droplet form. Most deposition from the ground cloud would occur within the near-field area reasonably close to the launch site. The exhaust ducts at both launch complexes force the exhaust plumes eastward. Launches frequently occur during the mornings, when prevailing winds are from the west or southwest. Under such wind conditions, deposition from the ground cloud could reach the Atlantic Ocean, where it would be diluted. With winds from the east or southeast (infrequent), deposition would occur into the wetland areas adjacent to the sites and, to a lesser extent, onto the Banana River. Because of the limited extent of deposition in the river and the volume of water available for dilution, impacts would not be significant. Impacts to wetlands are discussed in Sect. 3.1.8.

3.1.4.2 Cumulative impacts

Construction in the ITL area and the launch complexes would be independent of construction for other programs and base activities; however, construction schedules may overlap. With use of Best Management Practices (e.g., straw berms) at all CCAFS construction sites, erosion and sedimentation would be minimized and no significant impacts would occur to water quality of CCAFS wetlands or the Banana River.

Launches of MLV program vehicles would occur at LCs 17 and 36 (see Fig. 1.2) which are located several miles east of the Banana River. Therefore, cumulative surface water impacts that may result from ground cloud deposition in the Banana River would not be expected.

3.1.4.3 Monitoring and mitigation

Best Management Practices would be used during construction to minimize the potential impacts of soil erosion and materials transport. For example, hay bales or plastic skirts installed between exposed soils and any on-site drainage ways would limit potential runoff. Significant impacts to surface waters would not be expected, and mitigation of construction impacts would not be necessary.

The water quality of the Banana River is monitored monthly by the FDER. Significant changes in quality could warrant mitigative actions at Titan IV launch and support facilities. If so, the FDER would advise the USAF of measures to be implemented.

3.1.5 Geology and Groundwater

3.1.5.1 Regional and local impacts

The launch water requirements described in Sect. 3.1.4.1 would not impact groundwater supplies at CCAFS because all such water would be drawn from municipal supplies (USAF 1986). Although there are no water supply wells within 500 ft of the percolation ponds (MMSLS 1988), 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.

MMSLS (1988) provides a limited discussion of groundwater impacts from wastewater discharges following launch. The following analysis is based on that discussion. One of the effects of disposal of wastewater through percolation ponds would be slight groundwater mounding beneath the launch complex. If all of the available wastewater (364,000 gal) were to infiltrate into 10 acres of ground surrounding the percolation ponds on the east side of the LC-41 site, the average water level rise per launch would be 0.3 ft (assuming that the aquifer has a porosity of 0.3—a larger porosity would reduce the impact). The maximum groundwater velocity in the surficial aquifer is estimated to be 110 ft/year (based on several assumptions: maximum hydraulic gradient = 0.01, average hydraulic conductivity = 9.3 ft/day, and effective porosity = 0.3).

Good management of the percolation ponds would prevent surface runoff from reaching wetlands on the west side of LC-41. Based on the preceding analysis, a minimum of 11 years would be required for groundwater to reach these wetlands, which are 1200 ft west of the percolation ponds. Although mixing with natural groundwater is expected to dilute contaminants released by a given launch to acceptable levels, a groundwater monitoring program has been established to provide regulatory control, allowing appropriate and timely mitigative action should the need arise (see Sect. 3.1.5.3).

3.1.5.2 Cumulative impacts

The cumulative impact of previous launches on groundwater is unknown. As stated in Sect. 3.1.5.1, a single launch would be insufficient to contaminate groundwater to such an extent that it could conceivably affect nearby wetlands. It is acknowledged, however, that contaminated groundwater from repeated Titan IV launches as well as other launches at CCAFS could have a long-term impact on groundwater and nearby wetlands.

There would be no significant impact on municipal water supplies because the shallow groundwater resources at CCAFS are insufficient and unsuitable as a potable water supply.

3.1.5.3 Monitoring and mitigation

A network of five groundwater monitoring wells has been installed around LC-40 LC-41 (Fig. 2.4) so that changes in groundwater quality can be observed. This would allow timely implementation of mitigating measures if contaminated groundwater migrated toward sensitive wetlands. One well is a background monitor well upgradient and northeast of each launch site. Two other wells are centrally located in percolation ponds on the west and east sides of each complex. Another two wells are located 75 ft west of each complex perimeter and between the launch site and the wetlands. All monitor wells are drilled to a depth of 15 ft, screened from 3 to 15 ft, and capped with a seal made of bentonite and a combination of bentonite and portland cement. Each well will be monitored quarterly for Florida primary and secondary drinking water standards. In addition, electrical conductivity, total organic carbon, and total organic halogen analysis will be performed until sufficient background data are obtained and potential groundwater quality changes are known.

If monitoring of groundwater identifies levels of contaminants that are above levels approved by FDER, treatment of the contaminated water could be required. If solvents are identified as contaminants, treatment would most effectively occur by (1) pumping the contaminated water to the surface and treating by air stripping, and (2) passing the contaminated water through an activated carbon column for sorption of the contaminant, or to biological treatment, depending on the contaminant. If metals are identified as the contaminants, treatment of the contaminated groundwater would most effectively occur by pumping the water to the surface and treating by precipitation or by ion exchange to remove the metal.

3.1.6 Terrestrial Ecology

3.1.6.1 Regional and local impacts

Construction

Construction activities would cause negligible impacts to terrestrial flora because only ruderal vegetation would be disturbed.

Launch

Launch activities could impact vegetation and wildlife in three ways: fire, acidic deposition on vegetation and fauna, and noise. Occasional small brush fires are sometimes associated with launches, and vegetation within 20 m (66 ft) 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 singing 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 inspection summaries to be very low.

Wet deposition of HCl could damage or kill vegetation and wildlife in high deposition zones. USAF environmental contractors who observed the June 1989 Titan IV launch from LC-41 reported no evidence of wet deposition outside the pad fence perimeter (personal communication, Paul Schmalzer, Bionetics Co., with R. L. Graham, ORNL, July 19, 1989).

Noise exceeding 95 dBA from Titan IV launches could possibly cause a temporary hearing loss in sensitive wildlife living near the launch pads. Brattstrom and Bondello (1983) found that fringe-toed lizards, desert kangaroo rat, and Couch's spadefoot toad all suffered immediate hearing loss when exposed to off-road vehicle sounds of 95 dBA for less than 9 min. No other reports are known to document wildlife hearing losses associated with short-term exposures to loud (95 to 120-dBA) noises. The 95-dBA radius of impact for a Titan IV launch is estimated to be about 24 km (15 mi) (Sect. 3.1.2). After the June 1989, Titan IV launch at CCAFS, Florida scrub jays did not respond to alarm calls (personal communication, D. Breininger, Bionetics Co., with R. L. Graham, ORNL, July 19, 1989). In contrast, following the STS mission-34 launch, scrub jays west of the pad displayed normal behavior and responded to calls. Wildlife that are heavily dependent on sound (as opposed to visual) information could be more susceptible to predation because of a short-term hearing loss. Because of the low number of Titan IV launches at CCAFS (six per year), wildlife hearing loss would not be expected to significantly affect population densities.

Because the sonic boom from the Titan IV launches would occur over open waters, no significant noise impacts on wildlife are expected from the sonic boom. Sea birds and surface-swimming mammals may exhibit startle responses.

3.1.6.2 Cumulative impacts

Construction would not result in cumulative impacts on vegetation at CCAFS because activities would be concentrated in previously disturbed or man-made areas. The cumulative ecological impacts of acidic deposition from launch activities at CCAFS and KSC cannot be addressed in detail without information regarding the extent and intensity of near-field and far-field deposition from Titan IV launches. Assuming the worst case—deposition extent and intensity similar to that from Space Shuttle launches—22 ha (46 acres) of scrub vegetation adjacent to each of the launch pads might experience a partial loss of tree and shrub species and an increase in grass and sedge species as has been observed near the Space Shuttle launch pad 39 (Schmalzer et al. 1985). Because far-field deposition is not likely to occur over the same area for each launch, there may, in fact, be no cumulative impacts because vegetation is likely to recover during the interval between deposition episodes.

A maximum of 18 launches is scheduled to take place at CCAFS each year between 1989 and 1991 (USAF 1989a), and roughly one-half of these would be Titan IV launches.

If the worst case is assumed that (1) each launch would impair the hearing of sensitive animals residing within a given noise impact zone (e.g., launch noise exceeds 95 dBA) and (2) noise impact zones of the various launches overlap in areas where sensitive wildlife reside—then sensitive animals could be affected 18 times per year. Depending on the duration of hearing loss, the survival of sensitive species may be affected.

3.1.6.3 Monitoring and mitigation

Because three federally listed threatened species (Florida scrub jay, indigo snake, and the southeastern beach mouse) inhabit the area, a monitoring program will be initiated to collect baseline population information to evaluate impacts from the launches (see Sect. 3.1.9.4). Florida scrub jay and wood stork responses to launch noise will be studied, and the USAF will develop a plan for investigating long-term noise effects on surrogate species. Acidic deposition from launches will be monitored and baseline data collected for the vegetation surrounding the LCs so that possible changes due to deposition or burning can be evaluated.

3.1.7 Aquatic Ecology

3.1.7.1 Regional and local impacts

Aquatic biota in the 0.3 ha (0.8-acre) wetland would be displaced by construction of the new SMAB. There would be no dredging or alteration of aquatic habitat in the Banana River. Spill and stormwater containment practices during construction would minimize the amounts of eroded sediments and other contaminants that reach surface waters; therefore, impacts to the aquatic ecosystem from construction of the SMAB would be insignificant.

Construction at LC-40 and LC-41 would involve minimal land disturbance. Sediment control measures would be used during construction, and minimal erosion from the site should result. Because no surface water bodies receive direct runoff from the sites during deluge water discharge, there should be no impacts to surface waters or their associated biota.

Operation of the SMAB and other support facilities would not alter aquatic habitats in the surrounding Banana River. The only surface discharge from the site would be from the stormwater retention pond. This effluent would not be expected to contain levels of chemical contaminants or sediment that would adversely affect aquatic biota.

Deposition from the ground clouds associated with each Titan IV launch could occur into the wetlands and Banana River to the west of both launch complexes. Aquatic resources including fish and insects that occur in the area receiving the heaviest deposition of HCl 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 HCl in the ground cloud associated with the Titan IV-Type 2 (SRMU) launches should be less than 0.25 ppm (see Fig. 3.3) and should have significantly less effect 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.

3.1.7.2 Cumulative impacts

Construction in the ITL area and SMAB site could have minor impacts on aquatic resources of the Banana River in the site vicinities. With use of Best Management Practices for construction, erosion and sedimentation would be controlled to acceptable levels. Modifications to and discharge from LC-40 and LC-41 will not affect aquatic biota in the adjacent wetlands. Deluge water would discharge to grassy areas on the sites; gate valves would prevent water movement off-site. Potential cumulative impacts from acidic ground cloud disposition would be expected from six Titan IV launches per year (and 18 total launches at CCAFS), but are likely to be undetectable in the Banana River and on-site wetlands because of their dilution capacity.

3.1.7.3 Monitoring and mitigation

Because the proposed action would include construction of a 1.6-acre replacement wetland along the western portion of the SMAB site, further mitigation of aquatic ecological impacts would be unnecessary. Dilution of ground cloud deposition in the wetlands west of the launch sites would minimize impacts to aquatic biota. If necessary, the water level in the wetlands could be manipulated to increase the flow from the Banana River into the wetland to increase dilution capacity.

3.1.8 Floodplains and Wetlands

3.1.8.1 Regional and local impacts

To prevent flooding of the SMAB site, portions of the low-lying areas would be built up with fill (loamy sand with shell) to raise the site to a level of 9 ft above mean sea level (MSL). This elevation is above both the base (100-year) and critical action (500-year) floodplains. In addition, the SMAB facility would be designed to collect stormwater and channel it to the Banana River. Because of the small area affected by the proposed construction relative to the floodplain of this lagoon system (the Banana and Indian Rivers together have an open-water area of 150,000 acres in Brevard County and drain 540,000 acres), the action would have no effect on flood potential in the drainage basin. A Sect. 404 dredge-and-fill permit has been obtained from the U.S. Army Corps of Engineers (see Sect. 4.1.2.4).

Construction of the SMAB would require the removal of about 0.8 acre of wetland vegetation (primarily woody shrubs) along the southern causeway portion of the site. The total area of vegetation, both wetland and non-wetland, on the SMAB site is 14 acres. Because the SMAB is located on a man-made causeway, it is likely that all vegetation on the site is secondary growth, with no unique plant communities. Removal of wetlands vegetation would destroy animal habitat that does not support threatened or endangered species and is not unique to the area. The wetlands represent a small percentage of the 12,000 acres of wildlife habitat managed on the CCAFS (George 1987). Prior to construction of the SMAB, a new wetland of 1.6 acres would be created along the western edge of the site.

3.1.8.2 Cumulative impacts

Impacts to wetlands at the Titan IV launch and support facilities sites would not exacerbate impacts from other CCAFS activities or launches. To the contrary, the creation of 1.6 acres of wetland along the western portion of the site would be a net positive effect on wetlands at CCAFS.

Depending on meteorological conditions, deposition of HCl and Al_2O_3 from the ground clouds from various launches at CCAFS could impact the biota and water quality in these areas. Impacts would result from decreases in pH associated with the HCl deposition. The wetlands to the west of the launch complexes are lagoons with recharge occurring from groundwater, rainfall, and gate access from the Banana River. [These gates are used by the Fish and Wildlife Service to control inflow for mosquito control (C. Hall, Bionetics, personal communication with V. R. Tolbert, ORNL, June 14, 1989)]. The only organisms that might be affected would be those occurring in the upper 0.5–1 m of the wetland area. Natural buffering should raise the pH to normal levels within a few hours after deposition occurred. Deposition of Al_2O_3 should be minimal, and the Al_2O_3 should be nontoxic because of its insolubility at the normal pH of the receiving waters (USAF 1986).

3.1.8.3 Monitoring and mitigation

The following mitigation activities are proposed for the wetlands disturbance at the SMAB construction site:

1. The wetland creation will have an approximate area of 1.6 acres which is 2:1 ratio to the lost wetland for saltwater marshes wetland type.
2. The new wetland area will be created prior to construction at the wetland loss.
3. New wetland area shall be graded to an acceptable elevation. For the proposed site, the recommended elevation is at 2.5 ft or less above the mean sea level.
4. Plants, removed from the wetland loss area, shall be transplanted at the created wetland area. Additional wetland-type plants will be purchased and planted in

accordance with the recommendations of local nurseries who are familiar with the wetlands habitat.

5. A minimum of 4 in. of organic topsoil, taken from the wetland loss and other areas on-site, shall be spread and mulched over the new wetland.
6. Since the mitigation is performed on-site the effects on local and regional ecology and faunal diversity are kept to a minimum.
7. A monitoring program on a 4 to 6 month cycle shall be conducted over 3 or more years to ensure that the new wetlands are taking hold.
8. A report of each monitoring program, including picture of the new wetlands, shall be submitted to the St. Johns River Water Management District to show how the mitigation of the wetlands is progressing.

If wetlands receive repeated deposition of HCl and the normal buffering capacity is reduced, inflow from the Banana River could be increased to improve buffering capacity.

3.1.9 Threatened and Endangered Species

3.1.9.1 Facility lighting impacts

The impacts of security and operations lighting at the LCs and ITL Area on endangered sea turtle nesting is a major concern associated with all CCAFS launch programs. Lights that emit in the ultraviolet, violet-blue, and blue-green wavelengths, such as high-pressure sodium lights, disorient endangered sea turtle hatchlings. If these illuminate sea turtle nests on the beach, hatchlings move inland rather than seaward and subsequently suffer increased mortality (USAF 1988d).

As indicated in Sect. 1.1.4.1, light management plans designed to reduce beach lighting are being developed for all existing facilities at CCAFS. With the approval of the FWS and the implementation of these plans, significant impacts to endangered sea turtle populations would not be expected. Light surveys have been completed for LC-40 and LC-41 and light management plans are currently under development for these facilities. When the LC-40 and LC-41 plans are approved by the FWS, complete implementation, including replacement of light controls and fixtures, is expected to take about one year.

3.1.9.2 Habitat destruction or disturbance

The FWS has designated no critical habitat for the Florida scrub jay or the southeastern beach mouse at CCAFS, although the predominant on-site coastal scrub, strand, and dune vegetation are excellent habitat for both species. Construction activities associated with renovations of LCs 40 and 41 to support the Titan IV program will not destroy or significantly disturb scrub jay or beach mouse habitat. Most construction will occur on previously disturbed land; therefore, impacts to habitat will be minimal, and populations of threatened species will not be adversely affected.

Acidic deposition from hydrogen chloride (HCl) in the ground cloud that forms following ignition and combustion of the Titan IV 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 LCs 40 and 41 extending about 600 ft (182 m) out from the launch pad. During launch, this area will experience intense heat and pressure (noise, vibrations), and concentrations of SRM exhaust will be extremely toxic. 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.

3.1.9.3 Launch effects

In response to FWS concerns about the potential effects of the Titan IV vehicle ground cloud and launch noise, the USAF prepared a Biological Assessment (USAF 1989e; see Appendix B) to provide current information on the populations of the Florida scrub jay and the southeastern beach mouse near LCs 40 and 41 and to project impacts to these species from Titan IV launches. The FWS subsequently issued a Biological Opinion regarding the potential effects of Titan IV launches on the two species (FWS 1990; see Appendix B) which stated" ... it is the Service's Biological Opinion that the operational phase of the Titan IV program is not likely to jeopardize the continued existence of the scrub jay or the southeastern beach mouse." Because of the potential for mortalities within the vicinity of either launch complex, the FWS issued an incidental take exemption to the USAF under Sections 7(b)(4) and 7(o)(2) of the Endangered Species Act. The terms of the exemption are stated in the Opinion, which is provided in Appendix B of this EA.

3.1.9.4 Cumulative impacts

Cumulative impacts are the direct and indirect impacts of the Titan IV program in combination with the identifiable effects of other actions at CCAFS. Two other launch programs are planned at CCAFS during the same time period as the Titan IV program: the MLV I, which will launch Delta vehicles, and the MLV II, which will launch Atlas vehicles. The Delta vehicle uses SRMs having a similar chemical composition as the Titan, but in much smaller quantities. The Atlas vehicle does not use SRMs. Launches of Delta and Atlas vehicles will occur at LCs 17 and 36, which are located several miles south of LCs 40 and 41 (see Fig. 1.2).

Potential cumulative impacts to the scrub jays and beach mice could result from habitat destruction or disturbance associated with the three programs and from vehicle launches. Neither the MLV I nor II program will destroy or significantly disturb habitat or forage for either species; therefore, cumulative impacts to habitat would not be expected. Delta launches will produce a ground cloud containing HCl, but it will not directly or indirectly affect the populations of scrub jays or beach mice near LCs 40 or 41; therefore, cumulative impacts from launch vehicle emissions would not be expected.

The implementation of light management plans to reduce beach lighting from all CCAFS facilities during the nesting season should reduce adverse impacts to sea turtles.

3.1.9.5 Monitoring and mitigation

In consultation with the FWS regarding impacts to protected species, the USAF agreed to establish a monitoring plan to measure the effects of the ground cloud and noise from a Titan III launch vehicle on surrogate species of a rodent and bird.

The Titan III vehicle has one-third less power than the Titan IV; however, the FWS believes the results from this test will be applicable. The proposal calls for setting up transect lines extending outward from LC-40 for a distance of 2,000 feet. Monitoring stations will be established at appropriate intervals beginning at the security fence. Cages will be placed at different heights within the vegetation, each cage holding one surrogate bird. To determine the effect on beach mice, a rice rat will be placed in a cage in an excavated burrow. In addition, at each location, measuring devices will be used to record noise levels and concentration of chemicals in the cloud. The launches of two other Titan III's will be videotaped to record the dispersion of the cloud over the test area. Results of the two monitoring periods will provide further information to the FWS so that a realistic number of "incidental takes" of scrub jays and beach mice can be established for the Titan IV program. The results of these tests will also set the protocol for similar monitoring of Titan IV launches at LC-41. The USAF and FWS will conduct joint field inspections of the habitat immediately following launches.

In addition, the USAF has agreed to leg-band and color mark scrub jays at both pads for the purpose of future monitoring during the Titan IV launches. The results of the banding effort will provide information on home range, density, mortality, and emigration/immigration resulting from the launch activity.

3.2 VANDENBERG AIR FORCE BASE

3.2.1 Man-Made Environment

3.2.1.1 Regional and local impacts

A maximum of 15 construction workers would be expected to be hired for the expanded Titan IV-Type 2 (SRMU) program. About 21 additional operations employees would be required. In-migration and project-induced growth would be negligible. A previous EA evaluated impacts to community resources from the Titan IV–Type 1 program (USAF 1988b) and projected a population increase of 474 personnel and their families. No adverse socioeconomic impacts have resulted from the existing Titan IV program (Sect. 3.2.1.2), and no impacts to regional and local community resources would be expected from the expanded Titan IV program.

3.2.1.2 Cumulative impacts

Cumulative impacts to community resources would be dependent on existing and planned launch programs and operations at VAFB. The principal planner of the City of Lompoc was contacted to determine whether impacts have occurred as a result of project-induced population growth during the year that it has been underway. No impacts from the Titan IV program have been evident. Since the Space Shuttle program at VAFB was discontinued in 1986, employment and activity in the business sector have declined. Sharp growth in services such as restaurants occurred during the 1980s to accommodate the construction phase of the Space Shuttle program. Thus, a large surplus in those services now exists (personal communication from T. Martin, Principal Planner, City of Lompoc, to Janice Morrissey, SAIC, June 15, 1989).

Rental housing has experienced no adverse impacts, and possibly some benefits, as a result of the USAF actions at Vandenberg. Although the ownership housing stock is strained, this has not been directly attributable to activities at VAFB (personal communication from T. Martin, Principal Planner, City of Lompoc, to Janice Morrissey, SAIC, June 15, 1989). No adverse cumulative impacts on the housing market would be expected.

No impact on utilities is expected. The municipal wastewater system is at 60% capacity. Although the water table is overdrafted, the number of people associated with Titan IV would not affect water service (personal communication from T. Martin, Principal Planner, City of Lompoc, to Janice Morrissey, SAIC, June 15, 1989).

Traffic flow near the base is not a problem. Traffic has decreased substantially since completion of SLC-6 for the Space Shuttle program. Therefore, no impact on transportation would be expected.

Industrial wastes generated during construction associated with the proposed action would consist of materials such as metal, concrete, lumber and other building materials which would be disposed of at an approved Class III or Class II landfill, either onbase or at the Brevard County Solid Waste Disposal Facility, as prescribed by the USAF in the project specifications. No additional industrial wastes would be generated by operations. The useful life of the landfill used would be incrementally reduced, but not significantly.

Hazardous wastes generated during project construction would consist of materials such as waste oils, hydraulic, cleaning and cutting fluids, waste antifreeze and paint wastes. These materials would be containerized, then transferred to the EPA-permitted RCRA hazardous waste storage facility on North VAFB for subsequent recycling or disposal at a Class I landfill. The North VAFB facility has a capacity of 45,760 gallons and stored an average of 15,400 gallons in 1987. Disposal at a Class I landfill would contribute to the reduction of the overall life of the landfill but not significantly.

If asbestos is encountered during refurbishment, it would be removed by a licensed contractor in accordance with National Emissions Standards for Hazardous Air Pollutants (40 CFR 61) and disposed of in accordance with VAFB OPLAN 855505-89.

The quantities of industrial and hazardous wastes expected as a result of the proposed action would not result in significant impacts.

3.2.1.3 Mitigation

Because no impacts to population, facilities and services, transportation, economy, and land use are expected to occur, no mitigation measures are necessary.

3.2.2 Cultural Resources

The proposed action involves only internal modifications to existing structures at SLC-4E and internal modifications to Bldg. 398. Thus, no historic or archaeological sites would be affected by these actions. The USAF has received a determination of no effect from the SHPO regarding the proposed action. Correspondence is reproduced in App. C.

3.2.3 Noise

3.2.3.1 Regional and local impacts

Construction at SLC-4E and Bldg. 398 would consist primarily of interior modifications. Few, if any, heavy vehicles would be needed. Noise from construction would be concentrated near the site and would not be perceptible at the nearest receptor, about 3 mi away. Therefore, impacts from construction noise would not be significant.

Noise levels associated with launch of Titan IV vehicles at VAFB would be the same as those described for CCAFS (Sect. 3.1.2.1) The nearest uncontrolled locations where the public could be exposed to launch noise from SLC-4E are about 3.4 mi away along Ocean Ave. At these locations, noise levels would be about 125 dB total sound pressure, or 113 dBA. In Lompoc, the nearest community (about 9 mi from SLC-4E), noise levels would be about 103 dBA. Because Titan IV launches would occur infrequently (4 per year maximum) and would involve very short exposure duration (1-2 min), no significant adverse impacts would be expected from launch noise associated with the expanded Titan IV program. Some individuals might be annoyed briefly.

The nature of sonic booms was discussed in Sect. 3.1.2.1. Space launches from VAFB are into polar orbit, and some launch trajectories from VAFB travel over the

Channel Islands. Although the coastal communities near VAFB would not be affected by sonic booms, the Channel Islands to the south of VAFB might experience focused sonic booms with overpressures up to 10 lb/ft^2 (USAF 1989d). Potential noise impacts to wildlife on the Islands are discussed in Sect. 3.2.7.

3.2.3.2 Cumulative impacts

The brief, infrequent but intense noise levels associated with the proposed launches of Titan IV vehicles would correspond to the brief increase in noise resulting from other launches at VAFB, but because launches would not occur simultaneously, a cumulative impact in noise intensity would not result at a given point in time. However, the Titan IV program and other launches at VAFB would increase the frequency of launches per year, thereby increasing the number of launch noise disturbances in the region per year.

To assess cumulative noise impacts during the period of 1990-1995, the maximum number of Titan IV launches (4 per year) was considered with the other USAF launch programs at VAFB, specifically (1) 1 to 2 launches per year of the Atlas and Scout missiles from South VAFB, (2) up to 3 launches per year of the Titan II vehicle from SLC-4W, and (3) about 10 launches per year of Minuteman missiles from North VAFB (USAF 1988f). This represents a maximum to 19 launches per year, or a maximum launch frequency of about 1 every 3 weeks. The launches of Minuteman missiles from North VAFB (up to 10 per year) make only a minor noise contribution to South VAFB and adjacent communities because the launch site is in the northernmost portion of VAFB. No significant cumulative noise impacts would be anticipated from all USAF launch operations, although annoyance among sensitive individuals might increase slightly.

3.2.3.3 Monitoring and mitigation

Significant noise impacts to off-site receptors would not be expected from the proposed action; therefore, mitigation would be unnecessary. Occupational exposure to noise is regulated by the Occupational Safety and Health Administration (29 CFR 1910.95). Workers would wear ear protection or other noise-attenuating equipment and would be exposed to noise for only specified lengths of time. Vehicles would be equipped with mufflers and noise-abatement devices to minimize noise levels during operation.

In addition, a monitoring plan to be developed for the Titan IV program at VAFB would include noise measurement at selected locations.

3.2.4 Air Quality

3.2.4.1 Regional and local impacts

Construction

Construction activities at VAFB would involve minimal earthmoving operations, which are typically the major source of construction-related emissions. The only modified or new structures requiring such operations would be two concrete trailer pads for fuel and oxidizer systems at SLC-4E and a 20 × 100 ft paved transporter storage area adjacent to Bldg. 398. The area of land disturbed would be much less than an acre; therefore, fugitive dust emissions would be small and significant air quality impacts would not be expected.

Pre-launch processing

Pre-launch atmospheric emissions per launch at VAFB would approximate those described for CCAFS (see Sect. 3.1.3.1) and in previous assessments for the Titan IV program (USAF 1986; USAF 1988b). The only new equipment expected to affect the amounts of pre-launch emissions is an OVSS which would be installed at SLC-4E and would replace an Oxidizer Vapor Burner. The new OVSS would provide a greater range in operational flow rates and greater efficiency, and would result in lower emissions of NO_x. An Air Permit Application for the OVSS has been submitted to the Santa Barbara County Air Pollution Control District (USAF 1988e).

Launch

The rate of launches from SLC-4E (planned rate of two per year with a maximum of four per year) would not change under the proposed action. The only change at VAFB from actions assessed in previous documentation (USAF 1988b) is that some VAFB launches would be Titan IV–Type 2 (SRMU) vehicles, rather than Type 1. The marginal increase (15%) in solid propellant weight for the SRMU would have the potential for slight increases in the air quality impacts of launch emissions. The combustion products from a Type 2 (SRMU) launch and the rationale for the following analysis were discussed in Sect. 3.1.3.1 (see Table 3.5).

The air quality impacts of the SRMU launches were estimated using the REEDM model (see Sect. 3.1.3.1). For the VAFB launch impact analysis, four seasonal worst-case meteorological cases were chosen. These seasonal meteorological scenarios are summarized in Table 3.7. The meteorological profiles input for these runs were selected through consultation with VAFB staff experienced in using the REEDM model.

The results of the four VAFB REEDM runs are summarized graphically in Fig. 3.4. The four curves represent maximum predicted ground-level plume-centerline concentrations as a function of distance for the four meteorological scenarios. One-hr HCl and 24-hr Al_2O_3 concentrations at a given distance can be obtained from the left and right scales, respectively.

The maximum HCl concentration beyond the nearest VAFB property boundary was predicted to be approximately equal to the NRC-recommended SPEGL 1-hr limit of 1 ppm for the autumn meteorological scenario. This result is 4–5 times higher than the highest HCl concentration predicted for the CCAFS scenarios and is most likely the result of the higher terrain at VAFB, which reduces the effective height of the plume above ground-level receptors. As is the case with all potentially hazardous launch-related activities, VAFB meteorological forecasting staff would conduct dispersion modeling before launch to ensure that adverse concentrations do not occur over populated areas inside or outside VAFB.

The maximum predicted Al_2O_3 concentration beyond the distance of the nearest VAFB property boundary was 105 $\mu g/m^3$. Although no PM-10 monitoring data were available for VAFB, a maximum 24-hr background PM-10 concentration of 35 $\mu g/m^3$ was estimated, based on TSP measurements in Santa Barbara County (see Sect. 2.2.2.1). This

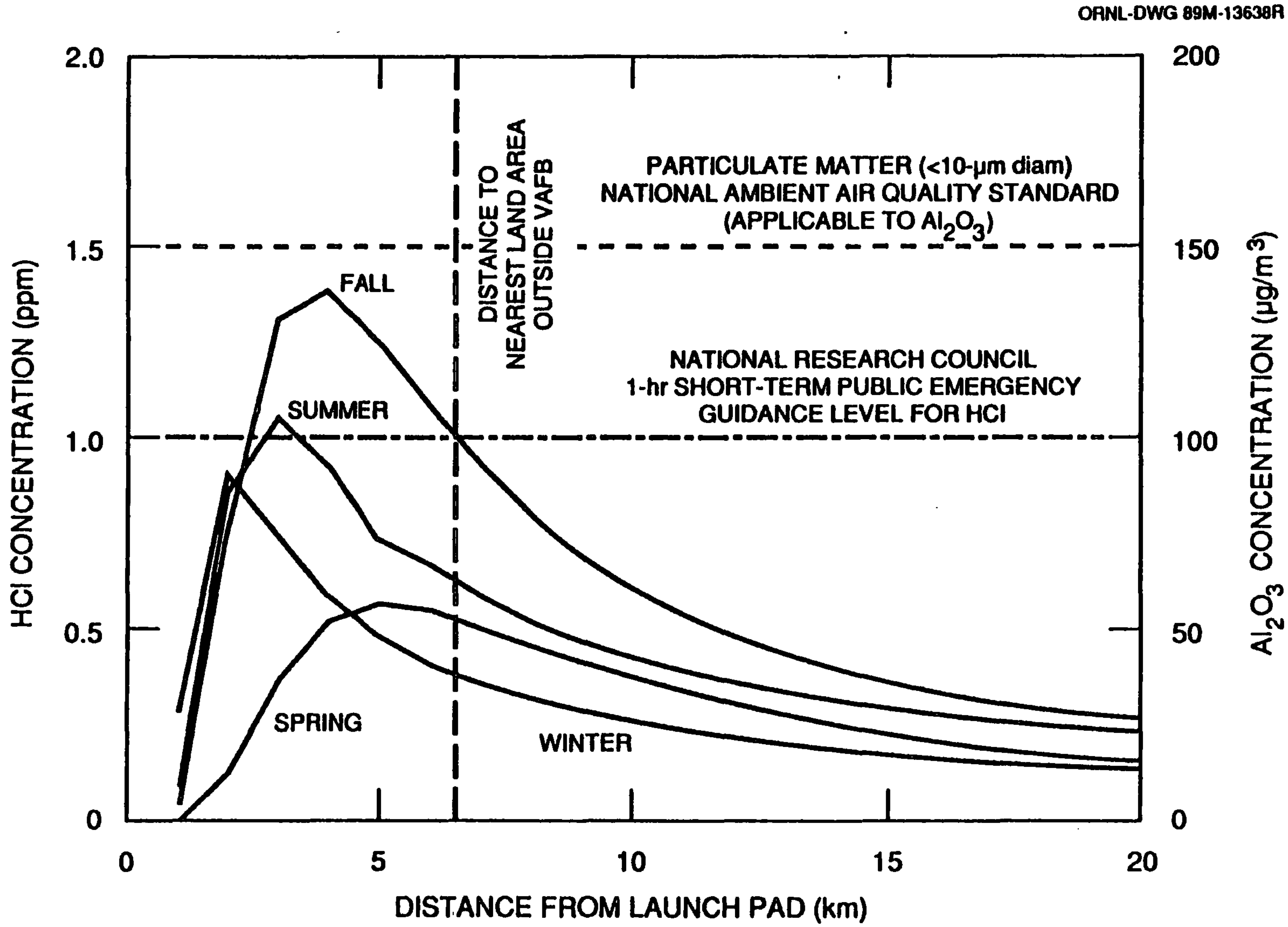


Fig. 3.4. Titan IV Solid Rocket Motor Upgrade maximum 1-h hydrogen chloride (HCl) and 24-h aluminum oxide (Al_2O_3) concentrations predicted by the Rocket Effluent Exhaust Dispersion Model (REEDM) for four meteorological scenarios at Vandenberg Air Force Base.

would yield a total maximum 24-hr PM-10 concentration of 140 $\mu g/m^3$, which is below the 24-hr NAAQS of 150 $\mu g/m^3$, but above the CAAQS of 50 $\mu g/m^3$. The maximum predicted total PM-10 concentration is considered to be an extremely conservative value, since maximum background and modeled impacts are assumed to coincide in time. It is also conservative because all plume Al_2O_3 was assumed to be in the PM-10 size range and because no depletion of particulate matter by deposition was accounted for by the model.

Table 3.7. Vandenberg Air Force Base meteorological parameters for four seasonal worst-case dispersion conditions used as input to the Rocket Effluent Exhaust Dispersion Model

	Date	Local time	Wind speed (m/s) Surface	Wind speed (m/s) 500 m	Wind direction Surface	Wind direction 500 m	Temperature inversions
Winter	2/20/88	0330	1.5	1.8	90°	330°	Surface–100 m (strong); 100–900 m (weak)
Spring	3/21/88	0400	1.0	2.6	240°	343°	150–350 m (strong); 350–600 m (weak)
Summer	8/12/87	0400	1.0	2.5	260°	250°	500–800 m (strong)
Fall	11/12/87	0400	1.0	3.1	65°	18°	Surface–100 m (strong); 100–500 m (moderate)

3.2.4.2 Cumulative impacts

Lower atmosphere

Given the brief and infrequent nature of the emissions associated with VAFB launch programs, cumulative impacts on lower atmosphere air quality would be minor. Air quality in the VAFB area is currently quite good, except that ozone levels are near the NAAQS.

Incremental emissions of ozone precursors (NO_x and VOCs) from the Titan IV-Type 2 (SRMU) program would be very minor. Also, it should be emphasized that no change in the number of launches at VAFB is proposed; the only change with regard to launches is that some vehicles would be Titan IV–Type 2 (SRMU) rather than Type 1.

Upper atmosphere

The incremental impacts of the VAFB Titan IV-Type 2 (SRMU) launches on upper atmosphere ozone levels would be very small compared with impacts from other natural and man-made causes (see Sect. 3.1.3.2). However, because stratospheric ozone depletion is a global-scale problem, many small "insignificant" sources can cause significant cumulative effects. Given the current alternative vehicles [Titan IV-Type 2 (SRMU) or STS] for launching the desired payloads, the Titan IV-Type 2 (SRMU) would have less impact on upper atmosphere ozone levels, since the HCl emissions per payload would be about 50-60% of those for the STS.

3.2.4.3 Monitoring and mitigation

A monitoring plan will be developed for the Titan IV program at VAFB and will include air quality sampling.

Construction and pre-launch processing

The proposed action would involve very little grading, fill, or excavation activity at VAFB. PM-10 emissions associated with such earthmoving operations would be controlled by watering as soil moisture conditions warrant.

Emissions from all routine fuel and oxidizer loading and transfer operations would be minimized through incineration and scrubbing of hazardous vapors. The potential for emissions from accidental spills would be minimized through the use of redundant systems for flow metering and cutoff in case of leaks. Propellant transfer systems would be situated over catch basins in which accidental spills could be quickly diluted, neutralized (if necessary), and promptly cleaned up. Hazardous propellant handling operations are undertaken only if PHC forecasts indicate that off-base or on-base populations would not be exposed to adverse vapor concentrations from an accidental spill.

Launch

Mitigation of potentially adverse air quality impacts from the exhaust cloud would be accomplished through dispersion forecasts that affect the decision whether to launch a vehicle at the scheduled time. VAFB maintains extensive meteorological monitoring and forecasting facilities. One function of the meteorological facilities and staff is to provide forecasts of the PHC before launches and associated operations. The VAFB meteorological forecasting staff uses site-specific dispersion models, together with real-time or forecast meteorological input data and potential source strength data, to predict the length and angular width of PHCs. The PHC forecast would be used to determine whether to launch, in order to prevent both off-base and on-base populations from being exposed to adverse effluent concentrations.

3.2.5 Surface Water

3.2.5.1 Regional and local impacts

Approximately 220,000 gal of deluge and washdown water would be required per Titan IV launch at SLC-4E. About 170,000 gal would be deluge water (USAF 1988b), some of which would be dispersed by the SRM/SRMU exhaust. (The quantity of deluge water differs from that used at CCAFS because of launch operations procedural differences.) About 150,000 gal would be collected in the flame bucket and directed to a wastewater retention basin [exhaust duct sump (EDS)] for temporary storage at SLC-4E. The entire exhaust duct system (flame bucket, exhaust duct, and EDS) has a capacity of 280,000 gal (USAF 1988b). The remaining 70,000 gal would be blown by the exhaust onto uncontrolled areas of the launch facility, where it would either percolate in the soil or vaporize and disperse into the atmosphere.

Past deluge and/or washdown discharges (earlier Titan program launches) have impacted the surface water quality of Spring Canyon Creek. Significant increases in iron, lead, copper, zinc, calcium, magnesium, chloride, and pH have occurred downstream of SLC-4 (USAF 1988b); pH levels decreased and aluminum increased upstream. For the Titan IV program, the RWQCB will consider surface water beneficial uses, including aquatic life, and will require mitigation measures to protect the beneficial uses and prevent further degradation of surface water quality (see Sect. 3.2.5.2).

Deluge water applied during the launch is largely consumed (evaporated) and forms part of the ground cloud. Washdown water applied to the launch pad after launch comprises the major portion of the water in the sump. The water in the sump would be transported to SLC-6 for treatment in an existing wastewater treatment system. The wastewater will be analyzed prior to treatment, and if hydrazine compounds are detected, they will be removed by ultraviolet/ozone treatment. The pH will be adjusted, and metals will be precipitated out of solution. Dissolved solids will be removed in a reverse osmosis (RO) unit. Reject water from the RO unit will be evaporated in ponds. Treated water will be stored in appropriately lined basins, and reused on-site, as needed.

Because the launch pad drains into the flame bucket and the exhaust duct sump, (EDS), stormwater discharges can constitute a significant portion of the wastewater collected between launches. The RWQCB has requested information on the quality of stormwater runoff to determine if residues in the retention basin contaminate stormwater to the extent that treatment is necessary prior to discharge (see Sect. 3.2.5.2).

Impacts, particularly to Spring Canyon Creek, can also occur as the result of interaction of the ground cloud with surface waters during launching of Titan IV vehicles. The impact of the ground cloud on surface water quality is a function of the composition of the exhaust cloud, duration of its contact with the water, wind speed and direction, and other atmospheric conditions. Calculation of the ground cloud deposition from future SLC-7 launches on surface waters in Honda Creek suggests that the pH levels in the stream would be depressed; however, the buffering capacity of the stream would minimize the actual pH depression (USAF 1989d).

Two concerns are associated with the ground cloud. The primary concern is the formation of large quantities of HCl. Short-term acidification of surface water may result from direct contact with the ground cloud and through deposition of HCl as dryfall or with precipitation. Because launches do not occur during rainfall or storm conditions, wet deposition should be limited primarily to the SLC-4E vicinity. Short-term acidification of waters in Spring Canyon Creek could occur under certain atmospheric conditions (see Sect. 3.2.4). Water quality samples taken in Spring Canyon Creek upstream of the SLC-4 launch area have shown depressed pH and alkalinity levels, which would be indicative of deposition from a ground cloud. These water quality parameters returned to levels reported for other VAFB streams downstream, indicating neutralization by the natural buffering system in the creek (USAF 1988b). The lower pH values upstream and the lower levels of Ca and Na (Table 2.4) indicate that much of the natural buffering capacity of the upstream portion of Spring Canyon Creek may have already been expended by past ground cloud neutralization.

The second concern associated with the ground cloud of the Titan IV is the potential impact of Al_2O_3 on surface water quality. Previous water quality sampling in Spring Canyon Creek has shown occasional high values of aluminum, which would be indicative of Al_2O_3 deposition. Because Titan IV launches will continue and Titan IV-Type 2 (SRMU) launches will release 15% more exhaust products, the concentrations of aluminum in the creek would continue to be elevated. The concentration of aluminum would continue to increase in the sediment of the streambed and might continue causing elevated levels into the water column on occasions. Most of the Al_2O_3 would remain in the streambed sediments because of its low solubility.

Based on the acidic deposition calculations for SLC-7 (USAF 1989d), deposition from Titan launches from SLC-4 could occur into Canada Honda Creek and Bear Creek. As discussed in Sect. 2.2.2.2, no information exists on the water quality of Bear Creek. However, based on the pH and buffering capacity of surface waters in the area, the impacts to both Bear Creek and Canada Honda from launches at SLC-4 should be minor.

3.2.5.2 Cumulative impacts

The current water quality in Spring Canyon Creek (Sect. 2.2.1.2) reflects the cumulative impacts of launches from SLC-4E and SLC-4W. With continued launches and possible stormwater discharge to the creek, surface water in Spring Canyon Creek will continue to be degraded. Deposition onto Spring Canyon Creek and its watershed from the ground cloud associated with each launch will continue to reduce the pH and alkalinity upstream of the site. Concentrations of aluminum will continue to accumulate in the streambed sediments as the result of continued launches at SLC-4.

3.2.5.3 Monitoring and mitigation

A surface water monitoring plan will be implemented as part of the Titan IV program. If water quality problems are noted, the RWQCB will advise the USAF of appropriate mitigation measures (personal communication, Bill Meese, RWQCB, to V. R. Tolbert, August 17, 1989).

A valve would be installed between the flame bucket and the EDS at SLC-4E to preclude contamination of stormwater with chemicals existing in the EDS. The stormwater, which would be segregated in the flame bucket, would be tested before being released through the retention basin into Spring Canyon Creek. The stormwater would bypass the EDS, which would serve only as a spill containment structure. There is currently no requirement to test or prevent the discharge of stormwater. However, the RWQCB has requested further information on runoff quality to determine if residues from the launch pad will contaminate stormwater and if treatment would be necessary prior to discharge (USAF 1988f). Treatment of stormwater, if necessary, would mitigate stormwater impacts to surface water quality in the Spring Canyon drainage.

Deluge water and washdown water from launches would collect in the flame bucket and EDS. This water will be pumped into tanker trucks and removed to SLC-6 for treatment as described in Sect. 3.2.5.1. This action would mitigate water quality impacts of deluge water discharge to Spring Canyon Creek associated with previous Titan (III and 34D) launches from SLC-4E.

3.2.6 Groundwater

3.2.6.1 Regional and local impacts

The impact on the groundwater supply at South VAFB would be insignificant for Titan IV launches at SLC-4E. Based on the preceding launch water requirements and a launch rate of two per year, annual groundwater withdrawn for deluge and washdown water would be about 0.3% of annual groundwater supplies currently consumed at South VAFB. It would take 300 years to deplete all the groundwater in storage at the projected consumption rates with or without SRMU program implementation. Thus, short- and long-term impacts on groundwater supplies are none and small, respectively, as a result of the SRMU program.

The impact on groundwater from deluge water in the ground cloud is uncertain. An unknown quantity of deluge water would condense and fall back to earth a short distance from the launch site, but much of it is expected to vaporize and disperse into the atmosphere.

As noted in Sect. 3.2.5.1, deluge and washdown water collected in the EDS system would be trucked to SLC-6 for treatment and disposal (EG&G, Inc. 1989) Water from the EDS may be contaminated with heavy metals, volatile organic compounds (VOCs), and rocket propellants. Treatment and disposal at SLC-6 would preclude any groundwater impacts near SLC-4E. Impacts of an accidental leak are discussed in Sect. 3.3.2.4.

3.2.6.2 Cumulative impacts

Cumulative impacts to groundwater could result from the unmitigated discharge of wastewater from the Titan IV launches and from a maximum of five additional annual launches in other programs at VAFB (see Sect. 3.2.3.2). This is not likely, however, because wastewater from launches at SLC-4E will be collected and treated.

The groundwater resource at SLC-4E is presently insufficient and unsuitable as a potable supply.

3.2.6.3 Monitoring and mitigation

Groundwater monitoring will be conducted as part of the planned comprehensive monitoring program for the Titan IV. If monitoring of groundwater identifies levels of contaminants that are above levels approved by the RWQCB, treatment could be required. If solvents are identified as contaminants, treatment would most effectively occur by (1) pumping the contaminated water to the surface and treating by air stripping, and (2) passing the contaminated water through an activated carbon column for sorption of the contaminant, or to biological treatment, depending on the contaminant. If metals are identified as the contaminants, water would be pumped to the surface for treatment by precipitation or ion exchange.

The flame bucket, EDS, and retention pond at SLC-4E will be routinely inspected for leaks and resealed, if necessary.

3.2.7 Terrestrial Ecology

3.2.7.1 Regional and local impacts

Construction activities associated with the proposed action would have negligible impacts on terrestrial vegetation. Only ruderal vegetation within the launch pad area would be affected.

Launch activities associated with the proposed action could impact vegetation and wildlife in three ways—fire, acid deposition on vegetation and fauna, and noise (see Sect. 3.1.7.1). Because of the drier climate at Vandenberg, brush fires are of greater concern at VAFB than at CCAFS. Likewise, vegetation recovery times from acid deposition damage may be longer at VAFB than at CCAFS because of the water stress that plants experience due to the drier climate. Plant species are also different at VAFB and may respond differently to acid deposition. Studies at CCAFS showed that different species showed different responses to the same amount of acid deposition. Furthermore, although there are no threatened and endangered wildlife species residing sufficiently close to the launch pad to be affected by fire or acid deposition, several candidate 2 plant species (soft-leaved

Indian paintbrush, San Luis Obispo monardella, black-flowered figwort, and perhpas Hoffman's sanicle) are likely to exist within the area that might be impacted by fire or acid deposition.

Least terns and pinnepeds using the shoreline at Vandenberg could possibly experience noise levels in excess of 95 dB and a temporary hearing loss. However, given the low number of Titan IV launches at VAFB (two per year), wildlife hearing loss would probably not be a significant impact to wildlife populations. The focal region of sonic booms has not been identified for Titan IV missiles launched from SLC-4. However, it is reasonable to assume that it might also include parts of the Channel Islands (USAF 1989d). Sonic booms from Titan IV missiles launched from SLC-4 could produce temporary hearing losses and startle responses in wildlife on the Channel Islands. As the Channel Islands are important breeding grounds for California sea lions, northern fur seals, Guadalupe fur seals, and harbor seals, the effect of sonic booms on these four pinnepids is important. Both California sea lions and Northern fur seals on the Channel Islands have been observed to run (stampede) in response to sonic booms. If this occurred during critical points in the reproductive cycle, it could cause adults to abandon a breeding ground, nursing females to abandon their pups, or pups to be crushed by stampeding adults, although none of these effects have been observed. Field studies for San Miguel Island found that only harbor seal pups less than 2 hr old could be separated from their mothers during a major startle (USAF 1989d). On San Miguel Island, 100–120 harbor seal pups are born each year over a 75-day breeding period, with a maximum of two or three per day born during the peak period. Thus, a single sonic boom could cause three mother-pup separations at most. However, the potential exists for certain insignificant impacts to occur. Therefore, in compliance with the requirements of Section 7(a) of the Endangered Species Act, a Small Incidental Take Permit may be needed.

3.2.7.2 Cumulative impacts

The cumulative impacts to terrestrial wildlife and vegetation from the construction aspects of the expanded Titan IV program are expected to be insignificant because construction would occur in previously disturbed areas.

Four Titan IV vehicles would be launched annually from VAFB and five launches for other programs would also be expected at south VAFB (see Sect. 3.2.3.2). Assuming acid deposition extent and intensity similar to that from Space Shuttle launches (a very conservative assumption for reasons noted in Sect. 3.1.6.1) and plant responses similar to those observed at CCAFS, 22 ha (46 acres) of vegetation directly adjacent to SLC-4 and other vehicles. Launch pads could change in plant species and cover. If species at VAFB are more sensitive to acid deposition than at CCAFS, more land could possibly be affected. At present, there are no data on the effects of acid deposition to plant species at VAFB so it is difficult to predict the possible effects of acid deposition on vegetation. As at CCAFS, the effect of these possible vegetation changes on wildlife might be positive or negative. Because far-field deposition is not likely to occur over the same area for each launch, far field deposition may have no cumulative impacts as the vegetation is likely to recover during the long interval between deposition episodes.

The cumulative impact of launch noises on sensitive wildlife (threatened, endangered, and protected species) can be analyzed only qualitatively. Including the Titan IV, a total of up to 19 launches could take place at North and South VAFB each year. If the worst case is assumed (1) that each launch will impair the hearing of sensitive animals living within a given noise impact zone (e.g., launch noise exceeds 95 dBA) and (2) that noise impact zones of the various missile launches overlap in areas where sensitive wildlife reside, then sensitive animals could be impacted 19 times per year. Depending on the duration of hearing loss, the worst-case scenario could affect the population and ultimately the survival of sensitive wildlife species.

Similarly, if the focal regions for the sonic booms from 19 launches overlap and fall on the Channel Islands, the marine mammal wildlife of the islands could be subjected to sonic booms once every 3 weeks if the launches were regularly spaced in time. The impact of such frequent sonic booms is unknown, although field observations of startle responses to single booms suggest there would be no significant impact. However, laboratory mice exposed to repeated sonic booms at either short (10-min) or long (24-hr) intervals did show cumulative impacts (i.e., inner ear bleeding) (Manci et al. 1988). It is not known whether this effect would occur in other mammals, whether 4-week intervals between exposures would produce cumulative effects, and whether such temporary ear damage would have any lasting effects on animal populations.

3.2.7.3 Monitoring and mitigation

As three candidate species for federal listing as threatened species (soft-leaved Indian paintbrush, San Luis Obispo monardella, black-flowered figwort, and perhaps Hoffman's sanicle) are likely to exist within the area that might be impacted by fire or acid deposition, a monitoring program will be initiated to collect baseline population information on these species and to evaluate any impact to the populations from the launches. Least tern and harbor seal responses to local launch noise will be studied. Acid deposition from the launches will also be monitored and baseline data collected on the vegetation surrounding the launch complexes so possible changes due to deposition or burning can be evaluated.

A possible mitigation measure with regard to noise effects on local and Channel Island wildlife is to schedule launches to avoid seasons of the year that are most critical to wildlife (e.g., breeding seasons). As such seasons vary among animals, it would be necessary to identify the most sensitive species and/or time of year critical to the most species. The National Marine Fisheries Service has recommended that the USAF continue to pursue a small-take permit to cover all launch operations at VAFB as they affect protected marine mammals on-base and on the Channel Islands.

3.2.8 Aquatic Ecology

3.2.8.1 Regional and local impacts

Effects on water quality from discharge of deluge and washdown water from SLC-4E to Spring Canyon Creek are discussed in Sect. 3.2.5.2. Impacts to existing aquatic resources in Spring Canyon Creek would be lessened by transport of deluge and washdown water to SLC-6 rather than discharge to the creek. However, impacts associated with deposition from the ground cloud onto the creek would continue as long as launches occur at the site.

Deposition onto Spring Canyon Creek and its watershed from the ground cloud would continue to reduce the pH and alkalinity upstream of the site and maintain a poor environment for the majority of aquatic biota in the creek. According to Versar (1987), diversity and abundance in Spring Canyon Creek are already very low, with no fish or other wildlife dependent on the biotic character of the creek for foraging.

Lesser impacts to aquatic biota in Canada Honda Creek and Bear Creek could occur as the result of deposition of the acidic ground cloud onto surface waters and watersheds. The unarmored three-spined stickleback, an endangered species, occurs in the downstream portion of Canada Honda Creek and potentially could be impacted by water quality degradation.

3.2.8.2 Cumulative impacts

Between 1990 and 1995, about 12 Titan IV launches are planned from SLC-4E. The cumulative impact to existing aquatic biota would result from continued water quality degradation associated with ground cloud deposition. Deposition onto Spring Canyon Creek from the ground cloud would exacerbate the already poor environment for the aquatic biota that inhabit VAFB ephemeral streams. With continued launches, the potential for impacts to aquatic biota in Canada Honda Creek and Bear Creek would increase with potentially decreased buffering capacity, as seen in Spring Canyon Creek. Although there is no information on current impacts to Bear Creek, its small size makes deposition a greater contribution to the overall water quality than in larger streams. Therefore, the potential for impacts to existing aquatic biota would increase.

3.2.8.3 Monitoring and mitigation

The USAF will develop and implement a comprehensive monitoring plan for environmental resources at VAFB to detect potential adverse impacts requiring mitigation. Water quality and aquatic biota sampling will be included.

Mitigation of impacts to water quality or protection of Spring Canyon Creek for beneficial biotic use might be required by the RWQCB for permitting of stormwater discharge. Upstream of SLC-4, where Spring Canyon Creek is affected by deposition from the ground cloud, alkalinity could be artificially increased during launches to raise the pH level of the creek and minimize the effects of fluctuations in pH and alkalinity on biota.

Similar mitigation measures to protect aquatic biota of Canada Honda Creek and Bear Creek may be necessary if monitoring of water quality and aquatic biota show cumulative effects from ground cloud deposition from launches. This is particularly important for Canada Honda Creek, which contains a population of federally listed, endangered unarmored three-spined sticklebacks.

3.2.9 Floodplains and Wetlands

3.2.9.1 Regional and local impacts

Deluge discharge from SLC-4E would not affect the wetland area in Spring Canyon. Stormwater discharge to the creek could help provide recharge and maintain soil saturation, thereby helping to maintain the extent of the wetland area in the Canyon. Cattails and rushes are particularly tolerant of low pH waters and are used in filtration ponds in surface mining areas in the eastern United States to remove heavy metals and reduce the acidity of streamflow. These vegetation types in Spring Canyon could help reduce water quality effects of stormwater discharge and downstream water quality effects of ground cloud deposition. Historically, the effects of acidic deposition on vegetation have been minimal.

3.2.9.2 Cumulative impacts

Significant adverse impacts to wetland areas in Spring Canyon are not expected to result from the Titan IV program; therefore, there should be no cumulative impacts to wetland areas.

3.2.9.3 Monitoring and mitigation

Because there has been no observed impacts to wetland areas in Spring Canyon, no mitigation measures are proposed. Monitoring of wetlands will be included in a comprehensive monitoring program planned for the Titan IV program.

3.3 IMPACTS OF ACCIDENTS

3.3.1 Cape Canaveral Air Force Station

3.3.1.1 Storage and assembly

Because the launch vehicle storage and assembly facilities are not much closer to off-base land areas than to LC-40 and LC-41, the potential impacts of an accident involving ignition of the SRMs during assembly at CCAFS are discussed in the context of a launch accident in Sect. 3.4.1.3. 3

3.3.1.2 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 on the Titan IV core vehicle are N_2O_4 and Aerozine-50 (a mixture of equal portions of hydrazine and unsymmetrical dimethylhydrazine). The mass of N_2O_4 used is nearly twice that of Aerozine-50. Previous studies have indicated that for a given amount of propellant, N_2O_4 has greater potential than the hydrazines for toxic air quality effects (USAF 1989c). Although the hydrazines have lower recommended exposure limits than N_2O_4 (NRC 1985a NRC 1985b), the latter evaporates much faster at typical ambient temperatures. Thus, for Aerozine-50 and N_2O_4 spills of comparable mass, the plume of N_2O_4 would travel farther downwind before atmospheric dispersion reduced the concentrations below recommended safety limits.

Spills of N_2O_4 or Aerozine-50 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 this reason, 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 PHC. If the PHC would overlay uncontrolled areas, the nearest of which are about 8 mi away from LC-40 or LC-41, or unprotected CCAFS or KSC populations, the propellant handling operations would be postponed until more favorable meteorological conditions were expected.

3.3.1.3 Launch

An accident shortly before or during launch of a Titan IV vehicle has the most potential for adverse air quality impacts, as compared with other accident hazards related to vehicle assembly and liquid propellant handling. The worst-case air quality impacts of launch or launch-pad accidents are discussed with respect to two general types of combustion events: conflagration and deflagration.

Conflagration is defined here as an accident involving the burning of large solid fuel fragments that have become dislodged, by whatever means, from the SRM casing. For this analysis, conflagration is assumed to take place at the launch pad either before or shortly after launch. The rate at which the solid fuel would burn depends 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, perhaps for an hour or more. The air contaminant of primary concern for a conflagration event is HCl.

Deflagration is defined here as a rapid, explosive type of combustion involving the hypergolic liquid propellants (N_2O_4, N_2H_4, and UDMH) in a fully fueled vehicle on the launch pad or shortly after liftoff. Obviously, the SRMs would also be affected by such an event. If the explosion were caused by a properly functioning command destruct, the SRMs would likely disintegrate into relatively small chunks, which would be more widely dispersed than they would in the conflagration event described above and would also burn more quickly. If the command destruct did not work, the solid fuel would probably break into larger fragments and burn as described for the conflagration event. Thus, HCl impacts for a conflagration event are expected to be greater than or equal to those for a deflagration event.

The REEDM model has been enhanced in order to simulate both the conflagration and deflagration events described previously. For the deflagration event, the REEDM model assumes that 80% of the N_2O_4 and 20% of the N_2H_4 and UDMH remain uncombusted after detonation. These assumptions are based on observations made after a 1986 Titan 34D vehicle destruct at VAFB, which occurred at an altitude of 300 ft above the launch pad. Note that N_2O_4 dissociates almost completely in the ambient air, forming NO_2. Therefore, all impacts from N_2O_4 propellant are discussed in terms of NO_2.

In order to provide an indication of the potential air quality impacts from conflagration or deflagration events at CCAFS, the REEDM model was run without the VAFB-specific terrain/wind algorithms disengaged. The meteorological scenarios considered for the CCAFS REEDM accident simulations were the same as for the routine launch modeling for CCAFS (Sect. 3.1.3.1).

REEDM model results for Titan IV SRMU deflagration and conflagration events at CCAFS are summarized in Table 3.8. Except for NO_2, the maximum predicted concentrations beyond the distance of the nearest uncontrolled areas (outside CCAFS and KSC, 10 mi from LC-40) were below the SPEGLs recommended by the NRC (NRC 1987, NRC 1985a, NRC 1985b). The maximum predicted 1-hr NO_2 concentration was 1.09 ppm, which is only slightly above the NRC SPEGL of 1.0 ppm. As is done with other potentially hazardous operations, the CCAFS meteorological forecasting staff would use dispersion models to forecast the PHC before launch operations are conducted. These forecasts would be used to determine whether to launch, in order to prevent adverse exposures to people off-site, at CCAFS, or at KSC in case of accidents.

Table 3.8. Rocket Effluent Exhaust Dispersion Model–predicted air quality impacts for deflagration and conflagration events at Cape Canaveral Air Force Station

Event	Air pollutant	Maximum 1-hr concentration outside CCAFS/KSC[a] (ppm)	Meteorological scenario	National Research Council 1-hr SPEGL[b] (ppm)
Conflagration	HCl	0.66	Winter, cold morning	1.0
Deflagration	N_2H_4	0.07	Summer, light wind	0.12
	UDMH	0.04	Summer, light wind	0.24
	NO_2	1.09	Summer, light wind	1.0

[a]Cape Canaveral Air Force Station/Kennedy Space Center.
[b]Short-term public emergency guidance levels (SPEGLs) recommended by the National Research Council (NRC 1987, NRC 1985a, NRC 1985b).

The occurrence of fire and/or the explosion of a Titan IV 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. However, under unusually dry and windy conditions, a successful Titan 34D launch at CCAFS ignited a groundfire which escaped the launch complex and burned 20 acres of adjacent scrub forest.

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 column receiving the propellant input. Based on the dispersion model for the Titan IIIC and IIID launch failure, the radius of the contaminated water column could vary from 800 to 8000 ft, depending on the amount of propellant released (USAF 1988a). Such an accident would cause short-term impacts to water quality and aquatic resources (see Sect. 3.2.8.1).

3.3.2 Vandenberg Air Force Base

3.3.2.1 Storage and assembly

Assembly of most Titan IV vehicle components (including SRM segments) at VAFB would take place at SLC-4E. Thus, the worst-case assembly-related accident probably would take place at SLC-4E, involving accidental ignition/explosion of one or more SRM segments. This type of accident would probably cause air quality impacts of severity lesser than or equal to an on-pad detonation of a fully fueled vehicle. Therefore, the analysis of launch-related accidents in Sect. 3.3.2.3 provides an upper bound on the potential air quality impacts resulting from the worst-case assembly accident.

3.3.2.2 Liquid propellant handling

The types and amounts of liquid propellants used for Titan IV-Type 2 (SRMU) launches at VAFB would be essentially identical to those used at CCAFS. Safety procedures for handling the propellants at VAFB would also be the same as procedures at CCAFS. However, at VAFB, the nearest uncontrolled (off-base) area is less than 4 mi from SLC-4E. Also, based on the analysis of normal launch air quality impacts (Sect. 3.1.4.1 and 3.2.4.1), it appears that the unique terrain and meteorological conditions at VAFB could cause air contaminant concentrations for the same source size to be several times larger than at CCAFS. As at CCAFS, PHC forecasts would be used at VAFB to determine whether to conduct hazardous propellant transfers, thus protecting off-base and on-base populations in the event of accidental spills.

3.3.2.3 Launch

The analysis of potential air quality impacts associated with a launch accident at VAFB was identical to the analysis for CCAFS, except that the VAFB analysis utilized the VAFB-specific wind/terrain algorithms of REEDM and the four VAFB meteorological cases used for the routine launch analysis described in Sect. 3.2.4.1. The REEDM results for the conflagration and deflagration events (Sect. 3.3.1.3) are summarized in Table 3.9.

For the worst-case (fall) meteorological scenario, maximum concentrations of N_2H_4 and NO_2 beyond the distance to the nearest land area outside VAFB (4 mi from SLC-4E) were several times greater than the NRC-recommended SPEGLs. The VAFB meteorological forecasting staff would utilize real-time and forecast meteorological data, together with atmospheric dispersion models, to predict the extent of the PHCs in order to prevent such impacts from occurring. To prevent adverse impacts to on-base and off-base populations, launch operations would be postponed, if necessary, until more favorable meteorological conditions prevailed. As noted in Sect. 3.4.1.3, normal launches always carry the risk of fires which can burn a sizeable area if prompt control is not achieved.

Table 3.9. Rocket Effluent Exhaust Dispersion Model–predicted air quality impacts for deflagration and conflagration events at Vandenberg Air Force Base

Event	Air pollutant	Maximum 1-hr concentration outside Vandenberg Air Force Base (ppm)	Meteorological scenario	National Research Council 1-hr SPEGL[a] (ppm)
Conflagration	HCl	0.68	Fall	1.0
Deflagration	N_2H_4	0.33	Fall	0.12
	UDMH	0.17	Fall	0.24
	NO_2	4.29	Fall	1.0

[a]Short-term public emergency guidance levels (SPEGLs) recommended by the National Research Council (NRC 1987; NRC 1985a; NRC 1985b).

3.3.2.4 Failed liner at SLC-6 evaporation pond

Groundwater could be contaminated by the contents of the SLC-6 evaporation ponds should a major leak occur. The impacts could be minimized or prevented by weekly inspection for leaks and/or installation of a double liner and leak detection system in the ponds.

The single-layer liners of the SLC-6 retention basins would be inspected for leaks between launches. If leaks were found, the damaged liner would be repaired or replaced, with a leak detection system and a new primary liner placed above it. If a significant amount of water subsequently appeared in the leak detection system, contaminated water would be transferred to an operable retention basin, and the failed liner would be repaired without impact to groundwater.

4. PERMITS AND ENVIRONMENTAL COMPLIANCE

4.1 CAPE CANAVERAL AIR FORCE STATION

4.1.1 Air Quality

The FDER 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 such as the FVIS, OVSS, paint spray booths, and diesel-fired electrical generators are subject to review and permitting by the FDER. Construction permits for the OVSS and FVIS at LC-41 already exist. Operating permits are pending. New stationary sources that would require similar permits are the FVIS and OVSS at LC-40. Applications for construction permits for the LC-40 FVIS and OVSS have been submitted. Permits may also be required, at the discretion of the FDER, for new backup diesel generators.

4.1.2 Water Quality

4.1.2.1 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 VIB, LC-40, or LC-41 because the planned modifications will neither increase stormwater runoff rates nor reduce the quality of the existing runoff (Ralph Maloy, FDER, personal communication to V. R. Tolbert, ORNL, June 6, 1989). The St. Johns River Water Management District of FDER issued a stormwater permit for the new SMAB in May 1989 (SJRWMD 1989).

4.1.2.2 Sewage treatment

The VIB, LC-40, and LC-41 already have potable water and sanitary waste disposal permits. If new water lines (not replacement lines) are necessary to support the increased deluge water needs at LC-40 and LC-41, a general permit from FDER would have to be obtained. An FDER permit for construction and operation of the sewage treatment facility at the proposed SMAB is pending (personal communication, Lee Miller, FDER, with V. R. Tolbert, ORNL, September 26, 1989).

4.1.2.3 Industrial wastewater discharge

Wastewater from the LC-40 and LC-41 Titan IV program operations includes deluge and washdown water discharged during launch activities. An application has been filed with the FDER under Chap. 17-4 regulations to permit discharge from LC-40 and LC-41. The permit would be issued based on demonstration that discharge would not significantly degrade surface water or groundwater. A groundwater monitoring program will be required.

4.1.2.4 Floodplains and wetlands

Section 404 of the Clean Water Act (33 USC 1251 et seq.) authorizes the U.S. Army Corps of Engineers (COE) to issue permits for the discharge of dredged or fill material into navigable waters of the United States. For the purposes of Sect. 404, navigable waters are defined to include wetland areas. Consequently, disturbance of wetlands on the proposed SMAB site will require a Sect. 404 permit from COE prior to site preparation. Creation of a 1.6-acre wetland at the SMAB site would also be covered by the permit. A dredge-and-fill permit is also required from the St. Johns River Water Management District under Chap. 12-12 of the Florida regulations (personal communication, Perry Jennings, St. Johns River Management District, to V. R. Tolbert, ORNL, June 7, 1989). The joint COE-FDER permit was issued for the SMAB construction in August 1989.

The existing launch complexes (40 and 41) are not on a floodplain. With use of proper sediment control measures, proposed actions at these sites would not affect wetlands; therefore, a permit would not be required.

4.1.3 Threatened and Endangered Species

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 FWS and/or the NMFS 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. Consultation with the FWS and NMFS is included in the ecological impact analysis conducted as part of the NEPA review and is reported in NEPA documents. Correspondence with the FWS and NMFS requesting consultation regarding potential impacts of the proposed action on endangered or threatened species is presented in App. B and App. C, respectively.

4.1.4 Spill Prevention

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

No discharges of oil/petroleum or fuels are expected from the new SMAB, LC-40, or LC-41. The only potential sources of oil/petroleum products during operation of the SMAB would be lubricants used to maintain heavy equipment and an aboveground fuel storage tank for backup diesel generation. Fuels stored at the launch complexes are in paved and curbed areas designed to contain the volume of the tanks.

Spills of oil/petroleum products that may be federally listed hazardous materials would be collected and removed for proper disposal by a certified contractor in accordance with IAW OPLAN 19-14, Hazardous Substance Pollution Contingency Plan.

4.1.5 Coastal Zone Management

The Coastal Zone Management Act of 1972 (Pub. L. 92-583) 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 from the 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.

For the new SMAB, the USAF has determined that the project is consistent "to the maximum extent practicable" with the coastal policies and objectives of the state of Florida for those potential impacts from the project that could occur on nonfederal land and within Florida's designated coastal zone.

This EA, which provides the supporting documentation for this consistency determination, will be submitted to the state of Florida for consistency review.

4.1.6 Historic Resources

Consultation with the SHPO regarding a proposed federal action is required under Sect. 106 of the National Historic Preservation Act. In compliance with this requirement, the USAF has consulted the Florida SHPO with regard to the expansion of the Titan IV program at CCAFS. The SHPO has determined that no adverse impacts would result from the proposed action (see App. C).

4.2 VANDENBERG AIR FORCE BASE

4.2.1 Air Quality

The proposed action at VAFB would not require additional air pollution permits. However, the Air Force plans to replace an existing OVSS at SLC-4E with a new, more efficient, higher-capacity system. This action would result in a decrease in NO_2 emissions from oxidizer vapor scrubbing at SLC-4E. A permit application for the new OVSS been submitted to the Santa Barbara County Air Pollution Control District (USAF 1988e).

4.2.2 Water Quality

The wastewater management plan for launches at SLC-4E requires the approval of the California RWQCB, Central Coast Region.

4.2.2.1 Stormwater discharge

Currently, no requirement exists to test or permit stormwater discharge. The California RWQCB has requested information on the quality of stormwater runoff from SLC-4 to determine if it has contaminated water collecting in the EDS and flame bucket to the extent that a permit would be required.

4.2.2.2 Sewage treatment

The RWQCB regulates wastewater treatment facilities discharging their effluents to the surface. Sewage discharge from the outlying areas of VAFB that do not discharge to a sewer are regulated by RWQCB Order 89-98 (personal communication from Bill Meese, RWQCB, Central Coast Region, personal communication to V. R. Tolbert, ORNL, June 7, 1989).

4.2.2.3 Industrial wastewater discharge

Industrial wastewater discharge is regulated by the California RWQCB. Because of the potential for surface water and groundwater contamination, the RWQCB has determined that unmitigated discharge of wastewater from SLC-4 is no longer acceptable. In an Industrial Wastewater Management Plan submitted to RWQCB in June 1989, the USAF proposes to collect wastewater from SLC-4 and transport it to SLC-6 for treatment in an existing plant that was built for the Space Shuttle program. Prior to treatment, the water quality of the wastewater will be analyzed. If hydrazine is present, it will be removed in an ultraviolet/ozone treatment system. The pH will be adjusted, metals will be precipitated, and salts will be removed in a reverse osmosis unit. Treated water will be discharged to lined evaporation ponds and recycled for use during subsequent launches.

4.2.2.4 Floodplains and wetlands

Section 404 of the Clean Water Act (33 U.S.C. 1251 et seq.) authorizes the COE to issue permits for discharge of dredged or fill materials into navigable waters of the United States. Wetlands areas are considered navigable waters under Sect. 404. No dredge or fill activities would be associated with the proposed action at VAFB; therefore, a permit will not be required.

4.2.3 Threatened and Endangered Species

Sect. 4.1.3 describes the consultation required regarding threatened and endangered species. Consultation with the FWS and NMFS with jurisdiction in the VAFB region has been completed. Correspondence is included in App. B and App. C.

4.2.4 Spill Prevention

No discharges of oil/petroleum or fuels are expected from SLC-4. Lubricants and fuels stored on-site would be in bermed areas, containing any spills. Any spill of petroleum products or fuels that may be federally listed hazardous materials would be collected and removed for proper disposal by a certified contractor in accordance with IAW OPLAN 19-14, the Hazardous Substance Pollution Contingency Plan, and VAFB Operations Plan 855505-89, Hazardous Waste Management Plan.

4.2.5 Coastal Zone Management

Launches from the existing SLC-4 site are consistent "to the maximum extent practicable" with the coastal policies and objectives of the Act and will not affect non-federal coastal lands (see Sect. 4.1.5).

4.2.6 Historic Resources

Consultation with the SHPO regarding a proposed federal action is required under Sect. 106 of the National Historic Preservation Act. In compliance with this requirement, the USAF has consulted the California SHPO with regard to the expansion of the Titan IV program at VAFB (see App. C).

5. REFERENCES

Barton, D. F., and R. S. Levy 1984. *An Architectural and Engineering Survey and Evaluation of Facilities at Cape Canaveral Air Force Station, Brevard County, Florida*, Resource Analysts, Inc., Bloomington, Ind.

Banks, R. C., R. W. McDiarmid, and A. L. Gardner 1987. *Checklist of Vertebrates of the United States, the U.S. Territories, and Canada*. U.S. Fish and Wildlife Service Resource Publication 166.

Bionetics, Inc. 1988. *STS-27 Launch Effects Summary Report*, Bionetics Co., John F. Kennedy Space Center, Fla.

Brattstrom, B. H., and M. C. Bondello 1983. "Effects of Off-Road Vehicle Noise on Desert Vertebrates," pp. 167-206 in R. H. Webb and H. G. Wilshire (eds.), *Environmental Effects of Off-road Vehicles: Impacts and Management in Arid Regions*. Springer-Verlag, New York.

Breininger, D. R. 1989. "A new population estimate for the Florida scrub jay on Merritt Island National Wildlife Refuge," *Florida Field Naturalist*, 17:25-31.

Brevard County Job Service 1988. *Brevard Economic Indicator, 4th Quarter 1988*, Geographic Research Division, Merritt Island, Fla.

Brevard County Research and Cartography Division 1988. *1988 Data Abstract*, Merritt Island, Fla.

CARB (California Air Resources Board) 1987. *California Air Quality Data: Summary of 1986 Air Quality Data. Annual Summary*, Vol. XVIII, California Air Resources Board, Sacramento, Calif.

California Department of Education 1987. *California Public School Directory*, Bureau of Publications, Sacramento, Calif.

California Population Research Unit 1986. *Projected Total Population of California Counties, July 1, 1985 to July 1, 2020*, Sacramento, Calif.

Caltrans (California Department of Transportation) 1985. *Traffic Volumes on the California State Highway System*, Sacramento, Calif.

Canter, L. W. 1977. *Environmental Impact Assessment*. Mc-Graw-Hill Book Company, U.S.A.

Cocoa Beach Area Economic Development Council 1988. *Cocoa Beach Area Economic Profile*, Cocoa Beach Area Chamber of Commerce, Merritt Island, Fla.

COE (U.S. Army Corps of Engineers Mobile District) 1989. *Final Geotechnical Report for the Proposed Solid Motor Assembly Building Site*, Jan. 25.

Cofer III, W. R., R. J. Bendura, D. I. Sebacher, G. L. Pellet, G. L. Gregory, and G. L. Maddrea, Jr. 1985. "Airborne measurements of Space Shuttle exhaust constituents," *American Institute of Aeronautics and Astronautics Journal* 23:283-87 (February).

Edward E. Clark Engineers-Scientists, Inc. 1986. *Environmental Resources Document: John F. Kennedy Space Center, NASA*, prepared for Engineering Development Directorate, Kennedy Space Center, Fla., Miami, Fla.

Cox, J. 1984. Distribution, habitat, and social organization of the Florida scrub jay, with a discussion of the evolution of cooperative breeding in New World jays. Gainesville, Florida: Ph.D. dissertation, University of Florida.

Cox, J. 1987. Status and distribution of the Florida scrub jay. Gainesville, Florida: Florida Ornithological Society Special Publ. No. 3.

Darmer, Jr., K. I., E. R. Kinkead, and L. C. DiPasquale 1974. "Acute toxicity in rats and mice exposed to hydrogen chloride gas and aerosols. *American Industrial Hygiene Association Journal*, October.

EG&G, Inc. 1989. Wastestreams from the HSSF, associated with routine use of the SLC-6 Wastewater Treatment Facility (WWTF), letter from Wayne Bithell, Project Manager, EG&G Vandenberg Operations Division, to Lt. Col. David P. Schmarje, Department of the Air Force, Vandenberg Air Force Base, Calif.

Environment Reporter 1988. "Florida Water Quality Standards," pp. 141-48, The Bureau of National Affairs, Inc., Washington, D.C.

EPA (U.S. Environmental Protection Agency) 1985. *Compilation of Air Pollution Emission Factors, Volume I: Stationary, Point, and Area Sources (Fourth Edition)*. USEPA Publication No. AP-42, U.S. Environmental Protection Agency, Research Triangle Park, N.C. September.

EPA (U.S. Environmental Protection Agency) 1987. *Industrial Source Complex (ISC) Dispersion Model User's Guide - Second Edition (Revised), Volume I*, EPA-450/4-88-002a, U.S. Environmental Protection Agency, Research Triangle Park, N.C.

EPA (U.S. Environmental Protection Agency) 1988. *Gap Filling PM-10 Emission Factors for Selected Open Area Dust Sources*, EPA-450/4-88/003, U.S. Environmental Protection Agency, Research Triangle Park, N.C.

Extine, D. D., and I. J. Stout 1987. "Dispersion and habitat occupancy of the beach mouse, (Peromyscus polionotus niveiventris)," *J. Mamm.* 68:297-304.

FDER (Florida Department of Environmental Regulation) 1986. Chap. 17-2, Florida Administrative Code—Air Pollution Sources. Oct. 20.

FDER (Florida Department of Environmental Regulation) 1987. Summaries of ambient air quality data in tabular form. Bureau of Air Quality Management, Tallahassee, Fla., Sept. 16.

FDER (Florida Department of Environmental Regulation) 1989a. Florida Primary Drinking Water Standards, 17-550310.

FDER (Florida Department of Environmental Regulation) 1989b. Florida Secondary Drinking Water Standards, 17-550320.

Gille, J. C. 1982. "Ozone," *Advances in Space Research* 2(3), 67-70.

George, D. H. 1987. *Fish and Wildlife Management Plan for Cape Canaveral Air Force Station, Florida*, Pan Am World Services, Inc., Cape Canaveral Air Force Station, Fla.

Golden, J., R. P. Ovellete, S. Saari and P. N. Cheremisinoff 1979. *Environmental Impact Data Book*, Ann Arbor Science Publishers, Inc., Ann Arbor, Mich.

Greenwood and Associates 1987. *Archaelogical Survey for Construction of Titan IV Space Launch Vehicle Program Facilities at Vandenberg Air Force Base.* Pacific Palisades, California, Dec.

Hawkins, W. E., R. M. Overstreet, and M. J. Provancha 1984. "Effects of Space Shuttle exhaust plumes on gills of some estuarine fishes: a light and electron microscopic study," *Gulf Research Reports* 7(4):297-309.

Jordan, Tom 1989. *Student Projections and Classroom Needs Through 1993-94 School Year*, Brevard County School District, Rockledge, Fla.

Levy, R. S., D. F. Barton, and T. B. Riordan 1984. *An Archaeological Survey of Cape Canaveral Air Force Station, Brevard County, Florida*, Resource Analysts, Inc., Bloomington, Ind.

Malhotra, S., and D. Manninen 1981. *Migration and Residential Location of Workers at Nuclear Power Plant Construction Sites*, prepared for U.S. Nuclear Regulatory Commission. Pacific Northwest Laboratory, Richland, Wash., Patrick AFB 1988. Economic Resource Impact Statement. Cost Analysis Division, Comptroller, Patrick Air Force Base, Fla.

Manci, K. M., D. N. Gladwin, R. Villella, and M. G. Cavendish 1988. *Effects of Aircraft Noise and Sonic Booms on Domestic Animals and Wildlife: a Literature Synthesis*, NERC-88/29, U.S. Fish and Wildlife Service., National Ecology Research Center, Ft. Collins, Colo.

MMC (Martin Marietta Corporation) 1988. *Accident Risk Assessment Report, Titan IV NUS 404, Phase II, Western Test Range*, MCR-87-2518, Martin Marietta Aerospace, Denver, Colo.

MMSLS (Martin Marietta Space Launch Systems) 1988. Letter from H. G. Senter, Martin Marietta Space Launch Systems, to Lt. G. L. Ellison, 6555th Aerospace Test Group, Cape Canaveral Air Force Station, Fla., pertaining to Industrial Wastewater Permit Application, May 12, 1988.

Morton, H. J. 1989. Letter (#523-369), from H. J. Morton, EG&G, Inc. to Major Lance Bradley, 6555 ASTG/LVF, Cape Canaveral AFS, Florida, April 5.

NASA (National Aeronautics and Space Administration) 1978. *Final Environmental Impact Statement*, Space Shuttle Program, Washington, D.C. April.

NASA (National Aeronautics and Space Administration) 1984. *1983 Sea Turtle Nesting Survey at Merritt Island and Cape Canaveral, Florida*, NASA Tech., Mem. 83095.

NOAA (National Oceanic and Atmospheric Administration) 1987. "Ecology of east Florida sea turtles," *Proceedings of the Cape Canaveral, Florida Sea Turtle Workshop*, Miami, Feb. 26-27, 1985. NOAA Rep. NMFS 53.

NRC (National Research Council, Committee on Toxicology) 1985a. *Emergency and Continuous Exposure Guidance Levels for Selected Airborne Contaminants, Vol. 4*, National Academy Press, Washington, D.C.

NRC (National Research Council, Committee on Toxicology) 1985b. *Emergency and Continuous Exposure Guidance Levels for Selected Airborne Contaminants, Vol. 5*, National Academy Press, Washington, D.C.

NRC (National Research Council, Committee on Toxicology) 1987. *Emergency and Continuous Exposure Guidance Levels for Selected Airborne Contaminants, Vol. 7*, National Academy Press, Washington, D.C.

Pan Am World Services, Inc. 1987. *Eastern Test Range, Base information guide: Cape Canaveral. Facilities, Utilities, Instrumentation, Communications*. Patrick Air Force Base, Fla.

Patrick Air Force Base (Patrick AFB) 1988. *Economic Resources Impact Statement*, prepared by Cost Analysis Division, Comptroller. September 30.

Patrick Air Force Base (Patrick AFB) 1989. *Application for Industrial Wastewater Discharge Permit for Titan IV Launch Facilities*, submitted to Fla. Dept. of Environmental Regulation.

Pellett, G. L., D. I. Sebacher, R. J. Bendura, and D. E. Wornom 1983. "HCl in Rocket Exhaust Clouds: Atmospheric dispersion, acid aerosol characteristics, and acid rain deposition," *Journal of the Air Pollution Control Association*, 33:304-11.

Potter, A. E., 1978. *Revised Estimates for Ozone Reduction by Shuttle Operation*, NASA Technical Memorandum 58209, NASA Lyndon B. Johnson Space Center, Houston, Tex. May.

Provancha, J. A., and M. J. Provancha 1989. "Long-term trends in abundance and distribution of manatees *(Trichechus manatus)* in the northern Banana River, Brevard County, Florida," *Marine Mammal Science* 4:323-338.

Provancha, M. J., P. A. Schmalzer, and C. R. Hinkle 1986. *Vegetation Types John F. Kennedy Space Center*, Bionetics Co., Kennedy Space Center, Fla.

Reish, D. J. and M. L. Hallisey 1983. *A Checklist of the Benthic Macroinvertebrates of Kennedy Space Center, Florida*. *Florida Scientist* 46:303-13.

Rosenberg, S. D., and R. A. Newton 1983. STS SRB Atmospheric Contamination - An Area of Future Concern. Paper presented at *American Institute of Aeronautics and Astronautics, Shuttle Environment and Operations Meeting*, Oct. 31, 1983, Washington, D.C., pp. 234-240.

Schmalzer, P. A., D. E. Hickson, and C. R. Hinkle 1988. *Vegetation Studies on Vandenberg Air Force Base, California*, NASA Tech. Mem. 100985.

Schmalzer, P. A., C. R. Hinkle, and D. Breininger 1985. *Effects of Space Shuttle Launches STS-1 through STS-9 on terrestrial vegetation of John F. Kennedy Space Center, Florida*, NASA Tech. Mem. 83103.

Shane, S. H. 1983. "Abundance, distribution, and movements of manatees (*Trichechus manatus*) in Brevard County, Florida," *Bulletin of Marine Science* 33(1):1-9.

Stearns Catalytic 1987. *Hydrogeology Study of Space Launch Complexes 3 and 4, Vandenberg Air Force Base, California*.

SJRWMD (St. Johns River Water Management District) 1989. Permit # 42-009-0836NG. Stormwater permit for new Solid Motor Assembly Building at CCAFS, May 23, Palatka, Fla.

University of Florida, Bureau of Economic and Business Research 1987. *Florida County Populations by Age and Sex*. Gainesville, Fla.

University of Florida 1988. *Florida Statistical Abstract, 22nd Ed.*, Bureau of Economic and Business Research, College of Business Administration, The University Presses of Florida, Gainesville, Fla.

USAF 1978. *Space Shuttle Program Vandenberg AFB, California. Final Environmental Impact Statement*, Headquarters Space Division, Los Angeles Air Force Base, Calif., January 1978.

USAF 1983. *Supplement to the Final Environmental Impact Statement, Space Shuttle Program, Vandenberg AFB, California*, Headquarters Space Division, Los Angeles Air Force Base, Calif.

USAF 1986. *Environmental Assessment, Complementary Expendable Launch Vehicle, Cape Canaveral Air Force Station, Florida*, Headquarters, Space Division, Los Angeles Air Force Station, Calif.

USAF 1987. *A Biological Assessment of Impacts to the Threatened Florida Scrub Jay (Aphelocoma coerulesens coerulesens) Resulting from the Proposed Construction of a Test Operations Control Center on Cape Canaveral Air Force Station, Florida.*

USAF 1988a. *Supplement to the Environmental Assessment, U.S. Air Force Space Division, Titan IV Program, Cape Canaveral Air Force Station, Fla.*, Headquarters Space Division, Los Angeles Air Force Station, Calif.

USAF 1988b. *Environmental Assessment, Titan IV Space Launch Vehicle Modification and Operation, Vandenberg Air Force Base, California*, Department of the Air Force, Headquarters, Space Division, Los Angeles Air Force Station, Calif.

USAF 1988c. *Environmental Assessment, Titan IV Solid Rocket Motor Upgrade Testing at Edwards Air Force Base, California*, Headquarters Space Division, Los Angeles Air Force Station, Calif.

USAF 1988d. *Biological Assessment of Impacts to Threatened and Endangered Marine Turtles (Caretta caretta and Chelonia mydas) Resulting from Operations at Launch Complexes 40 and 41 on Cape Canaveral Air Force Station (CCFAS), Florida.*

USAF 1988e. *Vandenberg Air Force Base, Titan Program Air Permit Application, Space Launch Complex Four East, Oxidizer Vapor Scrubber System*, submitted to the Santa Barbara County Air Pollution Control District, Santa Barbara, Calif., November 1988.

USAF 1988f. *Programmatic Environmental Assessment for the Commercial Expendable Launch Programs, Vandenberg Air Force Base, California*, Headquarters Space Division, Los Angeles Air Force Station, Calif., January 1988.

USAF 1988g. *Environmental Assessment: U.S. Air Force, Space Division, Medium Launch Vehicle (MLV) Program, Cape Canaveral, Florida*, May.

USAF 1989a. *Medium Launch Vehicle II (MLV II) Program, Cape Canaveral Air Force Station, Florida, Environmental Assessment*, Department of Air Force, Headquarters Space Division, Los Angeles Air Force Station, Calif., February 1989.

USAF 1989b. *Requirement for Light Management Plans—Cape Canaveral AFS (CCAFS), Fla.*

USAF 1989c. *Final Environmental Assessment, Modifications to and Operations at the Hypergolic Maintenance and Checkout Facility, Vandenberg Air Force Base, California*, Department of the Air Force, Headquarters Space Division, Los Angeles Air Force Base, California. January 1989.

USAF 1989d. *Construction and Operations of Space Launch Complex 7, Vandenberg Air Force Base, Calif., Draft Environmental Impact Statement*, Department of the Air Force, Headquarters, Space Division, Los Angeles Air Force Station, Calif.

USAF 1989e. *Biological Assessment of Potential Impacts to Federally Listed Threatened Species: Florida Scrub Jay and Southeastern Beach Mouse* (**Aphelocoma coerulescens coerulescens** and **Peromyscus polionotus niveiventris**). *Titan IV Launch Program, Launch Complexes 40 and 41, Cape Canaveral Air Force Station, Brevard County, Florida*. Department of the Air Force, Headquarters, Space Systems Division, Los Angeles Air Force Base California. December.

U.S. Bureau of the Census 1983. *County and City Data Book, 1983*. U.S. Government Printing Office, Washington, D.C.

USFWS (U.S. Fish and Wildlife Service) 1988. *Endangered and Threatened Species of the Southeastern United States*, Region IV Office, Atlanta, Ga.

USFWS (U.S. Fish and Wildlife Service) 1989. *Endangered and Threatened Wildlife and Plants*, 50 CFR Pts. 17.11 and 17.12, January 1, 1989.

Versar 1987. *Environmental Assessment for the Repair and Restoration of Space Launch Complex 4 at Vandenberg Air Force Base, California*, Department of the Air Force, Headquarters Space Division/DEV, Los Angeles, Calif.

Webb, W. L. 1966. *Structure of the Stratosphere and Mesosphere*, Academic Press, New York, pp. 109-17, 258-59.

6. LIST OF AGENCIES AND INDIVIDUALS CONTACTED

6.1 U.S. AIR FORCE

6.1.1 Headquarters, Space Systems Division

DEV

Dan Pilson, Robert Mason

DEE

Sam Sampres

DEG

Lt. Col. R. M. Riccardi, Maj. Dan Berlinrut

PAM

Rick Huling

WE

Lt. Dawn Stewart

6.1.2 Patrick Air Force Base/Cape Canaveral Air Force Station

Public Affairs Office

6550 ABG/DEEV

Olin Miller, Mr. Smith, Chuck Foster

6555 ASTG/LVF

Maj. Lance Bradley

WE

Bill Boyd

ESMC/JAN

Capt. Thomas Epting

6.1.3 Vandenberg Air Force Base

WSMC/WE

Capt. Ken Carey

WSMC/SEY

Daryl Dargitz

SSD/DEC

Paul Toft

6595 ATG/TSLB

Capt. Ed Greer

1 STRAD/ET

Kathy Lindholm

Sarah Berry

Larry Gordon

6.2 FEDERAL AGENCIES

U.S. Department of Interior, Fish and Wildlife Service, Laguna Niguel Field Office

U.S. Department of Interior, Fish and Wildlife Service, Jacksonville Office

U.S. Department of Commerce, National Marine Fisheries Service

U. S. Army Corps of Engineers, Mobile (Ralph Etheridge, Michael Thompson)

6.3 STATE AGENCIES

Florida Department of Environmental Regulation (Perry Jennings, Lee Miller, Ralph Maloy)

Florida State Historic Preservation Officer

California State Historic Preservation Officer

California Regional Water Quality Control Board (Bill Meese)

6.4 LOCAL AGENCIES

Susan Cossey, Chamber of Commerce, Merritt Island, Fla.

Don George, Pan Am World Services, Inc., Cocoa Beach, Fla.

Charles Johnson, Brevard County Job Service, Merritt Island, Fla.

Robert S. Kamm, Brevard County Division of Traffic Management, Merritt Island, Fla.

Dick Martens, Water/Wastewater Division, Brevard County Utility Services, Merritt Island, Fla.

Tom Martin, Principal Planner, City of Lompoc, Lompoc, Calif.

6.5 OTHERS

Eldon Milner, Martin Marietta Corporation, Littleton, Colo.

Fred Meyer, Rod Cummins, Bechtel National, Inc., San Francisco, Calif.

Michael C. Philo, Florida Power and Light, Cocoa, Fla.

Carlton Hall, Paul Schmalzer, D. Bruninger, Bionetics, Inc.

7. LIST OF PREPARERS

Oak Ridge National Laboratory (Oak Ridge, Tenn.)

Andrea W. Campbell	M.S., Biology	Co-project leader, noise
Robin L. Graham	Ph.D., Ecology	Terrestrial ecology
Edward J. Liebsch	M.S., Meteorology	Air quality
R. Dickinson Roop	M.A., Ecology	Co-project leader, noise
William P. Staub	Ph.D., Geology	Groundwater
Virginia R. Tolbert	Ph.D., Ecology	Surface water, aquatic ecology

Science Applications International Corporation (Oak Ridge, Tenn.)

Janice C. Morrissey	M.A., Sociology	Man-made environment

APPENDIX A

FINDINGS OF NO SIGNIFICANT IMPACT (FONSIs) FOR PREVIOUS ENVIRONMENTAL ASSESSMENTS ON THE TITAN IV PROGRAM

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

FINDING OF NO SIGNIFICANT IMPACT (FONSI)
TITAN IV SPACE LAUNCH VEHICLE MODIFICATIONS AND LAUNCH OPERATIONS PROGRAM
VANDENBERG AIR FORCE BASE, CALIFORNIA

1. PROPOSED ACTION

In support of the Department of Defense (DOD) space program and to provide assured access to space using expendable space launch vehicles, the United States Air Force (USAF), Headquarters Space Division proposes construction and modifications at Space Launch Complex 4 - East (SLC-4E) and associated facilities at Vandenberg Air Force Base (VAFB), California for processing and launching of the Titan IV space booster. This action represents a continuation of the Titan launch program that began in the mid 1960s.

SLC-4 is composed of two separate launch facilities: SLC-4W, which was used until February 1987 for Titan IIIB launches and is being modified for Titan II launches, and SLC-4E, which currently launches Titan 34D vehicles. The Titan 34D vehicle is being phased out and will be replaced by the Titan IV vehicle. A maximum of four Titan IV launches per year is possible. Initial launch capability (ILC) is scheduled for October 1989.

The proposed action consists of vehicle design modifications to accommodate larger payloads, construction of facilities on North and Sout h VAFB, and modifications to processing and support facilities on North and South VAFB. Titan IV components will be manufactured in various parts of the country and transported by plane or rail to VAFB where systems installation, testing, and payload processing will be conducted in preparation for launch.

On North VAFB, a Materials Receipt and Inspection Facility will be constructed to provide component handling and distribution for the Titan IV program. Facility modifications on North VAFB will occur at the Payload Fairing and Processing Facility (Bldg 8337), Vehicle Assembly Building (Bldg 8401), and the Material Support Facility (Bldg 5500). Bldgs 8337 and 8401 are currently used for similar launch processing and will be modified to include new equipment, work areas, and new security fencing. Warehouse space at Bldg 5500 will be used and five modular trailers will be installed at this location to provide office space.

At SLC-4E, a new Mobile Service Tower (MST) Air Conditioning Building will be constructed at SLC-4E in place of the existing building. Modifications to SLC-4E will include: replacement of the MST; modifications to the Umbilical Tower; addition of a stairway from the fuel trailer pad area to the fuel incinerator pad; improvement of an intersection and repair of shoulders along two roads; and addition of a fuel vapor incinerator and concrete tailer pad, propane trailer pads, payload fuel trailer pad, and payload oxidizer trailer pad.

In the SLC-4 area, modifications will include: enlargement of an existing fallback area for use as a temporary construction prefabrication area, improvement of an existing road for use as a temporary construction haul road, reworking of existing road shoulders and burial of overhead utility lines to accommodate transport of prefabricated components, and addition of temporary contractor parking areas. Construction and modification activities in the SLC-4 area will require approximately 30,000 cubic yards of fill material which will be available from a new borrow site at SLC-4E and from the excavation of material for construction of the new MST Air Conditioning Building.

The Titan IV program will also require the modification of the existing Receipt, Inspection and Storage (RIS) Facility (Bldg 945) which is located on South VAFB. Modifications include: increasing its size; extension of paved areas; and addition of a modular office building, parking area, and a gaseous nitrogen trailer pad.

2. SUMMARY OF ENVIRONMENTAL IMPACTS

2.1 Meteorology and Air Quality

Titan IV program will result in a temporary increase in air emissions during construction and a continuation of existing emissions from processing and launch operations. No significant increase in operational emissions over the amount previously generated for Titan 34D operations is expected. Air emissions from process operations will be mitigated by the use of control equipment and by compliance with stipulations in air quality permits submitted by the USAF to the Santa Barbara Air Pollution Control District.

2.2 Geology and Soils

Because the amount of new construction in undisturbed areas is small, no significant impact to geologic resources will occur as a result of the Titan IV program. Potential impacts to geologic resources from erosion will be prevented or mitigated by measures such as revegetation and erosion control treatment.

2.3 Hydrology and Water Quality

Although the Titan IV program will obtain its water supply from an aquifer that is currently experiencing an overdraft, the proportion of water that will be extracted for the program is relatively insignificant in comparison to the amount currently consumed by ongoing programs at VAFB. There will be no impact to groundwater hydrology as a result of the Titan IV program. Impacts to surface water hydrology will be limited to the discharge of 50,000 gallons per launch and are considered insignificant. Potential impacts to groundwater and surface water quality will be mitigated by the adherence to waste discharge requirements specified by the Regional Water Quality Control Board. Such requirements may include testing of deluge water prior to discharge. Therefore, no significant impact to hydrology and water quality will occur.

2.4 Biota

The expansion of construction laydown areas for the Titan IV program will result in the loss of approximately one acre of dune scrub habitat. Although dune scrub is considered a sensitive habitat and this particular location has not previously been disturbed, this loss is relatively small when compared to the size of this habitat within the project area. This area will be restored after use as a construction laydown area. Other construction or use of areas for the Titan IV program will be limited to areas of previous disturbance. Therefore, no significant impact to local or regional biota will occur from construction or modification activities.

Certain launch trajectories from Titan IV space vehicles will produce sonic booms that may intersect the surface on or near the Channel Islands, which are important breeding grounds for a number of protected species of marine mammals and sea birds. Based on previous studies of the potential sonic boom effects associated with the Space Shuttle launch from VAFB, it is expected that the Titan IV space vehicle will result in a sonic boom of a substantially lower magnitude. This determination is based on the size and shape of the vehicle and the size of its exhaust plume relative to the Shuttle. The lack of documented impacts to marine species during previous launches from VAFB over the past 25 years and the existing noise environment of the Channel Islands contributes to the determination that Titan IV space vehicle launches will not result in any significant impact to any threatened or endangered species of the Channel Islands. To comply with Section 7(c) of the Endangered Species Act, the USAF is preparing a Biological Assessment to detail the lack of impacts to endangered or threatened plant and animal species from the proposed program. Because the Titan IV program is a continuation of existing launch activities and because a maximum of only four launches per year is planned, no significant impacts to biological resources will occur.

2.5 <u>Population</u>

The Titan IV program will not result in any increase in population on VAFB or in the surrounding area and, therefore, will not have a significant impact on the population of the VAFB region.

2.6 Socioeconomics

The Titan IV program will not result in a change to any land use designation or an increase in the need for additional community services and facilities. A temporary increase in traffic may occur during construction, but will have no significant impact. No long-term increase in traffic will occur. No change in the economy is expected. Therefore, the Titan IV program will not have a significant impact on socioeconomics.

2.7 Hazardous Waste

The increase in the amount of hazardous waste generated at VAFB as a result of the Titan IV program will be mitigated by management practices, as stipulated by applicable federal and state regulations. The Titan IV program is being evaluated under the USAF hazardous waste minimization program and measures will be implemented to reduce the production of hazardous wastes where feasible. Therefore, hazardous waste from the Titan IV program will not have a significant impact on the environment.

2.8 Safety

The Titan IV program will not result in an unreasonable or increased risk to the public. Potential impacts to public safety will be prevented by the safety and disaster preparedness plans for the program. Therefore, the Titan IV program will not have a significant impact on public safety.

2.9 Noise

The launch of a Titan IV vehicle will result in temporary and infrequent high noise levels. The magnitude of this effect will be slightly greater than for the previous Titan 34D program, but does not represent a significant impact to the noise environment of VAFB and the surrounding community. Therefore, the Titan IV program will not result in a significant noise impact on the environment.

2.10 Cultural Resources

The Titan IV program will involve some new construction in undisturbed areas. These areas have been evaluated by a qualified archaeologist and have been found not to impact any known archaeological resources. One area of construction is in close proximity to a known site, therefore archaeological monitoring during earthwork activities will be accomplished. In the unlikely event that any unknown archaeological resources are discovered during construction, activities in the area will cease or be redirected and the USAF will consult with the State Historic Preservation Officer and the National Park Service as required by the National Historic Preservation Act.

2.11 Cumulative Impacts

The Titan IV Space Launch Vehicle program is one of many programs being considered for development in the Santa Barbara County region. Other programs include military-related projects, oil and gas development projects, and urban/industrial development.

The proposed Titan IV program is a replacement of the Titan 34D program which is being phased out. The natural environment is not expected to experience any impact of greater intensity than that of the previous Titan programs. Temporary increases in emissions would occur during the construction phase and a temporary increase in the noise level would occur during launch for a maximum of four times per year. Therefore, the net increase in impacts to the environment is not significant and will not result in any cumulative impact to the environment.

3. FINDINGS

Based upon the above summary, a finding of no significant impact is made. An Environmental Assessment of the proposed action, dated February 1988, is on file at:

U.S. Air Force Headquarters Space Division/DEV
P. O. Box 92960
Los Angeles, California 90009-2960

ATTN: Mr. Robert C. Mason, SD/DEV

FINDING OF NO SIGNIFICANT IMPACT (FONSI)
INCREASE IN LAUNCH RATE OF THE TITAN IV SPACE VEHICLE
CAPE CANAVERAL AIR FORCE BASE, FLORIDA

DESCRIPTION OF THE PROPOSED ACTION

INTRODUCTION

To support the Department of Defense (DOD) space program and to ensure access to space through the use of expendable launch vehicles, the U.S. Air Force (USAF) has proposed the renovation of Launch Complex 41 on Cape Canaveral Air Force Base (CCAFB) to support the Titan IV program. An Environmental Assessment (EA) was prepared for this program in July 1986 and resulted in a FONSI. Subsequent to the submittal of this EA, the USAF proposed to increase the Titan IV launch rate from two to six launches per year. In compliance with National Environmental Policy Act (NEPA) guidelines, a supplement to the EA for the Titan IV program has been prepared covering those actions associated with the proposed increase in launch rate.

PROPOSED ACTION

The USAF proposes to modify the Titan IV program and program support facilities. Specific actions addressed in this supplemental EA are as follows:

1. An increase in the projected number of launches from two per year to six per year,
2. Expansion of the Titan Vertical Integration Building (VIB) and associated infrastructure to provide for the processing of an increased number of payload fairings,
3. The addition of industrial processing facilities and the use of additional chemicals within the VIB expansion, and
4. The use of backup mobile electrical generation units at Launch Complex 41.

The Titan IV program is scheduled to achieve an initial launch capability of 1 October 1988.

SUMMARY OF ENVIRONMENTAL IMPACTS

NATURAL ENVIRONMENT

Air Quality

The proposed Titan IV program modifications will not significantly impact the air quality of CCAFB or surrounding areas. Primary constituents of the ground-level exhaust cloud produced by the solid rocket motors (SRMs) of the Titan IV will be carbon monoxide (CO), hydrogen chloride (HCl), and aluminum oxide (Al_2O_3). Because the nearest uncontrolled area is approximately 16 kilometers (10 miles) 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. Because of the short, infrequent nature of Titan IV launches and the limited impacts associated with individual launches, no significant reduction in air quality will result from increasing the frequency of launches from two to six per year.

Air pollution control devices at Launch Complex 41 will 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 of propellants and prevent release of hazardous vapors to the atmosphere.

Significant air quality impacts will not result from industrial operations in the VIB. Based on six launches per year, estimated particulate emissions will not exceed NAAQS. The types of volatile organic compounds (VOCs) to be used in the VIB all have threshold limit values (TLVs), as established by the American Conference of Governmental Industrial Hygienists (ACGIH), well in excess of the concentrations that will result from the proposed operations.

Emissions associated with the operation of the backup mobile generators at Launch Complex 41 will not exceed any annual or short-term NAAQS.

Soils

The proposed expansion of the VIB facility and associated infrastructure will require about 7,650 cubic yards (yd^3) of fill material. Fill material will be clean sand obtained from a CCAFB upland borrow area. The total area to be filled will be approximately 2.36 acres. No other alteration to soil characteristics of CCAFB will result from the proposed modifications to the Titan IV program.

Hydrology

All water used to support the Titan IV program will be obtained from municipal water supplies. The annual volume of water used as deluge, fire suppressant, and washdown water will increase from 800,000 gallons (gal) for two launches to 2.4 million gallons (MG) for six launches. Some ground water recharge will occur as the result of this water flowing off the launch pad or being discharged to grade.

Titan IV program modifications will result in minor staffing increases at Launch Complex 41 and the VIB and associated increases in wastewater loads. Domestic wastewaters at Launch Complex 41 and the VIB are treated at onsite extended aeration sewage treatment plants (STPs). These STPs are permitted by the Florida Department of Environmental Regulation (FDER) and discharge to infiltration systems that allow the treated wastewaters to percolate to ground waters. Wastewater loads at both Launch Complex 41 and the VIB will be well within STP design capacities.

Following discharge to grade, launch water and wastewater at Launch Complex 41 will percolate into the ground water table and flow west toward the Banana River. Water discharged from the VIB wastewater facility will percolate to the ground water table and flow toward a tidal lagoon, which is connected via culvert to the Banana River.

No significant impacts to ground water or surface water hydrology will result from the Titan IV program.

Water Quality

No significant long-term adverse impacts to ground water or surface water quality will occur as a result of the Titan IV 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 in accordance with the CCAFB Hazardous Waste Management Plan. 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 IV 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 IV vehicle. Any HCl deposited in surrounding marine and estuarine surface waters will be rapidly neutralized by the extensive buffering capacity of these waters. In addition, any Al_2O_3 deposited in surface waters will remain insoluble and will not be toxic to aquatic life.

Impervious areas at the VIB facility will increase by approximately 1.58 acres as a result of VIB expansion and the paving of additional areas for roads and parking. Stormwater runoff will be collected in a swale system and retained in a basin located adjacent to the VIB. Most of the water collected in this system will infiltrate into the ground water table. This stormwater system has been approved by the State of Florida and will not result in the significant degradation of ground water or surface water quality.

The STPs at Launch Complex 41 and the VIB facility have design capacities well in excess of anticipated loads. These STPs will provide for adequate waste treatment and will not cause significant ground water quality degradation.

Biota

The proposed Titan IV program modifications are not expected to significantly impact terrestrial, wetland, or aquatic biota in the CCAFB vicinity. All proposed activities at Launch Complex 41 will be conducted within the existing launch complex boundary and will not result in the loss of any additional habitat. Wildlife in the vicinity of Launch Complex 41 have adapted to disturbances associated within normal operations and launch events. Terrestrial and aquatic biota will not be significantly impacted by ground-level exhaust clouds.

The expansion of the VIB and associated infrastructure will not result in the significant loss of wetlands or other areas critical to the support of wildlife resources. Permit approvals for this action have been obtained from FDER and the U.S. Army Corps of Engineers. Operations conducted at the VIB will not adversely affect local biota.

MANMADE ENVIRONMENT

Population

Titan IV program modifications will have no significant impacts on population and housing on CCAFB or surrounding communities. The Titan IV program will utilize existing personnel available at CCAFB, Patrick Air Force Base (PAFB), or surrounding communities.

Socioeconomics

The Titan IV program is compatible with current and projected future land uses on CCAFB. The proposed program modifications will not require new utility services, social services, or additional transportation access. No significant impacts to the socioeconomics of CCAFB or Brevard County, Florida, are anticipated.

Noise

Noise associated with the Titan IV program will not significantly affect the general public. Noise associated with launches is infrequent and of short duration.

Archaeology and Cultural Resources

Facility expansions required for the proposed Titan IV program modifications are minor and will occur on previously disturbed lands. Because no undisturbed lands will be affected by the proposed actions, no impacts to archaeological or cultural resources will occur.

FINDINGS

Based on the preceding discussion, a finding of no significant impact is made. An EA for the Titan IV program and a supplement to the EA, which addresses proposed program modifications, are on file at:

Headquarters Space Division
P.O. Box 92960
Worldway Postal Center
Los Angeles, California 90009
Attention: Mr. Robert C. Mason SD/DEV

FINDING OF NO SIGNIFICANT IMPACT (FONSI) ENVIRONMENTAL ASSESSMENT FOR TITAN IV SOLID ROCKET MOTOR UPGRADE TESTING AT EDWARDS AIR FORCE BASE, CALIFORNIA

DESCRIPTION OF THE PROPOSED ACTION

INTRODUCTION

To support the U.S. Department of Defense Space Program and to ensure access to space through the continued use of Titan solid propellant rocket motors, the U.S. Air Force (USAF) proposes to test-fire five Titan IV solid rocket motors at Test Stand 1-C, located at the Air Force Astronautics Laboratory (AFAL), Edwards Air Force Base (AFB), California, during the period from July 1989 to August 1990.

PROPOSED ACTION

The proposed action calls for the modification of an existing rocket motor test stand (Test Stand 1-C) and an associated receiving and inspection building located on Leuhman Ridge at AFAL to conduct the static test firings. Test Stand 1-C was used to test liquid rocket engines from 1965 until the early 1970s and was renovated in 1986 to test Titan solid propellant rocket engines (the 34D static rocket tests). Proposed test stand and receiving and inspection building modifications include refurbishment of and changes in structural, mechanical, and electrical systems; addition of a heat shield to protect the steel deflector plate; water collection basin improvements; and addition of instrumentation, control, and monitoring equipment. In addition to modifications to the test stand and associated buildings, an existing railroad spur will be upgraded to facilitate rocket motor transport. This upgrade will include improving roads, building a concrete-pad working area and asphalt parking areas, and modifying overhead high-voltage power lines.

Following renovation of the test stand and associated facilities, five three-segment Titan IV solid propellant rocket motors will be test-fired over a period of approximately 14 months. The tests will be conducted to

1. evaluate motor performance by measuring the thrust, motor case deflection, effects on fired cases and pressure of motors during firing;
2. measure insulator erosion;
3. evaluate nozzle performance by measuring force vectors, nozzle movement, and response time;
4. monitor ignitor performance through pressure monitoring; and
5. evaluate propellant performance by measuring burn time and rate.

SUMMARY OF ENVIRONMENTAL IMPACTS

NATURAL ENVIRONMENT

Air Quality

The proposed Titan IV rocket motor test firings will not significantly impact air quality at areas surrounding Edwards AFB. Primary constituents of the rocket exhaust will be aluminum oxide (Al_2O_3), hydrogen chloride (HCl), carbon monoxide (CO), and nitrogen (N_2). Afterburning in the atmosphere oxidizes some of the constituents, particularly CO to CO_2 and a small amount of N_2 to NO_x. A reasonable and conservative worst-case modeling analysis of the Titan IV motor exhaust indicates that the general population will not be exposed to HCl concentrations greater than the National Academy of Sciences (NAS) recommended limit for short-term public exposure (limit of 3 parts per million HCl, 10-minute average). Maximum downwind concentrations of CO and NO_2 are expected to be well below applicable federal and state standards.

The maximum downwind concentration of particulate matter less than 10 microns in diameter (PM_{10}) from the test firings will exacerbate existing exceedances of the state 24-hour standard of 50 micrograms per cubic meter. However, the worst-case predicted PM_{10} impact from a rocket test is only approximately 20% of the existing maximum 24-hr PM_{10} concentrations in the region. Given the relatively small number of tests (5) in a 14 month period. This is not considered a significant impact.

Soils

Implementation of the Titan IV testing program involves refurbishing the water containment berm at Test Stand 1-C because of its deterioration from earlier tests. Refurbishing the berm will not significantly affect the soils at Edwards AFB or the surrounding area. The deposition of HCl from the tests is expected to be heavy in the immediate area of the test stand based on the results of the 34D test firing. The impacts of this deposition to soils are expected to be small due to the use of the carbonate buffer system, the previously disturbed nature of the area, and the generally alkaline makeup of the soil.

In addition, soil erosion will occur in the immediate vicinity of the test stand, since approximately 344,000 gal of deluge water will not be trapped in the water collection system. The erosion will be limited in area, but perhaps extensive near the test stand. Pre- and post-test mitigation measures are proposed to minimize impacts to soils.

Hydrology

No significant impacts to groundwater or surface water hydrology will result from the Titan IV motor tests. All water used for the tests will come from a water storage tank fed from wells on Edwards AFB. Most of the deluge (cooling) water used in the tests will be conditioned with a carbonate buffer to mitigate potential effects of HCl absorption into the soil and low pH. Most deluge water will be deposited as acid mist (pH of 3 or lower) from the exhaust plume onto the ground surface near the test stand. The remainder of the deluge water not entrained into the exhaust gas stream will be collected and evaporated in concrete-lined channels and a basin located near Test Stand 1-C.

Water Quality

No significant impacts on water quality will result from the Titan IV tests. All deluge water contained in the channels and basin will be evaporated. The amount of deluge water that will be deposited from the exhaust onto the rocks and soil nearby will be large but will evaporate leaving a residue of HCl and inert nonhazardous compounds (mostly aluminum oxide and sodium chloride) on the ground surface. The amount of HCl deposition will have no significant impact on ground or surface waters.

Ecological Resources

No significant impacts to the ecological resources of Edwards AFB or surrounding areas are expected as a result of the Titan IV motor tests. Impacts to vegetation and habitat from acidic mist will be minor because much of the impact area has been previously disturbed. No critical habitat for threatened or endangered species will be lost as a result of the Titan IV test program. Adverse impacts to the desert cymopterus present in the area are unlikely because known populations occur outside the near-field deposition zone. Impacts to desert tortoises are presently uncertain because this species has only recently been observed in the area. Impacts to Mojave ground squirrels are presently uncertain because the presence of this species in the railroad spur construction area has not been determined. Planned additional surveys and monitoring of these species by the USAF, in consultation with DFG and USFWS, will provide additional information to avoid or minimize any impacts from future use of the test facility.

MANMADE ENVIRONMENT

Population

The renovation of Test Stand 1-C and the subsequent test program of the Titan IV rocket motors will have no significant impacts on population and housing at Edwards AFB or within surrounding communities. The Titan IV test program will utilize existing personnel at AFAL and Edwards AFB. Temporary staff from the USAF Space Division, Hercules, and their contractors will be on-site during renovation work and motor testing periods.

Socioeconomics

The proposed Titan IV test program is compatible with the surrounding land use, will require no land purchase and no construction work beyond the boundaries of the air base, and will not require additional permanent employment. No significant impacts on the socioeconomics of Edwards AFB, Los Angeles County, or Kern County, California, are anticipated.

Safety

All regulatory agency safety procedures and guidelines for rocket motor transportation and testing will be followed. Safety monitoring will be conducted during the tests. A protective clear zone of about 1 mile will be established around the test stand, and no one will be allowed into the immediate downwind area within the base boundaries. In addition, testing will only occur if the wind direction is such that the exhaust cloud will not proceed over housing areas. Thorough realtime dispersion monitoring, data analysis, and refinement of the rocket exhaust dispersion model will be conducted to determine if conditions would allow an easing of the wind restrictions for test firings. This process will ensure that if firings are conducted under alternate parameters, such testing would not in any way expose the general public to HCl concentrations above the recommended standards or reduce the level of protection provided by the current parameters. Essential test personnel will be located in a protected concrete bunker near the test stand. Realtime monitoring of bunker air supply, test area exhaust cloud and deposition will be performed in conjunction with downwind cloud monitoring. Tests will not proceed until appropriate meteorological conditions are verified.

Noise

Noise levels associated with the Titan test program will not significantly affect the general public due to the distance between the test site and the nearest unregulated area (3 miles). Noise produced during the test firings will be of short duration (approximately 2 minutes and 13 seconds for each event) and, at worst, will be a minor nuisance. Portions of the AFAL will be evacuated to minimize noise impacts to personnel on-site.

Archaeological and Cultural Resources

The areas surrounding Test Stand 1-C and the railroad spur do not contain unique archaeological or historic resources. As a result, the Titan IV test program will have no effect on archaeological or cultural resources.

FINDINGS

Based on the above, a finding of no significant impact is made. Copies of an Environmental Assessment of the proposed action, dated April 1988, can be obtained from

HQ Space Division
Post Office Box 92960
Worldway Postal Center
Los Angeles, California 90009-2960
ATTENTION: Mr. John R. Edwards, SD/DEV

John M. Hoffman, Col USAF
Chairman, Edwards AFB
Environmental Protection Committee

Raphael O. Roig, GM-14
Chairman, Space Division
Environmental Protection Committee

APPENDIX B

CONSULTATION WITH THE FISH AND WILDLIFE SERVICE

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS SPACE DIVISION (AFSC)
LOS ANGELES AIR FORCE BASE, PO BOX 92960
LOS ANGELES, CA 90009-2960

June 9, 1989

Mr. David J. Wesley
Field Supervisor
U.S. Fish and Wildlife Service
3100 University Boulevard, South
Suite 120
Jacksonville, Florida 32216

Dear Mr. Wesley:

The U.S. Air Force (USAF), Space Division proposes to expand its existing Titan IV program at Cape Canaveral Air Force Station (CCAFS), Florida to provide increased launch capabilities. To support the expanded Titan IV program launches, the USAF proposes to modify existing launch complexes and support facilities at CCAFS and to build an additional Solid Motor Assembly Building (SMAB) at CCAFS.

The facilities at CCAFS that would be affected by the proposed action are located in the northwest portion of the station, as indicated in the attached figures. The existing facilities include Launch Complexes 40 and 41 and the Titan Integrate-Transfer-Launch Area, immediately to the south of the launch complexes. The Launch Complexes are located on previously disturbed industrial land, and the Integrate-Transfer-Launch Area is located on a man made island. the USAF proposes to build the new Solid Motor Assembly Building at a site on the narrow man-made causeway in the Banana River.

Construction of the proposed SMAB would involve destruction of about 0.8 acres of wetland habitat for the transporter tracks to the SMAB; and the western edge of the SMAB site the USAF would create 1.8 acres of new wetland habitat (see attached layout). Most of the site is already disturbed by the existing fuel storage area. Stormwater runoff and sanitary sewage would be collected, treated, and discharged from the site in accordance with the permit requirements of the St. John's Water Management District and the Florida Department of Environmental Regulation.

To comply with the requirements of Section 7 of the Endangered species Act of 1978, as amended, the Air Force is requesting your input regarding the proposed action. We are including a list of federally listed endangered and threatened species residing or seasonally occurring on CCAFS; please review it and update as necessary. We would appreciate your opinion regarding (1) any possible effects of the proposed project on such species, and (2) suggested measures to avoid or minimize any adverse impacts on these species. The Air Force is continuing to evaluate its security requirements to reach a workable solution to the concerns with the high intensity lighting, particularly at launch complexes disturbing the federally listed turtles (see attached Light Management Plan Guidelines). These items will be fully covered in the Environmental Assessment for this program.

Mr. Dan Pilson can provide you with further details on the project if needed. His phone number is (213) 643-1409. As this project is on a tight schedule, we would appreciate hearing from your office as soon as possible.

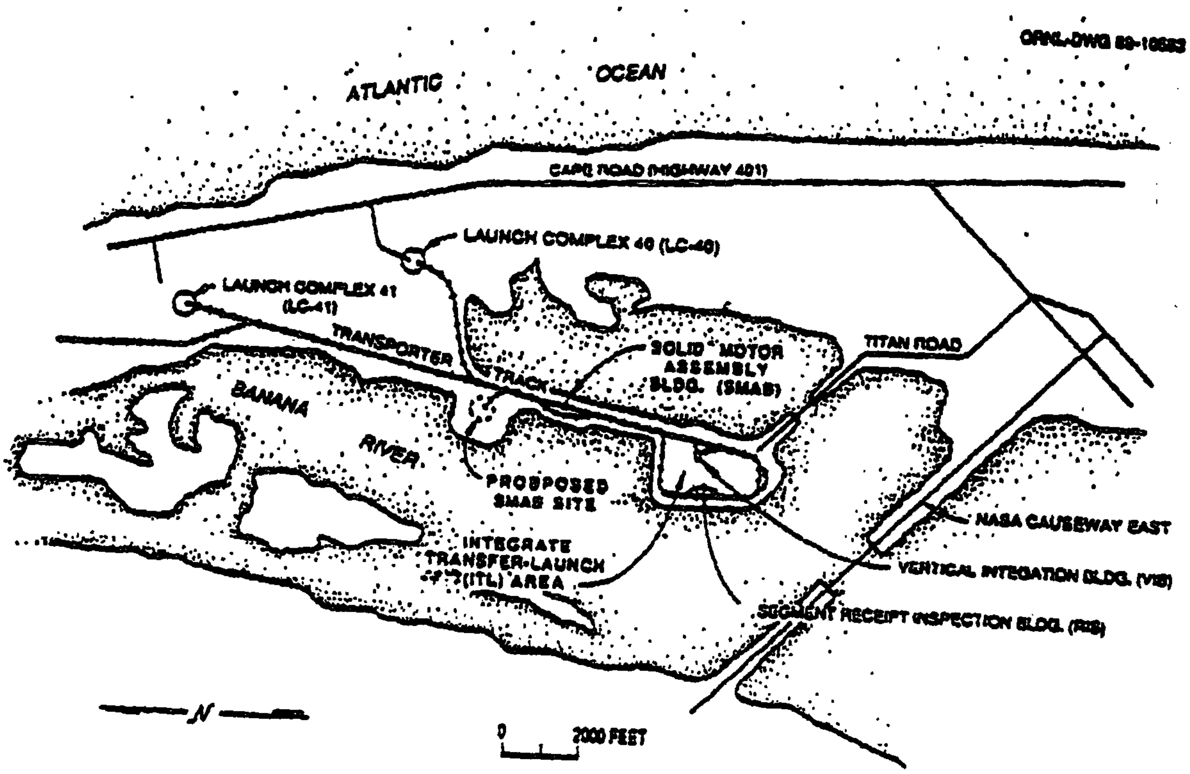
Sincerely,

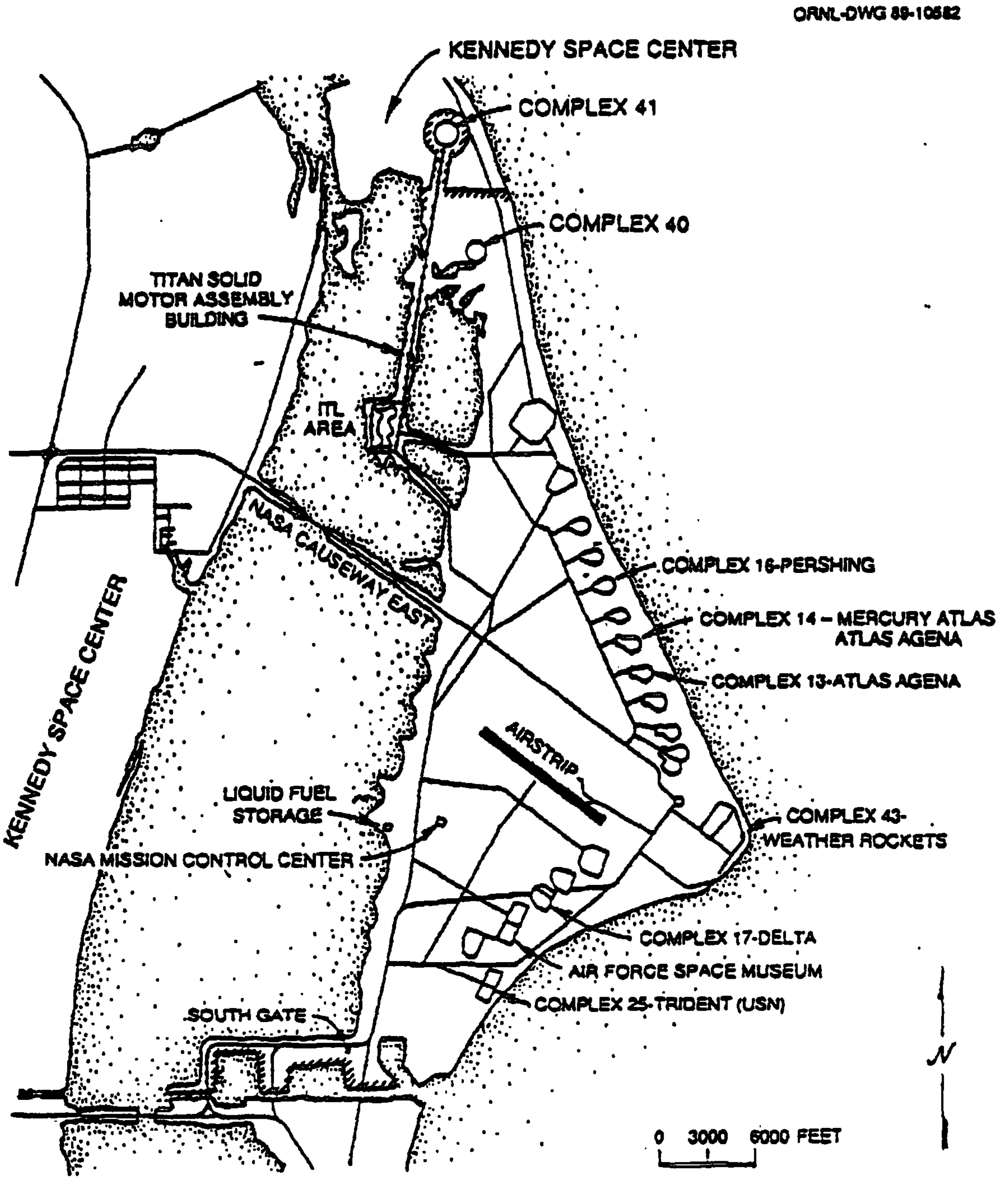
ROBERT C. MASON, AICP
Chief, Environmental Planning Division,
Directorate of Acquisition Civil Engineering

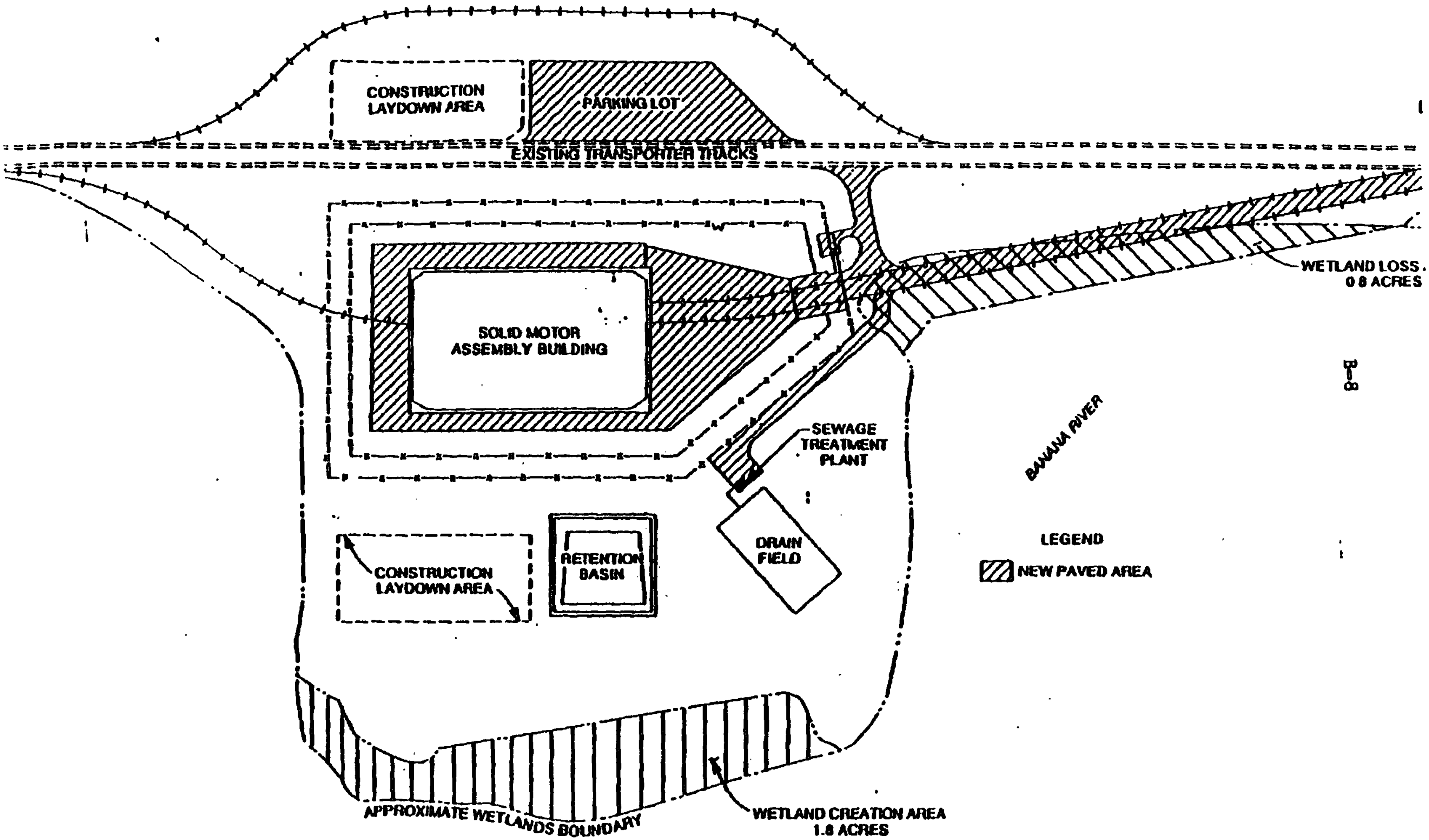
Attachments
1. Endangered Species list
2. Maps of CCAFS project area and SMAB layout
3. Light Management Plan Guidelines

Threatened and Endangered Species Associated with CCAFS

Loggerhead [sea turtle]
Green sea turtle
Leatherback [sea turtle]
Kemp's ridley [sea turtle]
Eastern indigo snake
American alligator
Atlantic salt marsh snake
Gopher tortoise
Florida gopher frog
Florida scrub jay
Kirtland's warbler
Wood stork
Bald eagle
Arctic peregrine falcon
Audubon's caracara
Red-cockaded woodpecker
Osprey
Brown pelican
Rothchild's magnificent frigate-bird
Roseate spoonbill
American oystercatcher
Southeastern American Kestral
Florida sandhill crane
Least tern
West Indian manatee
Southeastern beach mouse
Florida mouse
Sherman's fox squirrel


ATLANTIC OCEAN
CAPE ROAD (HIGHWAY 401)
LAUNCH COMPLEX 40 (LC-40)
LAUNCH COMPLEX 41 (LC-41)
TRANSPORTER TRACK
SOLID MOTOR ASSEMBLY BLDG. (SMAB)
TITAN ROAD
BANANA RIVER
PROPOSED SMAB SITE
INTEGRATE TRANSFER-LAUNCH (ITL) AREA
NASA CAUSEWAY EAST
VERTICAL INTEGRATION BLDG. (VIB)
SEGMENT RECEIPT INSPECTION BLDG. (RIS)
N
0 2000 FEET


ORNL-DWG 89-10582
KENNEDY SPACE CENTER
COMPLEX 41
COMPLEX 40
TITAN SOLID MOTOR ASSEMBLY BUILDING
ITL AREA
NASA CAUSEWAY EAST
KENNEDY SPACE CENTER
COMPLEX 16-PERSHING
COMPLEX 14 – MERCURY ATLAS ATLAS AGENA
COMPLEX 13-ATLAS AGENA
AIRSTRIP
LIQUID FUEL STORAGE
NASA MISSION CONTROL CENTER
COMPLEX 43-WEATHER ROCKETS
COMPLEX 17-DELTA
AIR FORCE SPACE MUSEUM
COMPLEX 25-TRIDENT (USN)
SOUTH GATE
0 3000 6000 FEET
N


CONSTRUCTION
LAYDOWN AREA
PARKING LOT
EXISTING TRANSPORTER TRACKS
SOLID MOTOR
ASSEMBLY BUILDING
WETLAND LOSS
0.8 ACRES
SEWAGE
TREATMENT
PLANT
BANANA RIVER
DRAIN
FIELD
RETENTION
BASIN
CONSTRUCTION
LAYDOWN AREA
LEGEND
NEW PAVED AREA
APPROXIMATE WETLANDS BOUNDARY
WETLAND CREATION AREA
1.8 ACRES

LIGHT MANAGEMENT PLAN GUIDELINES
CAPE CANAVERAL AFS, FLORIDA - 31 MARCH 1989

The following are general guidelines for the development of light management plans at Cape Canaveral AFS (CCAFS), Florida. This information has been compiled from correspondence and conversations with the U. S. Fish and Wildlife Service (USFWS) in looking for ways to mitigate the adverse effects of lighting from CCAFS on endangered species of turtles nesting at CCAFS. These guidelines will be updated as new information is learned from submittal of light management plans to the USFWS.

What has been agreed in principle with the USFWS is a four-part, interrelated approach to reach compliance within the next several years. All four parts must be implemented in a coordinated effort to ensure compliance. The end product shall be a Light Management Plan to be submitted to USFWS.

1. Lighting Survey:

- Each existing facility at CCAFS shall undergo a lighting survey. This survey shall identify those lights which could cause a disorientation problem (disorientation is defined as any kind of effects keeping the turtles from a direct path to the water) Our main concern at this time concerns the lighting shining directly on the shore and the beach. A secondary concern has to do with the composite glow from cluster of lights visible from the shore and the beach. The lights will be classified on the survey as either shining directly ,or indirectly (glow), on the beach.

- Based upon the results of this survey, those lights identified will be evaluated to determine which of the following corrective actions is most appropriate.
  - -- elimination of the light
  - -- redirection of the light
  - -- shielding of the light
  - -- use of low profile lights rather than pole/building mounted
  - -- change to low pressure sodium
  - -- installation of low light cameras or other appropriate technology

- Based upon this determination, the facility operator shall implement the necessary action to correct the problem.
  - -- For those corrective actions that are easy to accomplish (i.e., elimination, redirection or shielding), the corrective action shall be implemented no later than sixty (60) calendar days from the time these corrective actions are first identified.

  - -- For those actions that require engineering/design and construction efforts, the appropriate method which can achieve the required results in the shortest period of time shall be implemented immediately. Depending of which method is utilized, a compliance period shall be identified. The goal is to have all required plans approved by the USFWS, and most mitigation measures being implemented, within two (2) years.

-- For those actions requiring Congressional funding, the action shall be completed once funds are made available.

- Upon the completion of lighting program at each facility, a Lighting Survey shall be reaccomplished to ensure that the corrective actions are producing the desired results. If problems still exist, the above process shall be repeated. These will be an on-going action performed yearly.

2. New/Modified Facilities:

- For new programs or programs that call for the modification to existing facilities, the following shall be included in the design criteria.
  - -- non-essential lights shall be eliminated
  - -- lights shall be positioned so that they are not visible from the beach
  - -- in the case of modifications, lights shall be redirected
  - -- shielding of lights
  - -- use of low profile lights rather than pole/building mounted
  - -- low pressure sodium lights shall be used when feasible
  - -- installation of low light cameras or other appropriate technology as feasible

- Upon completion of construction or modification, a Light Survey shall be conducted to ensure that the facility does not have the potential for disorientation.
  - -- If the Light Survey identifies a problem, Item 1 above shall be implemented and repeated until the facility complies.

3. Light Management Plan:

- Each facility which has the potential for causing a disorientation problem shall develop a Light Management Plan. This Light Management Plan shall become a required part of the facility operational plan. The goal of the management plan is to reduce to the maximum extent practicable, while still meeting AF mission requirements, the light being generated by each facility at CCAFS. This shall be accomplished through but not limited to the following:
  - -- If the facility is not involved in any night work, all lights except for those necessary for security shall be turned off or eliminated.

  - -- If night work is required, only those lights necessary for the scheduled work on a particular area shall be used. For example, on a launch complex, only the lights on the actual work level shall be used. This may require rewiring of light control panels to allow for the selective use of lights.

-- To the maximum extent practicable, work shall be scheduled so that night work is not required during critical nesting and hatchlings periods (May thru October). To the extent that this is practicable, those facilities which can be dark (except for required security lighting) shall be dark. These periods need to be identified but should only account for two, one month periods during the year. With enough planning, it seems reasonable that night work could be scheduled to avoid these periods.

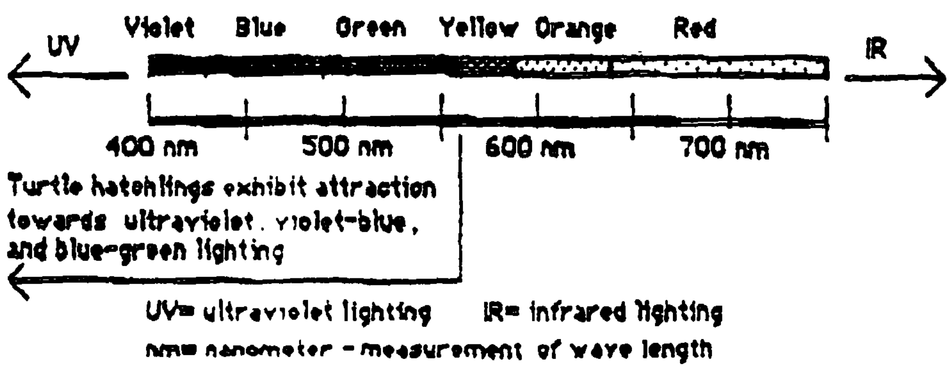
- Existing facilities shall prepare the Light Management Plan in conjunction with Item 1, Light Survey. As required, those portions of the Light Management Plan that require rewiring or other work, shall be incorporated into Item 2.

- New or Modified Facilities shall prepare the Light Management Plan as a part of their operational plan. It shall be available to implement during the design and construction phase to ensure that appropriate light fixtures and light control panels are designed and installed.

4. **Interim Measures:**

- Since some of these actions may take several years to accomplish, the Air Force shall continue and expand as necessary the following:
  -- Pan Am (or others) shall continue in cooperations with the USFWS and the State of Florida to monitor nest locations and accomplish nesting surveys. If a potential disorientation problem is identified, the facilities involved shall be identified and an evaluation made to determine where they are in the compliance process. If the facility is not yet in compliance, the facility operator shall be contacted to determine if night work is pending during the critical periods and if it is whether or not it can be rescheduled and the facility left dark. If this is not possible due to Air Force mission requirements, appropriate temporary nest screens shall be installed to eliminate the immediate disorientation potential.

5. **Color Spectrum of Light Waves:**



United States Department of the Interior
FISH AND WILDLIFE SERVICE
3100 University Blvd. South
Suite 120
Jacksonville, Florida 32216

June 27, 1989

Robert C. Mason
Chief, Environmental Planning Division
Headquarters Space Division
Los Angeles Air Force Base
P.O. Box 92960
Los Angeles, California 90009-2960

Dear Mr. Mason:

This responds to your letter of June 9, 1989, requesting our comments on the proposed expansion of the existing Titan IV program at Cape Canaveral Air Force Station, Florida. We have reviewed the information contained in your letter, and we have several comments. First, for our office to properly evaluate this project, we need copies of two additional environmental assessments. One has to do with the reactivation of Complex 41, and the other addresses the solid rocket motor upgrade. Prompt response to this request will speed-up our review.

With reference to particular listed species, the Air Force should evaluate the impact of the gas vapors expelled from the rocket engines on the Florida scrub jay and possibly the southeastern beach mouse and eastern indigo snake. We are concerned that the cloud of gas from the engines may adversely impact these species that may inhabit the area around the launch pad. Attached to your letter were guidelines for light management on the facility. These guidelines appear to be general in nature. As we have previously discussed, it will be necessary to provide a more detailed plan as to how these guidelines will be implemented.

With reference to the construction of the Solid Rocket Motor Assembly Building, the Service has reviewed the Army Corps' Public Notice 89IPD-20408, with reference to the filling of wetlands for the building. It is our position that the filling aspect of this project will significantly impact fishery resources.

We look forward to hearing from you regarding our requests for the assessments and the additional information on listed species. If we can be of further assistance, please contact our office.

Sincerely yours,

David J. Wesley
Field Supervisor

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS SPACE SYSTEMS DIVISION (AFSC)
LOS ANGELES AIR FORCE BASE, PO BOX 92960
LOS ANGELES, CA 90009-2960

August 18,1989

Mr. David J. Wesley
Field Supervisor
U.S. Dept. of the Interior
Fish and Wildlife Service
3100 University Blvd., Suite 120
Jacksonville, Florida 32216

Dear Mr. Wesley:

This responds to your letter of June 27, 1989, offering questions and commentary on the proposed expansion of the Titan IV launch program at Cape Canaveral Air Force Station (CCAFS), Florida.

1. In response to your request, we have enclosed copies of two Environmental Assessments (EAs) prepared by the U. S. Air Force (USAF) for the Titan IV program: Environmental Assessment, Complementary Expendable Launch Vehicle (June 1986) and Supplement (May 1988); and Preliminary Final Environmental Assessment, Titan IV/Solid Rocket Motor Upgrade Program (August 1989).

2. With regard to listed species, in the Preliminary Final EA for the Titan IV/SRMU program, we have included an analysis of the impacts of gas vapors in the exhaust cloud from the Titan IV/SRMU launch vehicle on terrestrial species inhabiting CCAFS, including the Florida scrub jay, southeastern beach mouse, and eastern indigo snake.

3. The light management plan for the launch complexes (and support facilities for the Titan IV program, if necessary) is presently in preparation. The initial step in the development of the plan, a lighting survey, was recently completed for the Titan launch areas. As you may know, we have prepared a draft light management plan for the MLV II program at launch complex (LC) 36. If the plan for LC 36 is approved by your office, it will be used as a model for other CCAFS light management plans. The design specifications for the new Solid Rocket Motor Assembly Building (SMAB) proposed to be located on Harrison Island in the Banana River include low pressure sodium lights for all outside lighting. We anticipate working closely with you to develop a light management plan for the Titan facilities that both minimizes adverse impacts to the protected sea turtles and meets our needs for security and operational

illumination. A draft light management plan for the Titan IV program is expected to be completed after the 1989 turtle breeding season has ended (October 1989), but before next year's season begins (May 1990).

4. Your comments on the Army Corps of Engineers' Public Notice 891-PD20408 related to the application for a wetlands permit have been reviewed. The Architect/Engineer for the SMAB, Bechtel National Inc., has responded to your concerns in a letter to the Chief, South Permits Branch, Department of Army. We will work with your office and other regulatory agencies to resolve all concerns associated with fisheries resources.

Please do not hesitate to contact Mr. Dan Pilson of my office at (213) 643-1409, should you have any further questions or comments.

Sincerely,

Robert C Mason

ROBERT C. MASON, AICP
Chief, Environmental Planning Division,
Directorate of Acquisition Civil Engineering

United States Department of the Interior
FISH AND WILDLIFE SERVICE
3100 University Blvd. South
Suite 120
Jacksonville, Florida 32216

October 18, 1989

Mr. Robert C. Mason AICP
Chief, Environmental Planning Division
Directorate of Acquisition Civil Engineering
Department of Air Force
Headquarters Space Division
Los Angeles Air Force Base
P.O. Box 92960
Los Angeles, California 90009-2960

Dear Mr. Mason:

We have reviewed the Preliminary Final Environmental Assessment for the Titan IV/Solid Rocket Motor Upgrade Program for Cape Canaveral Air Force Station, Florida. On 28 September 1989, Don Palmer of this office and I, accompanied by Air Force environmental staff and their consultant, inspected Complexes 40 and 41 and the proposed site for the new Solid Motor Rocket Assembly Building.

The information provided in the assessment clearly indicates that the operation of Complex 41, and possibly 40, may impact the threatened southeastern beach mouse and Florida scrub jay. These impacts are both from the toxic gas cloud generated from the firing of the rockets and the noise. Section 3.1.7. of the Assessment, entitled "Terrestrial Ecology", states that the gas generated from the firing of the rockets may kill scrub jays and possibly the southeastern beach mouse. Based on past firings of the Space Shuttle, the noise from the rockets has caused hearing loss in scrub jays; however, data were not available to determine if this was a permanent effect or only transient in nature. During the site visit, three scrub jays were seen adjacent to Complex 41, well within the anticipated high deposition zone of the gas cloud. The condition of the scrub habitat around Complex 41 is suitable for scrub jays; however, no information was presented in the assessment regarding distribution or density of the birds. The habitat around Complex 40 is not of the same quality, although no qualitative information was presented in the assessment. With reference to the southeastern beach mouse, the interdunal habitat associated with Complex 41 would appear to support this species, but again no specific information was presented. Under subsection 3.1.7.3., a monitoring program for these species is discussed, but no details regarding the protocol or responsible individuals were outlined.

Before the Fish and Wildlife Service can evaluate the impact of the proposed actions on threatened and endangered species we need to know the abundance and distribution of the animals around the two Launch Complexes; the size, duration and direction of the gas cloud and the impact of the noise on the species of concern. We also need to know the specifics of the monitoring program including a protocol for conducting the work. This type of information should be collected and developed prior to operation of these facilities, and should be forwarded to the U.S. Fish and Wildlife Service. Without these data, we do not believe the Air Force is able to complete its responsibility under Section 7 of the Endangered Species Act. We understand the Air Force will continue to work on environmental documentation, provide the information requested, and resolve any conflicts prior to launch.

A great deal of effort is being expended by the Air Force in designing a light system to prevent disorientation of turtle hatchlings; the beach mouse and scrub jay should be equally considered. We find the information presented in the assessment lacking in detail regarding distribution and density of the above listed species. We believe the Air Force should collect distribution and density data on the southeastern beach mouse and scrub jay, and investigate the long-term effect of noise on the scrub jay, using a surrogate species. This information along with a detailed follow-up monitoring program should be submitted to the Service in the form of a request for formal consultation pursuant to Section 7.

During the site visit at Complex 41, the by-pass road was discussed. This road will remove approximately one acre of scrub habitat that is occupied with scrub jays. This project was not coordinated with our office, nor is it addressed in the assessment. We, therefore, request the Air Force address this concern in the above consultation or initiate a separate consultation for this issue.

We look forward to hearing from you, and if you have a question regarding our comments or the Section 7 consultation process, please contact Don Palmer in this office.

Sincerely yours,

David J. Wesley
Field Supervisor

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS SPACE SYSTEMS DIVISION (AFSC)
LOS ANGELES AIR FORCE BASE, PO BOX 92960
LOS ANGELES, CA 90009-2960

December 4, 1989

Mr. David J. Wesley
Field Supervisor
U.S. Fish and Wildlife Service
3100 University Boulevard, South
Suite 120
Jacksonville, Florida 32216

Dear Mr. Wesley:

Enclosed is a Biological Assessment (Attachment 1) prepared in response to your letter of October 18, 1989 requesting additional information regarding the population distribution and density of two threatened species at Cape Canaveral Air Force Station (CCAFS), the Florida scrub jay and the southeastern beach mouse, and the potential impacts to these species from activities associated with the future Titan IV launch program at CCAFS.

The assessment provides data from population surveys conducted in November 1989 for both species. In addition, an estimate of the peak ground level hydrogen chloride concentrations in the near and far field area of the Titan IV launch complexes are shown in the assessment. Based on our findings presented in the assessment we do not expect any signifcant impacts on either the scrub jay or southeastern beach mouse from the Titan IV program.

Field surveys will be conducted during the course of the Titan IV program to monitor any effects on the scrub jays and southeastern beach mouse pre, during and post launch. We will confer with your office for specific requirements for the monitoring program.

The 6550 ABG/DEEV is presently preparing appropiate environmental documentation for the by-pass road at complex 41 and will submit the document under separate cover to your office.

In conjunction with our finding of no significant impact as documented in both the Environmental Assessment and Biological Assessment we request your office's concurrence with a "No Jeopardy" opinion in accordance with Section 7 of the Endangered Species Act.

If you have any further questions regarding the project or assessment, please contact Mr. Dan Pilson of my office at (213) 643-1409 or Mr. Olin Miller at Cape Canaveral, Florida at (407) 494-7288. Your prompt action on this request would be appreciated.

Sincerely,

Robert C Mason

ROBERT C. MASON, AICP
Chief, Environmental Planning Division
Directorate of Acquisition Civil Engineering

Attachment
1. Biological Assessment

United States Department of the Interior

FISH AND WILDLIFE SERVICE
3100 University Blvd. South
Suite 120
Jacksonville, Florida 32216

February 1, 1990

Mr. Robert C. Mason AICP
Chief, Environmental Planning Division
Directorate of Acquisition Civil Engineering
Department of Air Force
Headquarters Space Division
Los Angeles Air Force Base
P.O. Box 92960
Los Angeles, California 90009-2960

FWS Log No. 4-1-90-021

Dear Mr. Mason:

This represents the Biological Opinion of the Fish and Wildlife Service in accordance with Section 7 of the Endangered Species Act of 1973, as amended. A complete administrative record of this consultation is on file in this office.

PROJECT DESCRIPTION

The project entails the upgrading of existing Launch Complexes (LC) 40 and 41, and the construction of a Solid Rocket Motor Assembly Building on Cape Canaveral Air Force Station in Brevard County, Florida. The purpose of the work is to expand the Air Force's Titan IV launch program. The proposed action will result in the launch of 27 Titan IV rockets from 1991 through 1995 (Air Force Environmental Assessment).

CONSULTATION HISTORY

On June 9, 1989, the Air Force requested our comments on the upgrade program, and specifically asked for information on Federally listed species. Prior to the June 9, 1989 request, the Air Force had been working with our office on general lighting requirements and modifications as they affect nesting sea turtles on the Air Force Station. On June 27, 1989, we responded to the Air Force and requested an evaluation of the impact of the program on the Florida scrub jay and southeastern beach mouse. We were especially concerned about the vapor cloud and noise generated from the rocket at the time of launch. The Air Force provided additional information on August 18, 1989; and on September 28, 1989 we conducted a site inspection. On October 18, 1989 we informed the Air Force that we remained concerned about the project and requested more information on the vapor cloud and noise impact on the listed species. On December 4, 1989, the Air Force prepared a Biological Assessment on the two listed species.

A draft of this Biological Opinion was provided to the Air Force on January 30, at which time the Air Force provided comments and concurrence. This Biological Opinion addresses the scrub jay and beach mouse only; it does not address nesting sea turtles. A separate opinion will be provided at a later date with reference to the lighting program and its impact on turtles.

BIOLOGICAL OPINION

The southeastern beach mouse (Peromyscus polionotus niveiventris) is one of several subspecies of beach mice that inhabit the dune and interdunal areas of the Atlantic and Gulf coasts of Florida. The primary food item for this species is seeds from sea oats or other herbaceous plant species. The beach mouse will consume invertebrates, particularly in the late spring and early summer when seeds are scarce. Beach mice are burrow-inhabiting animals, and are located on the sloping side of sand dunes at the base of a shrub or clump of grass. Old burrows of ghost crabs are frequently used. The home range may contain up to 20 burrows, which are used for refuge, nesting and food storage.

Breeding occurs from November though early January, with litters ranging in size from two to seven, averaging four. Mice reach reproductive maturity in about six weeks, and there is a high infant and immature mortality rate.

The historic distribution of the this subspecies was along the beach dunes from Ponce Inlet in Volusia County, south to Hollywood Beach in Broward County. All along this coast, however, the beach mouse has been extirpated, usually as a result of human development. Based on past trapping records, high numbers of beach mice were found on Cape Canaveral National Seashore, Merritt Island National Wildlife Refuge, Cape Canaveral Air Force Station, and several other localities south of Brevard County. At our request, the Air Force contracted with biological consultants to determine the density of beach mice within what was considered a high risk zone around each of the complexes. A zone believed to contain toxic gas was defined by the Air Force as occurring for 0.4 mile (2,112 feet) radius from the launch pad immediately after each launch. The density estimate of mice determined by the capture/recapture method was 56 per acre. This indicates a healthy population of beach mice within this habitat. Trapping also revealed the density of beach mice outside of the 0.4 mile radius was equally high.

The Florida scrub jay (Aphelocoma coerulescens coerulescens) is geographically isolated from other subspecies found in Mexico and western United States. The scrub jay is found almost exclusively in peninsular Florida, but is restricted to scattered and often small, isolated patches of scrub habitat. Federal lands with scrub jays are Avon Park Air Force Range, Cape Canaveral Air Force Station, Merritt Island National Wildlife Refuge, and Ocala National Forest. On state land, jays are found in Jonathan Dickinson State Park in Martin County.

Scrub jays are non-migratory, extremely sedentary, and have very specific habitat requirements. Scrub habitat occurs only on fine, white, drained sand, vegetated with sand live oak, Chapman oak, scattered sand pine, and rosemary. Scrub jays are rarely found in habitats with more than 50 percent canopy cover over 9 feet in height. In general, scrub jay habitat consists of dense thickets of scrub oaks less than 9 feet tall, interspersed with bare sand used for foraging and storing of acorns. The habitat for the scrub jay greatly restricts the bird's distribution, and requires active management either through burning or mechanical clearing to maintain optimum habitat. The Service believes all optimum and less-than-optimum habitat on the Air Force Station is occupied by scrub jays.

Cox (1984, 1987) has stated that the scrub jay population has been reduced nearly in half as a result of habitat destruction since the beginning of the century. The three largest population centers are Merritt Island National Wildlife Refuge, Cape Canaveral Air Force Station and the Ocala National Forest. These areas are estimated to have at least 80 percent of the known population, totalling 15,600 to 22,800 birds (Cox 1984). Breininger (1989) believes the 1984 estimate to be too high. Mr. Breininger recalculated the estimate for the refuge using different criteria, and estimated the refuge to have 2,500 birds, not 6,000 as previously thought. The Air Force Station population was estimated by Cox (1984) to be 3,600 to 6,000 birds; however, the new estimate may be as low as 920 birds. The new statewide estimate may be approximately half (7,010 to 10,978 birds) of the previous estimate. Based on information provided by the Air Force, the number of jays found within 0.4 mile radius of LCs 40 and 41 may be from 60 to 199, or about 7 to 22 percent of the total population on the Air Force Station. At complex 40, the estimated population is 76 birds on 132 acres of scrub, and at 41, the figure is 93 birds on 187 acres. These estimates are based on available suitable habitat with the 0.4 mile radius of each complex.

The 0.4 mile radius around each complex is that area the Air Force believes may have the highest deposition of chemicals from the toxic cloud and the greatest noise produced by the launch vehicle. The cloud produced by the vehicle contains water vapor, hydrogen chloride, carbon monoxide, and aluminum oxide. The concentration of material in the cloud is significantly reduced further away from the pad. However, based on cloud data from the space shuttle program, and known toxicities the Service believes that if jays or mice are found within 0.4 mile radius of the pad, mortality may result. Based on field inspections, scrub jays and beach mice are found within this potential "kill zone". The Air Force acknowledges that wildlife found within the security fence, which is about 600 feet from the pad, would be killed, but no information exists as to the impact on these species outside of this area. Within the security fence, no habitat exists for either species, and the occurrence of scrub jays inside the fence is transitory.

As a result of a January 8, 1990, meeting with Air Force representatives, a monitoring plan will be established to test the effects of the toxic cloud and noise on surrogate species of a rodent and bird, using the Titan III rocket. This rocket has one-third less power than the Titan IV; however, the Service believes the results from this test will be applicable. The proposal calls for setting up three transect lines extending outward from Complex 40 for a distance of 2,000 feet. Monitoring stations will be established at 500-foot intervals beginning at the security fence. Three cages will be placed at different heights within the vegetation, each cage holding one surrogate bird. To determine the effect on beach mice, a rice rat will be placed in a cage in an excavated burrow. In addition, at each location measuring devices will be used to record the noise levels and concentrations of chemicals in the gas cloud. The Air Force will also videotape the launches of the two remaining Titan III's; recording the dispersion of the cloud over the test area. Results of the two monitoring periods will provide the Service with more complete information to set a realistic figure for incidental take for scrub jays and beach mice, if needed, for the Titan IV program. The results of these tests will set the protocol to conduct similar monitoring of Titan IV launches at LC41. The Air Force will conduct joint field inspections of the habitat immediately following launches.

In addition to the monitoring, the Air Force will leg-band and color mark scrub jays at both pads for the purpose of future monitoring during the Titan IV launches. The results of the banding effort will provide information on home range, density, mortality and emigration/immigration resulting from the launch activity.

In a worse case scenario the Titan IV program, as planned, may reduce the scrub jay population on the Air Force station by 20 percent. A confounding problem is that if scrub jays are killed as a result of the launches, birds outside of this area will emigrate into the empty habitat of the "kill zone" to set up territories. These birds may then succumb to the effects of a subsequent launch. Both LCs will act as a "sink" for scrub jays, and will continue to decimate the station population with each successive launch. It is conceivable that if a "sink" situation occurs, it would be prudent to develop a program to haze the birds from the area. If this is not practical, the Air Force may have to eliminate the scrub habitat within 0.4 mile of each complex to discourage use by the birds. At the conclusion of the Titan IV program, it is anticipated the scrub vegetation will return, and the habitat will be reoccupied if left undisturbed. Further research will be required to confirm this.

The estimated population of beach mice within the disturbed coastal scrub, which is primarily found within the 0.4 mile radius, is 5,732 for LC40 and 6,177 for LC 41. During daylight hours, mice are found in burrows which may provide them with some protection from the effects of a launch. Actual impact of a launch will not be answered until the monitoring is completed on the Titan III and possibly first Titan IV launches.

The Air Force and the Service are currently unable to provide an accurate level of incidental take of either species, as required in a Biological Opinion. Until monitoring is completed, information as to the impact of the launches is speculative. The Service, therefore, must assume for the purpose of this opinion that all beach mice and scrub jays found within the 0.4 mile radius of the launch pad may be killed directly or die as a result of secondary effects. Preliminary review of the data indicate mortality may not be as severe as predicted. Therefore, it is the Service's Biological Opinion that the operational phase of the Titan IV program is not likely to jeopardize the continued existence of the scrub jay or the southeastern beach mouse.

The Service bases this decision on several reasons. With reference to the scrub jay, a maximum loss for a single launch on the Air Force Station represents between 0.54 to 2.0 percent of the revised statewide estimate. While the potential loss on the Station is significant for this immediate population, the loss statewide is not. The scrub jay is able to reoccupy habitat quickly when it is restored if a donor population is located within emigration distance. At the conclusion of the Titan IV program, the scrub habitat will grow back and scrub jays will occupy it. With the acquisition of private lands and the cooperation of private land owners to preserve and enhance scrub habitat, the recovery of this species is possible.

Based on the trapping work conducted for this project for the combined LCs, the estimated population of the southeastern beach mice outside of the 0.4 mile area but within a 0.7 mile of both LCs is 12,500 to 22,200 animals. This number indicates a healthy population of beach mice within the immediate vicinity of the pads, and based on the lack of development on the coastal strand of the Air Force Station, we believe the installation population is large and healthy. The potential loss of beach mice within the 0.4 mile zone will not reduce the ability of this species to recover. The primary threat to this species rangewide is the destruction of coastal habitat. The habitat within the affected area will not be destroyed, and at the conclusion of the Titan IV program, beach mice will reoccupy the area.

The Service acknowledges that, depending on the results of the monitoring effort, the projected impact of the operational phase of the Titan IV program may be downgraded. If so, the level of incidental take and the conditions listed below in the reasonable and prudent measures will be adjusted. The conditions currently outlined below have been coordinated and accepted by the Air Force, including the dates of execution in the terms and conditions section. If the level of take is changed, the conditions will have to be renegotiated with the Air Force.

INCIDENTAL TAKE

Section 9 of the Endangered Species Act prohibits the taking of listed species without a special exemption. Taking is defined to mean harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct. Taking can only be authorized through special provisions. Under the terms of Sections 7(b)(4) and 7(O)(2), taking that is incidental to and not intended as part of the agency action is not considered taking within the incidental take statement.

The Service has reviewed the biological information and other available information relevant to this action, and based on our review at our current level of knowledge relative to the impact of the operational phase of this program, and the monitoring program involved with the Titan III launches, we anticipate that no more than 200 scrub jays and 12,000 beach mice will be killed as a result of the launches. The Air Force is, therefore, authorized to take up to a maximum of 200 Florida scrub jays and 12,000 southeastern beach mice on Cape Canaveral Air Force Station adjacent to LCs 40 and 41. We believe the actual number will be less.

When providing an incidental take statement, the Service is required to give reasonable and prudent measures it considers necessary or appropriate to minimize the take, along with terms and conditions that must be compiled with, to implement the reasonable and prudent measures. Furthermore, the Service must also specify procedures to be used to handle or dispose of any individual specimens taken. The Service believes the following reasonable and prudent measures are necessary and appropriate to reduce the impact of take on the statewide population of Florida scrub jays.

REASONABLE AND PRUDENT MEASURES

Although Cape Canaveral Air Force Station has the potential to lose about 20 percent of their extant population of scrub jays, we believe the following measures will offset this loss, and will not hinder the statewide recovery of this species. Cape Canaveral Air Force Station has been identified as one of the three population centers for scrub jays in the state; therefore, this installation is essential for the recovery of this species. Based upon this statement, the Service has identified two options from which the Air Force may select. Due to the potential for taking of endangered species, the Air Force has agreed that mitigation will be conducted in an amount approprtate with the documented take. Because the amount of take is not known at this time, we are unable to give specific figures except in a worse case scenario.

The Air Force has worked with us to develop the following two measures and has agreed to implement one of the following, or a combination of the following, in amounts consistent with the documented take:

1. There currently exist abandoned buildings, parking lots, and launch pads built in scrub jay habitat. These structures could be razed, and scrub vegetation planted. The Service believes that appropriate acreage (3:1 ratio) of reclaimed scrub habitat is required to compensate for the loss of occupied scrub jay habitat.

2. Donate sufficient funds to a National Conservation organization established to purchase and manage lands. Lands purchased must be at a 2:1 ratio (purchased to destroyed) and be occupied by scrub jays. Exact dollar figures to purchase appropriate acreage, and the agency to do this will be determined at a later date in consultation with the Fish and Wildlife Service.

In order to be exempt from the prohibitions of Section 9 of the Act, the following terms and conditions, which implement each reasonable and prudent measures described above respectively, must be met.

1. If the Air Force selects the option of reclaiming habitat, a map of the Air Force Station outlining the area to be reclaimed and a draft schedule for reclamation and management must be sent to the FWS by October 1, 1990. All reclamation efforts must be completed by September 30, 1996. The Air Force must guarantee a survival rate of 80 percent of planted scrub vegetation after three years and control exotic vegetation. The Air Force will submit a yearly report for ten years to the Service indicating the status of the project, including recolonization by scrub jays.

2. The amount of funds and a schedule for transfer to a third party must be completed within two years of the date of this opinion. The Service must be involved with the selection of the organization charged with the purchase of the property.

3. If in the course of the operational phase of the project a dead scrub jay or southeastern beach mouse is found, the carcass should be frozen immediately, and the Jacksonville Field Office notified within 24 hours for disposition (904/791-2580).

This completes Section 7 consultation. If modifications are made in the project or if additional information becomes available, reinitiation of consultation may be necessary.

Sincerely yours,

Donald T. Palmer

Donald T. Palmer
Acting Field Supervisor

LITERATURE CITED

Environmental Impact Analysis Process; Biological Assessment Titan IV Launch Program Launch Complex 40 and 41. Cape Canaveral Air Force Station, Florida. Department of the Air Force, December 1989.

Breininger, D.R. 1989. A new population estimate for the Florida Scrub Jay on Merritt Island National Wildlife Refuge. Vol. 17, No. 2. Florida Field Naturalist.

Cox, J. 1984. Distribution, habitat, and social organization of the Florida Scrub Jay, with a discussion of the evaluation of cooperative breeding in New Worlds jays. Gainesville, Florida: Ph.D. dissertation, University of Florida.

Cox, J. 1987. Status and distribution of the Florida Scrub Jay. Gainesville, Florida; Florida Ornithological Society Special Publ. No. 3.

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS SPACE DIVISION (AFSC)
LOS ANGELES AIR FORCE BASE, PO BOX 92960
LOS ANGELES, CA 90009-2960

June 9, 1989

Mr. Ray Bransfield
U.S. Fish and Wildlife Service
Endangered Species Office
24000 Avila Road
Laguna Niguel, California 92677

Dear Mr. Bransfield:

The U.S. Air Force (USAF), Space Division proposes to expand its existing Titan IV program at Vandenberg Air Force Base (VAFB), California to provide increased launch vehicle processing capabilities to support launch of the Titan IV/Solid Rocket Motor Upgrade. The proposed changes for the Titan IV program at VAFB include modifications at Space Launch Complex 4 East (SLC-4E) to accommodate the Solid Rocket Motor Upgrade (SRMU), modifications to the Solid Rocket Sub-assembly Facility (SRSF, Building 398) at SLC-6, launch of up to four Titan IV/SRMU vehicles per year, and disposal of the washdown wastewater from Titan IV launches in evaporation ponds at SLC-6.

The facilities at VAFB that would be affected by the proposed action are located in the southern portion of the base as shown in the enclosed figure. Modifications at SLC-4E would occur in previously disturbed areas associated with the launch structure, and modifications to the SRSF, Building 398 would be internal. Launch of the Titan IV/SRMU requires 15% more solid rocket propellant than the current Titan IV and is expected to require disposal of about 50,000 gal of washdown-water per launch. The Air Force is developing plans for disposal of washdown water; this issue will be addressed along with any other items in the Environmental Assessment for this program.

To comply with the requirements of Section 7 of the Endangered Species Act of 1978, as amended, the Air Force is requesting your input regarding the proposed action. We are including a list of federally listed endangered and threatened species residing or seasonally occurring in the project vicinity; please review and update it as necessary. We would appreciate your opinion regarding (1) any possible effects of the proposed project on such species, and (2) suggested measures to avoid or minimize any adverse impacts on these species.

Mr. Dan Pilson can provide you with further details on this project if needed. His phone number is (213) 643-1409. As this project is on a tight schedule, we would appreciate hearing from your office as soon as possible.

Sincerely,

ROBERT C. MASON, AICP
Chief, Environmental Planning Division
Directorate of Acquisition Civil Engineering

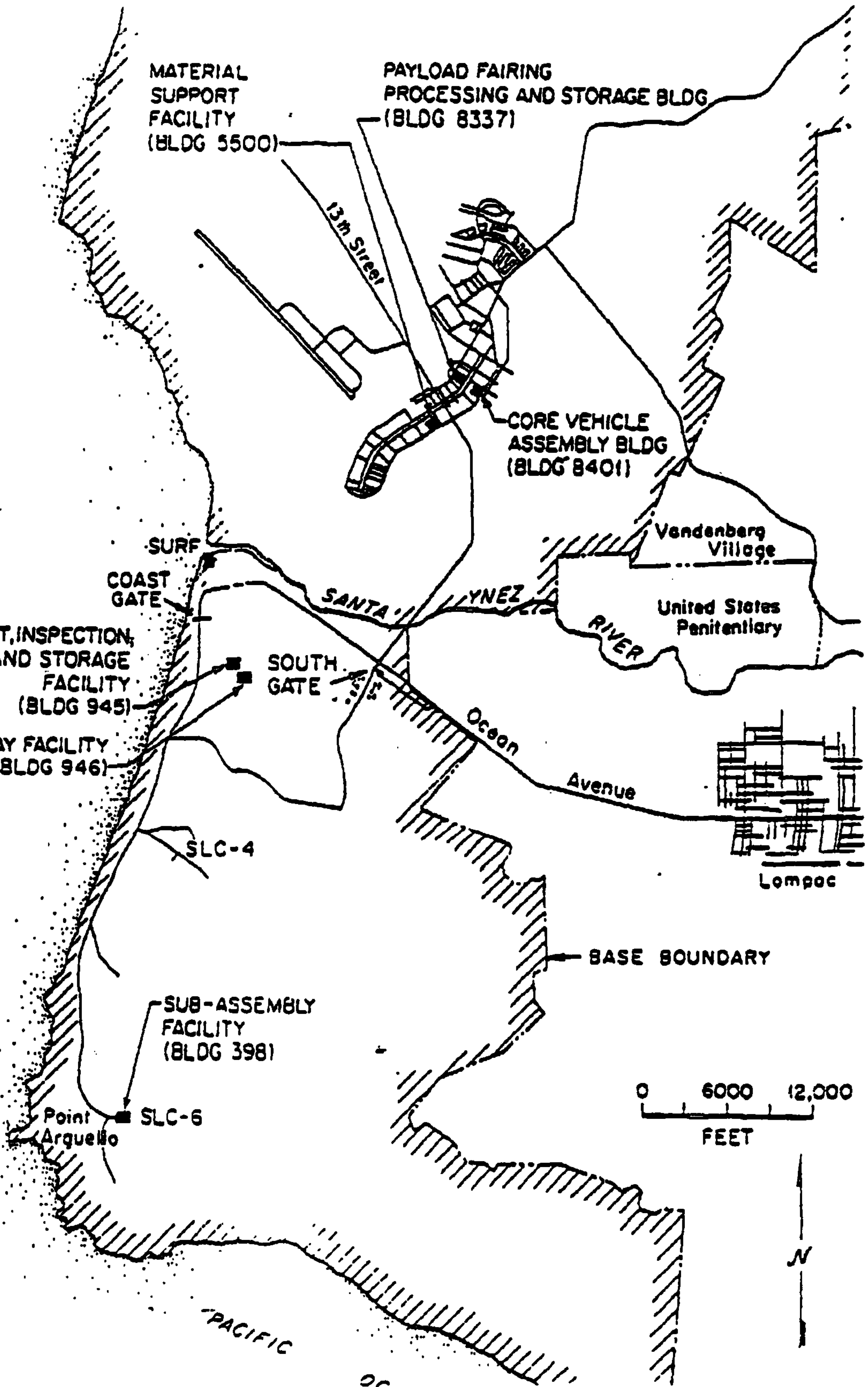
Attachments
1. Endangered Species list
2. Map of VAFB project area

Threatened and Endangered Species Associated with VAFB

Peregrine falcon
Bald eagle
California least tern
California brown pelican
Least Bell's vireo
Gray whale
Guadalupe fur seal
Southern sea otter
Unarmored threespine stickleback
Salt marsh bird's beak
California sea lion
Harbor seal
Stellar sea lion
Northern fur seal
Northern elephant seal

<u>Candidate species</u>

Spotted bat
Towsend's western big-eared bat
Greater mastiff bat
California black rail
Western snowy plover
Long-billed curlew
White-faced ibis
Ferruginous hawk
Tricolored blackbird
Western pond turtle
California red-legged frog
Arroyo toad
Tidewater goby
Salt marsh skipper butterfly
Swamp sand wort
Hoover's baccharia
Morning glory
Soft-leaved Indian paintbrush
Lilac
La Graciosa thistle
Surf thistle
Beach spectacle-pod
Lompoc yerba santa
Roderick's fritillary
Crisp monardella
San Luis Obispo curly-leaved monardella
Hoffman sanicle
Black-flowered figwort


MATERIAL SUPPORT FACILITY (BLDG 5500)
PAYLOAD FAIRING PROCESSING AND STORAGE BLDG (BLDG 8337)
13th Street
CORE VEHICLE ASSEMBLY BLDG (BLDG 8401)
Vandenberg Village
United States Penitentiary
SURF
COAST GATE
SANTA YNEZ RIVER
RECEIPT, INSPECTION, AND STORAGE FACILITY (BLDG 945)
SOUTH GATE
X-RAY FACILITY (BLDG 946)
Ocean Avenue
Lompoc
SLC-4
BASE BOUNDARY
SUB-ASSEMBLY FACILITY (BLDG 398)
0 6000 12,000
FEET
Point Arguello
SLC-6
N
PACIFIC

United States Department of the Interior

FISH AND WILDLIFE SERVICE

LAGUNA NIGUEL FIELD OFFICE
24000 Avila Road
Laguna Niguel, California 92656

In Reply Refer To:
FWS/LNFO (1-6-88-SP-932)

July 12, 1989

Robert C. Mason, AICP
Chief, Environmental Planning Division
Directorate of Acquisition Civil Engineering
Department of the Air Force
Headquarters Space Division (AFSC)
Los Angeles Air Force Base
P.O. Box 92960
Los Angeles, California 90009-2960

Dear Mr. Mason:

This is in response to your letter, dated June 9, 1989, and received by us on June 13, 1989 requesting information on listed and proposed endangered and threatened species which may be present within the influence of the proposed expansion of the Titan IV program at Vandenberg Air Force Base, Santa Barbara County, California. With the addition of the elegant tern (*Sterna elegans*) a category 2 candidate, we concur with your suggested list of species (see enclosure). Further refinement of your proposed project deatails should result in a much shortened list. Please note that the National Marine Fisheries Service has authority over the endangered California gray whale and threatened Guadalupe fur seal and should be contacted for consultation on these species. The California sea lion, harbor seal, Steller sea lion, northern fur seal, and northern elephant seal are not federally listed species however, they are afforded protection by the Marine Protection Act.

Your agency has the responsibility to prepare a Biological Assessment if your project is a construction project which may require an Environmental Impact Statement. If a Biological Assessment is not required, your agency still has the responsibility to review its proposed activities and determine whether the listed species will be affected.

During the assessment or review process, your agency may engage in planning efforts, but may not make an irreversible commitment of resources. Such a commitment could constitute a violation of Section 7(a) of the Endangered Species Act (Act). If a listed species may be affected, your agency should request, in writing through our office, formal consultation pursuant to Section 7 of the Act. Informal consultation may be used to exchange information and resolve conflicts with respect to listed species prior to a written request for formal consultation. Our suggested list also includes a list of candidate species presently under review by this Service for consideration as endangered or threatened. It should be noted that candidate species have no protection under the Act. Therefore, you are not required to perform a Biological Assessment for candidate species nor to consult with the Fish and Wildlife Service should you determine your project may affect candidate species. They are included for the sole purpose of notifying Federal agencies in advance of possible proposals and listings which at some time in the future may have to be considered in planning Federal activities. If early evaluation of your projects indicates that it is likely to adversely impact a candidate species, you may wish to request technical assistance from this office.

Your letter also included a request for our input in suggesting measures that may avoid or minimize any adverse impacts on these species. To these ends, the Service suggests that your office prepare a detailed monitoring plan to determine the cumulative impact of all proposed launches from Vandenberg Air Force Base. This analysis should focus on the projected levels and frequencies of noise and disturbance associated with both the proposed Titan IV launches, and other smaller missiles from the Base. Please refer to our Biological Opinion 1-6-88-F-53 dated October 6, 1988 for suggestions for monitoring potential impacts from Titan II and IV launches. We would be happy to work with your staff in developing such a plan. It is the Service's desire that implementation of a comprehensive monitoring plan may remove or substantially reduce the need for additional formal consultation on proposed launch programs.

Should you have any questions regarding the species on the enclosed list or your responsibilities under the Act, please contact Donna Brewer of my staff at (714) 643-4270 if any questions.

Sincerely,

Brooks Harper
Acting Field Supervisor

Enclosure

[1] "Construction Project" means any major Federal action which significantly affects the quality of the human environment designed primarily to result in the building or erection of man-made structures such as dams, buildings, road, pipelines, channels and the like. This includes Federal actions such as permits, grants, licenses or other forms of Federal authorizations or approvals which may result in construction.

Threatened and Endangered Species Associated with VAFB

Peregrine falcon
Bald eagle
California least tern
California brown pelican
Least Bell's vireo
Gray whale
Guadalupe fur seal
Southern sea otter
Unarmored threespine stickleback
Salt marsh bird's beak
California sea lion
Harbor seal
Stellar sea lion
Northern fur seal
Northern elephant seal

Candidate species

Spotted bat
Towsend's western big-eared bat
Greater mastiff bat
California black rail
Western snowy plover
Long-billed curlew
White-faced ibis
Ferruginous hawk
Tricolored blackbird
Western pond turtle
California red-legged frog
Arroyo toad
Tidewater goby
Salt marsh skipper butterfly
Swamp sand wort
Hoover's baccharia
Morning glory
Soft-leaved Indian paintbruch
Lilac
La Graciosa thistle
Surf thistle
Beach spectacle-pod
Lompoc yerba santa
Roderick's fritillary
Crisp monardella
San Luis Obispo curly-leaved monardella
Hoffman sanicle
Black-flowered figwort

BIOLOGICAL ASSESSMENT OF POTENTIAL IMPACTS TO FEDERALLY LISTED THREATENED SPECIES: FLORIDA SCRUB JAY AND SOUTHEASTERN BEACH MOUSE

(*Aphelocoma coerulescens coerulescens* and *Peromyscus polionotus niveiventris*)

U.S. AIR FORCE
TITAN IV LAUNCH PROGRAM
LAUNCH COMPLEXES 40 AND 41
CAPE CANAVERAL AIR FORCE STATION
BREVARD COUNTY, FLORIDA

DECEMBER 1989

1. INTRODUCTION

The Florida scrub jay (*Aphelocoma coerulescens coerulescens*) and the southeastern beach mouse (*Peromyscus polionotus niveiventris*) are both listed by the U.S. Department of Interior, Fish and Wildlife Service (FWS), as threatened species, pursuant to the Endangered Species Act of 1973, as amended (50 CFR Part 17). This Biological Assessment has been prepared by the USAF as the initial step of formal consultation between the USAF and FWS regarding the potential for adverse impacts to these species because of future Titan IV program launches at launch complexes (LCs) 40 and 41 at Cape Canaveral Air Force Station (CCAFS), Florida.

2. DESCRIPTION OF THE PROPOSED PROJECT

2.1 Project Location

CCAFS is located along the eastern coast of Florida near the city of Cocoa Beach in Brevard County. The base is about 15 miles (mi) north of Patrick AFB and adjacent to the National Aeronautics and Space Administration's (NASA's) Kennedy Space Center (KSC). CCAFS occupies about 15,800 acres (25 mi^2) of a barrier island that is bounded on the east by the Atlantic Ocean and on the west by the Banana River.

The facilities at CCAFS that would be affected by the proposed project are located in the northwest portion of the base, as indicated in Fig. 1. These include Launch Complexes (LCs) 40 and 41 and the Titan Integrate-Transfer-Launch (ITL) Area immediately south of the LCs. A new facility, the Solid Motor Assembly Building, is proposed to be constructed at a site near the ITL area on narrow man-made causeway in the Banana River.

The LCs are located on previously disturbed land and are industrial in character. LCs 40 and 41 were constructed in 1963-64. LC-41 was used by the USAF from 1964 to 1977 for Titan launches from 1964 to the present.

ORNL-DWG 89-10582R

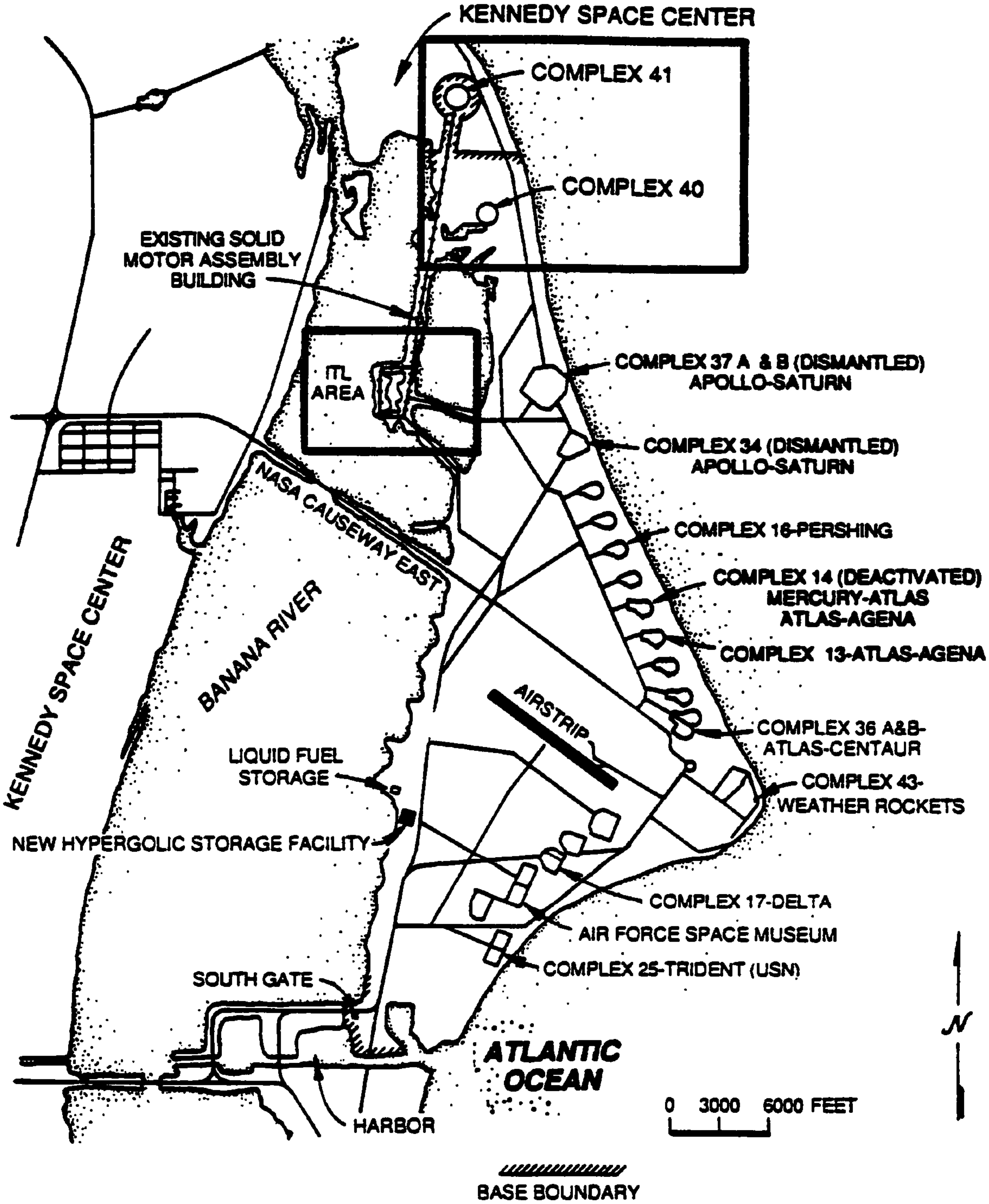


Fig. 1. Launch complexes and support facilities at Cape Canaveral Air Force Station, Florida.

2.2 Project Description

In support of the Department of Defense (DOD) space program, the USAF proposes to expand its existing Titan IV launch program at CCAFS. The proposed action would be to launch a maximum of 27 Titan IV vehicles from 1991 through 1995 and to increase payload capacity for Shuttle-class payloads by using some launch vehicles equipped with a larger solid rocket motor (SRM) known as the Solid Rocket Motor Upgrade (SRMU or Type 2 vehicle). To support the expanded Titan IV launch program, the USAF would have to modify existing launch complexes and support facilities at CCAFS.

The planned launch schedule for the Titan IV is given in Table 1. From 1991 to 1995, there would be a transition to the use of Titan IV/SRMU (Type 2) vehicles. The launch and flight of a Titan IV begins with ignition of the SRMs, which burn for about 2 min (Stage 0). At an altitude of about 31 miles (50 km), Stage 1 motors ignite, quickly followed by jettison of the SRMs. The payload fairings are jettisoned after about 4 min of flight, and Stage 1 shutdown/Stage 2 ignition occurs after about 5 min. In less than 9 min from liftoff, Stage 2 is shut down and jettisoned and the payload is established in a low earth "parking" orbit.

Table 1. Planned launches of Titan IV vehicles from CCAFS

Year	Launch site: LC-40	Launch site: LC-41	Total
1991	0	3	3[a]
1992	3	3	6[b]
1993	3	3	6[c]
1994	3	3	6[c]
1995	3	3	6[c]
Total	12	15	27

[a]All Titan IV (no SRMU).
[b]50% Type 1, 50% Type 2 (SRMU).
[c]All Type 2 (SRMU).

3. ECOLOGY OF THE THREATENED SPECIES

3.1 FLORIDA SCRUB JAY

3.1.1 Species Description

The following species description of the Florida scrub jay is excerpted from the Endangered Species Technical Bulletin (Vol. IX, No. 6, 1986). The Florida scrub jay is a bluish-colored, crestless bird that reaches 12 inches (30 centimeters) in total length. A necklace of blue feathers separates its white throat from gray underparts, and a white line over the bird's eye often blends into a whitish forehead. Florida scrub jays are long-lived (10 years or more), sedentary, and permanently monogamous. They are omnivorous, eating almost anything they can catch, but they concentrate on lizards and arthropods in spring and summer, and acorns in fall and winter.

The species *Aphelocoma coerulescens* is widely distributed in the western United States, but the Florida subspecies, *A. c. coerulescens*, is restricted to scattered and often isolated patches of oak scrub in peninsular Florida, which occurs on fine, white, drained sand. These areas have high real estate value in this rapidly growing state, and as a result, many of the coastal areas inhabited by the Florida scrub jay have been cleared for construction of beachfront hotels, houses, and condominiums. Scrub habitats in the interior of the Florida peninsula are also changing; they are subject to development for citrus groves as well as for housing developments. In many areas, scrub jays are barely hanging on, and they will probably disappear from these areas within a few years as land clearing continues.

In the past, scrub jays were reported to have occupied 40 Florida counties, but today they have been completely eliminated from some areas (40% of their historical locations), and their numbers have drastically declined in others. The Florida scrub jay's total population has dropped by about half in the past century, leaving between 15,000 and 22,000 known survivors in 1986. Of the remaining jays, over 80% occur only in two general areas: Merritt Island/Cape Canaveral (Brevard County) and Ocala National Forest (Lake, Marion, and Putnam Counties). Elsewhere, only small populations are scattered throughout peninsular Florida. Breininger (1989) reports a state-wide scrub jay population between roughly 7,000 to 11,000 birds.

By far, habitat destruction has played the major role in the Florida scrub jay's decline, but there is evidence that, in St. Johns County at least, some scrub jays have been shot by vandals. In addition, the tameness and beauty of this bird make it desirable as a pet, and although illegal, it has been used for such a purpose in the past. Another threat to this vulnerable bird's existence is the suppression of fires to protect human interests. Historically, natural-caused fires were major factors in maintaining the sparse, low scrub vegetation preferred by *A. c. coerulescens*.

Although the Florida scrub jay is protected by the Migratory Bird Treaty Act and Florida state law, these laws do not protect the bird from habitat destruction. To protect and manage the surviving populations, the Florida scrub jay was listed by the FWS as a threatened species on June 3, 1987 (52 *Federal Register* 20715).

3.1.2 Distribution and Density of Scrub Jays near LCs 40 and 41

Florida scrub jays extensively use the scrub vegetation surrounding the perimeter fences at LCs 40 and 41 (Fig. 2), and nests have been observed within 660 ft (201 m) of LC-41. The population of scrub jays within a 0.7-mile (1.1-km) radius of the LC 40 and 41 launch pads was estimated using scrub jay density and habitat data from studies at the adjacent Kennedy Space Center. This distance was used because it includes the high-risk-for-injury/death zone that extends about 600 ft (182 m) from the pad. The methods and information that served as the basis of two estimates are as follows.

Estimate #1 was calculated by multiplying scrub jay density estimates for coastal strand, coastal scrub, and disturbed coastal scrub habitats by the area [in hectares (ha)] of each of the respective habitats at LCs 40 and 41. Scrub jay density estimates were derived from data collected at five transects located in strand, scrub and disturbed scrub habitats in the vicinity of LC 41. Mean scrub jay density estimates for coastal strand (Transect 25), oak scrub, (Transects 3 and 15), and disturbed oak scrub (Transects 6 and 7) were calculated as 0.2 jays/ha, 0.85 jays/ha and 3.2 jays/ha, respectively (Breininger 1981). Habitat evaluation was conducted by interpretation of aerial infrared imagery of LCs 40 and 41, and ground truthing. Habitat areas were computed using an Alvin Model P1-655 compensating planimeter.

ORNL-DWG 89M-9559

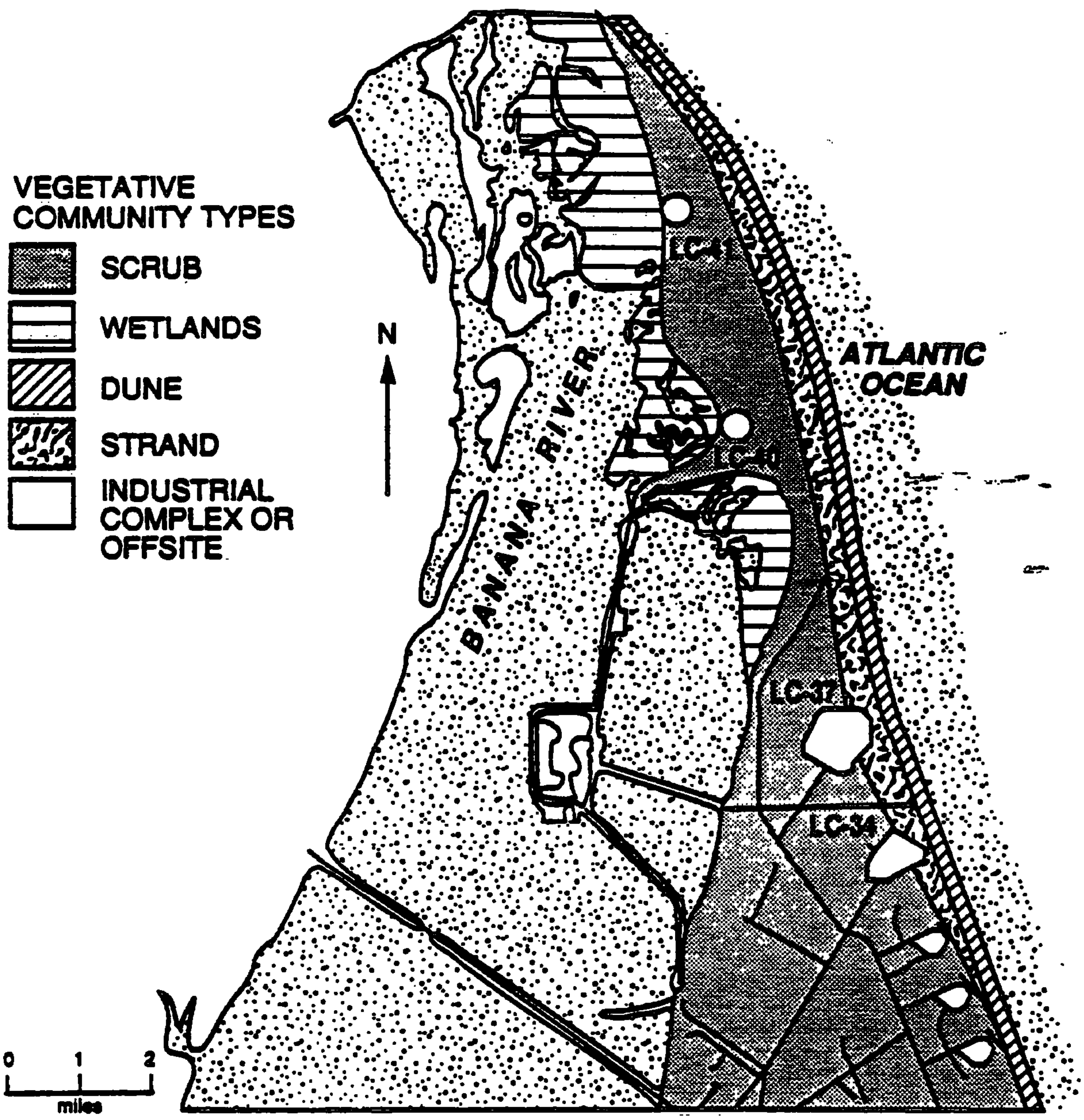


Fig. 2. Vegetation at Cape Canaveral Air Force Station, Florida.

Results are presented in Table 2. An estimated 444 jays were predicted within a 0.7-mi radius (1.1-km radius) of LCs 40 and 41. No confidence limits can be established for this estimate, therefore, a comparison was made using a different method.

Estimate #2 was derived from data collected at KSC using color-banded birds from 20 territories in disturbed and undisturbed scrub. Mean territory size of scrub jays was 2.4 ha in areas where mowed grass existed; unmowed territories averaged 6.9 ha. Mean group sizes were 3.7 and 3.2 birds for territories with, and without mowed grass, respectively (Breininger and Smith 1989). Habitat analysis was conducted using aerial imagery as described for Estimate #1. Minimum and maximum population estimates of 160 to 530 birds, respectively, were calculated by dividing total available scrub jay habitat (344 ha) by mean territory size (2.4 ha and 6.9 ha) then multiplying by mean group size (3.2 and 3.7 jays/territory) (Table 3). Estimate #1, based on habitat-specific densities, gave an estimated population of 444 jays, which falls within the 160-530 range.

Breininger (1989) estimated between 920 to 1,840 scrub jays at CCAFS (based on bird densities per hectare and hectares of available habitat) which is about 10% of the state population reported by Breininger (1989) based on Cox (1984, 1987). The estimated population at LCs 40 and 41 ranges, therefore, between 9 to 58% of the CCAFS population, or 1 to 6% of the state population.

3.2 SOUTHEASTERN BEACH MOUSE

3.2.1 Species Description

The southeastern beach mouse was listed by the FWS as a threatened species on May 12, 1989 (54 ***Federal Register*** 20598). The following species description is excerpted from the FWS proposed listing of the species (53 ***Federal Register*** 25185, July 5, 1988). The southeastern beach mouse is the largest of the beach mice, averaging 139 mm in total length and 52 mm in tail length. The mouse is restricted to sand dunes mainly vegetated by sea oats (*Uniola paniculata*) and dune panic grass (*Paspulum amarulum*) and to the adjoining scrub, characterized by oaks (*Quercus sp.*), sand pine (*Pinus clausa*), and palmetto (*Serenoa repens*). Extine and Stout (1987) studied dispersion and movements of *Peromyscus polionotus niveiventris* on Merritt Island. The habitat of these mice consisted of three contiguous zones of vegetation

Table 2. Scrub jay population estimate within 0.7 mile radius of LCs 40 and 41 at CCAFS based on KSC scrub jay density and habitat

Habitat type	Approximate area (hectares)	Jays/hectare[a]	Estimated population
<u>LC 40</u>:			
Coastal strand	34	0.2	6.8
Oak scrub	97.4	0.85	82.8
Oak scrub (disturbed)	<u>41.3</u>	3.2	<u>132.1</u>
Total	172.7		221.7
<u>LC 41</u>:			
Coastal strand	42.8	0.2	8.5
Oak scrub	83.7	0.85	71.1
Oak scrub (disturbed)	<u>44.5</u>	3.2	<u>142.4</u>
Total	171.0		222.0

*Scrub jay population for LCs 40 and 41 combined is estimated to be 444 birds.

[a]From Breininger, D. R. 1981. "Habitat preferences of the Florida scrub jay (*Aphelocoma coerulescens coerulescens*) on Merritt Island National Wildlife Refuge". Unpub. Master's thesis, Florida Institute of Technology, Melbourne, Florida.

Table 3. Scrub jay population estimate within 0.7 mile radius of LCs 40 and 41 based on minimum and maximum territory size of scrub jays on Merritt Island, Florida

1. Total available habitat = 344 ha
2. Minimum territory size = 2.4 ha[a]
3. Maximum territory size = 6.9 ha[a]
4. Mean group size = 3.2 birds (mowed grass not present)
3.7 birds (mowed grass present)
5. Maximum population size = $\frac{344}{6.9} \times 3.2 = 159.5$ birds
6. Maximum population size = $\frac{344}{2.4} \times 3.7 = 530$ birds

*Scrub jay population for LCs 40 and 41 combined is estimated to be 160 to 530 birds.

[a]From Breininger, D. R. and R. B. Smith 1989. "Relationships between habitat characteristics and territory size of the Florida scrub jay (*Aphelocoma coerulescens coerulescens*)". Supplement to the Bulletin of the Ecological Society of America, Vol. 70, No. 2.

running parallel with the beach and dune lines. Zone 1 was seaward and supported sea oats; Zone 2 was characterized by clumps of palmetto and sea grape (*Coccoloba uvifera*), and expanses of open sand; Zone 3 was interior and consisted of dense scrub dominated by palmetto, sea grape, and wax myrtle (*Myrica cerifera*). Zones 2 and 3 were found to be the preferred habitats of the beach mice, whereas Zone 1 was marginal.

Very little is known about the life history of any of the subspecies of beach mice. The food plants most utilized by beach mice are various beach grasses and sea oats. Beach mice also probably eat invertebrates from time to time, especially in late spring and early summer when seeds are scarce.

Beach mice are burrow-inhabiting animals. Burrow entrances are usually placed on the sloping side of a dune at the base of a shrub or clump of grass. Often old burrows of ghost crabs are utilized, but more commonly the burrows are dug by the mice themselves. A beach mouse's home range may contain up to 20 burrows in different parts of the range. The burrows are used as safe refuges, nesting sites, and food storage areas.

Along the Gulf Coast, much breeding activity was evident in November, December, and early January, and large numbers of immature animals were in the population at that time. Litter sizes range from two to seven, with an average of about four; young mice reach reproductive maturity as early as six weeks of age. In the laboratory, a female beach mouse is capable of producing 80 or more young during her lifetime, and litters are produced regularly at 26-day intervals. Mortality is very high, however. Only 19.5% of the beach mice on the Gulf Coast survived more than the four months from January to early May.

Beach mouse predators on the Gulf Coast dunes include raccoons, skunks, snakes, great blue herons, domestic dogs, and domestic cats. All of these predators occur on the Atlantic Coast and could prey on beach mice there as well.

The original distribution of the southeastern beach mouse (*P. p. niveiventris*) was along the beach dune from Ponce (Mosquito) Inlet, Volusia County, south along the coast to Hollywood Beach, Broward County. Recent studies have disclosed that this mouse still occurs in good numbers at Cape Canaveral and smaller numbers to the north in Cape Canaveral National Seashore. To the south, from Sebastian Inlet to Hutchinson Island, only a few small, scattered remnant populations survive. South of Hutchinson Island, nearly all the beach dune habitat has been totally destroyed by housing and condominium developments.

The dune grassland at Cape Canaveral is excellent, extensive habitat for beach mice (see Fig. 2), and the population density there is apparently high (see Sect. 3.2.2). Northward, the habitat narrows to a single dune in Canaveral National Seashore, where population density appears to be lower. To the south, beach mice no longer occur on East Peninsula, where the habitat has been severely disrupted by development. Sampling from Sebastian Inlet to Hutchinson Island shows that only a few, small, fragmented populations of beach mice remain. The subspecies apparently no longer occurs in the southern part of its range where beach development has destroyed its habitat at Jupiter Island, Palm Beach, Lake Worth, Hillsboro Inlet, and Hollywood Beach.

3.2.2 Distribution and Density of Beach Mice near LCs 40 and 41

3.2.2.1 Survey method

Four study sites were selected within distinct habitats in the vicinity of LC 40 on CCAFS (Fig. 3). Grid selection was based on the amount of homogenous habitat available, location in relation to potential impacts from launch vehicle emissions, and logistical constraints. Table 4 summarizes grid location, study design and trapping effort.

Table 4. Study sites, sampling design, and trapping effort used to estimate densities of southeastern beach mice at LC 40, Cape Canaveral Air Force Station, Florida

Grid	Location	Trapping dates (November 1989)	Rows and columns	Grid area (ha)	Trap-nights
1	Dune	19-23	5×20	0.76	400
2	Strand	21-25	11×14	1.3	516
3	Burned scrub	19-23	3×10	0.18	120
4	Xeric hammock	19-24	3×6	0.1	90

Grids were designed to accumulate capture-recapture data from a nested grid array of Sherman live traps set at 30 ft (10 m) intervals. Traps were baited with rolled oats each afternoon and checked the next morning. Each animal captured was fitted with a Salt Lake Stamp Co. Model FF ear tag and released at the point of capture.

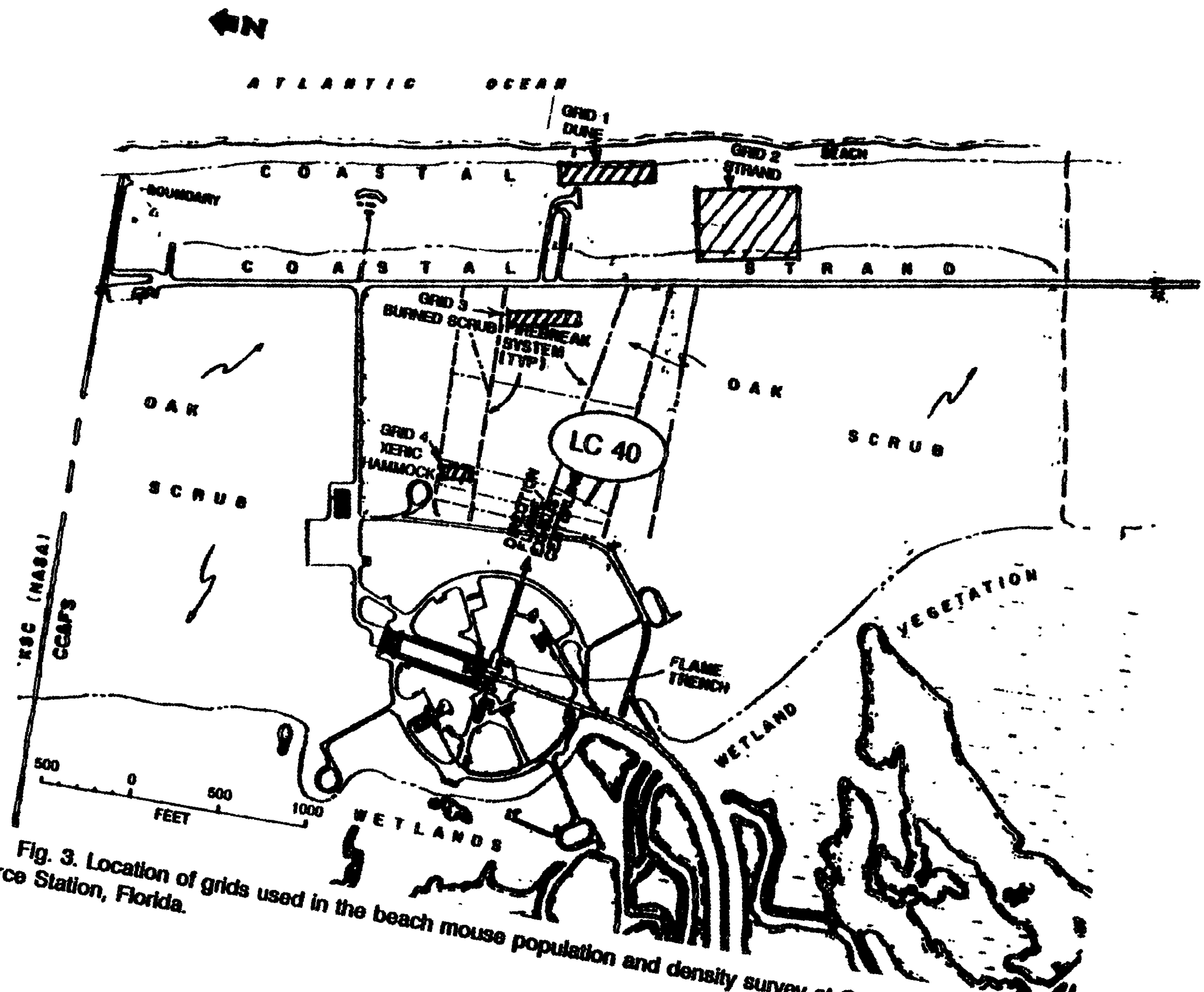


Fig. 3. Location of grids used in the beach mouse population and density survey at Cape Canaveral Air Force Station, Florida.

Data analysis on capture-recapture data was completed with the microcomputer version of the program CAPTURE, developed by the Utah Cooperative Wildlife Research Unit (1984). The program conducts seven chi-square goodness-of-fit and between-model tests for eight statistical population estimation models. These tests assess the fit of the data to each model and selects the simplest model that provides the best fit to the data (Humphrey 1988).

3.2.2.2. Analysis of data

CAPTURE provided population estimates for three of the four grids and density estimates for Grids 1 and 2 (Table 5).

Table 5. Probability models used to estimate population size and density of southeastern beach mice on Cape Canaveral Air Force Station, Florida, and corresponding population/density estimates

Grid	Model selected	Population estimate (± SE)[a]	95% confidence interval	Naive density estimate (n/ha)[a]	Adjusted density estimate (n/ha ± SE)[a]
1	Mh	90 ± 9.05	71-108	117.8	64.36 ± 19.3
2	Mh	282 ± 19.3	243-320	216.6	195.7 ± 24.4
3	Mo	25 ± 3.22	18-32	138.8	none
4	none	3[a]	none	30[a]	none

[a]SE = standard error, n = population, and ha = hectares.
[b]Based on minimum number of animals known alive on the grid.

Density estimates could not be produced for Grids 2 and 3 because they were too small for analysis. Sample size of captures at Grid 4 was too small for either density or population estimates from the program. The population estimate of 3 animals for the grid and a naive density of 30 animals per hectare was based on the minimum number of animals known to be alive on the grid.

A model which assumes heterogeneity of capture probabilities in the population (Mh) was chosen for Grids 1 and 2. Model Mo, which assumes equal capture probabilities within the population, was utilized to calculate the population in Grid 3.

The population at Grid 1 was estimated to be 71-108 animals with a 95% confidence interval. A naive density, which is the population estimate of the grid divided by the grid area, was calculated at 117.8. The adjusted density estimate, which considers that animals captured on grid edges have home ranges extending outside the grid boundaries, was 64.36 ± 19.3 [standard error (SE)]. Grid 2 had an estimated population of 243-320 animals, a naive density of 216.6 mice/ha and an adjusted density of 195.7 ± 24.4 mice/ha. Beach mice density for Grid 3 could not be estimated by CAPTURE; however, a population estimate of 25 ± 3.22 (18-32 with 95% confidence) was calculated.

3.2.2.3 Summary of results

Population Estimate for LC 40. Extrapolating the naive and adjusted beach mice densities from Grids 1-3 to all available habitats at LC 40 yielded a population estimate of 11.024-15,199 (Table 6).

Table 6. Beach mouse population estimate within 0.7 mile radius of the launch pad based on study grids at LC 40, Cape Canaveral Air Force Station, Florida

Habitat type	Area (ha)	Naive density (n/ha)[a]	Adjusted density (n/ha ± SE)[a]	Population estimates (individuals)
Coastal dune	11.2	—	64.36 ± 19.3	298-1,153
Coastal strand	34	—	195.7 ± 24.4	4,994-8,314
Disturbed scrub	41.3	138.8	—	5,732
Total suitable habitat	86.5			11,024-15,199

[a]n = population, ha = hectares, and SE = standard error.

Although 3 beach mice were captured in xeric oak scrub hammock, these individuals were believed to have been transients from a nearby section of scrub that had burned 6 months prior. Therefore, no population estimate was calculated for dense, oak scrub habitat, which comprises about 97 ha of the potentially impacted area.

Population Estimate for LC 41. Assuming similar beach mice densities exist at LC 41 as calculated for LC 40 and extrapolating those densities to all suitable habitat, a population estimate of 13,042-18,940 is suggested (Table 7).

Data obtained from trapping in selected habitats at LC 40 suggest that southeastern beach mice exist at moderate to very high densities in at least three distinct habitats: dune grassland, coastal strand and disturbed (burned) coastal scrub. To estimate populations, it was assumed that mice density in mechanically disturbed scrub would be similar to that in burned scrub, because the limiting factor of inhabitation is related to scrub density and canopy closure.

Although no trapping has been conducted at LC 41 to determine mice densities there, it can reasonably be assumed that because the habitats are similar at both complexes, beach mice densities are similar.

Table 7. Beach mouse population estimate within 0.7-mile radius of the launch pad at LC 41 based on beach mice densities obtained from LC 40, Cape Canaveral Air Force Station, Florida

Habitat type	Area (ha)	Naive density (n/ha)[a]	Adjusted density (n/ha ± SE)[a]	Population estimates (individuals)
Coastal dune	22.4	—	64.36 ± 19.3	577-2,305
Coastal strand	83.7	—	195.7 ± 24.4	6,288-10,464
Disturbed scrub	44.5	138.8	—	6,177
Total suitable habitat	150.6			13,042-18,946

[a]n = population, ha = hectares, and SE = standard error.

4. IMPACTS TO THREATENED SPECIES

4.1 HABITAT DESTRUCTION OR DISTURBANCE

The FWS has designated no critical habitat for the Florida scrub jay or the southeastern beach mouse at CCAFS, although the predominant on-site coastal scrub, strand, and dune vegetation are excellent habitat for both species (Fig. 4). Construction activities associated with renovations of LCs 40 and 41 to support the Titan IV program will not destroy or significantly disturb scrub jay or beach mouse habitat. Most construction will occur on previously disturbed land; therefore, impacts to habitat will be minimal, and populations of threatened species will not be adversely affected.

Acidic deposition from hydrogen chloride (HCl) in the ground cloud that forms following ignition and combustion of the Titan IV 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 LCs 40 and 41 (Figs. 5 and 6), extending about 600 ft (182 m) out from the launch pad. During launch, this area will experience intense heat and pressure (noise, vibrations), and concentrations of SRM exhaust will be extremely toxic. 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.

4.2 EFFECTS OF LAUNCH VEHICLE EXHAUST AND GROUND CLOUD

Launch of Titan IV vehicles will produce atmospheric emissions from the combustion of the SRMs (Type 1 or 2 vehicles). The combustion products listed in Table 8 would be distributed along the vehicle trajectory to an altitude of roughly 31 mi (50 km). However, because of the gradual acceleration of the vehicle off the launch pad, the emissions per unit length would be much greater near the ground, and would form a *ground cloud*. During the early stages of formation and transport, the ground cloud would contain large amounts of SRM chemical constituents [hydrogen chloride (HCl), carbon monoxide (CO), and aluminum oxide (Al_2O_3)] in both gaseous and aerosol form.

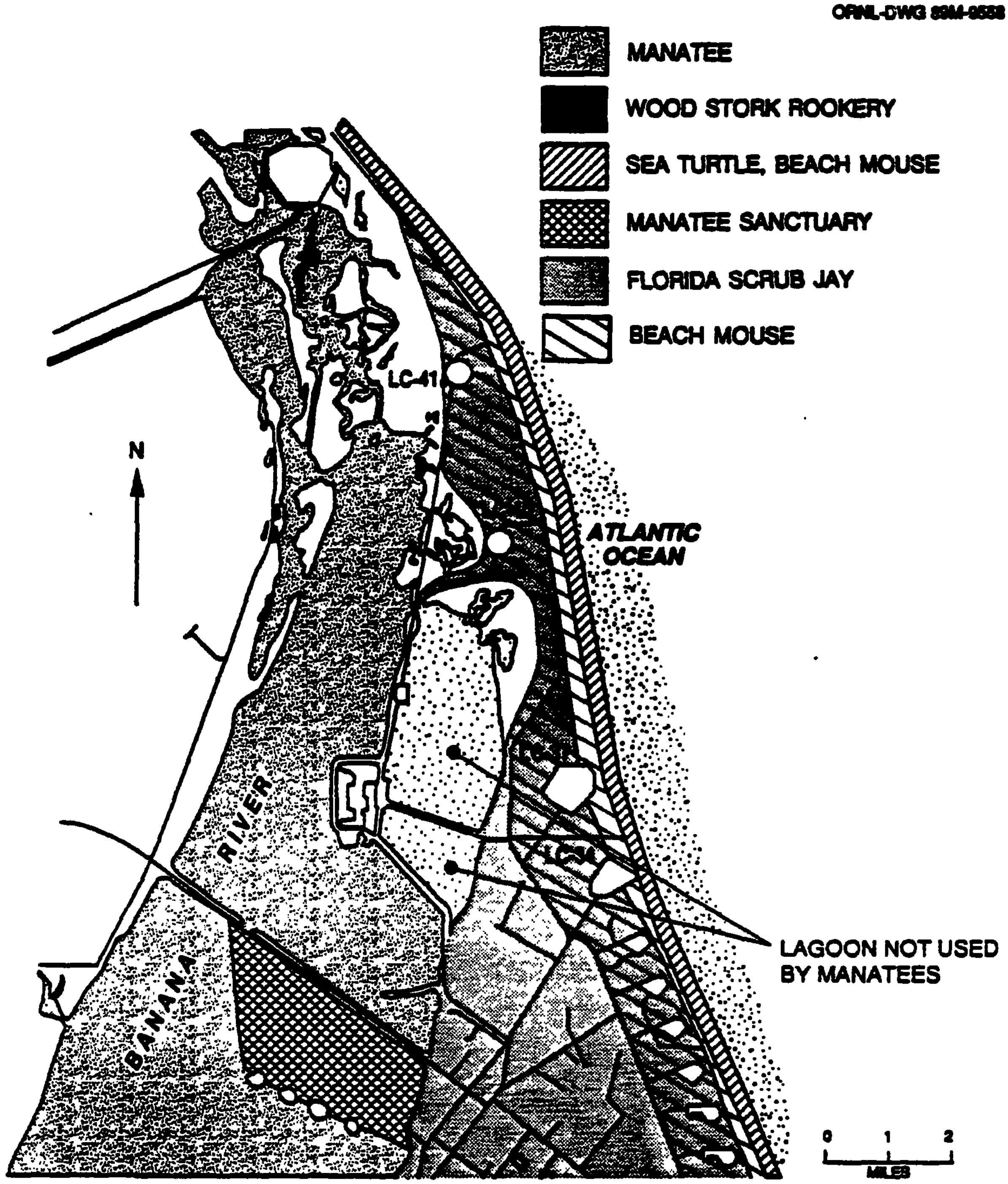


Fig. 4. Habitats of threatened and endangered species at Cape Canaveral Air Force Station, Florida.

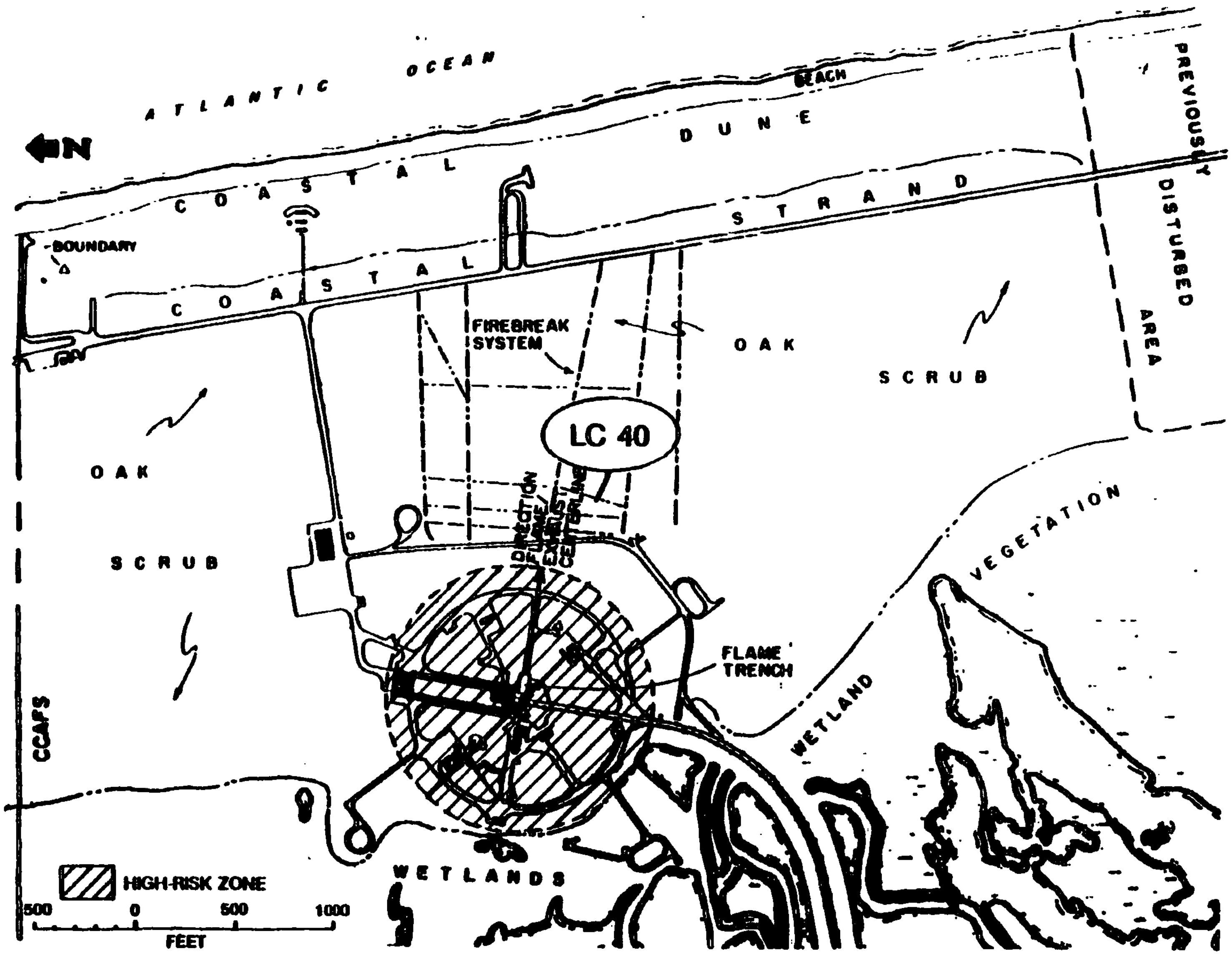


Fig. 5. High-risk zone for biota at Launch Complex 40 at Cape Canaveral Air Force Station, Florida. *During Titan IV launch, this area will experience intense heat and pressure, and the concentration of hydrogen chloride in the solid rocket motor exhaust will be highly toxic.*

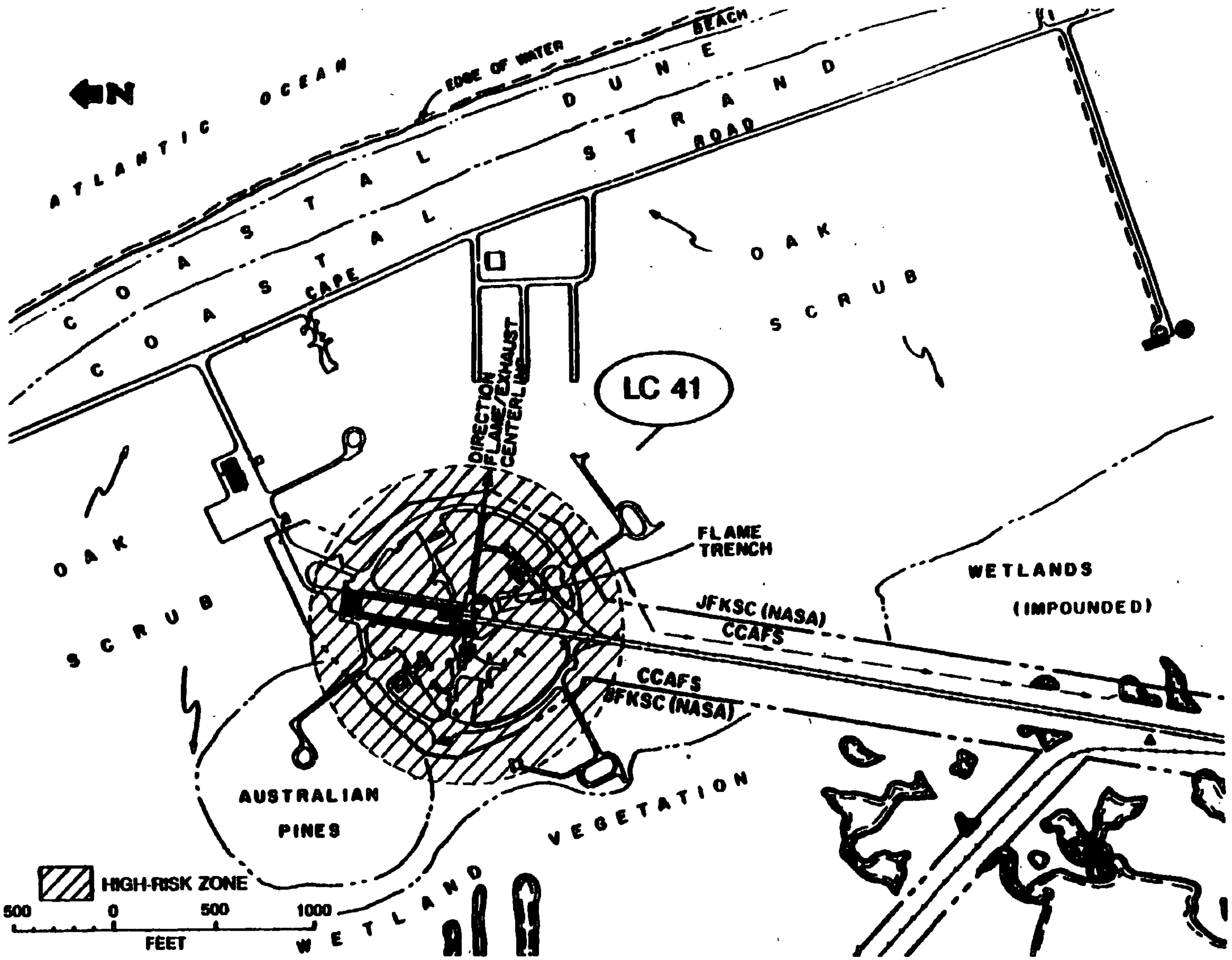


Fig. 6. High-risk zone for biota at Launch Complex 41 at canaveral Air Force Station, Florida. *During Titan IV launch, this area will experience intense heat and pressure, and the concentration of hydrogen chloride in the solid rocket motor exhaust will be high' xic.*

Table 8. Combustion products at the nozzle exit plane for Titan IV–Type 1 and Titan IV–Type 2 (SRMU) stage zero boosters[a]

Combustion Product	Titan IV–Type 1		Titan IV–Type 2 (SRMU)	
	Wt %	Wt (tons)	Wt %	Wt (tons)
Al_2O_3	30.45	180.2	35.88	244.2
CO	27.50	162.7	21.93	149.3
CO_2	2.97	17.6	2.49	17.0
Cl^-	0.05	0.3	0.25	1.7
$FeCl_2$	0.39	2.3	0.00	0.0
HCl	20.67	122.3	21.14	143.9
H_2	2.48	14.7	2.21	15.1
H_2O	6.97	41.2	7.69	52.3
N_2	8.50	50.3	8.34	56.8

[a]Total emissions from two solid rocket motors; emissions would be distributed along a trajectory from ground level to an altitude of 31 miles (50 km).

4.2.1 Maximum Potential Gaseous HCl Concentrations

The Titan IV/SRMU EA (USAF 1989) describes far-field [greater than 3 miles (5 km) from the launch pad] ground-level HCl concentrations predicted by the Rocket Exhaust Effluent Dispersion Model (REEDM) for a 1-hr averaging period. The highest predicted 1-hr concentration was 0.22 parts per million (ppm). REEDM estimates for a 1-hr period were used as a basis for comparison with the maximum 1-hr public exposure level (1 ppm) recommended by the National Research Council. The peak ground-level HCl concentration predicted by REEDM beyond 3 miles (5 km) was 12.3 ppm.

For a near-field [within 3 miles (5 km) of the launch pad] impact assessment, short-term maximum ground-level HCl concentration predictions are needed. Because the REEDM model is not an appropriate tool for predicting concentrations in the near field, other sources of near-field model predictions were explored, and measured HCl concentration data were obtained for previous Titan III launches. Table 9 summarizes gaseous HCl modeling results ("box model" and REEDM) for the Titan IV-Type 2 (SRMU), which has 15% more propellant than the Titan IV-Type 1, and HCl measurements aloft for two Titan III launches. The Titan III SRMs contain about 2/3 of the propellant mass of the Titan IV SRMUs. The concentrations in the

Table 9. Modelled and measured gaseous HCl concentrations in Titan launch vehicle ground clouds

Launch vehicle	Distance (km)	Height (km)	HCl concentration (ppm)	Source
Titan IV/SRMU	<0.6	ground level	150	Box model
Titan III[a]	0.5	0.5	28 (peak)	Measured aloft for 9/5/77 launch at L + 2.5 minutes
Titan III[a]	2.4	1.1	30 (peak)	Measured aloft for 8/20/77 launch at L + 4 minutes
Titan IV/SRMU	>5.0	ground level	12.3 (peak)	Peak ground-level REEDM, worst-case meteorology

[a]*Sources*: Pellett et al. 1983. HCl in Rocket Exhaust Clouds: Atmospheric Dispersion, Acid Aerosol Characteristics, and Acid Rain Deposition. J. of the Air Poll. Control Assoc., 33:304-311, and personal communication between E. J. Liebsch, Oak Ridge National Laboratory, Oak Ridge, TN, and G. L. Pellett, NASA Langley Research Center, Hampton, VA, November 7, 1989.

table are reported for gaseous HCl (the measured values were converted from gaseous plus aerosol HCl to gaseous HCl only) although some of the HCl in the SRM exhaust cloud exists as an aerosol.

The assumptions used for the ground cloud box model calculation were:

1) 5% of the SRM exhaust is contained in the ground cloud. This is roughly the fraction that would be produced in 6-7 seconds of SRM firing. After this time, the exhaust is assumed to be emitted well above ground level.

2) The volume of the box is described by a pancake-shape with a diameter of 1800 ft (600 m) and vertical depth of 300 ft (100 m).

3) The HCl is uniformly mixed in the box volume.

The dynamics of ground-cloud development are much more complex than those represented in a simple box model characterization. Near the launch pad and flame trench, (see Figs. 5 and 6) the HCl concentrations would be much higher (thousands of ppm) than those calculated for the uniformly mixed box (150 ppm). However, because of the extreme mechanically and thermally induced turbulence generated by the exhaust the ground cloud dilutes very rapidly. Supporting evidence has been offered by observations of two Titan III launches (Table 9), which indicated that the ground cloud volume was about 1-2 km^3 at 4 minutes after launch (personal communication, E. J. Liebsch, Oak Ridge National Laboratory, Oak Ridge, TN, with G. L. Pellett, NASA Langley Research Center, Hampton, VA, Nov. 7, 1989). This is 35-70 times greater than the volume assumed for the box model calculation. Therefore, the actual ground cloud volume for a Titan IV launch probably exceeds that assumed for the box model calculation within a few seconds after launch.

Another important factor is that the ground cloud typically ascends within one minute after launch, or within 0.3 miles (0.5 km) of the pad under most wind conditions. This does not mean that no exhaust constituents would remain at ground level. However, ground level HCl concentrations would be much less than those measured aloft, because most of the HCl will rise with the buoyant ground cloud. In fact, the peak Titan III ground cloud HCl concentrations measured aloft (Table 9) are probably much greater than the peak ground level concentrations at the same downwind distances.

Based on the data and estimates in Table 9, Figure 7 presents a graphic representation of the estimated maximum potential ground-level HCl concentrations for the CCAFS vicinity following a Titan IV launch. The concentrations are conservative peak values. The exposure areas are shown as circles to indicate that the ground cloud could move in any direction for a

ORNL-DWG 89-19211

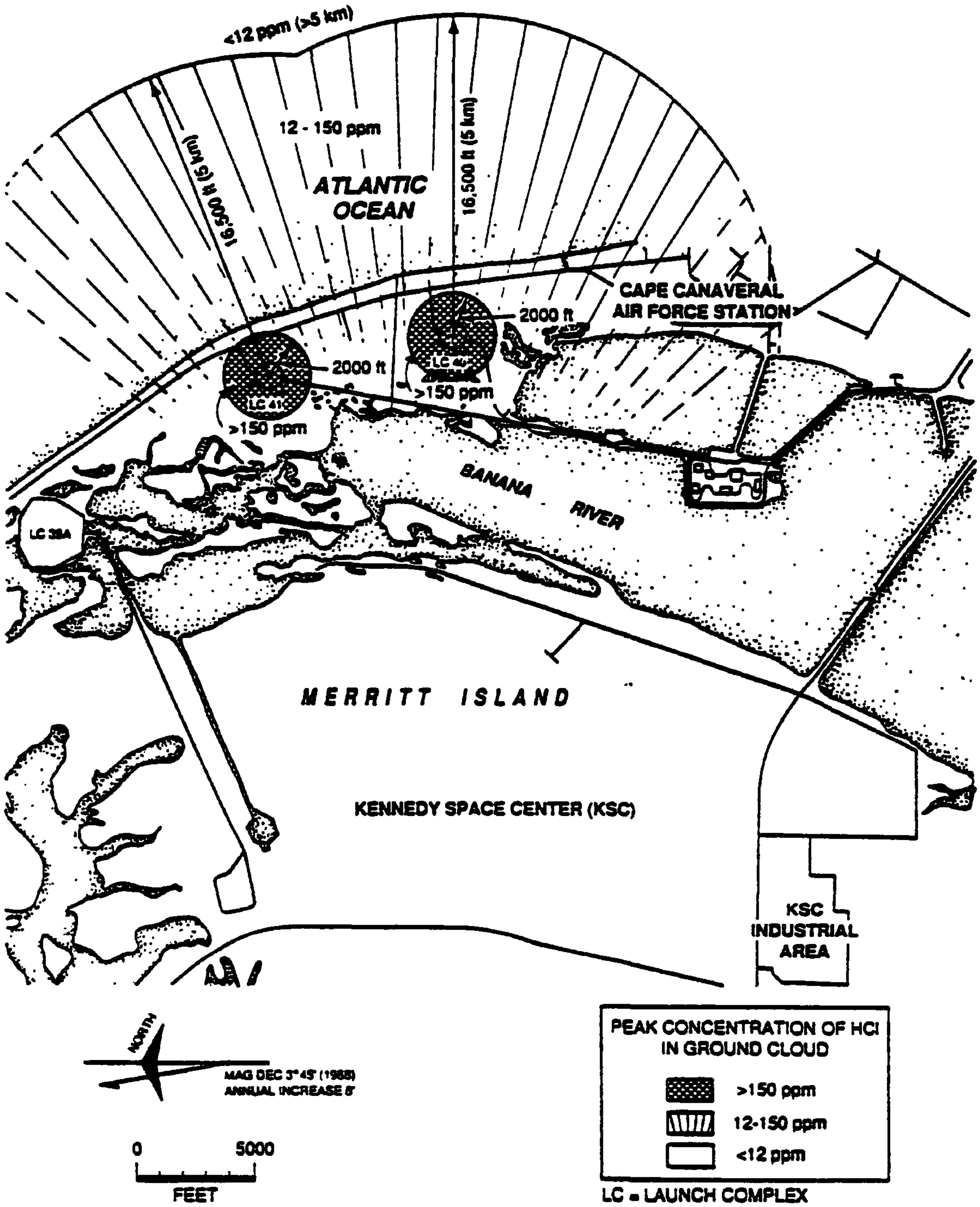


Fig. 7. Maximum potential peak ground-level hydrogen chloride (HCl) concentrations estimated for the normal launch of a Titan IV vehicle.

given launch, depending on the wind direction. Obviously, only a narrow corridor downwind of the launch pad would receive gaseous HCl exposure after each launch. Also, the centers of the exposure radii are shown as being at the launch pad. In reality, the initial ground cloud position is probably skewed slightly toward the ocean, because the flame trenches at both LC 40 and LC 41 direct the initial SRM exhaust toward the east (see Figs. 5 and 6).

Estimated peak ground-level concentrations of hydrogen chloride between 0.4 to 3 miles (0.6 to 4.8 km) beyond the launch pad are less than 5% of the lowest lethal concentration value (3,200 parts per million) reported for laboratory rats and mice exposed to either hydrogen chloride gas or aerosol for 5 minutes (Darmer et al. 1974). Therefore, beach mouse fatalities would not be expected at these distances. Within 0.4 miles (0.6 km) of the pad, hydrogen chloride concentrations would exceed 150 ppm, and near the flame trench, could be as high or higher than the lowest lethal concentration. However, intense sound pressures and heat would also be present during the 2-3 seconds of combustion on the pad, therefore, fatalities and/or injuries to transient birds or mice near the pad could be expected from any of these factors. Because no data are available for the lethal concentrations of HCl affecting birds, a similar conclusion regarding the effects of the gas cloud on scrub jays beyond 0.4 miles (0.6 km) from the pad can only be extrapolated from experimental studies with mice.

4.3 EFFECTS OF NOISE FROM LAUNCH

The launch of a Titan IV vehicle produces short-term, intense, low frequency noise as a result of the combustion of the SRM and the interaction of the exhaust jet with the atmosphere. Both Type 1 and Type 2 Titan IV vehicles will produce a maximum sound pressure of about 170 decibels (dB) in the immediate vicinity of the launch pad. Noise levels would attenuate with distance, and levels of about 125 dB would be expected at a distance of 2 mi (3.2 km) for about 30 seconds following launch. This level is roughly equivalent to that of a jet taking off from a distance of 200 ft (66 m). Continuous or repeated exposure to these levels can cause hearing damage in humans.

Information on the nature and effects of short-term exposure of wildlife to intense noise levels is sparse. Brattstrom and Bondello (1983) found that the fringe-toed lizard, desert kangaroo rat, and Couch's spadefoot toad all suffered hearing loss when exposed to off-road vehicle sounds of 95 dB (A-weighted) for less than 9 minutes. No other literature is known to document the effects of short-term exposure to noise within the 95-125 dBA range. Field surveys have been conducted following Space Shuttle launches from KSC and a June 1989 launch of a Titan IV vehicle from LC 41. Two scrub jays in the near-field area east of LC 41 did not respond to warning calls shortly after launch. In contrast, following the launch of Shuttle mission 34, scrub jays west of the pad displayed normal behavior and responded to calls. As part of the Titan IV monitoring program, field studies will be conducted immediately prior to and following each Titan IV launch to document the response of the scrub jay to calls. In addition, the USAF will work closely with the FWS to develop a methodology for investigating the long-term effects of intense noise levels on surrogate species for the scrub jay and the beach mouse.

4.4 SECONDARY IMPACTS

Secondary or indirect impacts to threatened species can result from habitat destruction associated with community growth and development induced by new economic activities, such as the Titan IV program. In-migration of workers and their families for construction and operation of the program has been estimated at 810, a population increase of less than 1% of the projected 1990 population for the region. Because this increase is negligible, it is highly unlikely that the Titan IV program will induce an increased demand for community services or that the regional economy will be stimulated. Thus, it can be concluded that neither the habitat or the population of scrub jays and beach mice will be indirectly and adversely affected by the effects of the Titan IV program on residential and industrial growth in the region.

4.5 CUMULATIVE IMPACTS

Cumulative impacts are the direct and indirect impacts of the Titan IV program in combination with the identifiable effects of other actions at CCAFS. Two other launch programs are planned at CCAFS during the same time period as the Titan IV program: the MLV I, which will launch Delta vehicles, and the MLV II, which will launch Atlas vehicles. The Delta vehicle uses SRMs having a similar chemical composition as the Titan, but in much smaller quantities. The Atlas vehicle does not use SRMs. Launches of Delta and Atlas vehicles will occur at LCs 17 and 36, which are located several miles south of LCs 40 and 41 (see Fig. 1).

Potential cumulative impacts to the scrub jays and beach mice could result from habitat destruction or disturbance associated with the three programs and from vehicle launches. Neither the MLV I nor II program will destroy or significantly disturb habitat or forage for either species, therefore, cumulative impacts to habitat would not be expected. Delta launches will produce a ground cloud containing HCl, but it will not directly or indirectly affect the populations of scrub jays or beach mice near LCs 40 or 41, therefore, cumulative impacts from launch vehicle emissions would not be expected.

4.6 MONITORING AND MITIGATION

The USAF will survey scrub jay and beach mouse populations near LCs 40 and 41 during the Titan IV program. The frequency and methodology of the surveys will be defined during further consultation with the FWS. In addition, prior to each launch, a walk-through survey of the area within the high-risk zones at the LCs (see Figs. 5 and 6) and outward in the direction of the flame/exhaust will be conducted to roughly approximate the density of scrub jays and to identify nests during the breeding season. During launch, noise levels will be measured, and field investigations following launch will determine near- and far-field acidic deposition; injuries and fatalities to birds, mice, and other species; changes in pH in nearby wetlands; and the responsiveness of scrub jays to warning calls immediately after launch and for several days following launch. A beach mouse density and distribution survey will be conducted to establish baseline population data at LC 41 to validate data extrapolation in this assessment.

The USAF will continue to work with the FWS to develop and implement an experimental program to document the long-term effects of launch-related noise on surrogate species for the scrub jay and beach mouse. The surrogate species will be identified during USAF-FWS consultation.

If future surveys indicate changes in the habitat or population of either species at LCs 40 and 41, the FWS will be consulted and appropriate mitigation measures developed. If an incidental take occurs, individuals will be visually assessed, and a post-mortem examination and toxicology analysis will be performed, if required, to determine the cause of death.

4.8 SUMMARY

This Biological Assessment of potential impacts to two federally listed threatened species, the Florida scrub jay and the southeastern beach mouse, has presented evidence to support a determination that significant adverse impacts to either species will not result from the U.S. Air Force Titan IV launch program. No suitable habitat for either species exists within the high-risk zone that extends about 600 ft (182 m) from the launch pad to the perimeter fence of launch complexes 40 and 41. During launch, intense heat and pressure and lethal concentrations of hydrogen chloride gas will be present within the high-risk zone, and transient birds or mice in this area could be adversely affected. Adverse impacts beyond the perimeter fence are not expected. Ground-level gaseous hydrogen chloride concentrations beyond 0.4 miles (0.6 km) from the launch pad will be less than 5% of the lowest lethal concentration reported for mice in laboratory studies. Temporary hearing loss may be experienced by both species, thereby increasing their susceptibility to predation; however, significant changes in population size would not be expected. Historical observations of Space Shuttle and earlier Titan program launches support the conclusion that adverse effects are unlikely outside the high-risk zone.

Questions or requests for additional information regarding this assessment should be directed to:

Mr. Olin Miller
6550th ABG/DEEV
Patrick Air Force Base, Florida
(407) 494-7288

REFERENCES

Brattstrom, B. H., and M. C. Bondello 1983. "Effects of Off-Road Vehicle Noise on Desert Vertebrates," pp. 167-206 in R. H. Webb and H. G. Wilshire (eds.), *Environmental Effects of Off-road Vehicles: Impacts and Management in Arid Regions.* Springer-Veriag, New York.

Breininger, D. R. 1981. Habitat preferences of the Florida scrub jay (Aphelocoma coerulescens coerulescens) as Merritt Island National Wildlife Refuge. Unpublished Master's Thesis, Florida Institute of Technology, Melbourne, Florida.

Breininger, D. R. 1989. "A new population estimate for the Florida scrub jay on Merritt Island National Wildlife Refuge," *Florida Field Naturalist*, 17:25-31.

Breininger, D. R. and R. B. Smith 1989. "Relationships between habitat characteristics and territory size of the Florida scrub jay *(Aphelocoma coerulescens coerulescens)*", Supplement to the Bulletin of the Ecological Society of America, Vol. 70, No. 2.

Cox, J. 1984. Distribution, habitat, and social organization of the Florida scrub jay, with a discussion of the evolution of cooperative breeding in New World jays. Gainesville, Florida: Ph.D. dissertation, University of Florida.

Cox, J. 1987. Status and distribution of the Florida scrub jay. Gainesville, Florida: Florida Ornithological Society Special Publ. No. 3.

Darmer, Jr., K. I., E. R. Kinkead, and L. C. DiPasquale 1974. "Acute toxicity in rats and mice exposed to hydrogen chloride gas and aerosols. American Industrial Hygiene Association Journal, October.

Extine, D. D., and I. J. Stout 1987. "Dispersion and habitat occupancy of the beach mouse, *(Peromyscus polionotus niveiventris)*," *J. Mamm.* 68:297-304.

Humphrey, S. R. 1988. "Density estimates of the endangered Key Largo woodrat and cotton mouse (*Neotoma floridana smalli* and *Peromyscus gossypinus allapaticola)*, using the nestid-grid approach." *J. Mamm*, 69(3):524-531.

U. S. Air Force (USAF) 1989. Preliminary Final Environmental Assessment, Titan IV/Solid Rocket Motor Upgrade Program, Cape Canaveral Air Force Station, Florida, and Vandenberg Air Force Base, California. August.

Utah Cooperative Wildlife Research Unit 1984. CAPTURE computer program (available from Colorado State University, Department of Fishery and Wildlife Biology).

White, Dr. Gary C., Department of Fishery and Wildlife Biology, Colorado State University, Ft. Collins, CO 80523.

APPENDIX C

CONSULTATION WITH STATE HISTORIC PRESERVATION OFFICES AND THE NATIONAL MARINE FISHERIES SERVICE

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS SPACE DIVISION (AFSC)
LOS ANGELES AIR FORCE BASE, PO BOX 92960
LOS ANGELES, CA 90009-2960

June 9, 1989

Mr. George W. Percy
State Historic Preservation Officer
Bureau of Historic Preservation
Division of Archives, History
and Records Management
Department of State, The Capitol
Tallahassee, Florida 32301-8020

Dear Mr. Percy:

The U.S. Air Force (USAF), Space Systems Division, is preparing an Environmental Assessment (EA) to evaluate the expansion of Titan IV program launches to include the use of Solid Rocket Motor Upgrade (SRMU). The proposed action involves modification of existing launch complexes and support facilities and the construction and operation of a new Solid Motor Assembly Building (SMAB) at Cape Canaveral Air Force Station (CCAFS), Florida.

The facilities at CCAFS that would be affected by the proposed action are located in the northwest portion of the base, as indicated in Attachment 1. The existing facilities to be modified include Launch Complexes (LCs) 40 and 41 and the existing Titan Integrate-Transfer-Launch Complexes (ITL) Area immediately to the south of the LCs. The LCs and the ITL Area are industrial in character and are located on previously disturbed land.

The proposed new SMAB is to be constructed on a 45-acre site on the narrow man-made causeway in the Banana River. The construction would begin with the decommissioning of hypergolic propellant storage facilities and the removal of railroad tank cars and spur tracks at the proposed location. The SMAB would consist of an approximately 60,000 square foot, high-bay structure with railroad tracks integral to the design. Titan IV solid-fueled rocket motor segments would be tested, assembled, and stored in the SMAB prior to transport to CCAFS LC 40 or 41. Because the causeway is man-made, no archaeological resources are expected to be disturbed during excavation and earthwork. There are no known historic structures on the causeway, although several sites eligible for the National Register of Historic Places are located at various launch complexes nearby at CCAFS.

To comply with the requirements of Section 106 of the National Historic Preservation Act, the Air Force is requesting that you provide us with official comment regarding the potential for significant adverse impacts to any archaeological, cultural, and historic resources at CCAFS as a result of the proposed Titan IV/SRMU program. Correspondence from your office will be reproduced in an appendix to the EA.

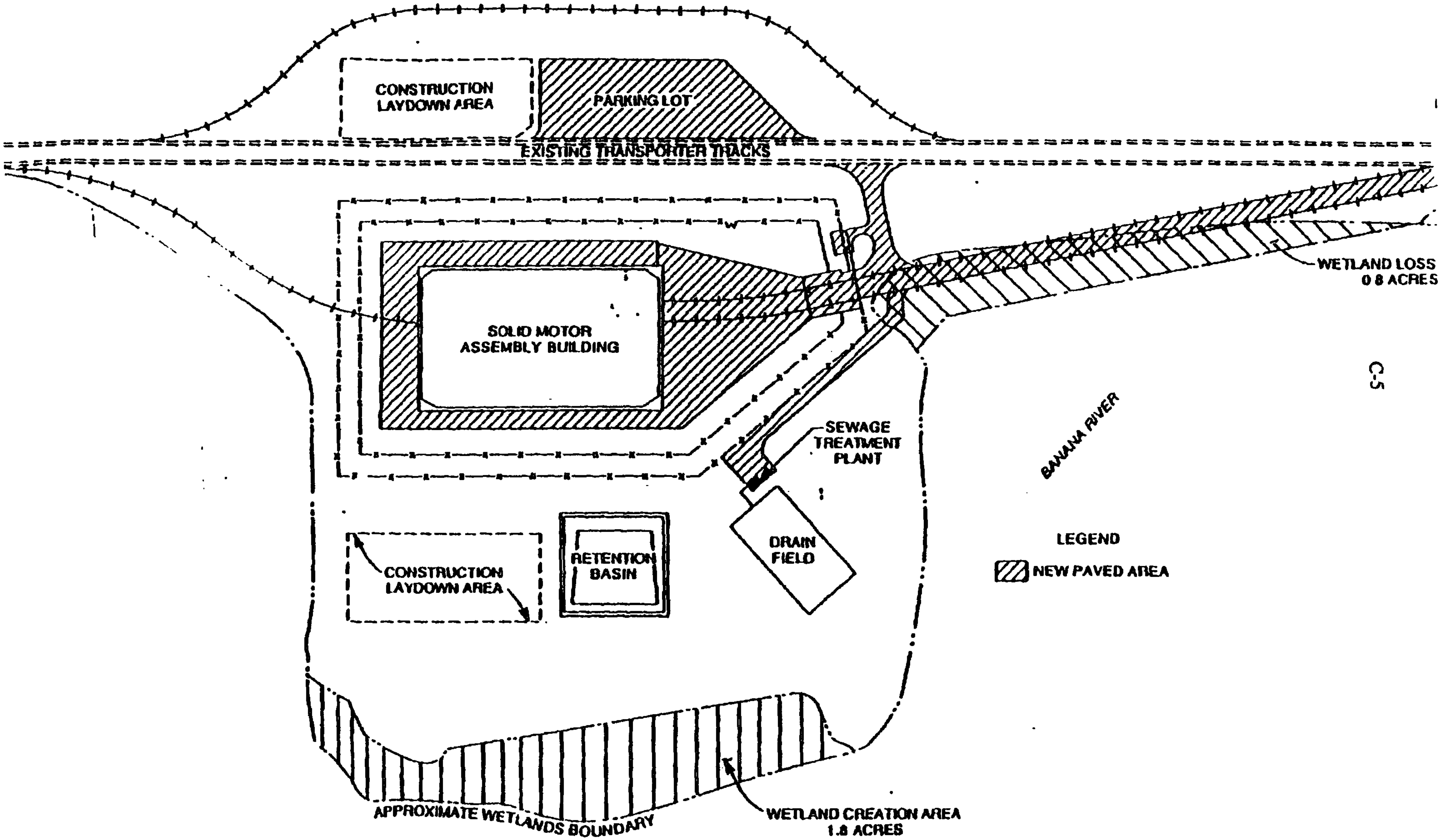
Mr. Dan Pilson can provide you with further details on this project if needed. His phone number is (213) 643-1409. As this project is on a tight schedule, we would appreciate hearing from your office as soon as possible.

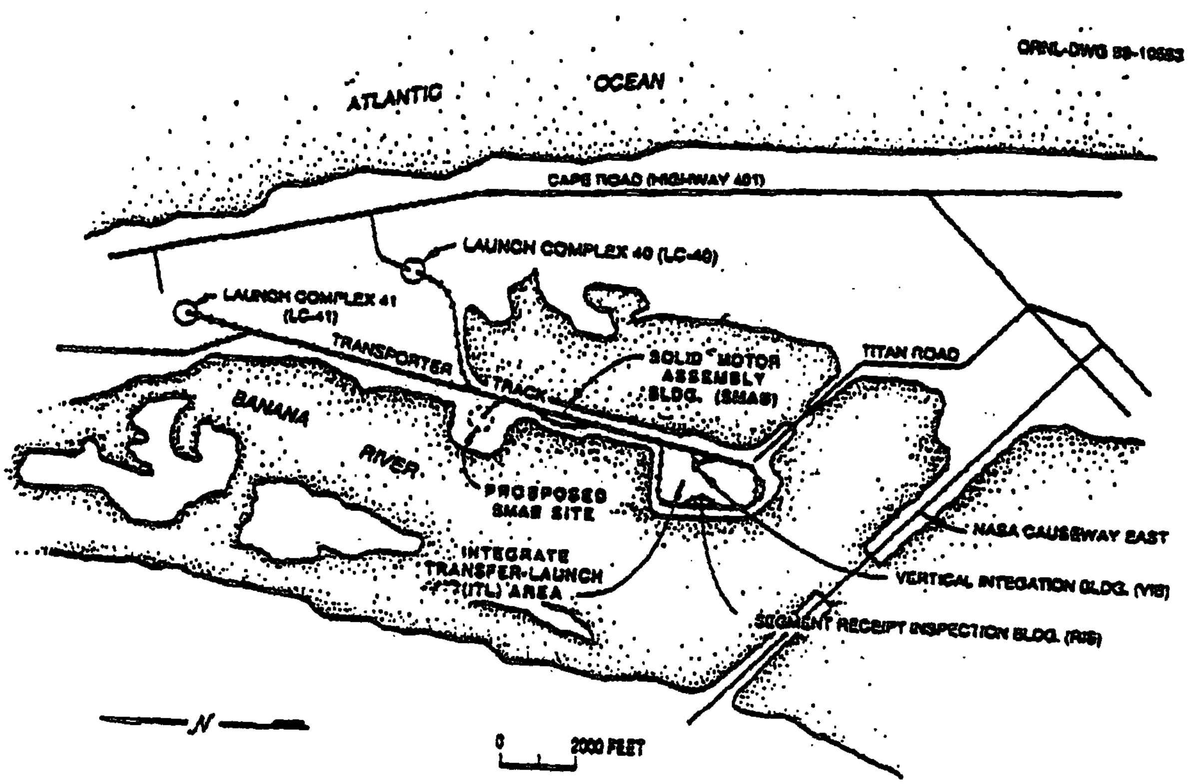
Sincerely,

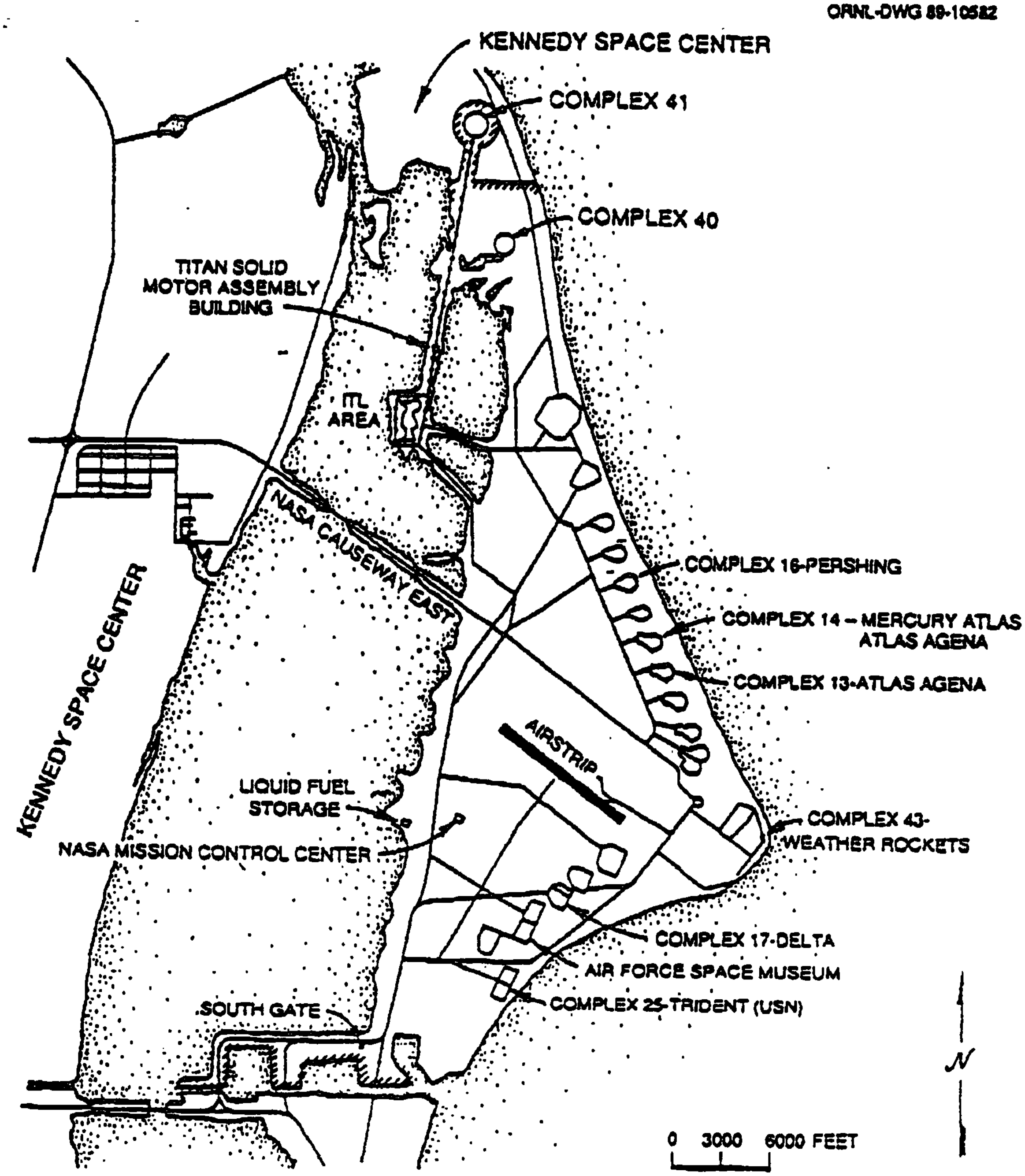
Robert C Mason

ROBERT C. MASON, AICP
Chief, Environmental Planning Division,
Directorate of Acquisition Civil Engineering

Attachment: Maps of CCAFs project area and SMAB layout


CONSTRUCTION
LAYDOWN AREA
PARKING LOT
EXISTING TRANSPORTER TRACKS
WETLAND LOSS
0.8 ACRES
SOLID MOTOR
ASSEMBLY BUILDING
SEWAGE
TREATMENT
PLANT
BANANA RIVER
DRAIN
FIELD
RETENTION
BASIN
CONSTRUCTION
LAYDOWN AREA
LEGEND
NEW PAVED AREA
APPROXIMATE WETLANDS BOUNDARY
WETLAND CREATION AREA
1.8 ACRES


ORNL-DWG 89-10583
ATLANTIC OCEAN
CAPE ROAD (HIGHWAY 401)
LAUNCH COMPLEX 40 (LC-40)
LAUNCH COMPLEX 41 (LC-41)
TRANSPORTER TRACK
SOLID MOTOR ASSEMBLY BLDG. (SMAB)
TITAN ROAD
BANANA RIVER
PROPOSED SMAB SITE
INTEGRATE TRANSFER-LAUNCH (ITL) AREA
NASA CAUSEWAY EAST
VERTICAL INTEGATION BLDG. (VIB)
SEGMENT RECEIPT INSPECTION BLDG. (RIS)
N
0 2000 FEET


ORNL-DWG 89-10582
KENNEDY SPACE CENTER
COMPLEX 41
COMPLEX 40
TITAN SOLID
MOTOR ASSEMBLY
BUILDING
ITL
AREA
NASA CAUSEWAY EAST
KENNEDY SPACE CENTER
COMPLEX 16-PERSHING
COMPLEX 14 – MERCURY ATLAS
ATLAS AGENA
COMPLEX 13-ATLAS AGENA
AIRSTRIP
LIQUID FUEL
STORAGE
NASA MISSION CONTROL CENTER
COMPLEX 43-
WEATHER ROCKETS
COMPLEX 17-DELTA
AIR FORCE SPACE MUSEUM
COMPLEX 25-TRIDENT (USN)
SOUTH GATE
N
0 3000 6000 FEET

FLORIDA DEPARTMENT OF STATE
Jim Smith
Secretary of State
DIVISION OF HISTORICAL RESOURCES
R.A. Gray Building
500 South Bronough
Tallahassee, Florida 32399-0250
Director's Office (904) 488-1480
Telecopier Number (FAX) (904) 488-3353

June 30, 1989

Robert C. Mason, Chief
Environmental Planning Division
Department of the Air Force
Headquarters Space Division
Los Angeles Air Force Base
P.O. Box 92960
Los Angeles, California 90009-2960

In Reply Refer To:
Susan M. Henefield
Historic Sites Specialist
(904) 487-2333
Project File No. 891535

RE: Your June 9, 1989, Letter and Attachments
Cultural Resource Assessment Request
Expansion of Titan IV Program Launches
Cape Canaveral Air Force Station, Brevard County, Florida

Dear Mr. Mason:

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 judgment 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, or local significance. The project 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

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS SPACE DIVISION (AFSC)
LOS ANGELES AIR FORCE BASE, PO BOX 92960
LOS ANGELES, CA 90009-2960

June 9, 1989

Ms. Kathryn Gualteri
State Historic Preservation Officer
Department of Parks and Recreation
P. O. Box 2390
Sacramento, California 95811

Dear Ms Gualteri:

The U.S. Air Force (USAF), Space Division proposes to expand its existing Titan IV program at Vandenberg Air Force Base (VAFB), California to provide increased launch vehicle processing capabilities to support launch of the Titan IV/Solid Rocket Motor Upgrade. The proposed changes for the Titan IV program at VAFB include modifications at Space Launch Complex 4 East (SLC-4E) to accommodate the Solid Rocket Motor Upgrade (SRMU), modifications to the Solid Rocket Sub-assembly Facility (SRSF, Building 398) at SLC-6, launch of up to four Titan IV/SRMU vehicles per year, land disposal of the washdown wastewater from Titan IV launches in evaporation ponds at SLC-6.

The facilities at VAFB that would be affected by the proposed action are located in the southern portion of the base as shown in the enclosed figure. Modifications at SLC-4E would occur in previously disturbed areas associated with the launch structure, land modifications to the SRSF, Building 398 would be internal.

To comply with the requirements of Section 106 of the National Historic Preservation Act, the Air Force is requesting that you provide us with official comment regarding the potential for significant adverse impacts to any archaeological, cultural, and historic resources at VAFB as a result of the proposed Titan IV/SRMU program. Correspondence from your office will be reproduced in an appendix to the EA.

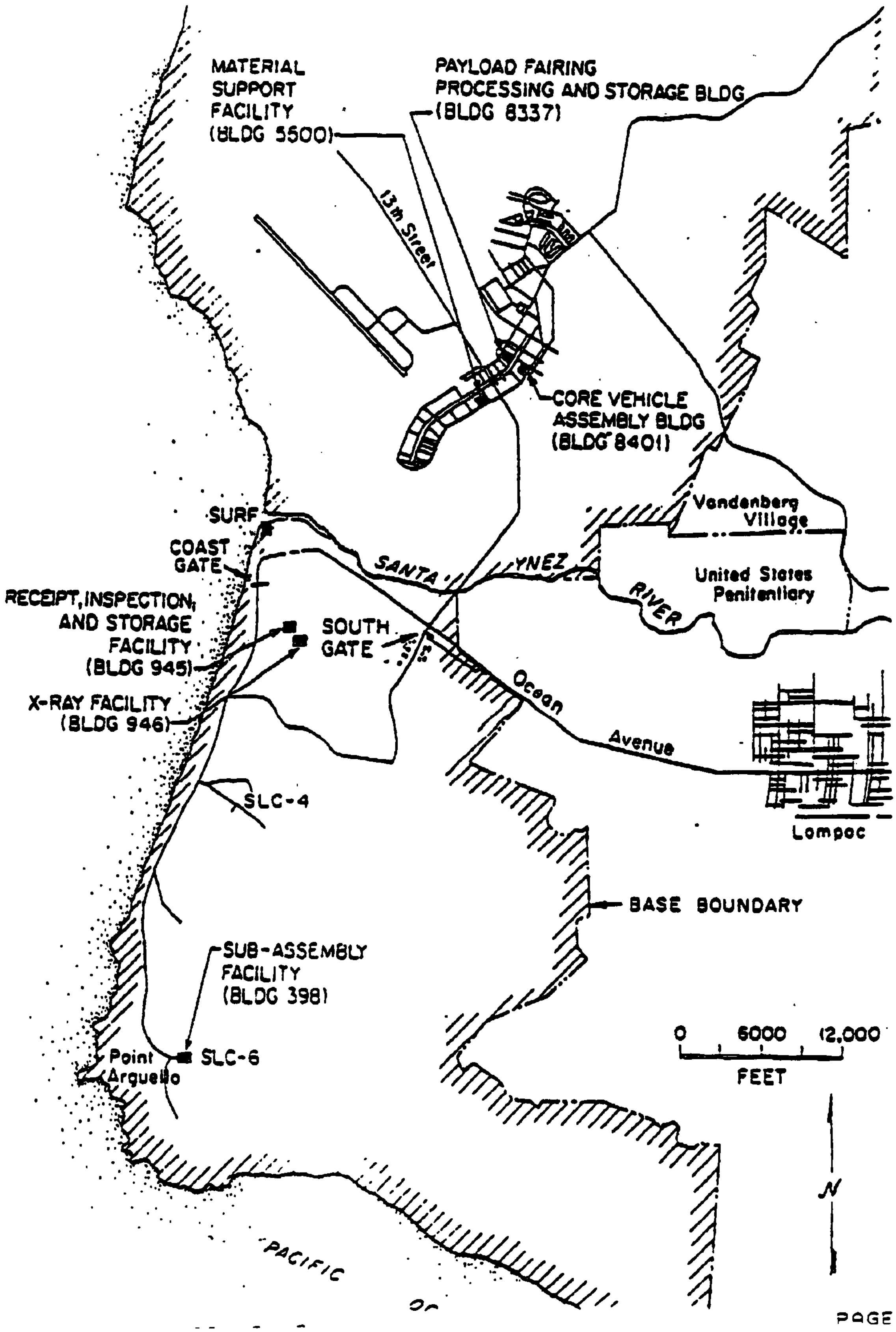
Mr. Dan Pilson can provide you with further details on this project if needed. His phone number is (213) 643-1409. As this project is on a tight schedule, we would appreciate hearing from your office as soon as possible.

Sincerely,

Robert C Mason

ROBERT C, MASON, AICP
Chief, Environmental Planning Division,
Directorate of Acquisition Civil Engineering

Attachment: Map of VAFB project area


MATERIAL SUPPORT FACILITY (BLDG 5500)
PAYLOAD FAIRING PROCESSING AND STORAGE BLDG (BLDG 8337)
13th Street
CORE VEHICLE ASSEMBLY BLDG (BLDG 8401)
Vandenberg Village
United States Penitentiary
SURF
COAST GATE
SANTA YNEZ RIVER
RECEIPT, INSPECTION, AND STORAGE FACILITY (BLDG 945)
SOUTH GATE
X-RAY FACILITY (BLDG 946)
Ocean Avenue
Lompoc
SLC-4
BASE BOUNDARY
SUB-ASSEMBLY FACILITY (BLDG 398)
Point Arguello
SLC-6
0 6000 12,000
FEET
N
PACIFIC

STATE OF CALIFORNIA – THE RESOURCES AGENCY

GEORGE DEUKMEJIAN, *Governor*

OFFICE OF HISTORIC PRESERVATION
DEPARTMENT OF PARKS AND RECREATION
POST OFFICE BOX 942896
SACRAMENTO, CALIFORNIA 94296-0001
(916) 445-8006

REPLY TO:USAF890613B
July 12, 1989

Mr. Robert C. Mason, AICP
Chief, Environmental Planning Division,
Directorate of Acquisition Civil Engineering
Department of the Air Force
Headquarters Space Division (AFSC)
Los Angeles Air Force Base, P.O. Box 92960
Los Angeles, California 90009-2960

Re:Proposed Expansion of existing Titan IV program at Vandenberg Air Force Base.

Dear Mr. Mason:

The Office of Historic Preservacion (OHP) has reviewed your letter of June 9, 1989, requesting our comments regarding the potential for significant adverse impacts to historic properties resulting from the proposed undertaking.

The activities that you have briefly described appear to constitute an undertaking. That is, the project has the potential to change the character or use of historic properties, if any such properties exist. Therefore, as you apper to imply, the project is an undertaking subject to Section 106 of the National Historic Preservation Act of 1966, as amended.

Implementing regulations for Section 106 are found in 36 CFR Part 800, which describes a process by which federal agencies can meet their responsibilities under Section 106. This process involves the identification and consideration of effects to historic properties, affording the Advisory Council on Historic Preservation the opportunity to comment on such effects.

Before we can comment on the effects of the undertaking (the potential for significant adverse effect in your words) we need further information on the Area of Potential Effects (APE), historic properties within the APE, and the specific proposed facilities and activities as they may relate to historic properties. We recommend that you follow the procedures outlined in 36 CFR Part 800 and will consider your correspondence a request for OHP participation in the Section 106 process pursuant to 36 CFR 800.1(c)(ii).

The project you described sounds familiar, but your letter does not reference previous correspondence, reports, or meetings. If we have information or have consulted on this project in the past, please inform us of the correspondence, preferably by OHP file number (located in the upper right hand corner of previous correspondence).

Thank you for considering cultural resources during project planning. If you have any questions please contact Mr. Robert Jackson of my staff, at (916) 322-9602.

Sincerely,

Kathryn Gualtieri
State Historic Preservation Officer

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS SPACE SYSTEMS DIVISION (AFSC)
LOS ANGELES AIR FORCE BASE, PO BOX 92960
LOS ANGELES, CA 90009-2960

August 18,1989

Ms. Kathryn Gualtieri
State Historic Preservation Officer
Office of Historic Preservation
Department of Parks and Recreation
P. O. Box 942896
Sacramento, California 94296-0001

Dear Ms. Gualtieri:

This letter is written in response to your reply(USAF890613B) to our letter of June 9, 1989 (Attachment 1) in which you request further details regarding proposed U.S. Air Force actions at Vandenberg Air Force Base in support of the Titan IV launch program. The location of the Vandenberg facilities that would be affected by the proposed project and a description of the proposed actions that would occur are provided for your review in Attachment 2.

In your reply of July 12, 1989, you indicated that the proposed project sounded familiar. Indeed it is, for it is an expansion of activities previously documented by the USAF in an environmental assessment of the Titan IV space launch vehicle modification and operation in February 1988. For that assessment, an archaeological survey was performed by Greenwood and Associates and reviewed by your office (File No. USAF 870817A). A copy is included for your information (Attachment 3).

The current proposed action involves construction work in previously disturbed areas at Space Launch Complex (SLC) 4-E and interior modifications at the Rocket Sub-assembly Facility (Building 398) at Space Launch Complex 6 and the launch of Titan IV/SRMU vehicles from SLC-4-E. Neither construction nor launch operations are expected to adversely impact historic or archaeological resources.

We hope this additional information will enable you to provide us with official comment on the proposed action pursuant to Section 106 of the National Historic Preservation Act. If you have any further questions regarding the project, please contact Mr. Dan Pilson of my office at (213) 643-1409. Your prompt action on this request would be appreciated.

Sincerely,

ROBERT C. MASON, AICP
Chief, Environmental Planning Division
Directorate of Acquisition Civil Engineering

Attachments
1. Ltr, Mason to Gualtieri, 9Jun89
2. Site and Project Description
3. Archaeological Survey

STATE OF CALIFORNIA – THE RESOURCES AGENCY GEORGE DEUKMEJIAN, Go.

OFFICE OF HISTORIC PRESERVATION
DEPARTMENT OF PARKS AND RECREATION
POST OFFICE BOX 942896
SACRAMENTO, CALIFORNIA 94296-0001
(916) 445-8006

REPLY TO: USAF890613B

September 26, 1989

Robert C. Mason, Chief
Environmental Planning Division
Los Angeles Air Force Base
Department of the Air Force
P.O. Box 92960
Los Angeles, CA 90009-2960

Project: Titan IV Launch Expansion Project

Dear Mr. Mason:

The Office of Historic Preservation (OHP) has reviewed and provides the following comments on the supplemental documentation you submitted in support of the cited project. That documentation provides the information we requested in our letter of July 12, 1989 and satisfies us that reasonable measures were taken to identify historic properties within the project's Area of Potential Effect (APE).

Aside from miscellaneous modifications to existing structures, the only area where historic properties might be affected by the project was in the Space Launch Complex 4E area. A historic property survey by Greenwood and Associates entitled Archaeological Survey Report for Construction of Titan IV Space Launch Vehicle Program Facilities at Vandenberg Air Force Base, California reports that no historic properties are located in the APE. We are therefore satisfied that your project will not affect any NRHP eligible sites.

Therefore, your agency has complied with 36 CFR 800.4(d) and fulfilled its responsibilities for this undertaking under Section 106 of the National Historic Preservation Act of 1966, as amended.

Thank you for considering cultural resources during project planning. If you have any questions regarding our review of the cited project, please telephone Thad Van Bueren of our staff at (916) 322-9610.

Sincerely,

Kathryn Gualtieri
State Historic Preservation Officer

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS SPACE DIVISION (AFSC)
LOS ANGELES AIR FORCE BASE, PO BOX 92960
LOS ANGELES, CA 90009-2960

June 9, 1989

Mr. E. Charles Fullerton
Southwest Regional Director, National Marine Fisheries Service
U. S. Department of Commerce
National Oceanic and Atmospheric Administration
300 South Ferry Street
Terminal Island, California 90731

Dear Mr. Fullerton:

The U.S. Air Force (USAF), Space Division proposes to expand its existing Titan IV program at Vandenberg Air Force Base (VAFB), California to provide increased launch vehicle processing capabilities to support launch of the Titan IV/Solid Rocket Motor Upgrade. The proposed changes for the Titan IV program at VAFB include modifications at Space Launch Complex 4 East (SLC-4E) to accommodate the Solid Rocket Motor Upgrade (SRMU), modifications to the Solid Rocket Sub-assembly Facility (SRSF, Building 398) at SLC-6, launch of up to four Titan IV/SRMU vehicles per year, and disposal of the washdown wastewater from Titan IV launches in evaporation ponds at SLC-6.

The facilities at VAFB that would be affected by the proposed action are located in the southern portion of the base as shown in the enclosed figure. Modifications at SLC-4E would occur in previously disturbed areas associated with the launch structure, and modifications to the SRSF, Building 398 would be internal. Launch of the Titan IV/SRMU requires 15% more solid rocket propellant than the current Titan IV and is expected to require disposal of about 50,000 gal of washdown water per launch. The Air Force is developing plans for disposal of washdown water; this issue will be addressed along with any other items in the Environmental Assessment for this program.

This letter requests your input on this action. We are including a list of federally listed endangered and threatened species residing or seasonally occurring in the project vicinity; please review and update it as necessary. We are also consulting with the U. S. Fish and Wildlife Service regarding the federally listed species under their jurisdiction. We would appreciate your opinion regarding (1) any possible effects of the proposed project on federally listed species. and (2) suggested measures to avoid or minimize any adverse impacts on these species.

Mr. Dan Pilson can provide you with further details on this project if needed. His phone number is (213) 643-1409. As this project is on a tight schedule, we would appreciate hearing from your office as soon as possible.

Sincerely,

Robert C Mason

ROBERT C. MASON, AICP
Chief, Environmental Planning Division,
Directorate of Acquisition Civil Engineering

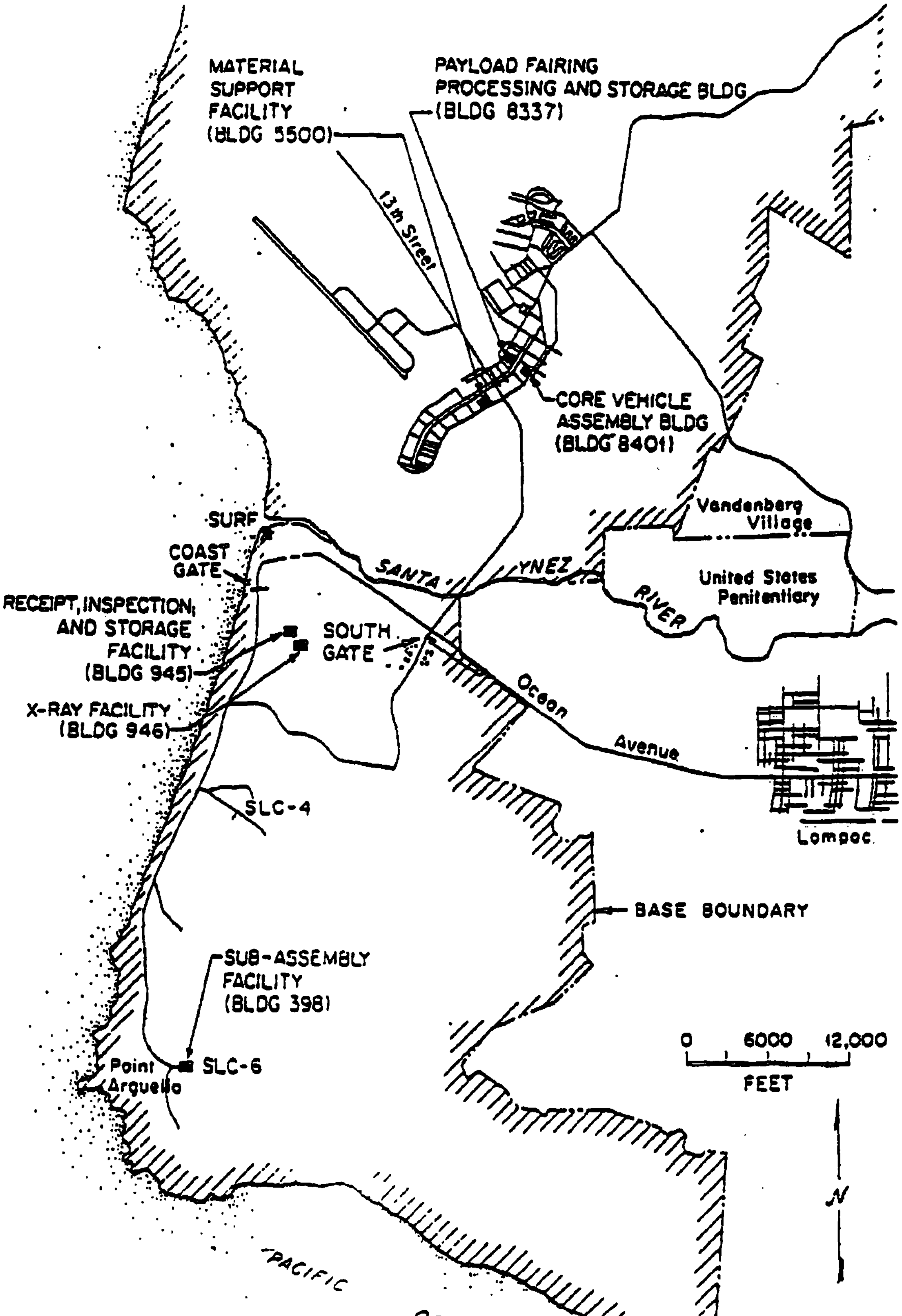
Attachments
1. Endangered Species list
2. Map of VAFB project area

Threatened and Endangered Species Associated with VAFB

Peregrine falcon
Bald eagle
California least tern
California brown pelican
Least Bell's vireo
Gray whale
Guadalupe fur seal
Southern sea otter
Unarmored threespine stickleback
Salt marsh bird's beak
California sea lion
Harbor seal
Stellar sea lion
Northern fur seal
Northern elephant seal

<u>Candidate species</u>

Spotted bat
Towsend's western big-eared bat
Greater mastiff bat
California black rail
Western snowy plover
Long-billed curlew
White-faced ibis
Ferruginous hawk
Tricolored blackbird
Western pond turtle
California red-legged frog
Arroyo toad
Tidewater goby
Salt marsh skipper butterfly
Swamp sand wort
Hoover's baccharia
Morning glory
Soft-leaved Indian paintbruch
Lilac
La Graciosa thistle
Surf thistle
Beach spectacle-pod
Lompoc yerba santa
Roderick's fritillary
Crisp monardella
San Luis Obispo curly-leaved monardella
Hoffman sanicle
Black-flowered figwort


MATERIAL SUPPORT FACILITY (BLDG 5500)
PAYLOAD FAIRING PROCESSING AND STORAGE BLDG (BLDG 8337)
13th Street
CORE VEHICLE ASSEMBLY BLDG (BLDG 8401)
Vandenberg Village
SURF
COAST GATE
SANTA YNEZ RIVER
United States Penitentiary
RECEIPT, INSPECTION, AND STORAGE FACILITY (BLDG 945)
SOUTH GATE
X-RAY FACILITY (BLDG 946)
Ocean Avenue
Lompoc
SLC-4
BASE BOUNDARY
SUB-ASSEMBLY FACILITY (BLDG 398)
Point Arguello
SLC-6
0 6000 12,000
FEET
N
PACIFIC

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Region
300 South Ferry Street
Terminal Island, California 90731

August 7, 1989 F/SWR14:BH

Mr. Robert C. Mason, AICP
Chief, Environmental Planning Division
Directorate of Acquisition Civil Engineering
Los Angeles Air Force Base
P.O. Box 92960
Los Angeles, CA 90009-2960

Dear Mr. Mason,

This is a response to your letter of June 9 requesting input on the proposed changes in the Titan IV program at Space Complex 4 East on Vandenberg Air Force Base (VAFB). Pursuant to Section 7 of the Endangered Species Act we find that the proposed project will not adversely affect any of the listed species, and formal consultation will not be necessary.

However, due to the existence of pinniped populations on the mainland portion of the base and the Channel Islands, which are protected under the Marine Mammal Protection Act, we would like to urge you to continue to pursue obtaining a small take permit to cover all the launch operations at VAFB. It is possible that the small take permit that was issued to the space shuttle program to cover disturbances of pinnipeds in the Channel Islands might be modified to accomplish this. However, effects on pinnipeds hauled out at mainland sites on the base also need to be considered relative to current and proposed programs. If you have any further questions please contact Jim Lecky of my staff at (213) 514-6664.

Sincerely,

E C Fullerton
E. C. Fullerton
Regional Director

APPENDIX D

THERMOCHEMICAL DATA FOR EXHAUST EMISSIONS

SYSTEM STUDIES
Hercules - Bacchus Works
System Design Optimization

October 29, 1987
Log #S-54

Titan IV Exhaust Plume Thermal Properties

These comparative data are for the Hercules 126 inch SRMU and the CSD seven segment SRM, using best available data for the latter.

Pressure *vs* time at 60°F

SRMU		
	0 sec	1090 psia
	15	1100
	25	1000
	35	1000
	100	580
	133	470

Web action time 133

CSD SRM
Maximum pressure = 835 psia
Web action time = 112.4 sec
Action time = 123.8 sec

Thermal properties at the nozzle exit plane were calculated using the Solid Propellant Performance (SPP) code. These calculations were run at action time average pressure for consistency with the specific impulse performance calculations, but pressure is not expected to have a major effect on calculated temperature at the nozzle exit plane.

The SPP code considers axisymmetric two dimensional two phase flow assuming fixed exhaust composition. The oxide particle size distribution is based on an empirical correlation.

Configuration		
Propellant	QDI	UTP-3001
Action time, sec	139.6	123.8
Action time average P, psia	891	663
Initial throat diameter, in.	32.5	39.8
Nozzle exit diameter, in.	128.6	126.1
Conditions at nozzle exit plane		
Average oxide particle T, °R	4189	4189
Gas temperature °R	3781	3630
Average particle concentration, W_p/W_g	0.5013	0.4077
Thermal emissivity	0.29	0.33
Radiation thermal flux, BTU/ft^2-sec	43	48

The oxide particle temperature, 4189°, is the melting point of aluminum oxide. The SPP calculation actually considers three particle size classes, and the smaller particles are somewhat cooler than the average temperature given above. Also the oxide particle concentration and size distribution varies between the nozzle centerline and the exit ID.

The plume emissivity and radiation thermal flux were estimated using the procedure defined in F. C. Price *et al*, *Internal Environment of Solid Rocket Nozzles*, Air Force Rocket Propulsion Laboratory, Edwards AFB, RPL-TDR-64-140, 30 July, 1964. This procedure requires consideration of the variation in particle concentration and size distribution across the exit plane. These depend on nozzle expansion ratio and contour as well as thermochemical properties.

ATTACHMENT 4.4.1-4

Thermochemical data were calculated for one dimensional isentropic flow using the KENVIL code, which uses the same free energy minimization algorithm as the NASA-Lewis code. JANNAF thermochemical data for the combustion products were used. The effective gamma calculated by this code is the value for the isentropic exponent required to give the same thrust coefficient by the classical equation assuming fixed composition as is calculated by the code assuming equilibrium flow.

The weight basis for these data is 100 grams. In particular, note that the fixed composition heat capacity for the gas is given in cal/100 gm of total products.

SRMU	Chamber	Throat	Exit
Pressure, psia	891	515.4	8.16
Temperature, °K	3452.3	3353.7	2245.0
Weight % oxide particles	33.39	34.16	35.88
Enthalpy, cal/100 gm	-43642	-56334	-130496
Moles gas/100 gm	3.3989	3.3713	3.2678
Isentropic exponent, γ	1.1299	1.1298	1.1645
Fixed composition γ	1.166	1.164	1.185
Effective γ	-	-	1.1290
Fixed composition C_p, cal/100 gm			
Total products	47.50	47.46	41.57
Gas only	32.44	32.05	29.93
Equilibrium C_p, cal/100 gm	93.35	87.63	49.99

CSD SRM	Chamber	Throat	Exit
Pressure, psia	663	381.5	9.76
Temperature, °K	3293.2	3094.1	2007.5
Weight % oxide particles	28.96	29.57	30.45
Enthalpy, cal/100 gm	-44465	-57168	-122591
Moles gas/100 gm	3.6351	3.6104	3.5450
Isentropic exponent, γ	1.1419	1.1445	1.1951
Fixed composition γ	1.180	1.179	1.204
Effective γ	-	-	1.1405
Fixed composition C_p, cal/100 gm			
Total products	47.44	47.31	41.53
Gas only	34.37	33.97	31.77
Equilibrium C_p, cal/100 gm	80.43	73.95	44.05

Calculated exhaust compositions are shown on the following pages.

Lowell Smith	Thermochemical calculations	251-6185
Dennis Davis	SPP Flow calculations	251-6323
Monty Cunningham	Thermal	251-6765

Hercules SRMU

Conditions at Nozzle Exit Plane
One Dimensional Ideal Equilibrium Flow

Chamber pressure = 891 psia   Expansion ratio = 15.67
Exit pressure = 8.16 psia   Exit temperature = 2245.0 K
Eathaply = −130496 cal/100 gm   3.26783 moles gas/100 gm

PRODUCT	MW	MOLES	WT. PCT.	MOLE PCT.	VOLUME PCT.
AL	26.98150	1.40433D-07	0.0000	0.0000	0.0000
AL CL	62.43450	1.58940D-04	0.0099	0.0044	0.0049
AL CL2	97.88750	6.48512D-06	0.0063	0.0018	0.0020
AL CL3	133.34050	3.31608D-05	0.0044	0.0009	0.0010
AL H	27.98947	1.06040D-08	0.0000	0.0000	0.0000
AL N	40.98820	2.54349D-13	0.0000	0.0000	0.0000
AL O	42.98090	2.10684D-07	0.0000	0.0000	0.0000
AL O CL	78.43390	7.51254D-06	0.0059	0.0021	0.0023
AL O H	43.98887	6.28506D-06	0.0003	0.0002	0.0002
AL O2	58.98030	2.66884D-08	0.0000	0.0000	0.0000
AL O2H	59.98827	1.03047D-06	0.0006	0.0003	0.0003
AL2O	69.96240	3.48439D-09	0.0000	0.0000	0.0000
AL2O2	85.96180	1.31840D-09	0.0000	0.0000	0.0000
BI	208.98000	5.48945D-06	0.0011	0.0002	0.0002
BI CL	244.43300	9.11918D-08	0.0000	0.0000	0.0000
BI H	209.98797	7.08115D-08	0.0000	0.0000	0.0000
BI O	224.97940	2.64870D-08	0.0000	0.0000	0.0000
BI2	417.96000	5.45086D-13	0.0000	0.0000	0.0000
C H2O	30.02649	8.99233D-08	0.0000	0.0000	0.0000
C H4	16.04303	7.40753D-10	0.0000	0.0000	0.0000
C N	26.01785	2.87308D-10	0.0000	0.0000	0.0000
C O	28.01055	7.82825D-01	21.9274	21.6265	23.9555
C O CL	63.46355	2.77777D-07	0.0000	0.0000	0.0000
C O2	44.00995	5.66745D-02	2.4942	1.5657	1.7343
CL	35.45300	6.96615D-03	0.2470	0.1924	0.2132
CL O	51.45240	5.22812D-08	0.0000	0.0000	0.0000
CL2	70.90600	2.89582D-06	0.0002	0.0001	0.0001
H	1.00797	1.82753D-02	0.0184	0.5049	0.5592
H AL O	43.98887	1.20414D-10	0.0000	0.0000	0.0000
H C N	27.02582	3.37962D-07	0.0000	0.0000	0.0000
H C O	29.01852	5.17969D-07	0.0000	0.0000	0.0000
H CL	36.46097	5.79852D-01	21.1420	16.0191	17.7442
H N O	31.01407	5.10845D-09	0.0000	0.0000	0.0000
H O CL	52.46037	1.64958D-07	0.0000	0.0000	0.0000
H2	2.01594	1.09729D+00	2.2121	30.3139	33.5785
H2O	18.01534	4.26717D-01	7.6875	11.7886	13.0581
N	14.00670	2.77164D-08	0.0000	0.0000	0.0000
N H	15.01467	1.09691D-08	0.0000	0.0000	0.0000
N H2	16.02264	8.08630D-08	0.0000	0.0000	0.0000
N H3	17.03061	1.85475D-08	0.0000	0.0000	0.0000
N O	30.00610	2.79330D-05	0.0008	0.0008	0.0009
N O2	46.00550	3.93126D-11	0.0000	0.0000	0.0000
N2	28.01340	2.97750D-01	8.3410	8.2257	9.1115
O	15.99940	1.21910D-05	0.0002	0.0003	0.0004
O H	17.00737	1.08222D-03	0.0184	0.0299	0.0331
O2	31.99880	1.99638D-06	0.0001	0.0001	0.0001
AL2O3(C)	101.96120	3.51919D-01	35.8820	9.7222	

CSD 7 Segment SRM

Conditions at Nozzle Exit Plane
One Dimensional Ideal Equilibrium Flow

Chamber pressure = 663 psia   Expansion ratio = 10.04
Exit pressure = 9.76 psia   Exit temperature = 2007.3 K
Enthaply = -122591 cal/100 gm   3.54499 moles gas/100 gm

PRODUCT	MW	MOLES	WT. PCT.	MOLE PCT.	VOLUME PCT.
AL	26.98150	1.39247D-09	0.0000	0.0000	0.0000
AL CL	62.43450	9.55978D-06	0.0006	0.0002	0.0003
AL CL2	97.88750	8.70921D-06	0.0009	0.0002	0.0002
AL CL3	133.34050	1.52203D-05	0.0020	0.0004	0.0004
AL H	27.98947	1.85522D-10	0.0000	0.0000	0.0000
AL N	40.98820	1.38701D-15	0.0000	0.0000	0.0000
AL O	42.98090	1.77865D-09	0.0000	0.0000	0.0000
AL O CL	78.43390	4.58374D-06	0.0004	0.0001	0.0001
AL O H	43.98887	3.00656D-07	0.0000	0.0000	0.0000
AL O2	58.98030	1.80968D-10	0.0000	0.0000	0.0000
AL O2H	59.98827	4.56142D-07	0.0000	0.0000	0.0000
AL2O	69.96240	9.15284D-12	0.0000	0.0000	0.0000
AL2O2	85.96180	3.83526D-12	0.0000	0.0000	0.0000
C H2O	30.02649	1.47683D-07	0.0000	0.0000	0.0000
C H4	16.04303	7.27436D-09	0.0000	0.0000	0.0000
C N	26.01785	7.21457D-11	0.0000	0.0000	0.0000
C O	28.01055	9.81649D-01	27.4965	25.5394	27.6912
C O CL	63.46355	1.33592D-07	0.0000	0.0000	0.0000
C O2	44.00995	6.75709D-02	2.9738	1.7580	1.9061
CL	35.45300	1.49086D-03	0.0529	0.0388	0.0421
CL O	51.45240	2.15279D-09	0.0000	0.0000	0.0000
CL2	70.90600	7.34710D-07	0.0001	0.0000	0.0000
FE	55.84700	1.94522D-05	0.0011	0.0005	0.0005
FE CL	91.30000	1.53772D-06	0.0001	0.0000	0.0000
FE CL2	126.75300	3.07525D-03	0.3898	0.0800	0.0867
FE CL3	162.20600	4.15144D-07	0.0001	0.0000	0.0000
FE O	71.84640	1.24813D-07	0.0000	0.0000	0.0000
FE O2H2	89.86174	9.66944D-07	0.0001	0.0000	0.0000
H	1.00797	4.36047D-03	0.0044	0.1134	0.1230
H AL O	43.98887	1.41038D-12	0.0000	0.0000	0.0000
H C N	27.02582	6.21580D-07	0.0000	0.0000	0.0000
H C O	29.01852	2.74528D-07	0.0000	0.0000	0.0000
H CL	36.46097	5.66889D-01	20.6693	14.7486	15.9913
H N O	31.01407	4.84590D-10	0.0000	0.0000	0.0000
H O CL	52.46037	2.39044D-08	0.0000	0.0000	0.0000
H2	2.01594	1.22934D+00	2.4783	31.9835	34.6783
H2O	18.01534	3.86844D-01	6.9691	10.0644	10.9124
N	14.00670	1.26892D-09	0.0000	0.0000	0.0000
N H	15.01467	1.07745D-09	0.0000	0.0000	0.0000
N H2	16.02264	2.99476D-08	0.0000	0.0000	0.0000
N H3	17.03061	2.89850D-06	0.0000	0.0001	0.0001
N O	30.00610	2.48290D-06	0.0001	0.0001	0.0001
N O2	46.00550	8.24089D-13	0.0000	0.0000	0.0000
N2	28.01340	3.03553D-01	8.5036	7.8975	8.5629
O	15.99940	3.58965D-07	0.0000	0.0000	0.0000
O H	17.00737	1.41950D-04	0.0024	0.0037	0.0040
O2	31.99880	4.87085D-08	0.0000	0.0000	0.0000
AL2O3(C)	101.96120	2.98687D-01	30.4544	7.7709	