Environmental Impact Analysis Process

Environmental Assessment
for
NAVSTAR Global Positioning System, Block IIR, and Medium Launch Vehicle III

Cape Canaveral Air Station, Florida

November 1994

DEPARTMENT OF THE AIR FORCE
Materiel Command
Headquarters, Space and Missile Systems Center

FINDING OF NO SIGNIFICANT IMPACT

ENVIRONMENTAL ASSESSMENT FOR NAVSTAR GLOBAL POSITIONING SYSTEM, BLOCK IIR AND MEDIUM LAUNCH VEHICLE III CAPE CANAVERAL AIR STATION, FLORIDA

Agency: United States Air Force (USAF), Headquarters Space and Missile Systems Center (HQ SMC), Air Force Materiel Command

Cooperating Agency: Air Force Space Command

Background: Pursuant to the National Environmental Policy Act, the Council on Environmental Quality regulations implementing the Act (40 CFR 1500-1508), Department of Defense Directive 6050.1, Air Force Regulation 19-2, which implements these regulations in the Environmental Impact Analysis Process (EIAP), Air Force Regulation 19-9 regarding interagency coordination, and other applicable federal and local regulations, the US Air Force has conducted an assessment of the potential environmental consequences of the NAVSTAR Global Positioning System (GPS) Block IIR satellite constellation and the Medium Launch Vehicle III (MLV III) program.

Proposed Action: The Air Force proposes to transport, process, launch, operate, and ultimately dispose of 21 NAVSTAR GPS Block IIR Space Vehicles (SV) using the 21 Delta II Launch Vehicles (LV) proposed for acquisition under the MLV III program from Cape Canaveral Air Station (AS), Florida. The Block IIR SVs will replenish the current Block II/IIA SVs as their operational life ends.

Alternatives: HQ SMC considered three alternatives to the proposed action which have been excluded from further consideration: processing and launch from Vandenberg Air Force Base (AFB), California, use of the Space Shuttle as a launch vehicle, and use of the current Block II/IIA SV design. Launch of NAVSTAR GPS SVs from Vandenberg AFB would require a launch path over populated areas, with unmitigable safety concerns. The space shuttle could not support the launch schedule for the NAVSTAR GPS program. The Block II/IIA SV design does not meet current mission requirements. The use of the Atlas II as an alternative LV was considered along with the no action alternative.

Summary of Findings: The environmental assessment evaluated the environmental impacts with regard to processing, launching, operation, and disposal. The potential environmental effects of the programs were assessed for the most affected environmental issues among the following components: air quality (including stratospheric ozone), hazardous materials, hazardous waste, solid waste, pollution prevention, nonionizing radiation, ionizing radiation, water quality, biological communities, cultural resources, noise, socioeconomics, orbital debris, and safety. A summary of findings is presented below.

Air Quality: Operations will be conducted in accordance with applicable air quality permits and regulations, minimizing potential air quality impacts. Stratospheric ozone will not be significantly affected by the proposed action.

Hazardous Materials: Use of hazardous materials will be in accordance with federal, state, local, and 45th Space Wing (45 SW) regulations and safety plans, which will minimize potential impacts. Contractors and programs at Cape Canaveral Air Station must provide material safety data sheets for all hazardous materials to 45 CES/CEV and 45 MDG/SGPB.

Hazardous Waste: Prelaunch processing will generate an estimated 12,815 pounds of hazardous waste per year, which is approximately 3.1 percent of the hazardous waste produced at Cape Canaveral AS. With the termination of the NAVSTAR GPS Block II/IIA program, net hazardous waste generation will actually decrease by 540 pounds per year. All hazardous and regulated wastes will be managed and disposed of in accordance with applicable federal, state, local, and Air Force regulations, as well as 45th Space Wing management plans.

Solid Waste: Prelaunch processing and program operations will produce an estimated 125.3 tons of solid waste per year, which is approximately 4.2 percent of the solid waste produced at Cape Canaveral AS in 1992. With the termination of the NAVSTAR GPS Block II/IIA program, net solid waste generation will actually decrease by 30.9 tons per year.

Pollution Prevention: The proposed action will comply with the Pollution Prevention Management Plan (PPMP) that will be developed by Cape Canaveral AS. Compliance with the PPMP will minimize pollution and meet the regulatory requirements relative to pollution prevention.

Nonionizing Radiation: Safety features including enclosure of SV and LV radio antennas with radiation shields during testing and operation of ground antennas in accordance with radiation restrictions will reduce nonionizing radiation to safe levels.

Ionizing Radiation: The potential dose of radiation from the rubidium in the atomic clock on a NAVSTAR GPS SV ($5x10^{-5}$ millirems/year) is substantially less than the maximum dose under federal regulations for unrestricted areas (500 millirems/year).

Water Quality: Compliance with wastewater discharge permits will minimize impacts on water quality. Launch cloud emissions will not adversely impact water quality.

Biological Communities: The proposed action will utilize existing facilities engaged in activities similar to the proposed action and will not affect existing biological communities or any habitat that would have been utilized by threatened or endangered species beyond current operational impacts.

Cultural Resources: No facility renovations or construction is proposed which would affect any properties eligible for the National Register of Historic Places or archaeological resources.

Noise: Prelaunch processing operations will not produce hazardous noise levels. Safety precautions will assure that launches will not expose personnel or the public to hazardous noise levels in excess of 140 dB impulse noise or 115 dBA averaged over 15 minutes. The noise level at 1,500 feet from a launch is 132 dB, or 120 dBA, occurring for approximately two minutes. Harm to threatened and endangered species from these noise levels is not anticipated.

Socioeconomics: Approximately 220 personnel that are already employed at Cape Canaveral AS will be used in support of the proposed action, representing approximately 2.9 percent of the Cape Canaveral AS work force.

Utilities: Utility usage will be essentially unchanged from current consumption.

Orbital Debris: NAVSTAR GPS SVs will operate in Medium Earth Orbit (MEO), which is not widely used. To minimize orbital debris, sufficient fuel will be reserved to move each SV to an unused disposal orbit and to orient the SV to minimize the possibility of battery explosions. For the near-term, this method of disposal will minimize impacts of orbital debris. The third stage of the LVs will increase the number of cataloged objects in MEO by 3.1 percent, but will reenter within an estimated 70 years.

Safety: Processing, launching, operation, and disposal operations in accordance with applicable federal, state, local, and 45 SW safety plans and regulations will minimize risk.

Overseas Stations: Operation of the Diego Garcia, Kwajalein Atoll, and Kaena Point GPS stations in support of the NAVSTAR GPS IIR SVs will not affect existing baseline environmental conditions.

Conclusion: Based on this environmental assessment, it is concluded that the proposed action will not result in significant environmental impacts or cause significant cumulative impacts with other programs, and an environmental impact statement is not required.

Permits: A review of the regulatory requirements indicated that no additional federal, state, or local permits will be required for the proposed action.

Point of Contact: A copy of the "NAVSTAR Global Positioning System, Block IIR and Medium Launch Vehicle III Finding of No Significant Impact and Environmental Assessment," November 1994, may be obtained from, or comments on these documents may be submitted to:

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Prepared for

Department of the Air Force
Headquarters Space and Missile Systems Center/CEV
Los Angeles Air Force Base, California
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CONTENTS

Contents, continued Page

Contents, continued Page

FIGURES

Figures, continued Page

TABLES

Page

ACRONYMS AND ABBREVIATIONS

45 SW	45th Space Wing
45 CES/CEV	Patrick AFB environmental support organization
°F	Degrees Fahrenheit
Aerozine 50	50 percent by weight unsymmetrical dimethylhydrazine and 50 percent hydrazine
AFB	Air Force Base
AFOSH	Air Force Occupational Safety and Health
AFR	Air Force Regulation
ARTS	Automated Remote Tracking Station
AS	Air Station
AFSPC	Air Force Space Command
AKM	Apogee Kick Motor
ALARM	Alert, Locate, and Report Missiles
$AlCl_x$	Aluminum Chlorides
Al_2O_3	Aluminum Oxide
AQCR	Air Quality Control Region
AST	Aboveground Storage Tank
BE	Brilliant Eyes
CAA	Clean Air Act
CEQ	Council on Environmental Quality
CFC	Chlorofluorocarbon
CFR	Code of Federal Regulations
Cl	Chloride Anion
cm	centimeter
CO	Carbon Monoxide
CO_2	Carbon Dioxide
dB	decibels
dBA	decibels A-weighted
DMCO	Delta Mission Checkout
DOD	Department of Defense
DPF	Defense Satellite Communication System Processing Facility
DRMO	Defense Reutilization and Marketing Office
DSCS	Defense Satellite Communication System
EA	Environmental Assessment
EEGL	Emergency Exposure Guidance Levels
EIAP	Environmental Impact Analysis Process
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
EPA-17	Environmental Protection Agency 17 Priority Pollutants
EPCRA	Emergency Planning and Community Right-to-Know Act
ESA-60	Explosive Safe Area 60
FAC	Florida Administrative Code
FDEP	Florida Department of Environmental Protection
FGFWFC	Florida Game and Fresh Water Fish Commission

Acronyms and Abbreviations, continued

FIP	Federal Implementation Plan
FONSI	Finding Of No Significant Impact
FPL	Florida Power and Light
FR	Federal Register
FSA-1	Fuel Storage Area 1
FSA-2	Fuel Storage Area 2
FSA-5	Fuel Storage Area 5
GEO	Geosynchronous Earth Orbit
GLONASS	Global Navigation Satellite System
gpd	gallons per day
gpm	gallons per minute
GPS	Global Positioning System
H_2	Hydrogen
H_2O	Water
HBFC	Hydrobromofluorocarbon
HCFC	Hydrochlorofluorocarbon
HCl	Hydrochloric Acid
HPF	Horizontal Processing Facility
HPTF	High Pressure Test Facility
HTPB	Hydroxyl Terminated Polybutadiene
IDLH	Immediately Dangerous to Life or Health
IPA	Isopropyl Alcohol
JPC	Joint Propellants Contractor
km	kilometer
KPSTS	Kaena Point Satellite Tracking Station
lb/ft^2	pounds per square feet
LBSC	Launch Base Support Contractor
LC-17	Launch Complex 17
LC_{50}	Concentration at which 50 percent mortality occurs
L_{dn}	Day-night average sound level
LEO	Low Earth Orbit
L_{eq}	Energy equivalent sound level
Loran-C	Long-Range Navigation C
LOX	Liquid Oxygen
LV	Launch Vehicle
M	Mach
MAC	Maximum Acceptable Concentration
MCS	Master Control Station
MEK	Methyl Ethyl Ketone
MEO	Medium Earth Orbit
mgd	million gallons per day
mg/L	milligrams per liter
mg/m^3	milligrams per cubic meter
MHz	Megahertz
MIL-STD	Military Standard
MLS/ILS	Microwave Landing System/Instrument Landing System
MLV	Medium Launch Vehicle
MRTB	Missile Research Test Building
MSDS	Material Safety Data Sheet
MST	Mobile Service Tower
mW/cm^2	milliwatts per square centimeter

Acronyms and Abbreviations, continued

N_2	Nitrogen
NAAQS	National Ambient Air Quality Standards
NASA	National Aeronautics and Space Administration
NCS	Nutation Control System
NUDET	Nuclear Detonation
NDS	Nuclear Detonation Detection System
NEPA	National Environmental Policy Act
nm	nanometer
NO	Nitric Oxide
NO_2	Nitrogen Dioxide
NO_x	Nitrogen Oxides
NPF	NAVSTAR Processing Facility
NTL	No Threat Levels
NTL	Nondestructive Test Laboratory
O	Oxygen Anion
O_2	Oxygen
O_3	Ozone
OASPL	Overall A-Weighted Sound Level
ODC	Ozone Depleting Chemical
ODP	Ozone Depleting Potential
OFW	Outstanding Florida Water
OPlan	Operations Plan
PAF	Payload Attach Fitting
Pb	Lead
PCF	Propellant Conditioning Facility
PEL	Permissible Exposure Limit
PM-10	Particulate matter smaller than 10 micrometers
POL	Petroleum, Oil, and Lubricant
ppm	Parts per million
PPMP	Pollution Prevention Management Plan
PSD	Prevention of Significant Deterioration
PSF	Propellant Servicing Facility
PTS	Propellant Transfer Set
REEDM	Rocket Exhaust Effluent Dispersion Model
RF	Radio Frequency
ROI	Region of Influence
RP-1	Rocket Propellant 1
SARA	Superfund Amendments and Reauthorization Act
SAR	Specific Absorption Rate
SCAPE	Self-Contained Atmospheric Pressure Ensemble
SEL	Sound Exposure Level
SIP	State Implementation Plan
SMCB	Solid Motor Checkout Building
SMSB	Solid Motor Storage Building
SO_2	Sulfur Dioxide
SO_x	Sulfur Oxides
SPEGL	Short-term Public Emergency Guidance Levels
SRM	Solid Rocket Motor
SSCB	Second Stage Checkout Building
SV	Space Vehicle
TACAN	Tactical Air Navigation
TLV	Threshold Limit Value

Acronyms and Abbreviations, continued

TNT	Trinitrotoluene
tpy	tons per year
TSP	Total Suspended Particulates
UDMH	Unsymmetrical dimethylhydrazine
US	United States
USAF	United States Air Force
USFWS	United States Fish and Wildlife Service
UST	Underground Storage Tank
UV	Ultraviolet
UV-B	Ultraviolet B wavelength region
VOC	Volatile Organic Compounds
VOR/DME	Very High Frequency Omnidirectional Range/Distance Measuring Equipment
VORTAC	Collocated VOR and TACAN
W/kg	Watts per kilogram

SECTION 1.0

PURPOSE OF AND NEED FOR THE ACTION

1.1 BACKGROUND

Design conception for a Global Positioning System (GPS) occurred in the 1960s and advanced under the sponsorship of three different United States (US) Department of Defense (DOD) programs. The US Navy sponsored two programs and the US Air Force (USAF) sponsored a separate program. In 1973, these programs merged and were designated the NAVSTAR GPS program.

The NAVSTAR GPS space segment consists of two satellite constellations, Block I and Block II. Block I is a test constellation consisting of ten Space Vehicles (SV) that were launched from Vandenberg Air Force Base (AFB), California. Twelve Block I SVs were manufactured. Block II is the operational constellation that has been formed with launches from Cape Canaveral Air Station (AS), Florida. The operational Block II constellation comprises twenty-four active SVs in orbit.

The first Block I SV was launched in 1977 and the last in 1985. The Block II SVs were manufactured in two types, Block II and IIA. Block II can refer to either the operational constellation or the initial type of SV. The Air Force acquired ten Block II and eighteen Block IIA SVs, totaling twenty-eight SVs. The first Block II/IIA SV launch occurred in 1989, and launches are ongoing, with the final launch anticipated in 1995.

The estimated life of a Block II/IIA SV is 7.5 years. As each SV reaches the end of its operational life, an additional SV must be launched to maintain the operational integrity of the Block II constellation. To replenish the constellation, the Air Force is now procuring twenty-one additional SVs, designated Block IIR.

The Air Force also proposes to acquire twenty-one enhanced Delta II Model 7925 Launch Vehicles (LV) to launch the Block IIR SVs. The LV acquisition is designated Medium Launch Vehicle (MLV) III. The MLV I contract provided Delta II LVs to launch the Block II/IIA SVs. The MLV II contract provided 11 Atlas II LVs for the launch of 10 Defense Satellite Communication System (DSCS) SVs and one Space Test Program SV from Cape Canaveral AS.

Apparently, not all portions of the NAVSTAR program control segment facilities were included in previous Environmental Impact Analysis Process (EIAP) actions. The operational environmental impacts associated with these ground facilities will be addressed in this Environmental Assessment (EA).

In summary, this EA will address the Block IIR portion of the NAVSTAR GPS space segment, the operational impacts of control segment facilities that have not been considered in previous EIAP actions, and the MLV III program.

1.2 PURPOSE AND NEED

The NAVSTAR GPS program provides three-dimensional position, velocity, and time information worldwide under all weather conditions to DOD and civilian users. Precise navigational data enhances control of military units, and provides for enhanced navigation and location control for civilian users. A secondary payload, the Nuclear Detonation (NUDET) Detection System (NDS) detects nuclear detonations at or above the Earth's surface. Detection of nuclear detonations enables monitoring of treaty compliance and potential threats to national security. The operational NAVSTAR GPS Block II SV constellation will require periodic replenishment as active SVs reach the end of their operational life to maintain these capabilities. The proposed Block IIR SVs will meet this need for replenishment of the operational Block II SV constellation. The proposed MLV III program will provide launch vehicles for the Block IIR SVs.

1.3 PROGRAM DESCRIPTION

The NAVSTAR GPS program consists of four system segments as depicted in Figure 1.

The space segment includes twenty-four operational SVs placed in six orbital planes, each plane having an inclination of 55 degrees with respect to the equator (GE, 1992). The space segment also includes the ground support equipment and facilities required to support and maintain the SVs during transportation, processing, and launch site activities.

The control segment includes the Master Control Station (MCS), located at Falcon

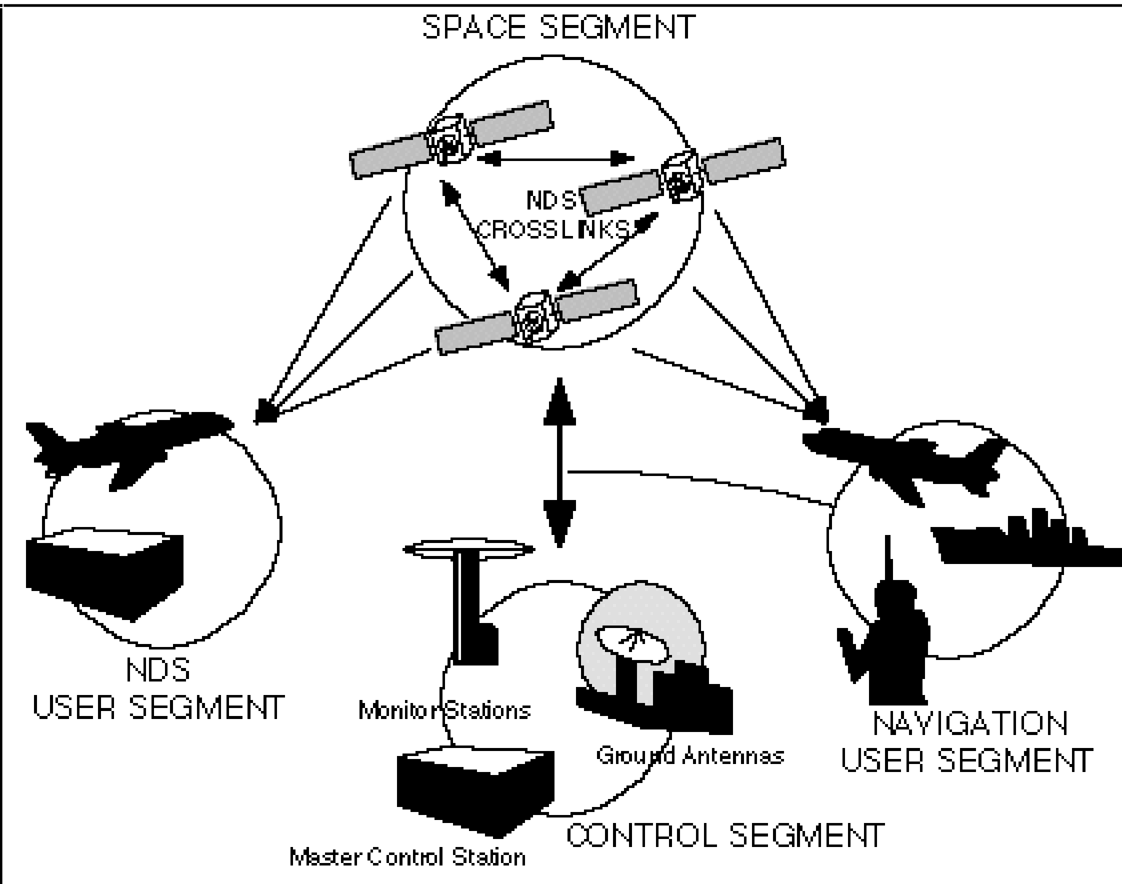


FIGURE 1
NAVSTAR GPS PROGRAM SEGMENTS

AFB, Colorado, with monitor stations and ground antennas at various locations around the world. Combined monitor stations and ground antennas are located at Falcon AFB (ground antenna is GPS capable, but not normally used for operations), Cape Canaveral AS, Kwajalein Atoll, Ascension Island, and Diego Garcia. A ground antenna is located at Kaena Point, Hawaii. The MCS provides mission control capability for GPS operations. It has the communications equipment necessary to send and receive transmissions through the ground antennas. The fixed ground terminal equipment at Falcon AFB is located on the southwest side of the existing Defense Satellite Communications System facility. The monitor stations receive radiated signals from SVs in the constellation. Data from the stations are relayed to the MCS and processed to determine each SV's precise current coordinates and the prevailing time registered by the on-board atomic clock. Detected errors are corrected by periodically transmitting new upload data to the SVs through the ground antennas. The MCS also monitors the status of the SV subsystems and payloads.

The GPS user segment utilizes various receivers to receive and process position and navigation data transmitted by the SVs. Four GPS SVs are in view at any location in the world. Coded radio signals from three of the SVs are used to compute the distance from the receiver to each SV by multiplying the signal travel time by the speed of light. The distances are triangulated to determine the positional coordinates of the receiver. Data from the fourth SV is used to eliminate any timing errors in the receiver clock.

The NDS user segment receives data regarding nuclear events that are detected by the SVs. A SV detecting a nuclear event processes the data and provides the data to other SVs within broadcast range. All SVs that generate or receive nuclear event data transmit the data to the NAVSTAR GPS ground stations for processing at the MCS.

Beginning in 1996 and extending through approximately 2003, the 21 proposed Block IIR SVs will be launched as needed to replace existing Block II/IIA SVs. The 21 Delta II LVs proposed for acquisition under the MLV III program will launch the Block IIR SVs.

The Delta LV family originated in 1959, when the Douglas Aircraft Company received a contract to produce 12 LVs. The first Delta was produced using components from the Thor Intermediate Range Ballistic Missile and the Vanguard LV. The first launch occurred on May 13, 1960. Since that time, over 200 launches of Delta LVs have occurred. The Delta II series was created to launch the Block II/IIA SVs under the MLV I contract. The latest model of the Delta II, the 7925, is proposed to launch the Block IIR SVs.

1.4 PURPOSE OF THE ENVIRONMENTAL ASSESSMENT

The purpose of this EA is to make the decision maker(s) aware of the environmental consequences of the proposed action and alternatives, including the no-action alternative. The most impacted environmental issues associated with the transportation, processing, launching, operation, and ultimate disposal of NAVSTAR GPS Block IIR SVs, MLV III Delta II LVs, and associated ground operations are identified and analyzed. Additionally, this EA identifies mitigative measures that should be implemented to ensure environmentally safe NAVSTAR GPS program functions.

1.5 ISSUES

The most significant issues are air quality (including ozone depletion), hazardous materials, and hazardous wastes. Other environmental attributes considered are solid waste, pollution prevention, nonionizing radiation, ionizing radiation, water quality, biological communities, cultural resources, noise, socioeconomics, utilities, orbital debris, and safety (including transportation). A conformity analysis or determination under the Clean Air Act is not required since the Cape Canaveral AS area is in attainment for the national ambient air quality standards.

1.6 SCOPE OF THE ENVIRONMENTAL ASSESSMENT

This EA is part of the EIAP for the proposed project. The EIAP is set forth in Air Force Regulation (AFR) 19-2, which implements the National Environmental Policy Act (NEPA), the President's Council on Environmental Quality (CEQ) regulations, and DOD Directive 6050.1, July 30, 1979, which detail the environmental impact analysis process. This EA identifies, describes, and evaluates the potential environmental impacts of activities associated with the proposed action, and other reasonable alternatives, including the no-action alternative. It also identifies all required environmental permits. As appropriate, the affected environment and environmental consequences of the action and alternatives may be described in terms of a regional overview (i.e., Brevard County and the City of Cocoa Beach) or a site-specific description (Complex 17). Finally, the EA identifies mitigation measures to prevent or minimize any significant environmental effects.

Applicable program and environmental data were collected to analyze and document the environmental consequences of the proposed action and alternatives. Under NEPA, the Air Force is charged with determining the effects of the proposed action and alternatives on the environment. If the Air Force approves the EA determination that the environmental impacts will not be significant, they will prepare a Finding Of No Significant Impact (FONSI).

For the proposed action, this EA assesses environmental impacts of NAVSTAR GPS Block IIR SV transportation, processing, and operations; the transportation, processing, and launch of the Delta II medium launch vehicle proposed for acquisition under the MLV III contract, operational environmental impacts associated with ground segment facilities, and ultimate disposal of the SVs and LVs. The issues analyzed are identified in Section 1.5.

The environmental effects from construction and operation of the Master Control Station and the ground antenna and monitor station at Falcon AFB were addressed in an Environmental Impact Statement (EIS), completed February 2, 1981, for the Consolidated Space Operations Center (USAF, 1981b). This EIS was reviewed, and additional assessment of the facilities at Falcon AFB is not considered necessary.

The environmental effects from construction and operation of the ground antenna and monitor station at Ascension Island were addressed in an environmental review signed May 19, 1983 (USAF, 1983). This document was reviewed, and additional assessment of the facilities at Ascension Island is not considered necessary.

Environmental review documentation for the stations at Kwajalein Atoll, Diego Garcia, and Kaena Point, Hawaii, could not be obtained. The operational effects from these stations are considered under appropriate resource areas in this EA.

The environmental effects of the Block II/IIA portion of the space segment and the associated launch vehicle have been respectively addressed in EAs and FONSIs dated January 4, 1994, and July 5, 1988 (USAF, 1994; USAF, 1988b), respectively.

Although the Air Force has decided to use the Delta II LV for the MLV III contract, the Atlas II LV was also considered as an alternative LV. The Atlas II will be considered as an alternative LV in this EA based on information presented in previous EAs for launches of the Atlas II and IIAS at Cape Canaveral AS (USAF, 1989c; USAF, 1991c).

The user segment receivers do not transmit and no operations are performed that would affect the environment (McLaughlin, 1993). Therefore, the user segment will not be addressed further in this EA.

1.7 ORGANIZATION OF THE ENVIRONMENTAL ASSESSMENT

This EA comprises eight major sections. Section 1 contains an introduction, a description of the purpose and need for the proposed action and the scope of this EA. Section 2 describes the proposed action, alternatives to the proposed action, and summarizes the environmental impacts of the alternatives. Section 3 presents information on the affected environment, providing a basis for analyzing the impacts of the proposed action and alternatives. Section 4 is an analysis of the environmental consequences of the proposed action and alternatives. Section 5 addresses regulatory requirements and lists the relevant laws that pertain to the proposed action. Section 6 lists persons and agencies consulted in the preparation of this EA. Section 7 is a list of source documents relevant to the preparation of the EA. Section 8 lists preparers of this document. Three appendices provide additional information relevant to the EA.

SECTION 2.0

DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES

2.1 PROPOSED ACTION

The United States Air Force (USAF) proposes to process and launch twenty-one NAVSTAR Global Positioning System (GPS) Block IIR Space Vehicles (SV) at Cape Canaveral Air Station (AS), Florida, using twenty-one Delta II Launch Vehicles (LV) acquired under the Medium Launch Vehicle (MLV) III contract to replenish and maintain the NAVSTAR GPS Block II satellite constellation.

2.2 PROJECT DESCRIPTION AND LOCATION

2.2.1 Location and Background

Cape Canaveral AS is located on Cape Canaveral in Brevard County, on Florida's Atlantic coastline near the City of Cocoa Beach. Figure 2 shows the general location of Cape Canaveral AS, which is located on the northern portion of a barrier island. The island is bounded by the Atlantic Ocean to the east and the Banana River to the west (NASA, 1990a).

In 1947, Cape Canaveral AS was selected as the location for a United States (US) missile testing range, with construction beginning in 1950. The first missile was launched from Cape Canaveral AS on July 24, 1950. Continuous advancement in technology made possible the launching of the National Aeronautics and Space Administration (NASA) Saturn 1B in 1961, the Air Force Titan II in 1974, and the Navy Trident missile, which began testing in 1977. Cape Canaveral AS has 81 miles of paved roads which connect various launch and support facilities with the centralized industrial area. Development of Cape Canaveral AS as a missile test center has produced an installation that is unique with respect to other Air Force installations (USAF, 1991a).

Cape Canaveral AS occupies a total of 15,804 acres of land (USAF, 1991a). Facilities at Cape Canaveral AS are scattered, with scrub separating these developed areas. Cape Canaveral AS elevations range from sea level to 15 to 20 feet above mean sea level.

2.2.2 Space Vehicle

The NAVSTAR GPS IIR SV will weigh 4,480 pounds at launch, and consist of ten spacecraft bus subsystems and three payload subsystems:

Spacecraft Bus Subsystems

- Mechanical
- Attitude Determination and Control
- Electrical Power
- Telemetry, Tracking, and Command
- Reaction Control
- Propulsion
- Antenna
- Space Processor Software

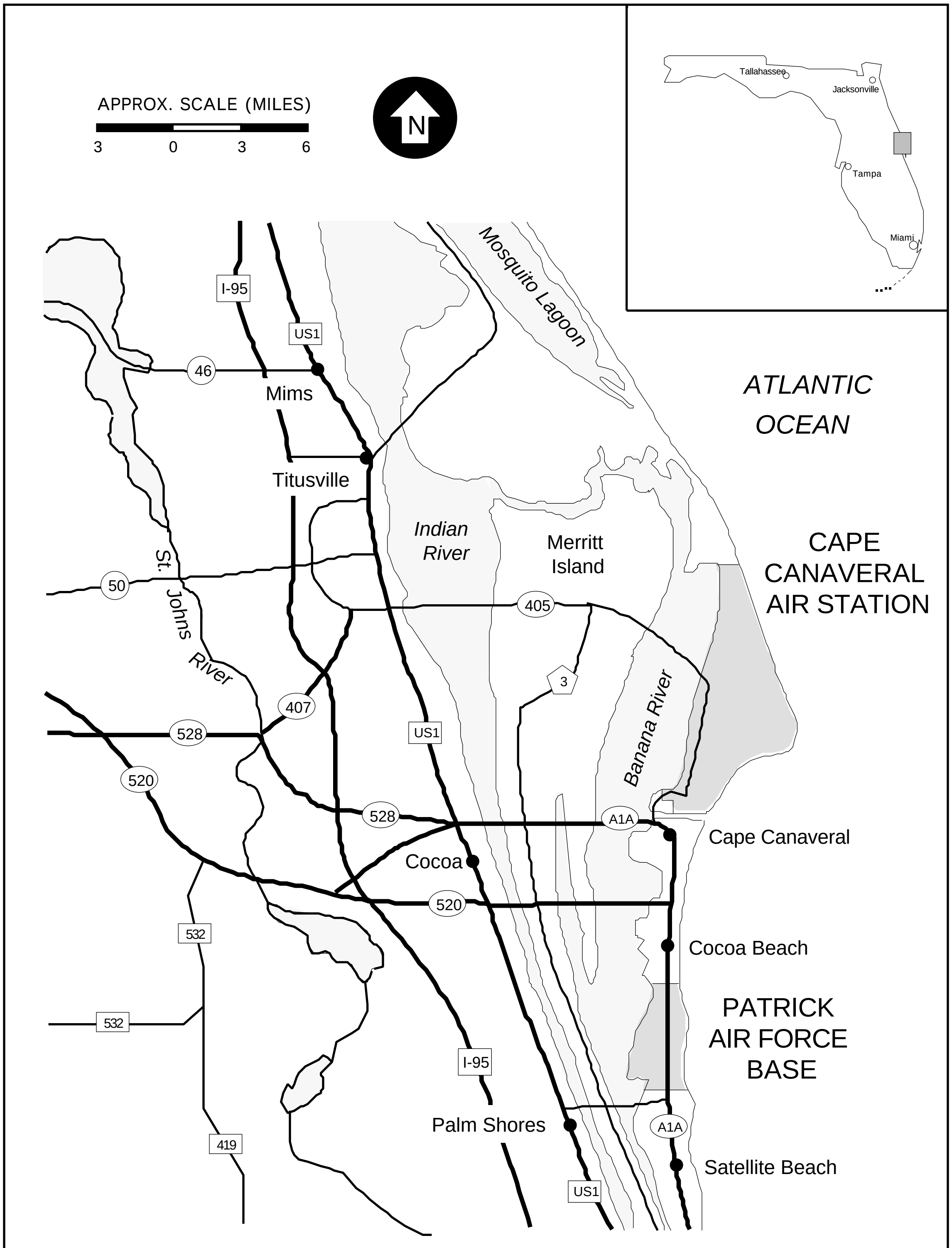


FIGURE 2
GENERAL LOCATION MAP
CAPE CANAVERAL AIR STATION

Payload Subsystems

- Total Navigation Payload
- Nuclear Detonation Detection System
- Reserve Auxiliary Payload

Figure 3 shows a Block IIR SV in its orbital configuration.

The mechanical subsystem includes the SV structure, mechanisms to provide both mission and orbit adjustment functions, thermal control systems, and ordnance. The structure consists of a six-sided box that transmits panel loads to a central thrust cylinder. It is primarily manufactured from aluminum honeycomb with some steel and titanium. Mechanisms include the solar array drives, the solar array panel deployment system, the W-sensor antenna (discussed below) deployment system, and the reaction wheel assemblies. Thermal control is provided by coatings, shields, insulation, heat sinks, and heaters. Ordnance includes the explosive devices to deploy the solar arrays and the W-sensor antenna, and the safe and arm device to ignite the apogee kick motor.

The attitude (orientation) determination and control subsystem consists of four mechanical reaction wheel assemblies and sensors that detect the position of the earth and sun. This subsystem monitors and controls the orientation of the SV.

The electrical power subsystem generates, stores, controls, and distributes electrical power to all SV subsystems. It consists of four solar panels, two nickel-hydrogen batteries, the SV wiring harness, a power regulation unit, and the ordnance controller.

The telemetry, tracking and command subsystem provides command, control, and monitoring of all SV functions. It includes the computer that controls the SV and associated electronic devices.

The reaction control subsystem provides maneuvering capabilities during the life of the SV. It consists of two spherical 19.7-inch titanium tanks containing a total of 209 pounds of monopropellant hydrazine, 12 0.2-pound and four 5-pound

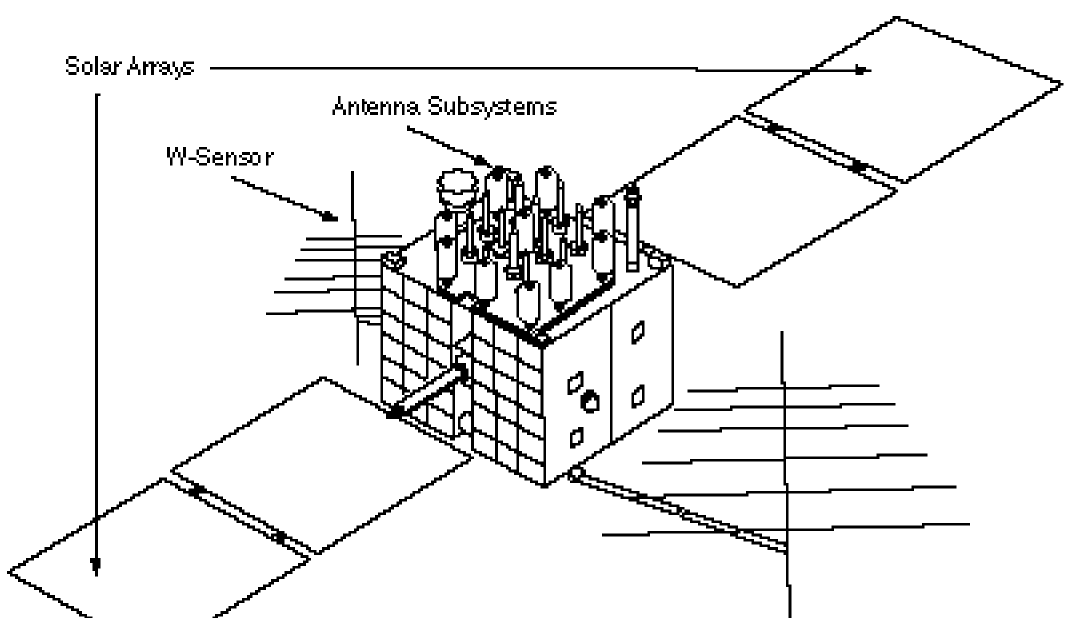


FIGURE 3
NAVSTAR GPS BLOCK IIR SPACE VEHICLE

catalytic thrusters, the propellant distribution system, and pressure monitoring instruments.

The propulsion subsystem consists of an apogee kick motor that boosts the SV from a transfer orbit into an initial drift orbit. The motor is a Morton Thiokol Star 37FM containing 2,010 pounds of Hydroxyl Terminated Polybutadiene (HTPB) solid fuel. The solid fuel is composed of 71 percent ammonium perchlorate, 18 percent aluminum powder, and 11 percent HTPB. The motor case is titanium.

The antenna subsystem includes the four types of antennas used by the SV. The L-band array transmits continuous navigation data to ground receivers on two L-band frequencies designated L-1 and L-2. It also intermittently transmits nuclear detonation event data to ground stations on a third frequency designated L-3. The ultra high frequency array transmits and receives nuclear detonation event data in communication with other NAVSTAR GPS SVs. The S-band array contains three antennas that transmit and receive operational control data between the telemetry, tracking, and command subsystem and ground stations. The W-sensor array includes two log periodic antennas that sense nuclear detonation events, but do not transmit.

The spacecraft processor software is the software that controls the SV computer.

The total navigation payload provides navigational information to GPS users, transmits and receives data through the L-band antenna array, processes navigation and nuclear detonation event data, and transmits and receives data through the ultra high frequency antennas. This subsystem also contains two rubidium atomic frequency standards.

The nuclear detonation detection subsystem receives and transfers nuclear detonation event data from the W-sensor antenna array to the navigation payload.

The reserve auxiliary payload will be an additional payload weighing up to 25 pounds that would be carried on IIR SVs. No specific payloads have been identified, and the SVs can be launched with or without the auxiliary payload.

Table 1 compares components of the Block IIA and IIR SVs.

2.2.3 Space Vehicle Processing Facilities

The following existing facilities at Cape Canaveral AS will be used in support of NAVSTAR GPS Block IIR prelaunch processing operations: the Cape Canaveral AS runway (skid strip), Defense Satellite Communication System (DSCS) Processing Facility, NAVSTAR Processing Facility,, Fuel Storage Area 2, Missile Research Test Building, Nondestructive Test Laboratory, Fuel Storage Area 1, Propellant Conditioning Facility, and Launch Complex 17. Figure 4 shows the locations of the SV and LV processing facilities at

Table 1 Comparison of Block IIA and IIR SV Components

	Block IIA SV	**Block IIR SV**
Threat Shielding	Silver	Tantalum
Batteries	Nickel-cadmium	Nickel-hydrogen
Weight	4,150 pounds	4,480 pounds
Solid Fuel HTPB	1,950 pounds	2,010 pounds
Hydrazine	133 pounds	209 pounds
Reserve Auxiliary Payload	None	Up to 25 pounds
Frequency Standards	2 rubidium, 2 cesium	2 rubidium, 1 cesium
Operational Life	7.5 years	10 years

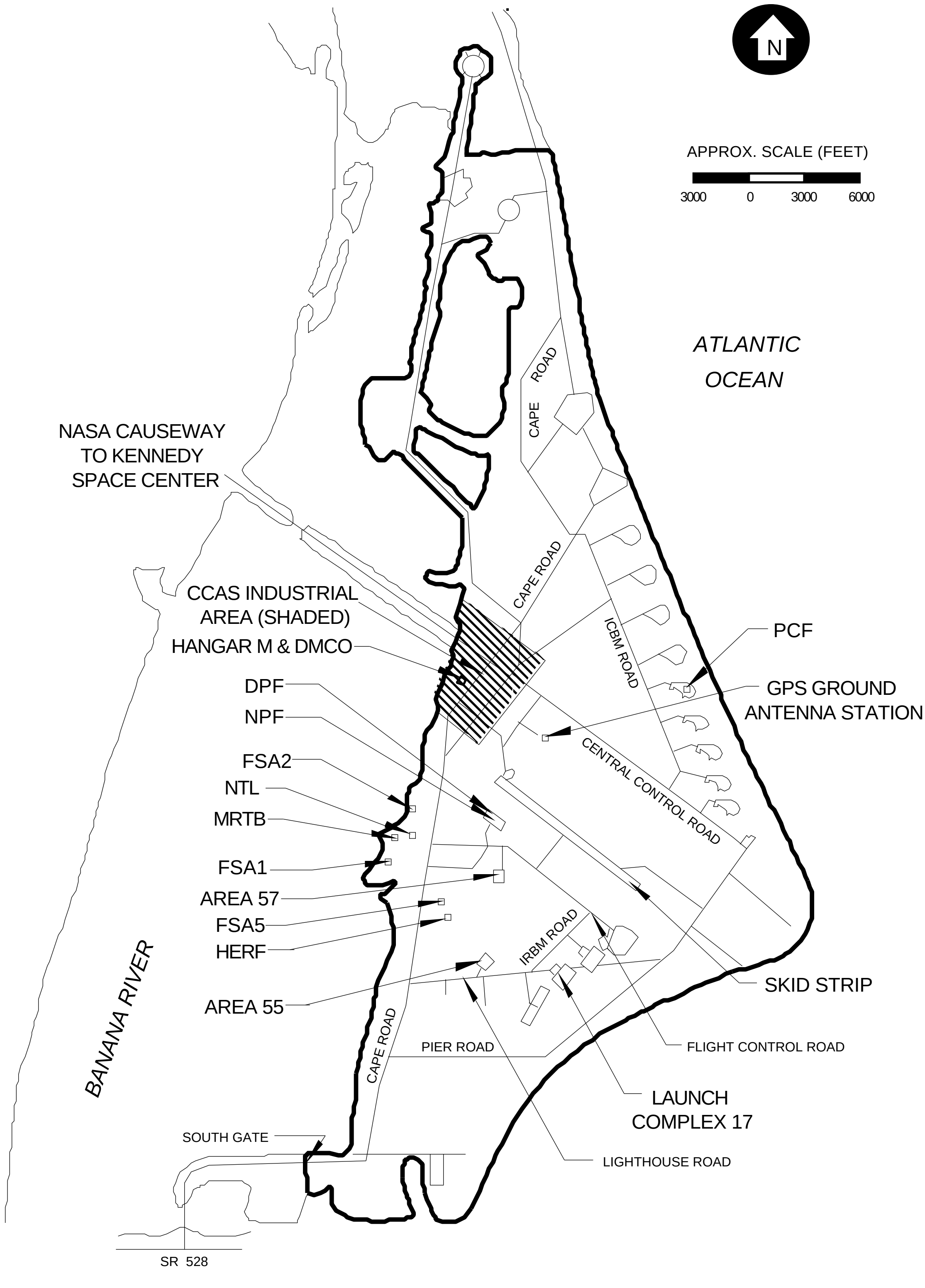


FIGURE 4
PROCESSING LOCATIONS AT CAPE CANAVERAL AIR STATION

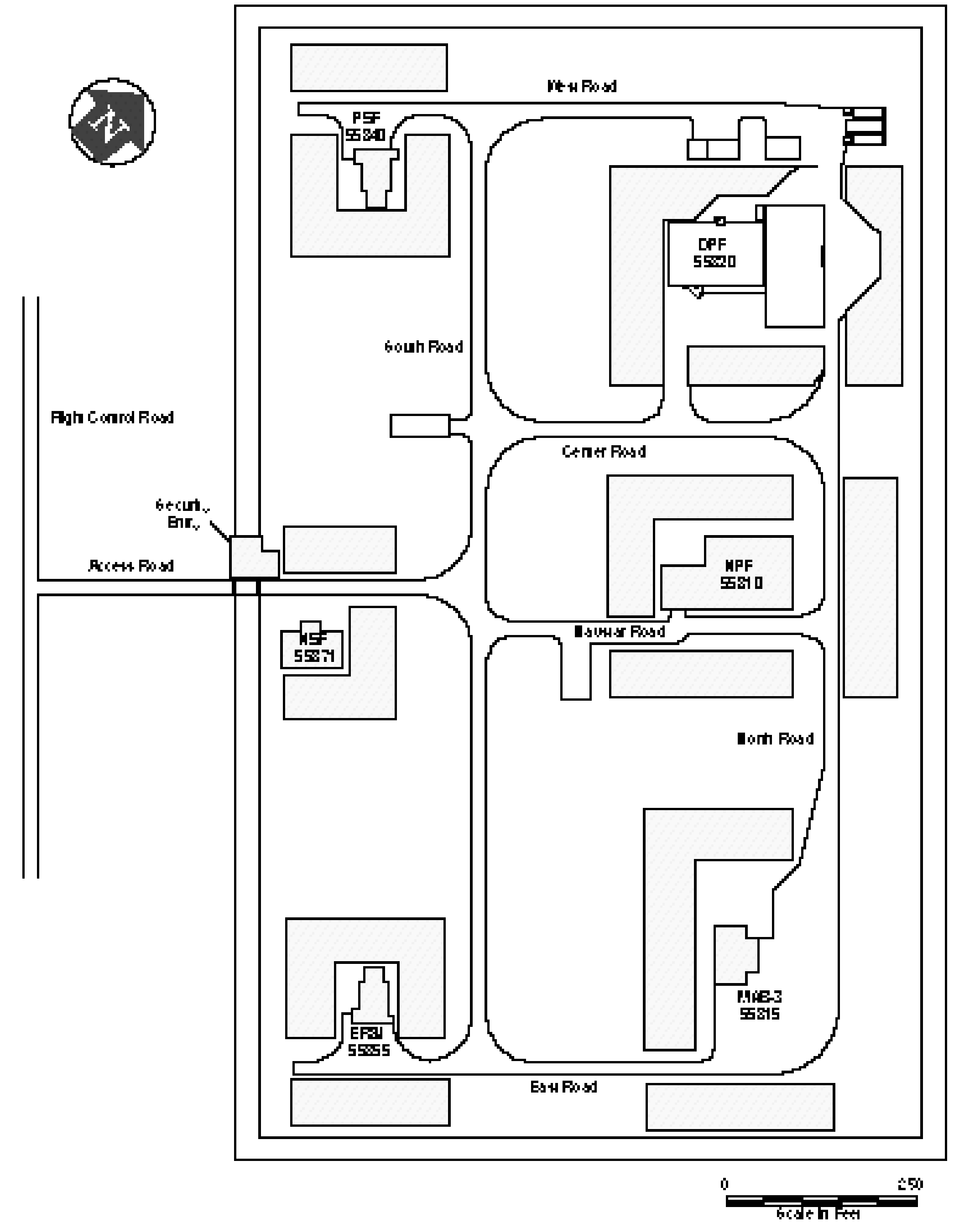


FIGURE 5 MAIN SPACECRAFT PROCESSING AREA

Cape Canaveral AS. Figure 5 shows the location of facilities in the main spacecraft processing area.

Skid Strip. The skid strip (Facility Number 50305) will be utilized by aircraft delivering manufactured SVs. It was constructed in 1952.

Defense Satellite Communication System (DSCS) Processing Facility (DPF). The DPF (Facility Number 55820) will be the

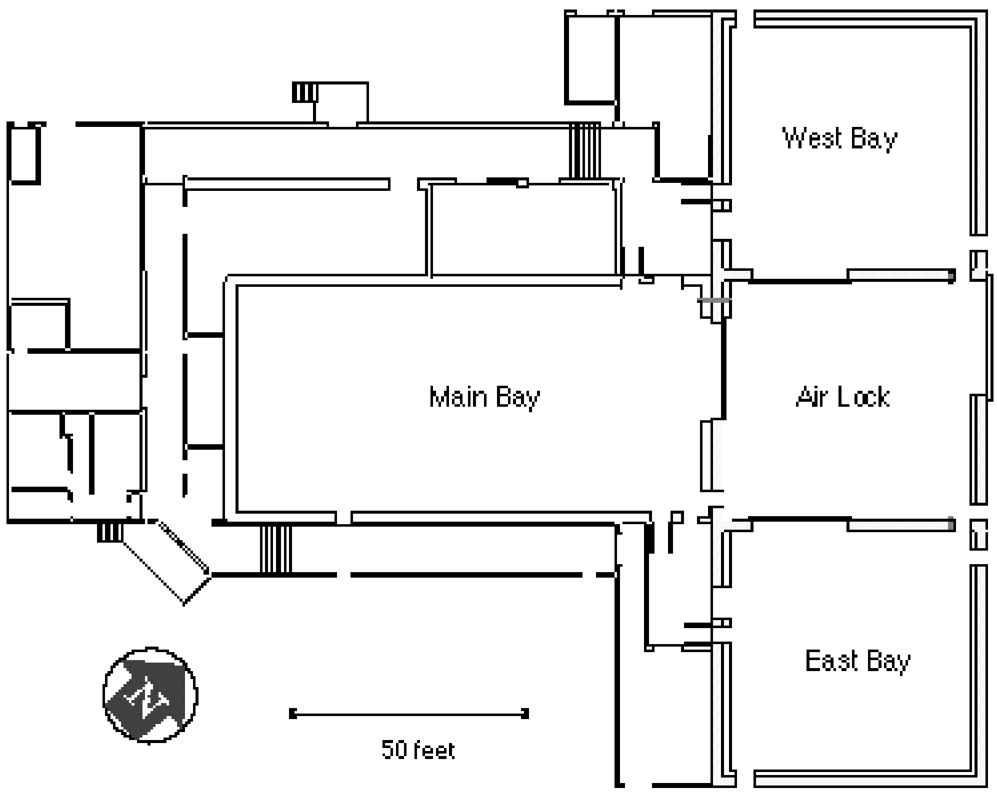


FIGURE 6 PLAN VIEW OF DSCS PROCESSING FACILITY

main processing facility for Block IIR SVs. Figure 6 is a plan view of this facility.

The DPF contains four bays that are used to process spacecraft. The Main Bay is a class 100,000 clean room that is used for receiving and inspection, battery installation, ordnance testing, electronics testing, and communications testing. A class 100,000 clean room has filtering systems that maintain a particle count of less than 100,000 particles per cubic foot of size 0.5 microns and larger.

The airlock provides contamination control for the Main, East, and West Bays. The West Bay is a class 100,000 clean room that will be used for propellant loading operations, build-up of the Apogee Kick Motor (AKM), leak checks of the propellant system and AKM, and mating the SV with the AKM. The East Bay is a class 100,000 clean room that will be used to mate the SV/AKM with the third stage of the launch vehicle and prepare the mated SV/AKM/third stage for transport to Launch Complex 17.

The specific locations within the DPF actually used for various processes may vary from the foregoing description, but the potential environmental impacts would not change.

Two antennas on the roof of the DPF will be used to test the SV communications system.

NAVSTAR Processing Facility (NPF). The NPF (Facility Number 55810) is the main processing facility for Block II/IIA SVs. It contains an air lock, a main bay, a high bay, a shop area, two control rooms, and administrative support areas. For processing of IIR SVs, the NPF will be used for overflow SV storage and prelaunch preparation of the third stage of the launch vehicle.

Fuel Storage Area 2 (FSA-2). FSA-2 will be used for AKM and ordnance storage.

Missile Research Test Building (MRTB). The MRTB (Facility Number 80505) contains a refrigerated room used to "cold soak" an AKM prior to x-ray inspection for voids in the solid rocket fuel.

Nondestructive Test Laboratory (NTL). The NTL (Facility Number 77375) will be used for x-ray inspection of an AKM's solid fuel after it is "cold soaked" at the MRTB.

Fuel Storage Area 1 (FSA-1). FSA-1 will be used to store hydrazine and other liquid fuels.

Propellant Conditioning Facility (PCF). The PCF (Facility Number 8610) will be used to store propellant transfer equipment. It is located at Launch Complex 14.

Launch Complex 17 (LC-17). The payload fairing will be installed at LC-17 and final electronics testing will be performed prior to launch.

2.2.4 Space Vehicle Processing

Block IIR SVs will be transported to the skid strip by Air Force C-5A cargo aircraft. Arriving in late evening, the SVs will be transported from the skid strip to the Defense Satellite Communications System Processing Facility (DPF) using an air-ride tractor-trailer. AKMs will arrive at Cape Canaveral AS by commercial carrier and be stored at Fuel Storage Area 2 (FSA-2).

At the DPF, the SV will be moved into the air lock, unpacked, inspected, and then moved into the main bay. Within the main bay, the SV will be stored until needed. When needed, the SV will be moved to a main bay work area, batteries will be installed, and ordnance, electronics, and communications systems will be tested.

While the SV is processed at the DPF, an AKM will be taken from storage at FSA-2 to the Missile Research Test Building (MRTB) for inspection and "cold soak." The AKM will be "soaked" in refrigerated air for a minimum of 72 hours. After the "cold soak," the AKM will be transported to the Nondestructive Test Laboratory (NTL) for an x-ray inspection of the motor's solid fuel to determine if there are any voids in the solid fuel.

From the NTL, the AKM will be taken to the DPF West Bay for "buildup." AKM buildup includes installation of heater strips, transducers, temperature switches, and the wiring harness. The AKM will also be checked for leaks using helium gas.

The AKM and the SV will be mated in the DPF West Bay. After mating, the SV will be fueled in the West Bay.

The liquid fuel, monopropellant hydrazine, will be temporarily stored in 55-gallon drums at FSA-1 under the supervision of the Joint Propellants Contractor (JPC). The JPC will deliver a hydrazine drum to the DPF when needed.

206 pounds of hydrazine will be transferred from the drum to the two SV fuel spheres. Prior to propellant transfer, the SV's reaction control subsystem will be pressurized to check for leaks. A standpipe assembly will be attached to the hydrazine drum, and transfer lines connected between the hydrazine drum and the SV. The propellant transfer apparatus will be vented through the DPF scrubber system. The hydrazine drum will then be pressurized with helium, inducing flow into the SV fuel spheres.

Once transfer is complete, the pressure in the hydrazine drum will be released and the transfer lines drained into the hydrazine drum under pressure supplied by nitrogen gas. The nitrogen gas will also purge the lines. Isopropyl alcohol or pure water (preferably) will be used to flush the lines into a separate drum that will be labeled by SV processing personnel as non-hazardous waste, and disposed of by the JPC. The hydrazine drum will be returned to FSA-1 by the JPC.

Propellant transfer equipment will then be moved to the Propellant Conditioning Facility at Launch Complex 14 for storage. The contractor loading the propellants is responsible for proper identification, containerization, marking, and accumulation of wastes prior to pickup by the JPC. The entire propellant transfer operation will be performed by certified hydrazine handling and servicing personnel using Self-Contained Atmospheric Pressure Ensemble (SCAPE) suits. Propellant transfer equipment will be cleaned as needed by the JPC. Under current plans, a subcontractor of the JPC will clean the equipment at the Kennedy Space Center, and be responsible for proper identification, containerization, marking, and accumulation of any wastes prior to pickup by the JPC.

After propellant loading, the SV will be moved to the East Bay of the DPF for mating with the upper stage of the launch vehicle. The SV and the upper stage will be mated, additional ordnance installed, the electrical interface tested, and the assembly placed in a transport container for transfer to Launch Complex 17.

2.2.5 Launch Vehicle

The Delta II 7925 Launch Vehicle (LV) is a three-stage expendable LV consisting of a first stage booster with nine attached solid rocket motors, an interstage, a second stage utilizing an Aerojet engine, an upper stage consisting of a solid rocket motor, and a payload fairing that covers the upper stage and the payload. It is an existing design. Figure 7 shows the Delta II LV.

First Stage. In ascending order, the first stage consists of an engine section, an oxidizer tank, a centerbody section, and a fuel tank. The engine section houses the Rocketdyne RS-27A main engine and two vernier engines that are used for roll control. The oxidizer tank is made of aluminum and contains 146,070 pounds of liquid oxygen. The centerbody section contains control electronics and batteries. The fuel tank is made of aluminum and contains 66,504 pounds of Rocket Propellant 1 (RP-1). RP-1 is rocket grade kerosene. The first stage contains five silver-zinc alkaline batteries. Three titanium spheres supply pressurized helium and one titanium sphere supplies pressurized nitrogen.

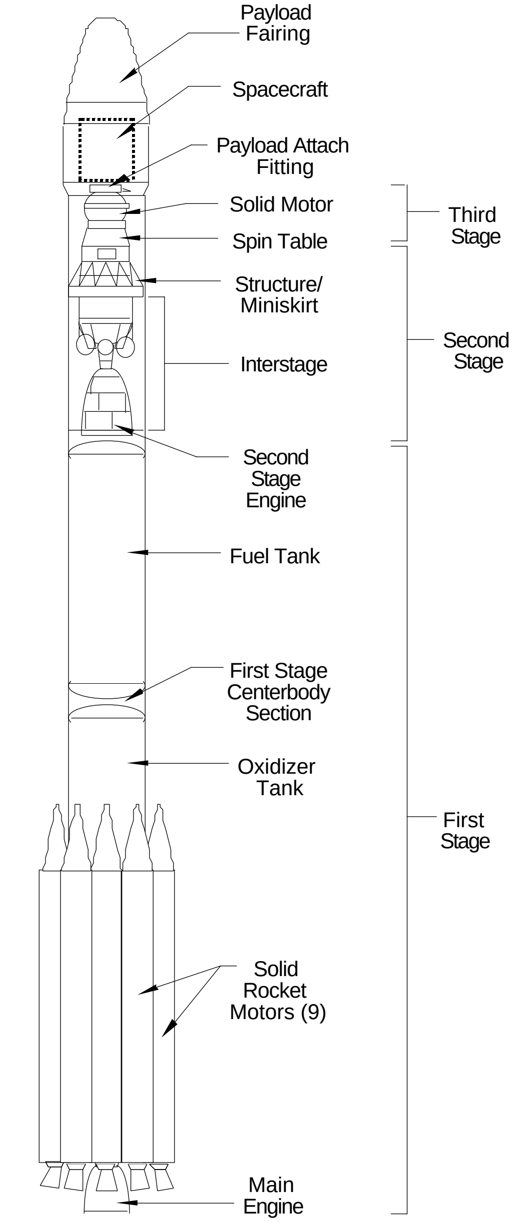


FIGURE 7
DELTA II LAUNCH VEHICLE

Solid Rocket Motors. Nine solid rocket motors are attached to the first stage engine section to provide additional thrust. These motors have graphite epoxy motor cases and each hold 25,882 pounds of Hydroxyl Terminated Polybutadiene (HTPB) solid fuel. As indicated in Section 2.2.2, this type of solid fuel is composed of 71 percent ammonium perchlorate, 18 percent aluminum powder, and 11 percent HTPB.

Interstage. The interstage assembly extends from the top of the first stage to the base of the second stage "miniskirt." It is an aluminum isogrid structure that shields the second stage engine and supports the load from the upper stages and payload. The interstage remains attached to the first stage during second stage separation.

Second Stage. The second stage contains fuel and oxidizer tanks and an Aerojet AJ10-118K restartable engine. The interstage attaches to the "miniskirt" which carries structural loads. Aluminum support struts transfer upper stage loads to the miniskirt and the payload fairing attaches directly to the miniskirt. A dual compartment stainless steel tank with a common bulkhead between the fuel and oxidizer compartments contains 4,614 pounds of Aerozine-50 fuel and 8,669 pounds of nitrogen tetroxide oxidizer. Aerozine-50 is composed of 50 percent by weight unsymmetrical dimethylhydrazine and 50 percent hydrazine. Three titanium spheres provide pressurized helium for pressure maintenance in the fuel and oxidizer compartments. Two of the spheres are 24 inches in diameter and one is 17 inches.

A fourth 17-inch titanium sphere provides pressurized nitrogen for the second stage reaction and control system. The guidance section is above the miniskirt and contains guidance and electronic equipment. The second stage contains five silver-zinc alkaline batteries.

Third Stage. The third stage consists of a spin table, a solid rocket motor, and a payload attach fitting with a hydrazine fueled nutation control system. The spin table attaches to the support struts on the second stage and contains up to eight solid fuel spin rockets on its periphery. These spin rockets impart spin to the second and third stages and payload prior to separation of the third stage from the second stage and ignition of the third stage motor. The spin table remains attached to the second stage after separation.

Each spin rocket contains 513 grams of solid fuel and burns for two seconds. The third stage motor is a Morton Thiokol Star 48B containing 4,431 pounds of HTPB solid fuel. The payload attach fitting mates the space vehicle to the motor. The nutation control system in the payload attach fitting maintains stability during the third stage motor burn. It includes six pounds of monopropellant hydrazine in an 8.5-inch diameter titanium sphere. The third stage contains one silver-zinc alkaline battery.

Payload Fairing. The payload fairing is an aluminum structure that protects the payload from buffeting and aerodynamic heating during flight in the lower atmosphere. The payload fairing also shields the third stage equipment as well as the second stage miniskirt. It is 9.5 feet in diameter with two half-shells and attaches to the base of the second stage miniskirt.

2.2.6 Launch Vehicle Processing Facilities

The following existing facilities at Cape Canaveral AS will be used for Delta II LV prelaunch processing operations: Hangar M, Facility Number 49934, Delta Mission Checkout, Horizontal Processing Facility, Area 55, Area 57, Hangar O, Fuel Storage Area 2, Fuel Storage Area 5, Missile Research Test Building, Nondestructive Test Laboratory, NAVSTAR Processing Facility, Fuel Storage Area 1, Propellant Servicing Facility, Propellant Conditioning Facility, Explosive Safe Area 60, Defense Satellite Communications Satellite Processing Facility, and Launch Complex 17. Figure 4 shows the location of these processing facilities. Other facilities at Cape Canaveral AS may also be used for storage, but prelaunch processing will not occur at these storage facilities.

Hangar M. The first and second stages, interstage, and payload fairing will be received and stored at Hangar M (Facility Number 1731) after transport to Cape Canaveral AS by truck. The interstage and fairing will be cleaned with isopropyl alcohol wipes and prepared for erection, and ordnance will be installed on the payload fairing. Batteries will also be stored and prepared at Hangar M. Two nearby structures, Little Hangar M and the Petroleum, Oil, and Lubricant Storage Building (Facility Numbers 60500 and 60501, respectively) will be used for storage.

Facility Number 49934. This is an existing facility located in the main industrial area of Cape Canaveral AS. It was recently constructed and will be used for overflow storage of first stages.

Delta Mission Checkout (DMCO). After receipt at Hangar M, the first and second stages will be transported to the DMCO (Facility Number 60510), located behind Hangar M. At the DMCO, the pneumatic, propulsion, hydraulic, telemetry, and control systems will be checked. A simulated flight test will also be performed and guidance computers installed and checked.

Horizontal Processing Facility (HPF). At the HPF (Facility Number 1270BE), first stage destruct ordnance will be installed and the first stage prepared for erection.

Area 55. At Area 55, the second stage pressure checks will be performed, and the nozzle extension and destruct ordnance will be installed. Area 55 is also known as the Delta Operations Support Facility and includes a number of structures in close proximity as listed in Table 2 and shown in Figure 8.

Table 2 Area 55 Facilities

Number	Name
1305A	Delta Offices and Supply Building
1305B	Petroleum, Oil, and Lubricant Storage Building
1305D	Second Stage Checkout Building
1305G	Delta Laboratories
56616	Hazardous Waste Accumulation Facility
56617	Petroleum, Oil, and Lubricant Drum Storage
56618	Second Stage High Pressure Test Facility

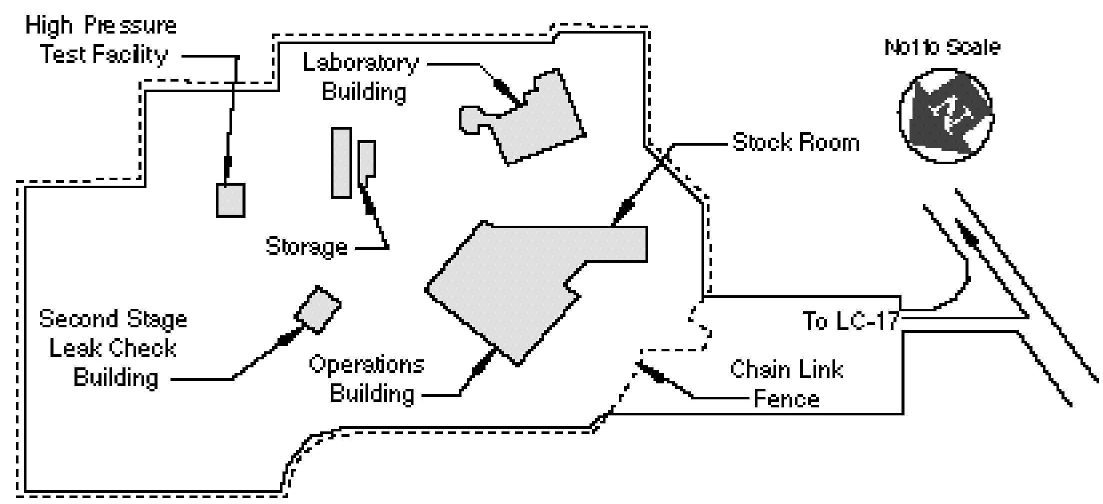


FIGURE 8 AREA 55 FACILITIES

Area 57. The solid rocket boosters will be transported to Area 57 by truck. Two main facilities are located at Area 57, the Solid Motor Storage Building (SMSB) and Solid Motor Checkout Building (SMCB) (Facility Numbers 50801 and 50803, respectively). The SMSB will be used only for storage of the solid rocket motors. All processing of the solid rocket motors will be performed at the SMCB, including receipt and inspection, leak checks, grain inspection, electronics and ordnance installation, and nose cone installation. Figure 9 shows Area 57.

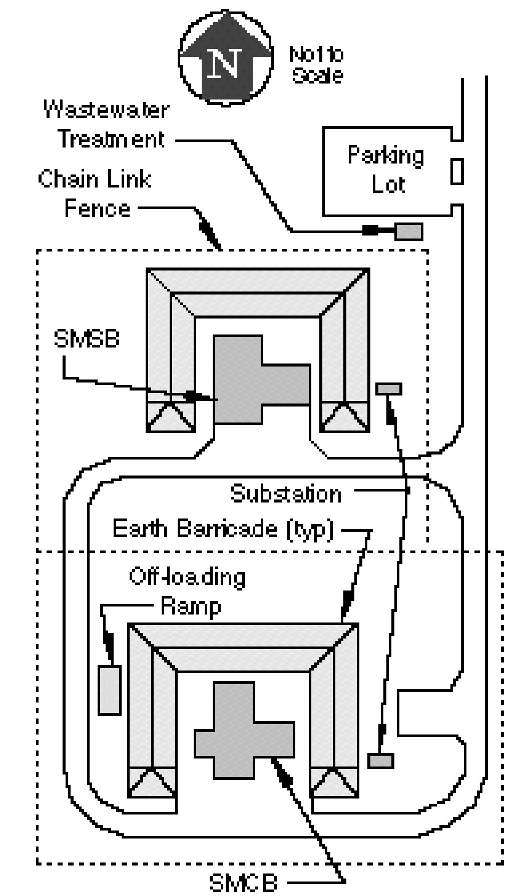


FIGURE 9
AREA 57 FACILITIES

An additional new solid rocket motor storage facility for overflow storage is located off Flight Control Road near Facility Numbers 35440 and 35445. This new facility has not been named or numbered.

Hangar O. Hangar O is a facility in the main industrial area of Cape Canaveral that will be used for overflow storage of first stage solid rocket motors.

Fuel Storage Area 2 (FSA-2). FSA-2 will be used for receipt and storage of the third stage motor, and for ordnance storage.

Fuel Storage Area 5 (FSA-5). FSA-5 is an alternate location for receipt and storage of the third stage motor, and for ordnance storage. It is near FSA-2.

Missile Research Test Building (MRTB). The MRTB (Facility Number 80505) contains a refrigerated room that will be used to "cold soak" the upper stage solid rocket motor prior to x-ray inspection for voids in the fuel.

Nondestructive Test Laboratory (NTL). The NTL (Facility Number 77375) will be used for x-ray inspection of the upper stage solid motor after it is "cold soaked" at the MRTB.

NAVSTAR Processing Facility (NPF). The NPF (Facility Number 55810) will be the main processing facility for the third stage. It contains an air lock, a main bay, a high bay, a shop area, two control rooms, and administrative support areas.

At the NPF, electrical and leak tests will be performed on the third stage components. The wiring harness and ordnance will also be installed, and the components mated.

Fuel Storage Area 1 (FSA-1). FSA-1 is used to store liquid fuels.

Propellant Servicing Facility (PSF). The PSF (Facility Number 55840) will be used to load hydrazine into the nutation control system in the payload attach fitting.

Propellant Conditioning Facility (PCF). The PCF (Facility Number 8610) will be used to store propellant transfer equipment. It is located at Launch Complex 14.

Explosive Safe Area 60 (ESA-60). ESA-60 (Facility Number 54446) is used to spin balance the third stage and payload attach fitting prior to mating with the spin table.

Defense Satellite Communications System Processing Facility (DPF). The DPF (Facility Number 55820) will be the main processing facility for IIR SVs.

The DPF contains four bays that are used to process spacecraft. The East Bay is a class 100,000 clean room that will be used to mate the SV with the third stage of the LV and prepare the mated SV/third stage for transport to Launch Complex 17.

Table 3 Launch Complex 17 Facilities

Number	Name
1270A	Blockhouse
1270B	Launch Pad A
1270C	Launch Pad B
1270J	Operations Support Building
1270K	Supply Building and Shop
1270L	Battery Laboratory
1270P	White Room Air Conditioning Building
1270Q	Equipment Storage
1270R	Storage Building
1270S	Area Warning Facility
1270U	Liquid Oxygen Storage Area
1270W	RP-1 Storage Area Pad A
1270X	RP-1 Storage Area Pad B
1270AC	High Pressure Gas Facility
1270AE	Self-Contained Atmospheric Pressure Ensemble Building
1270AK	Gaseous Nitrogen Storage Area
1270AL	Pneumatic Control Room Pad A
1270AP	Operations Support Building
1270AT	Pneumatic Control Room Pad B
1270AU	Delta Inertial Guidance System Pad B
1270AV	Petroleum, Oil, Lubricant Storage
1270BB	Delta Inertial Guidance System Pad A
1270BD	Liquid Nitrogen Storage Area
1270BY	Gantry - Pad A
1270CY	Gantry - Pad B

Launch Complex 17 (LC-17). The various components of the LV will be assembled at one of the two launch pads at LC-17. Final prelaunch processing will take place at the pad.

LC-17 includes a number of structures associated with prelaunch processing and launch as shown in Table 3. Figure 10 is a layout of LC-17.

There are also several modular offices at Complex 17.

2.2.7 Launch Vehicle Processing

First Stage. The first stage will be trucked from the manufacturer to Hangar M. At Hangar M, it will be checked and then transported to the Delta Mission Checkout (DMCO). In the DMCO, the following will be performed:

- Hydraulic system preparation
- Propulsion system leak check and functional tests
- Rate gyro functional test
- Electrical preparation
- Telemetry evaluation
- Engine insulation installation
- Mechanical preparations
- Control system checkout

The second stage, which will also have been moved to DMCO, will be connected electronically to the first stage and the two tested together.

The first stage will then be returned to Hangar M or an alternate facility for storage. When a first stage is needed for launch, it will be transported to the Horizontal Processing Facility (HPF) near

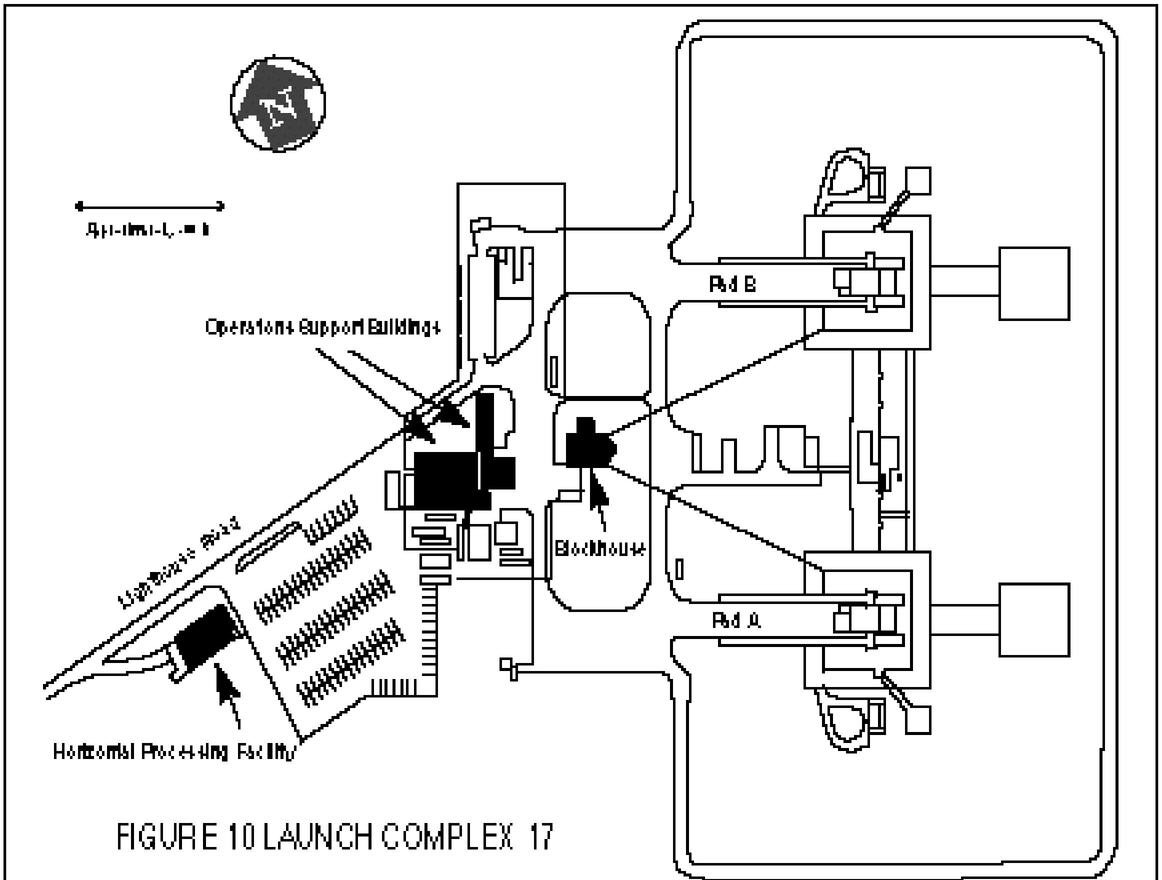


FIGURE 10 LAUNCH COMPLEX 17

Launch Complex 17 (LC-17). At the HPF, the first stage destruct ordnance will be installed and the first stage prepared for erection on one of the two launch pads at LC-17. At the launch pad, the first stage will be erected and secured for assembly with the remaining parts of the launch vehicle.

Solid Rocket Motors. The solid rocket boosters will be transported by truck to the Solid Motor Checkout Building (SMCB) in Area 57 for offloading, receiving, and leak check. The wiring harness and ordnance will be installed, the nose cone will be attached and the motor prepared for erection. The motor will then be transported to the Solid Motor Storage Building in Area 57 or an alternate location for storage.

When solid rocket motors are needed, nine will be transported from storage to LC-17. The nine motors will be erected in the Mobile Service Tower (MST), attached to the first stage, and aligned.

Interstage. The interstage will be delivered to Hangar M by truck. At Hangar M, the electrical connections will be checked and the interstage prepared for transport to LC-17 and erection.

At LC-17, the interstage will be hoisted on top of the first stage and the electrical interface with the first stage will be connected. The interstage will be erected prior to attachment of the solid rocket motors.

Second Stage. The second stage will be transported to Hangar M from the manufacturer and offloaded. It will then be moved to the DMCO where the following will be performed:

- Hydraulic system testing
- Guidance computer installation
- Telemetry and electronic testing
- Installation and testing of Delta inertial guidance system
- Mechanical preparation

As indicated earlier, the second stage will be connected to the first stage and the two tested together.

From the DMCO, the second stage will either be returned to Hangar M for storage or transported to Area 55 for additional prelaunch processing.

At Area 55, two buildings will be used for processing second stages: the High Pressure Test Facility (HPTF) and the Second Stage Checkout Building (SSCB), Facility Numbers 56618 and 1305D, respectively. At the HPTF, the propulsion system will be checked for leaks, the nozzle extension installed, and the electrical system installed and checked. At the SSCB, ordnance will be installed and the second stage prepared for transport to LC-17.

At LC-17, the second stage will be hoisted to Level 5 of the MST and connected to the interstage.

Third Stage. The third stage motor will be transported by truck to Fuel Storage Area 2 (FSA-2). The motor will be taken to the Missile Research Test Building (MRTB) to be "cold soaked" prior to x-ray inspection of the propellant grain. The cold soak involves placing the motor in a refrigerated compartment to lower its temperature.

From the MRTB, the motor will be taken to the Nondestructive Test Laboratory (NTL) for x-ray inspection of the grain to determine if there are large voids that would make the motor unusable. After the inspection, the motor will be returned to FSA-2 for storage until needed.

The Payload Attach Fitting (PAF) and the spin table will be trucked to the NAVSTAR Processing Facility (NPF). At the NPF, the spin table and the PAF will be unloaded and prepared for further processing. The PAF electrical equipment will be installed and tested, and the PAF will be transported to the Propellant Servicing Facility (PSF) for a propulsion system leak check, a thruster response test, and hydrazine loading of the Nutation Control System (NCS).

A drum containing monopropellant hydrazine will be brought to the PSF from Fuel Storage Area 1 (FSA-1) by the Joint Propellants Contractor (JPC) for Cape Canaveral AS. Prior to propellant loading operations, all nonessential personnel will be cleared from the PSF and loading personnel will don self-contained atmospheric pressure ensemble suits.

The drum will be placed on a scale and the standpipe assembly and transfer hoses connected. The drum will be pressurized and six pounds of hydrazine transferred into the NCS. After the transfer is complete, the pressurized drum will be vented to the PSF hydrazine vent system. An oxidizer stack or scrubber is not required under current Florida Department of Environmental Protection regulations for the vent system.

The transfer lines will be drained back into the hydrazine drum and purged with gaseous nitrogen. The lines will then be disconnected and flushed into a separate container with isopropyl alcohol or water (preferably). The resultant liquid will be tested to determine if it is hazardous, and neutralization of the rinsate will be provided as necessary. Rinsates determined to be non-hazardous will be labeled and prepared for transport as non-hazardous waste. The JPC will remove the hydrazine drum and the waste container.

After the transfer operation is complete, the NCS will be pressurized with helium and the PAF returned to the NPF for further processing. The propellant transfer equipment will be taken to the Propellant Conditioning Facility at Launch Complex 14 for storage.

A third stage solid rocket motor will be transported from storage to the NPF and checked for leaks. The motor will be placed in the buildup stand and the PAF mated to it. PAF ordnance and thermal insulation will be installed, and the motor and PAF will be transported to Explosive Safe Area 60 for spin balancing. After spin balancing, the motor and PAF will be returned to the NPF and mated to the spin table. The composite electrical system will be connected and tested, and additional ordnance installed.

The third stage assembly will then be taken to the Defense Satellite Communications System Processing Facility (DPF) for mating with the SV. Processing of the SV is described in Section 2.2.4. The SV will be mated to the PAF and the separation clamp installed. The third stage/SV assembly will be placed in a transport container and taken to LC-17.

At LC-17, the assembly will be hoisted to Level 5 of the MST and the transport container removed. The assembly will then be connected to the second stage guidance section.

Payload Fairing. The payload fairing will be transported from the manufacturer to Hangar M. At Hangar M, the fairing will be cleaned with isopropyl alcohol and the explosive ordnance installed. The fairing will be stored in Hangar M until needed for launch. When needed, the fairing will be transported to LC-17, hoisted to Level 5 of the MST, and placed in the Level 5 storage position until the upper stages and the SV are ready for encapsulation. The fairing will then be mated to the second stage miniskirt.

2.2.8 Mission Profile

2.2.8.1 Prelaunch

Approximately 25 days prior to launch, the first stage and interstage will be taken to LC-17 and erected. The solid rocket motors and the second stage will then be mated to the first stage and the fairing installed in its storage position in the Mobile Service Tower (MST).

Approximately 19 days prior to launch, testing of the electrical and mechanical systems will begin, and the first and second stage propulsion systems will be checked. Eight days before launch, the third stage and SV will be hoisted and mated to the second stage. Integrated systems testing will be performed for the next two days.

Approximately five days prior to launch, a simulated flight test will be performed. The remaining destruct ordnance will be installed and preparations made for second stage propellant loading and fairing installation. The second stage propellant compartments will be purged and pressurized with helium.

The second stage propellants will be loaded approximately two days prior to launch. Separate mobile Propellant Transfer Sets (PTS) will be used to transfer Aerozine 50 fuel and nitrogen tetroxide oxidizer into the second stage storage compartments. A PTS with a fuel or oxidizer container will be brought to LC-17 by the Joint Propellants Contractor (JPC) for Cape Canaveral AS. The propellant container will be pressurized and the vent system connected to mobile packed column scrubbers.

Valves will then be opened, allowing the propellant to flow into the second stage. A total of 4,614 pounds of Aerozine-50 fuel and 8,669 pounds of nitrogen tetroxide will be loaded. After loading is complete, the system will be depressurized and drained back into the fuel and oxidizer containers on the PTSs. The system will be vented through mobile scrubbers to remove air contaminants. Then the lines will be flushed with nitrogen, and the flushed air will also be vented through the scrubbers. Finally, the lines will be flushed with water into 55-gallon drums.

Each launch operation will generate approximately 225 gallons of fuel rinsate and the same amount of oxidizer rinsate.

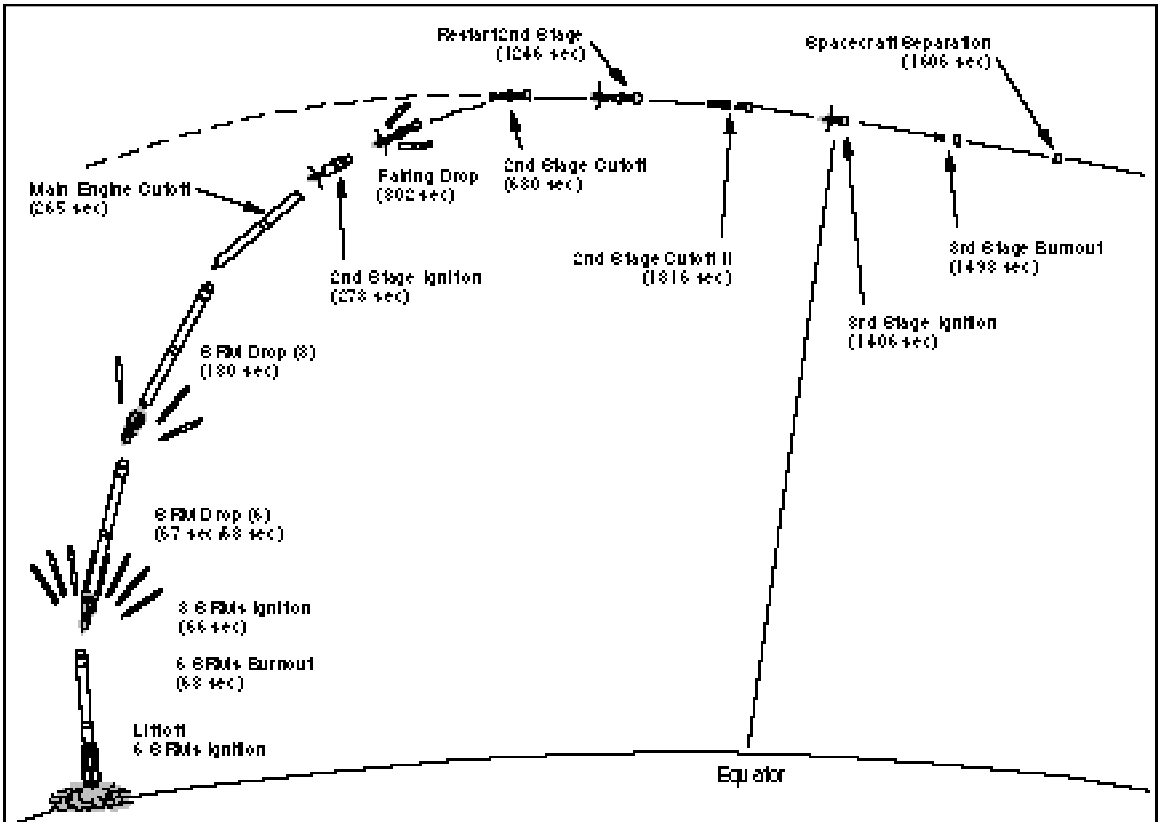


FIGURE 11 LAUNCH PROFILE

The oxidizer rinsate may be neutralized and disposed in the wastewater collection system. The fuel rinsate will be disposed by the Joint Propellants Contractor (JPC) as a non-hazardous waste.

Rocket Propellant 1 (RP-1) is stored at both launch pads. Each launch pad has two 6,500-gallon storage tanks. Approximately 125 minutes prior to launch, loading operations will begin with a transfer rate of 600 gallons per minute (gpm). A total of 66,504 pounds of RP-1 will be loaded. The transfer piping will be drained back into the storage tanks, but remain connected until launch. A small section of flexible hose connects the transfer piping to the LV. This section is destroyed at launch and replaced. The only portion of the transfer piping that is cleaned is the fuel bellows assembly, which is disconnected and cleaned as needed at Area 55 along with other fuel-contaminated launch components. The cleaning process produces hazardous waste which is disposed by the JPC.

Liquid Oxygen (LOX) is stored at LC-17 in a 27,350-gallon storage tank that supplies both launch pads. The flow rate is approximately 700 gpm. Approximately 75 minutes prior to launch, 146,070 pounds of LOX will be loaded. The transfer piping will be drained back into the storage tank, but remain connected until launch. Supplemental transfer of LOX may be necessary prior to launch.

The LV will then be pressurized and all remaining ordnance armed. For the final three hours, all personnel will be cleared from the launch pad. The MST will be rolled away from the LV, and support will be provided by the fixed gantry.

2.2.8.2 Launch

Figure 11 and the following discussion describe a typical launch. Once the engine start sequence has been commanded, the main engine ignition sequence will require 2.5 seconds. The solid rocket booster motors will not ignite until main engine ignition has been confirmed. Once the main engine has ignited, six of the nine solid rocket motors will be ignited.

At 63 seconds after liftoff, the six ignited solid rocket booster motors will burn out, and the remaining three will be ignited at 66 seconds. Three each of the burned out boosters will drop off at 67 and 68 seconds, respectively. At 130 seconds, the last three boosters will burn out and be jettisoned three seconds later.

At 265 seconds after liftoff, main engine cutoff will occur. The second stage separation bolts that attach to the interstage will be blown eight seconds later. The interstage will remain attached to the first stage. Five seconds later, the second stage engine will be ignited, and fairing separation will occur 24 seconds after the second stage ignition. The second stage engine will burn for 352 seconds and cut off. The second stage engine will be restarted 616 seconds later for an additional 70-second burn.

The first and second stages of the launch vehicle will insert the third stage and payload into a parking orbit of approximately 171 by 204 kilometers (km).

With the second stage still attached, the spin rockets on the third stage spin table will be ignited to produce spin prior to third stage ignition. Spin rocket ignition will occur approximately 50 seconds after the final second stage engine cutoff, and the rockets will burn for two seconds. One second later, the second stage with the spin table will be jettisoned.

Third stage motor ignition will occur 90 seconds after the final second stage engine cutoff and the third stage solid rocket motor will burn for 87 seconds. The third stage will be jettisoned 113 seconds after the third stage motor burns out. The payload will be inserted into a transfer orbit of approximately 186 by 20,491 km.

When the SV or payload reaches the apogee of the transfer orbit (the point in the orbit that is furthest from the Earth), the apogee kick motor (AKM) will ignite. AKM burning will place the SV in an orbit approximate to the final drift orbit. Small thrusters aboard the SV will fine-tune the drift orbit, and the result will be the final 20,426-km circular orbit. The thrusters will be used over the 10-year projected life of the SV.

2.2.8.3 Postlaunch

The solid rocket booster motors, the first stage, the interstage, and the payload fairing will fall into the ocean. All remaining propellants in the second stage will be burned to deplete the propellants and to lower the orbit. Reentry of the second stage will normally occur within two to three months. The orbital life of the third stage is estimated as sixty to seventy years.

The end-of-life plan for the SV is to burn all remaining propellant while moving the vehicle into a higher orbit. The SV will be oriented to shield the batteries and ensure minimum volatility. The SV will then be turned off and considered dead. NAVSTAR GPS SVs are placed in inclined half-geosynchronous orbits with lifetimes beyond present estimating capabilities. Reentry of a NAVSTAR GPS SV within 1,000 years is a highly unlikely event.

2.2.9 Control Segment Facilities and Operations

Section 1.3 includes an overview of the GPS program and the four program segments. As stated in Section 1.3, the control segment includes the Master Control Station (MCS), located at Falcon AFB, Colorado, with monitor stations and ground antennas at various locations around the world. Combined monitor stations and ground antennas are located at Falcon AFB (ground antenna is GPS capable, but not normally used for

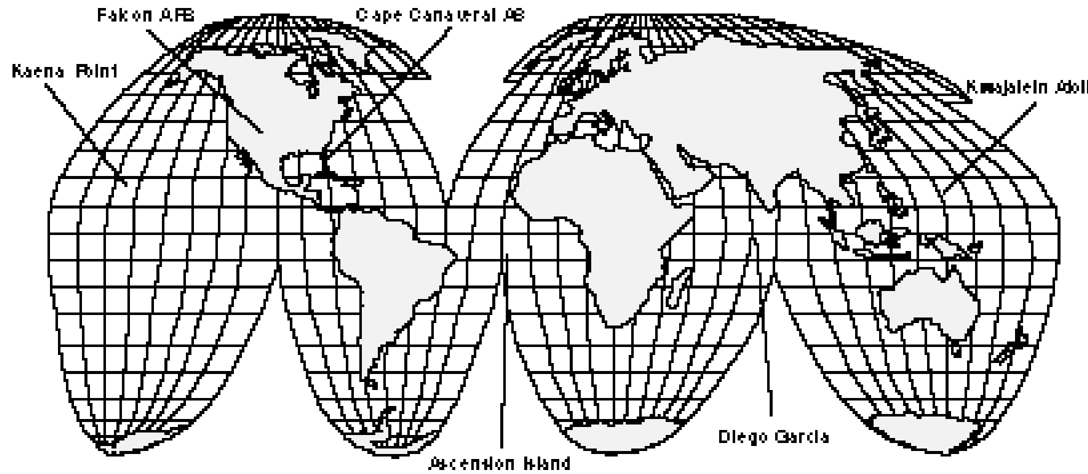


FIGURE 12
NAVSTAR GPS GROUND FACILITIES

operations), Cape Canaveral AS, Kwajalein Atoll, Ascension Island, and Diego Garcia. A ground antenna is located at Kaena Point, Hawaii. The monitor stations do not transmit radio signals. The ground antennas transmit and receive radio signals. The MCS provides mission control capability for GPS operations. It has the communications equipment necessary to send and receive transmissions through the ground antennas. The fixed ground terminal equipment at Falcon AFB is located on the southwest side of the existing Defense Satellite Communications System facility. The monitor stations receive radio signals from SVs in the Block II constellation. Data from the stations are relayed to the MCS and processed to determine each SV's precise current coordinates and the prevailing time registered by the on-board atomic clock. Detected errors are corrected by periodically transmitting new upload data to the SVs through the ground antennas. The MCS also monitors the status of the SV subsystems and payloads. Figure 12 shows the locations of the ground segment facilities.

Environmental effects associated with the MCS and facilities at Falcon AFB have been previously addressed (USAF, 1981b), as have the effects of the Ascension Island facilities (USAF, 1983). The current operational effects associated with the other existing facilities will be included in this environmental assessment.

2.2.9.1 Cape Canaveral AS

Facility Numbers 39761A, B, C, and D comprise the control segment facility at Cape Canaveral AS. The radome houses a 10-meter antenna that is mechanically positioned by signals from the MCS. The facility does not currently have dedicated monitor (nontransmitting) antennas. There will be two six or eight-foot monitor antennas in radomes when the Block IIR SVs are operational.

2.2.9.2 Diego Garcia

A GPS ground antenna and monitor are located at Diego Garcia, British Indian Ocean Territory, in close proximity to an Automated Remote Tracking Station (ARTS) facility. The GPS facility includes the ground antenna and radome, a maintenance office trailer, and a generator building. Monitoring equipment is located in part of a building occupied by the U.S. Navy Computer and Telecommunications Station.

2.2.9.3 Kwajalein Atoll

A GPS ground antenna and monitor station are located at Kwajalein Atoll. The ground antenna site includes the ground antenna and radome, an equipment building, and a power building that does not contain a backup generator. The monitor station is located in a nearby building shared with other programs.

2.2.9.4 Kaena Point

The Kaena Point Satellite Tracking Station (KPSTS) contains two ARTS facilities, a radar system, communications facilities, and a GPS monitor station. A total of 60 personnel work at KPSTS. The monitor station does not emit radio frequency radiation.

2.3 MISSION

The NAVSTAR GPS program has two missions. The first is to provide three-dimensional position, velocity, and time information worldwide under all weather conditions to Department of Defense and public users. The second is to detect nuclear detonations at or above the Earth's surface. The MLV III program's mission is the launch of the NAVSTAR GPS IIR SVs.

2.4 ALTERNATIVES TO THE PROPOSED ACTION

2.4.1 No-Action Alternative

The Department of Defense currently uses a variety of navigational systems (USDOT, 1993), including Long-Range Navigation C (Loran-C), Omega, Very High Frequency Omnidirectional Range/Distance Measuring Equipment (VOR/DME), Tactical Air Navigation (TACAN), Microwave Landing System/Instrument Landing System (MLS/ILS), Transit, radio beacons, and collocated VOR and TACAN (VORTAC). As of December 31, 1994, the DOD requirements for Loran-C and Omega will end. Transit will cease operations in December 1996. VOR/DME and TACAN will be phased out by 2000. GPS will replace these systems.

The no-action alternative is continued reliance on the existing Block II/IIA constellation with no replenishment until the operational life of the constellation is over.

2.4.2 Other Alternatives Eliminated from Consideration

Vandenberg AFB, California, is the only alternative location for processing and launching NAVSTAR GPS SVs in the United States. Generally, the environmental impacts would be similar to those experienced at Cape Canaveral AS if existing facilities could be utilized. However, the orbital requirements would call for a launch path over populated areas, with attendant safety concerns that could not be mitigated. Therefore, the Vandenberg AFB alternative will not be considered.

The space shuttle is not now used for DOD launches because of a presidential directive.

The existing Block II/IIA SV design is an alternative to the IIR SV design. However, the II/IIA design does not meet modified mission requirements and will not be considered further in this EA.

2.4.3 Alternative Launch Vehicle

2.4.3.1 Atlas II Launch Vehicle

The Atlas II family of LVs contains three types: the Atlas II, IIA, and IIAS. All of the Atlas II LVs use a core vehicle consisting of a booster section and a sustainer section, which together comprise 1-1/2 stages using propellants from the same tanks. These two sections fire simultaneously, but the booster section ceases its burn before the sustainer section. The booster section is then jettisoned and the sustainer section continues its burn until all propellants are expended. The core vehicle uses Rocket Propellant 1 (RP-1) as fuel and liquid oxygen as oxidizer. RP-1 is

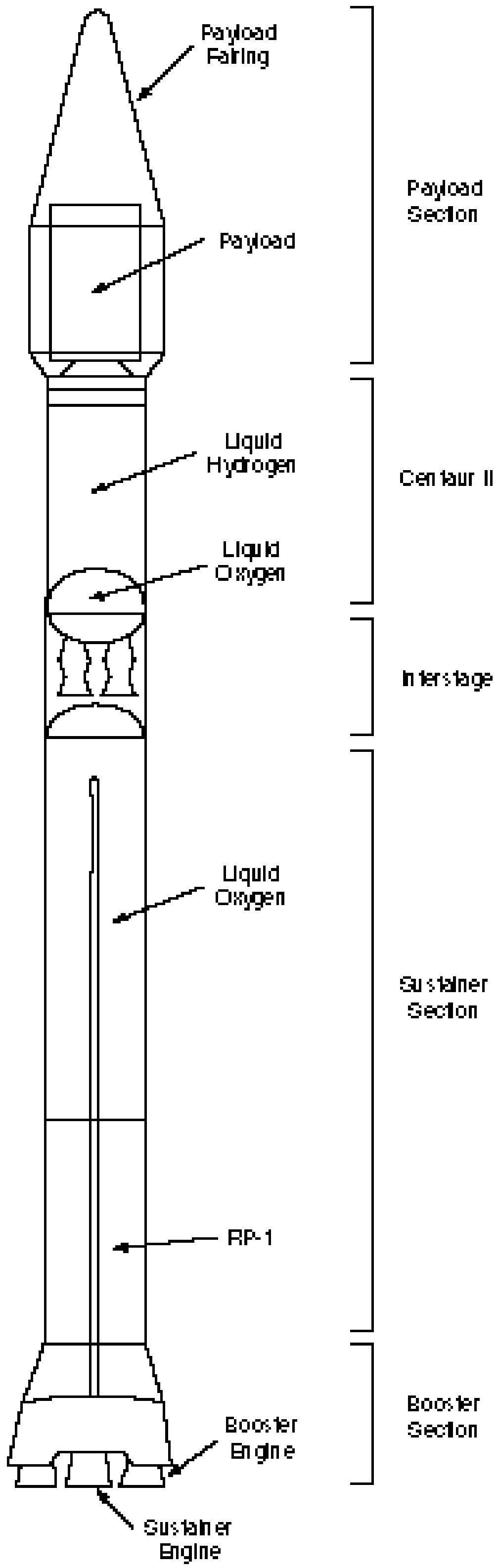


FIGURE 13
ATLAS II LAUNCH VEHICLE

a kerosene hydrocarbon. All Atlas II LVs use a Centaur II upper stage which is fueled by liquid hydrogen (H_2) and uses liquid oxygen (O_2) as oxidizer. Additionally, approximately 210 pounds of hydrazine fuels small catalytic thrusters that provide reaction and roll control for the core vehicle and the Centaur II. The Atlas II uses a Centaur II upper stage, the Atlas IIA uses an improved Centaur IIA upper stage which provides greater control and thrust. The Atlas IIAS is an Atlas IIA with four SRMs providing additional boost capacity. Figure 13 shows the Atlas II LV.

Booster and Sustainer Section. The booster section contains two engines and the sustainer section one engine. Above the engines are two stainless steel tanks containing 242,000 pounds of liquid oxygen and 108,000 pounds of RP-1 propellant. Hydrazine-fueled thrusters provide roll control.

Interstage. A 13-foot aluminum interstage assembly provides the structural link between the booster and sustainer section and the Centaur stage.

Centaur II. The Centaur upper stage contains 5,692 pounds of liquid hydrogen and 31,308 pounds of liquid oxygen in two stainless steel tanks. Two engines provide thrust and hydrazine-fueled thrusters provide roll control. The two propellant tanks are separated by a double-wall bulkhead. An equipment module and stub adapter are situated on top of the Centaur. The equipment module contains the Centaur avionics module and the stub adapter provides structural support for the equipment module, payload fairing, and a spacecraft adapter. The Centaur is capable of multiple restarts.

Payload Fairing. An aluminum payload fairing comprising two "clamshell" sections protects the payload during atmospheric ascent.

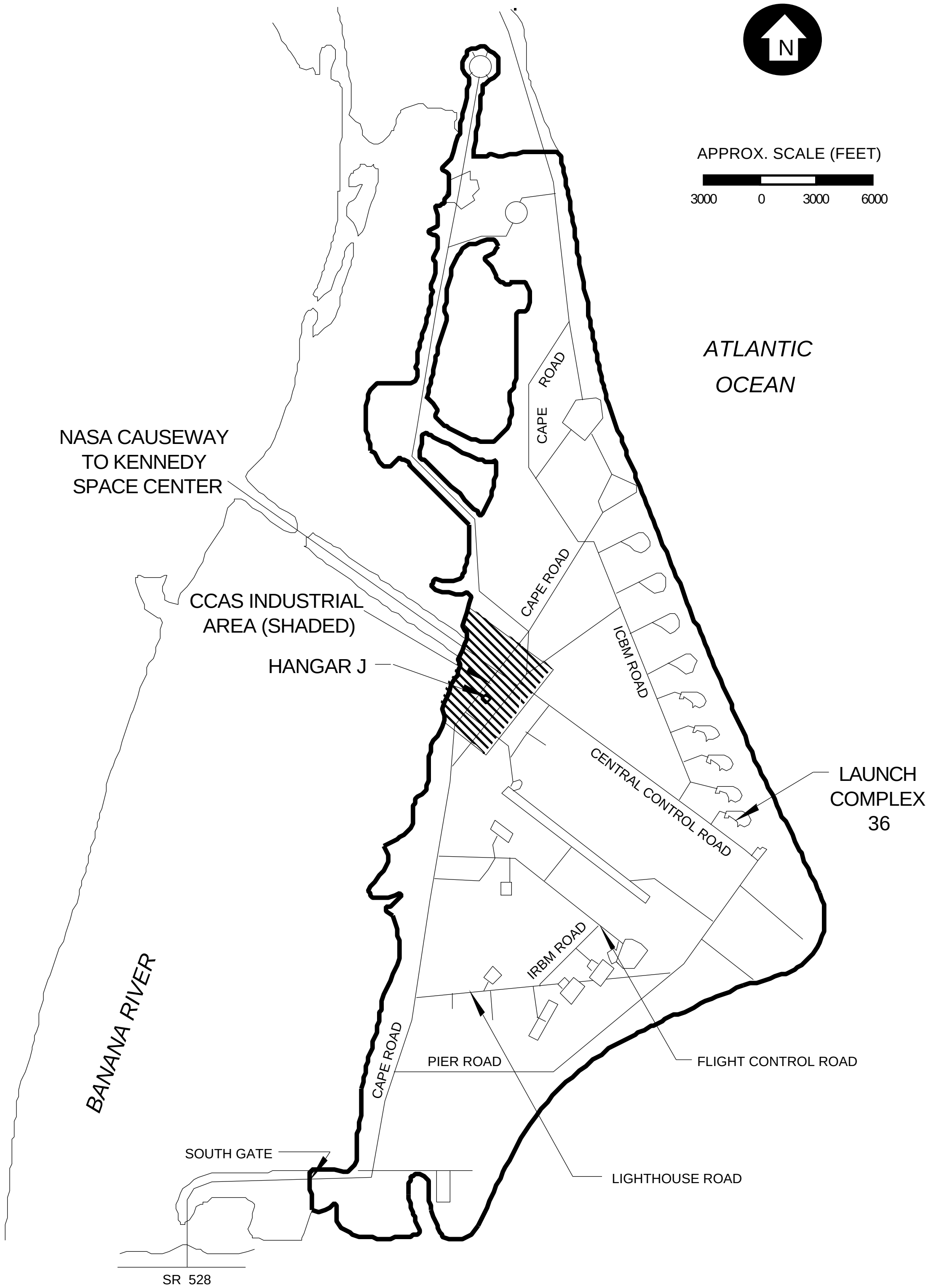


FIGURE 14
ATLAS II PROCESSING FACILITIES

2.4.3.2 Atlas II Processing Facilities

The following existing facilities at Cape Canaveral AS would be used for Atlas II prelaunch processing operations: Hangar J and Launch Complex 36, Pad A (LC-36A). Figure 14 shows the location of these facilities.

Hangar J. After arriving at the Cape Canaveral AS skid strip by USAF cargo aircraft, the LV components would be taken to Hangar J for initial testing and storage.

Launch Complex 36A. The major facilities at LC-36A include the mobile service tower, the umbilical tower, and the blockhouse. Assembly, testing, and propellant loading occur at LC-36A. The mobile service tower contains an overhead bridge crane for hoisting LV components into position and multiple levels and platforms for LV and SV servicing and checkout. The umbilical tower contains retractable service booms that provide electrical power, instrumentation, propellants, and conditioned air. The blockhouse contains control and monitoring equipment.

2.4.3.3 Atlas II Processing and Mission Profile

The Atlas II core vehicle, the Centaur II, and the payload fairing would be transported from the manufacturer's facilities to the Cape Canaveral AS skid strip by USAF C-5 cargo aircraft. From the skid strip, these components would be taken to Hangar J for initial testing and storage. The Atlas II and the Centaur II would then be taken to LC-36A for assembly and testing. The payload fairing would be taken to a payload processing facility to encapsulate the SV.

The encapsulated SV would then be transported to LC 36 for mating with the LV. At LC 36, the SV would be mated with the LV, the combined LV/SV would be tested, the LV would be fueled from on-site storage, and the vehicle would be launched.

At liftoff, the booster and sustainer engines would be ignited. At 172 seconds, the booster engine would cut off and the booster section would be jettisoned. The

Table 4 Comparison of Proposed Action and Alternatives

	Proposed Action	Atlas II LV	No Action
Air Quality	£	£	°
Stratospheric Ozone	£	°	°
Hazardous Materials	£	£	°
Hazardous Waste	£	£	°
Solid Waste	£	£	°
Pollution Prevention	£	£	°
Nonionizing Radiation	£	£	°
Ionizing Radiation	£	°	°
Water Quality	£	£	°
Biological Communities	£	£	°
Cultural Resources	°	°	°
Noise	£	£	°
Socio-economics	°	°	°
Utilities	°	°	°
Orbital Debris	£	£	°
Safety	£	£	£

° No or minimal impact or consequence

£ Minor impact or consequence

l Significant impact, not mitigable

payload fairing would be jettisoned at 226 seconds. At 288 seconds, the sustainer engine would cut off and the Atlas II would be separated from the Centaur upper stage and the SV. The Centaur main engine would fire 291 seconds into the flight and cut off at 673 seconds, injecting itself and the SV into a parking orbit. The Centaur and the SV would then enter a short coast period. At a mission-dependent time, the Centaur main engine would again be fired, injecting the SV into its final orbit. The Centaur would then separate from the SV. Typically, end of mission time for the Centaur would be approximately 1,712 seconds into the flight.

2.5 MITIGATION MEASURES FOR THE PROPOSED ACTION

No impacts have been identified which would require mitigation.

2.6 SUMMARY OF IMPACTS

Table 4 contains a matrix comparing the impacts of the proposed action, the Atlas II LV alternative, and the no-action alternative for each of the environmental attributes considered in this environmental assessment. Table 5 summarizes the effects of the proposed action.

Table 5 Effects of the Proposed Action

Air Quality	Total emissions are not expected to cause a violation of the national or Florida ambient air quality standards. Prelaunch processing quantities are less than those considered de minimis by EPA under its Clean Air Act conformity regulations. A conformity analysis is not required since the Cape Canaveral AS area is in attainment. Concentrations of hazardous constituents in the ground cloud from launch or catastrophic failure would not be hazardous to personnel in exposed areas.
Stratospheric Ozone	The estimated increase in the melanoma rate due to ozone depletion from the proposed action is less than the acceptable level of one excess cancer per million persons used for environmental risk analysis.
Hazardous Materials	Handling and use of hazardous materials in accordance with applicable regulations would not adversely affect personnel or the natural environment. Spill prevention and control measures will minimize the possibility of accidents and the risk associated with potential spills.
Hazardous Waste	The proposed action will replenish the existing Block II/IIA satellite constellation. The rate of launches for the proposed action will be less than the rate for the current program. Therefore, the quantity of hazardous waste generated by the proposed action will be less than the quantity produced by the current program. Hazardous waste will be managed in accordance with applicable regulation, minimizing potential adverse effects. Waste minimization will be employed by contractors.
Solid Waste	Fewer personnel, a slower launch rate than the current program, recycling, and waste minimization will cause a decrease in the solid waste generation rate from the current program.
Pollution Prevention	The Delta II contractor has initiated pollution prevention measures to comply with federal requirements. Both the LV and the SV contractor will comply with the pollution prevention management plan under development for Cape Canaveral AS.

Table 5, continued

Nonionizing Radiation	Radio frequency radiation will either be non-hazardous or controlled so that no personnel are exposed to hazardous levels. Wildlife will not be adversely affected.
Ionizing Radiation	The maximum possible dose of radiation from the frequency standards on the SV is negligible compared to permissible doses.
Water Quality	Wastewater will be disposed of in accordance with permit conditions, minimizing adverse effects. The anticipated concentrations of constituents in the launch cloud would not adversely affect water quality.
Biological Communities	Effects from normal launches would be limited to the launch complex which is a disturbed area with poor habitat. Under certain circumstances, minor foliar damage to vegetation could occur from hydrochloric acid. Adverse effects from catastrophic launch failures would be localized. The anticipated concentrations of constituents in the launch cloud for anticipated times of exposure would not adversely affect biological communities, including threatened and endangered species, except within the launch complex.
Cultural Resources	No construction activities would occur under the proposed action that would affect cultural resources.
Noise	Clear zones will ensure that personnel are not exposed to hazardous noise levels. Noise levels outside the installation boundaries from launches could be annoying, but would occur for short durations. Wildlife, including threatened and endangered species, may suffer temporary hearing loss in the immediate area of the launch complex.
Socioeconomics	Personnel associated with the proposed action would not increase above the baseline conditions.
Utilities	Utility usage would be essentially unchanged from current baseline conditions.
Orbital Debris	The proposed action will fractionally increase the total amount of debris in orbit, but utilize orbits with minimal present problems. Orbital debris mitigation techniques will be utilized.
Safety	The proposed action will be conducted in accordance with safety plans and regulations to minimize risks.

SECTION 3.0

AFFECTED ENVIRONMENT

The level of detail of the baseline data presented in the following sections reflects the likelihood and significance of potential impacts.

3.1 AIR QUALITY

3.1.1 Meteorology

The climate of Cape Canaveral AS is characterized by long, relatively humid summers and mild winters. Owing to its location adjacent to the Atlantic Ocean and the Indian and Banana Rivers, annual variations in temperature are moderate. The annual average temperature at Cape Canaveral AS is 71 degrees Fahrenheit (°F). Average monthly temperatures range from 60°F during January to 81°F during July. Freezing temperatures are rare at Cape Canaveral, though occasional freezes occur farther inland in Brevard County. Temperature inversions are infrequent, occurring approximately 2 percent of the time (USAF, 1988b).

Rainfall distribution is seasonal, with a wet season occurring from May to October, while the remainder of the year is relatively dry. Average annual rainfall for Cape Canaveral AS is 48.5 inches, 70 percent of which occurs from May through October at the rate of approximately 5 inches per month (USAF, 1989a).

The Cape Canaveral area has the highest number of thunderstorms in the United States, and one of the highest frequencies of occurrence in the world during the summer. On average, thunderstorms occur 76 days per year at Cape Canaveral. Between May and September, thunderstorms can be expected more than 10 days per month (USAF, 1989a). During the summer months, lightning detection systems indicate that 1,400 ± 840 cloud strikes occur per month on the 135-square mile Kennedy Space Center (NASA, 1990a).

Cape Canaveral AS is subject to tropical storm activity from June through November. The annual probability of hurricane-force winds in the area is approximately 1 in 20 (Jordan, 1984). A wind rose for the Cape Canaveral AS area is presented in Figure 15.

3.1.2 Local Air Quality

As required by the Clean Air Act (CAA) and its amendments, the United States Environmental Protection Agency (EPA) has promulgated regulations that set National Ambient Air Quality Standards (NAAQS). Two classes of standards were established: primary and secondary. Primary standards define levels of air quality necessary to protect public health with an adequate margin of safety. Secondary standards define levels of air quality necessary to protect public welfare (i.e., soils, vegetation, and wildlife) from any known or anticipated adverse effects of a pollutant.

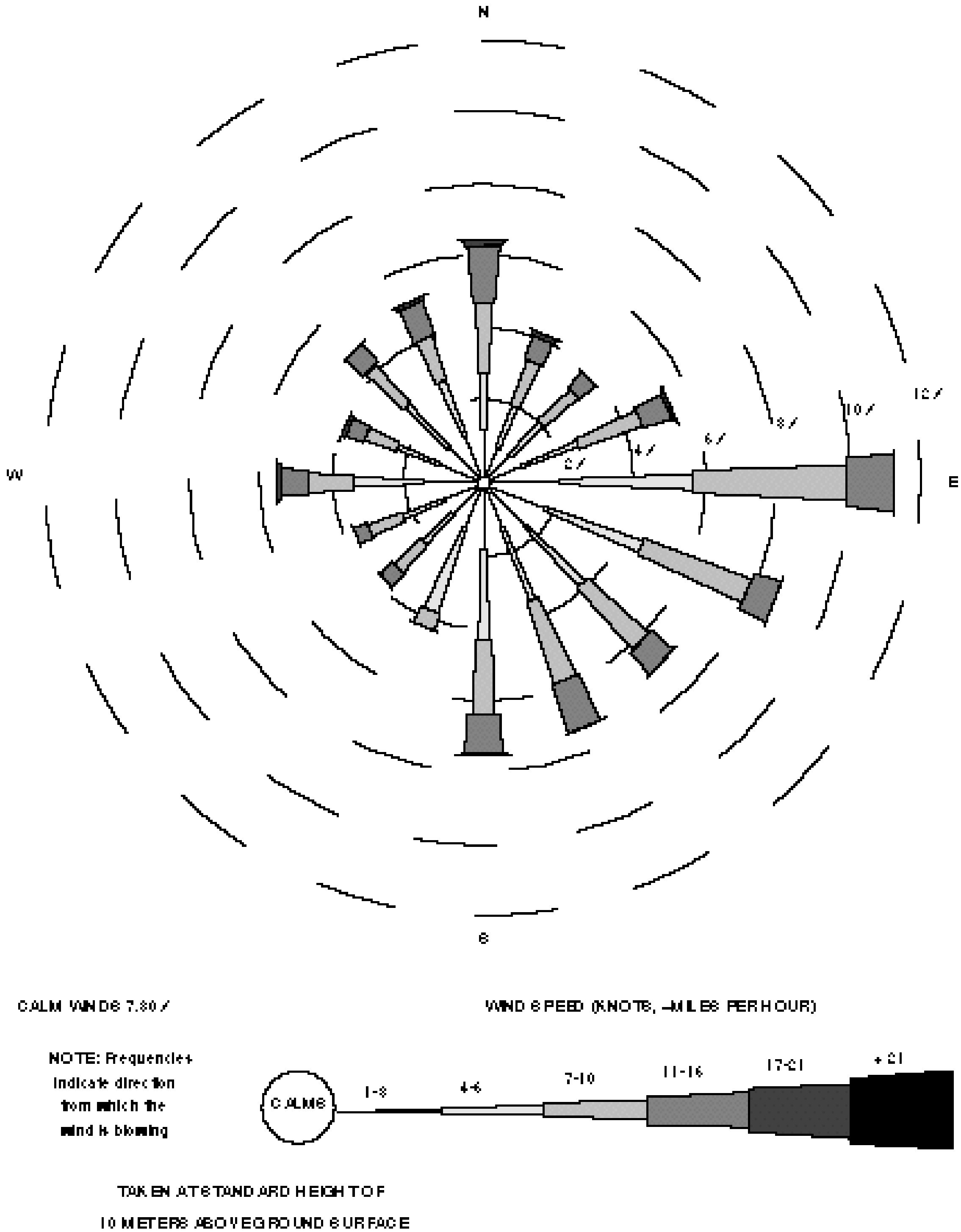


FIGURE 15
WIND ROSE
KENNEDY SPACE CENTER
1968-70 AND 1973-80

National and Florida ambient air quality standards are currently in place for six pollutants (known as "criteria pollutants"): carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), sulfur oxides (SO_x [measured as sulfur dioxide, SO_2]), lead (Pb), and particulate matter smaller than 10 micrometers (PM-10). The state of Florida has adopted the NAAQS except for SO_2. The state requires the NAAQS be met at ambient air, defined as air that is accessible to the general public. National and state primary and secondary air quality standards are presented in Table 6.

The air quality at Cape Canaveral AS is good since there are few air pollution sources in the local area. Cape Canaveral AS is located in the federally defined Central Florida Intrastate Air Quality Control Region (AQCR 48). The AQCR consists of the following counties: Brevard, Lake, Orange, Osceola, Seminole, and Volusia. AQCR 48 is classified by EPA as an attainment area for all of the criteria pollutants. Attainment means that the air quality in an area is equal to or better than the NAAQS.

Section 176(c) of the CAA states that no federal department or agency shall support or approve any activity or action that does not conform to an approved State Implementation Plan (SIP) or Federal Implementation Plan (FIP). On November 30, 1993, the EPA promulgated final rules on conformity of general federal projects. A separate rule addressed transportation programs developed under the Federal Transit Act. The general conformity rules, included in 40 Code of Federal Regulation (CFR) Parts 6, 51, and 93, apply to areas that are nonattainment or maintenance for the NAAQS and where a SIP has been adopted.

3.1.3 Stratospheric Ozone

The Earth's atmosphere can be described by a series of four vertical strata or layers distinguished by temperature profile, structure, density, composition, and degree of ionization. The four strata, in ascending order from the Earth's surface are the troposphere, stratosphere, mesosphere, and thermosphere. The boundaries between these atmospheric layers are indistinct and vary with latitude The troposphere extends up from the surface of the earth to a height ranging from 12 kilometers (km) at the equator to 8 km at the poles. The stratosphere extends from the troposphere to about 50 km above the earth's surface. Above 50 km is the mesosphere, a transition zone between the stratosphere and the thermosphere. The mesosphere extends to about 80 km above the Earth's surface. The region overlying the mesosphere is the thermosphere, which largely includes the ionosphere. This is a region of very high vacuum with fewer than 10^{19} molecules per cubic meter compared to 2.5 x 10^{25} molecules per cubic meter at sea level. Figure 16 shows the Earth's atmospheric regions.

The stratosphere is the main atmospheric region of ozone (O_3) production. The highest O_3 concentrations are found near the middle of the stratosphere at a height of about 25 km. The concentration of O_3 results from a dynamic balance between O_3 transported by stratospheric circulations and O_3 production/destruction mechanisms. Ozone concentrations vary with stratospheric location. Stratospheric circulation carries O_3 from the equatorial regions, where it is produced primarily by chemical reactions, to other regions of the stratosphere where circulation and heterogeneous chemistry (gas-phase reactions with liquids or solid particles) play an important role.

An O_3 molecule contains three atoms of oxygen and is produced by the chemical combination of an oxygen molecule (O_2) and an oxygen atom (O). In the upper atmosphere, above 50 km, high energy radiation ($h\nu$) of wavelengths shorter than 242 nanometers (one billionth of a meter: nm) attacks molecular oxygen, as shown by the reaction:

$$O_2 + h\nu = 2O$$

Table 6 State and National Ambient Air Quality Standards

Pollutant	Averaging Time	Florida Standard[(a,b,c)]	National Standards[(a,b,c)] Primary[e]	Secondary[f]
Sulfur dioxide	Annual	60 µg/m³ (0.02 ppm)	80 µg/m³ (0.03 ppm)	
	24-hour	260 µg/m³ (0.10 ppm)	365 µg/m³ (0.14 ppm)	
	3-hour	1300 µg/m³ (0.5 ppm)		1300 µg/m³ (0.50 ppm)
Particulate Matter	Annual	50 µg/m³[(d)]	50 µg/m³[(d)]	50 µg/m³[(d)]
PM-10	24-hour	150 µg/m³[(d)]	150 µg/m³[(d)]	150 µg/m³[(d)]
Carbon monoxide	8-hour	10 mg/m³ (9 ppm)	10 mg/m³ (9 ppm)	
	1-hour	40 mg/m³ (35 ppm)	40 mg/m³ (35 ppm)	
Ozone	1-hour	235 µg/m³ (0.12 ppm[d])	235 µg/m³ (0.12 ppm[c])	235 µg/m³ (0.12 ppm[d])
Nitrogen dioxide	Annual	100 µg/m³ (0.05 ppm)	100 µg/m³ (0.053 ppm)	100 µg/m³ (0.053 ppm)
Lead	Quarterly	1.5 µg/m³	1.5 µg/m³	1.5 µg/m³

Notes:

a. National and state standards, other than ozone and those based on an annual/quarterly arithmetic mean, are not to be exceeded more than once per year. The ozone standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above the standard is equal to or less than 1.

b. All measurements of air quality are corrected to a reference temperature of 25 degrees C and to a reference pressure of 760 millimeters of mercury. µg/m³ refers to micrograms per cubic meter. ppm refers to parts per million of volume.

c. Arithmetic average.

d. Attainment determinations will be made on the criteria contained in 40 CFR 50, July 1, 1987.

e. National Primary Standards: The levels of air quality necessary, with an adequate margin of safety to protect the public health. Each state must attain the primary standards no later than 3 years after the state's implementation plan is approved by the EPA.

f. National Secondary Standards: The levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant. Each state must attain the secondary standards within a "reasonable time" after the implementation plan is approved by the EPA.

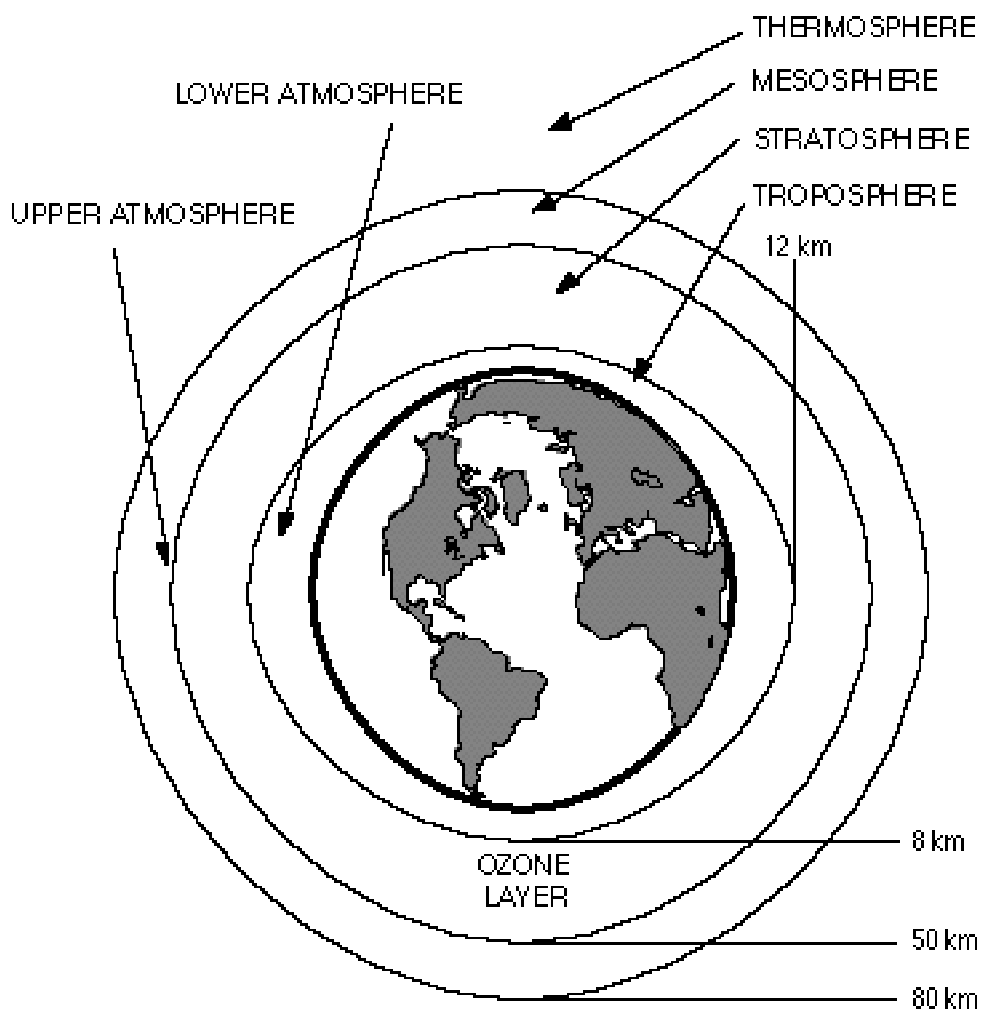


FIGURE 16
EARTH'S ATMOSPHERIC LAYERS

As a result, the ratio of O to O_2 increases with altitude in the upper mesosphere and lower thermosphere. Above 120 km, O is more abundant than O_2. In the mesosphere and stratosphere, the oxygen atoms react with molecular oxygen to form O3 according to the reaction:

$$O + O_2 + M = O_3 + M$$

where M is any energy-accepting third body. O_3 itself experiences photochemical change so that:

$$O_3 + h\nu = O_2 + O$$

The final result is that an O_3 layer is formed above the earth. The O_3 distribution in the stratosphere is maintained as a result of this dynamic balance between these creation and destruction mechanisms. The lifetime of an O_3 molecule in the stratosphere is about a year, so stratospheric O_3 can be redistributed by prevailing winds. This causes the peculiar situation that O_3 is produced mostly at low latitudes, but it is most abundant at high latitudes. In summary, O_3 formation occurs in the upper stratosphere by the action of solar UV radiation on O_2. The intensity of the solar radiation and the distribution of O_2 and O_3 in the mesosphere and stratosphere affects the formation of O_3. Formation of O_3 is relatively insensitive to human activities. The single exception is the O_3 in the circumpolar vortex above the Antarctic continent in October and November. During the winter, a large swirling mass of cold air forms over the Antarctic continent and forms the so called polar vortex. Temperatures within the vortex can drop below -112˚F and, at theses temperatures, moisture in the air freezes to form ice clouds, also referred to as polar stratospheric clouds. Because of the intense cold and the cutoff of tropical air by the vortex, an O_3 hole develops at this time and place.

Ozone in the vortex is destroyed as a result of heterogeneous reactions involving chlorine nitrate ($ClONO_2$), hydrochloric acid (HCl), and nitric oxides (NO_x) on the abundant ice crystals in the Antarctic stratosphere. The heterogeneous reactions involving these species can produce chlorine monoxide (ClO). Since the polar vortex is an isolated air mass, the ClO concentrations can build up during the winter to levels 50 times greater than those outside the vortex. When exposed to sunlight in the spring, the ClO photolyzes to form atomic chlorine which participates in a catalytic reaction that destroys O_3. The O_3 is not replaced until the vortex breaks down in December (McCoy, 1993).

Both extremely low temperatures and sunlight are necessary to accelerate O_3 loss in the polar vortex. In Antarctica, sunlight always arrives before the vortex warms; therefore, an ozone hole always forms. However, this is not always the case over the Arctic. Sunlight may arrive after warming of the vortex occurs and large O_3 losses do not occur; thus, an O_3 hole does not always materialize.

Even though O_3 is a trace element in the stratosphere, its presence is very important because it has the ability to absorb ultraviolet (UV) radiation from the sun. It is able to absorb virtually all UV radiation with wavelengths less than 290 nanometers (nm) and most of the radiation in the harmful 290-320 nm wavelength region (ultraviolet-B [UV-B] region). The stratosphere is considered an important shield against harmful UV radiation. The absorption properties of O_3 present in this layer prevent UV radiation from reaching the Earth's surface in quantities that could be harmful to human health, natural environmental systems, and climate.

Title VI of the Clean Air Act (CAA) Amendments of 1990 reflects Congressional concern that chlorofluorocarbons (CFC), hydrochlorofluorocarbons (HCFC), brominated hydrocarbons (halons), carbon tetrachloride, methyl chloroform, and other chemicals are destroying the stratospheric ozone layer. Even though these chemicals are released in the lower atmosphere (troposphere), their lifespan is such that they can be transported to the stratosphere through tropospheric mixing. Once in the stratosphere, these compounds are broken down by ultraviolet radiation, producing highly reactive chlorine and bromine radicals which participate in the catalytic destruction of O_3. Title VI (Sections 602-618 of the Clean Air Act, codified at 42 United States Code 7671a-q) requires the phase-out of production and consumption of Ozone-Depleting Chemicals (ODC), regulates the use and disposal of ODCs, bans nonessential products containing ODCs, requires labeling of products manufactured with and containing ODCs, and regulates their replacement with substitutes so that the stratospheric concentration of chlorine and bromine can be reduced.

The CAA required the Environmental Protection Agency (EPA) to regulate ODCs in two classes. Class I substances include CFCs, halons, carbon tetrachloride, and methyl chloroform. Class II substances are specifically listed HCFCs. EPA is required to add substances to the Class I category if they have an Ozone Depleting Potential (ODP) of 0.2 or greater. The ODP is a factor established by EPA to reflect the ozone-depleting potential of a substance as compared to chlorofluorocarbon-11 (CFC-

11). For Class II substances, EPA is required to add any other substance that is known or may reasonably be anticipated to cause or contribute to harmful effects on the O_3 layer.

The actions detailed in Title VI carry out the United States obligations under the "Montreal Protocol on Substances that Deplete the Ozone Layer." The Montreal Protocol is a treaty, ratified by the U.S. Senate in December 1988, limiting global production and consumption of ODCs. The Montreal Protocol, as embodied in the CAA Amendments of 1990, originally required the production of CFCs to be phased out by January 1, 2000, with the exception of methyl chloroform which had a deadline of January 2, 2002. Also, effective January 1, 2015, it would be unlawful to sell or consume Class II substances without certain restrictions, and their production would be phased out by January 30, 2030.

During 1992, the parties to the Montreal Protocol amended the treaty to reflect recent scientific information on the harmful effects caused by the destruction of stratospheric O_3. The Montreal Protocol now calls for an accelerated phase-out of CFCs, methyl chloroform and carbon tetrachloride by January 1, 1996, with the exception of critical CFC uses. It calls for the phase-out of halons by the end of 1993. Finally the protocol calls for the addition of methyl bromine (a broad spectrum pesticide) and hydrobromofluorocarbons (HBFC) as Class I substances with the phase-out of methyl bromide by January 1, 2001, and HBFCs by January 1, 1996. The EPA has elected to accelerate the phase-out of the three Class II HCFCs with the highest ODP: HCFC-141B, HCFC-22, and HCFC-142B. The EPA will ban the production and consumption of HCFC-141B as of January 1, 2003, and the production and consumption of HCFC-142B and HCFC-22 by January 1, 2020. The EPA will ban the production and consumption of all other HCFCs by January 1, 2030. The EPA has incorporated the accelerated phase-out and additions called for by the amendments in its final rule on the protection of stratospheric O_3, published in 58 Federal Register (FR) 65018-65082 (Dec. 10, 1993) and codified at 40 Code of Federal Regulations (CFR) Part 82. Ultimately, the goal is to reverse the observed reduction in global O_3 and limit resulting damage to the Earth from increased UV radiation.

3.2 HAZARDOUS MATERIALS

Hazardous materials management is the responsibility of each individual or organization at Cape Canaveral AS. The primary outlet for hazardous materials purchase and acquisition is through Patrick AFB supply channels. Individual hazardous materials obtained through base supply at Patrick AFB are assigned a code which allows limited tracking of the materials and provides knowledge of hazardous materials usage for industrial hygiene and environmental compliance purposes. Currently, Patrick AFB is developing a pharmacy-style hazardous materials acquisition system in order to improve hazardous materials tracking and reduce amounts of certain hazardous materials. Under this system, only specific individuals within an organization will be able to order and sign for hazardous materials.

Individual contractors at Cape Canaveral AS may also obtain hazardous materials through their own supply organizations, local purchases, or other outside channels. No program has been developed at Cape Canaveral AS to track hazardous materials purchased through outside channels. It is the responsibility of each contractor to provide adequate tracking and management of hazardous materials obtained through outside channels.

Hazardous materials must be handled and stored in accordance with Occupational Safety and Health Administration, Environmental Protection Agency, and Air Force regulations. Bulk-quantity storage of hazardous materials is limited to designated storage areas at Cape Canaveral AS.

Smaller, shelf-life items, such as paints and varnishes, are stored in approved petroleum, oil, and lubricant storage cabinets maintained by individual contractors. Hazardous fuels are controlled by the Joint Propellants Contractor (JPC) for 45th Space Wing (45 SW). The JPC provides for the purchase, transport, temporary storage, and loading of hazardous fuels and oxidizers.

Spills of hazardous materials are covered under 45 SW Operations Plan (OPlan) 19-1, Oil and Hazardous Substances Pollution Contingency Plan, required by 40 Code of Federal Regulations (CFR) 112. Included in OPlan 19-1 are all applicable federal, state, and local contacts in the event of a spill.

The Superfund Amendments and Reauthorization Act (SARA) of 1986 incorporated reporting requirements in Title III. Pursuant to Executive Order 12856, signed August 4, 1993, federal facilities are now subject to these reporting requirements.

Under Section 311 of SARA Title III, facilities which must prepare or have available Material Safety Data Sheets (MSDS) under Occupational Safety and Health Administration regulations are required to submit the MSDSs or a list of MSDS chemicals to the local emergency planning committee, the state emergency response commission, and the local fire department. Under Section 312, the same facilities must also submit an emergency and hazardous chemical inventory form. Under Section 313, facilities using over 10,000 pounds of listed toxic chemicals in a calendar year must submit annual toxic release inventory forms to the Environmental Protection Agency and designated state officials. Cape Canaveral AS is not required to submit SARA Title III information in the current reporting period, but will provide this information in the next reporting period.

Contractors and programs operating at Cape Canaveral AS must provide 45 CES/CEV and 45 MDG/SGPB with copies of MSDSs for all hazardous materials proposed for use. Additionally, information on hazardous materials used by contractors or programs must be provided to 45 CES/CEV in accordance with SARA Title III and Clean Air Act Title V reporting requirements.

3.3 HAZARDOUS WASTE

Hazardous waste management at Cape Canaveral AS is regulated under 40 CFR, Parts 260 through 280, and Florida Administrative Code (FAC) 17-730. These regulations are implemented at Cape Canaveral AS through 45 SW OPlan 19-14, Petroleum Products and Hazardous Waste Management Plan. Five main entities are involved in hazardous waste management and disposal for Cape Canaveral AS. These include the generator of the waste, the Joint Propellants Contractor (JPC), the Launch Base Support Contractor (LBSC) for Cape Canaveral AS, the Defense Reutilization and Marketing Office (DRMO) of the Department of Defense, and the environmental support organization at Patrick AFB (45 CES/CEV).

The US Air Force, as the owner of the facilities at Cape Canaveral AS, is considered the generator of hazardous wastes at Cape Canaveral AS, and is responsible for hazardous wastes physically generated by contractors. All hazardous waste generated by contractors at Cape Canaveral AS is labeled with the US Air Force's EPA identification number for Cape Canaveral AS, and it transported, treated, and disposed under this number. Each individual or organization at Cape Canaveral AS is responsible to the Air Force for identifying, minimizing, packaging, and labeling hazardous waste generated by their activities, as well as requesting sampling and pickup of hazardous waste by the JPC. Additionally, they are responsible for administering all applicable regulations and plans regarding hazardous waste, and for complying with applicable regulations regarding the temporary accumulation of hazardous waste at the process site. Physical generators of hazardous waste are required to submit to the JPC each year a process waste questionnaire technical response package which details the types and amounts of hazardous wastes expected to be generated during the year. The JPC assigns each hazardous waste stream a process waste code so that the waste may be tracked from generation through disposal.

The JPC services include waste determinations sampling, pickup, packaging assistance, technical assistance, and disposal of petroleum products, hazardous wastes, and non-hazardous wastes. The JPC collects and transports hazardous waste from the process site to a 90-day hazardous waste accumulation area, one of three permitted one-year hazardous waste storage facilities at Cape Canaveral AS, or to a licensed disposal facility off-station. They are responsible to the Air Force for providing an operational level of hazardous waste disposal which complies with all applicable regulations governing handling, transport, storage, treatment, and disposal or reclamation of the waste.

The LBSC provides environmental management and technical support for Cape Canaveral AS. The LBSC ensures that contractors have hazardous waste management programs in place, and reviews and inspects contractors to ascertain compliance with OPlan 19-14 and all applicable federal, state, and local regulations. Additionally, the LBSC operates the permitted hazardous waste storage areas on Cape Canaveral AS, maintains records and inventories of permitted hazardous waste storage and process site accumulation areas, and maintains records pertaining to facility inspections, hazardous waste training, safety training, and other hazardous waste matters.

The DRMO is responsible for managing and marketing excess and recoverable products and waste materials in accordance with applicable regulations. Hazardous items which cannot be marketed by the DRMO are disposed of as hazardous wastes. The DRMO is also responsible for obtaining offsite hazardous and non-hazardous wastes disposal contracts at all downrange sites.

The 45 CES/CEV at Patrick AFB is the environmental support organization which provides oversight of the LBSC at Cape Canaveral AS. 45 CES/CEV acts as the point of contact with regulatory agencies and informs the LBSC and JPC of new policies and policy changes concerning hazardous waste management.

Cape Canaveral AS currently operates three hazardous waste storage facilities (Facility Numbers 44632, 54810, and 55123), and one hazardous waste treatment facility (Facility Number 15305). All are operated under a single five-year Resource Conservation and Recovery Act permit which expires in 1997 (HO05-185569). The three storage facilities are relatively small storage areas which are permitted to store hazardous wastes for up to one year until the waste can be disposed of by the JPC at an off-station location. These storage sites are not permitted to store hydrazine, monomethyl hydrazine, or nitrogen tetroxide hazardous wastes. The wastes must be taken offsite for storage and disposal when temporary accumulation time limits have been reached Facility 15305, the Explosive Ordnance Disposal Facility, provides thermal treatment of waste explosive ordnance (Byrd, 1994).

Cape Canaveral AS has obtained a Resource Recovery and Conservation Act construction permit to build a single hazardous waste storage area to replace the existing three. The single storage facility will be permitted to store hazardous wastes for up to one year. Cape Canaveral AS plans to obtain closure permits for the three existing storage areas.

Individual contractors and organizations at Cape Canaveral AS maintain hazardous waste satellite accumulation points and 90-day hazardous waste accumulation areas in accordance with 45 SW OPlan 19-14. Hazardous waste satellite accumulation points are volume-based accumulation sites operated at or near the point of hazardous waste generation. A maximum of 55 gallons per waste stream of hazardous waste (or one quart of acutely hazardous waste) can be accumulated at a satellite accumulation point. Once the volume limit is reached the container of hazardous waste must be dated and moved to a 90-day accumulation area or to a permitted storage facility. Satellite accumulation points have indefinite accumulation times. 90-day hazardous waste accumulation areas are time-based accumulation sites used for temporary accumulation of hazardous waste. Hazardous wastes must be moved from a 90-day accumulation area to a permitted hazardous waste storage facility within 90 days from the accumulation start date. There is no limit on the volume of hazardous waste that can be accumulated at a 90-day hazardous waste accumulation area.

The contractor for the Block IIR SV maintains one hazardous waste satellite accumulation point and no 90-day hazardous waste accumulation areas. The Delta II LV contractor maintains eight satellite accumulation points and one 90-day accumulation area. The 90-day accumulation area, located at Area 55, is used as a central location for the temporary accumulation of hazardous wastes from Delta II activities. This area receives waste directly from points of generation as well as from the eight satellite accumulation points. The JPC is responsible for collection and transportation of hazardous wastes from all accumulation sites associated with SV and LV processing.

Cape Canaveral AS reported the generation of 411,668 pounds of hazardous waste in 1992. Additionally, over 60,300 pounds of hazardous waste were processed through the DRMO in 1992 (Brown, 1994).

3.4 SOLID WASTE

Solid waste management is the responsibility of each individual or organization generating the waste. Solid waste is managed according to the nature and quantity of the waste. The Cape Canaveral AS landfill located near the airstrip accepts construction debris, demolition debris, and asbestos-containing material. Waste is segregated within the landfill according to waste type (i.e. concrete waste is placed in one section, wood waste in another, etc.).

General solid refuse from daily activities at Cape Canaveral AS is collected by private contractor and disposed off-station at the Brevard County Landfill. The Brevard County Landfill is a Class I landfill that occupies 192 acres near the City of Cocoa. The landfill receives between 2,200 and 2,400 tons of solid waste per day (Hunter, 1994). Cape Canaveral AS generated 2,876 tons of disposed solid waste and 767 tons of recyclable solid waste in 1992 (Brown, 1994). All of the solid waste is disposed in the Brevard County Landfill.

3.5 POLLUTION PREVENTION

The Air Force Space Command (AFSPC) has established baselines for ozone depleting chemical usage, purchases of Environmental Protection Agency seventeen priority industry chemicals, and hazardous and solid waste disposal. The AFSPC has initiated a one-year contract to perform pollution prevention opportunity assessments, develop parts of installation Pollution Prevention Management Plans (PPMP), perform economic analyses and feasibility studies for recyclable and compostable materials, and recommend training plans and material for activities which use hazardous substances or generate pollution at AFSPC installations. The objective of the contract is to provide a comprehensive tool for multi-media pollution prevention involving all facets of the installations. At Cape Canaveral AS, forty-seven process locations are in process of evaluation. Cape Canaveral AS will then prepare a PPMP.

The PPMP will incorporate the following principles in priority order:

- Generation of hazardous substances, pollutants, or contaminants will be reduced or eliminated at the source whenever feasible (source reduction)
- Pollution that cannot be prevented will be recycled in an environmentally safe manner
- Disposal, or other releases to the environment, will be employed only as a last resort and will be conducted in an environmentally safe manner.

The environmental protection committee will be required to adopt specific goals that incorporate the following, in addition to goals required to comply with the Air Force action memoranda dated 7 January 1993 regarding the Air Force ban on purchases of ozone depleting chemicals and the Air Force pollution prevention program, and Executive Order 12856:

- Provide training to all USAF military members and civilians in environmental awareness and pollution prevention
- Implement pollution prevention practices (e.g., contract language, tools, and models) in all base procurement programs
- Characterize installation waste streams to all media (air, water, groundwater, and soil) by the end of 1993
- Provide input on applicable USAF technical orders, military specification, and standards to eliminate unnecessary use of the EPA seventeen priority chemicals and reduce the use of these chemicals by fifty percent by the end of 1996 from a 1992 baseline.

Executive Order 12856, signed 4 August 1993, requires federal facilities previously exempt from Emergency Planning and Community Right-to-Know Act (EPCRA) section 313 reporting requirements to begin reporting no later than for the 1994 calendar year. The executive order also requires compliance with the reporting requirements of EPCRA, sections 301 through 312. The Superfund Amendments and Reauthorization Act (SARA) was passed in 1986. Title III of SARA was the EPCRA, which added significant public notification and reporting requirements to the Comprehensive Environmental Response, Compensation, and Liability Act, notably the toxic chemical release inventory reporting.

3.6 NONIONIZING RADIATION

Nonionizing radiation is electromagnetic radiation emitted at wavelengths whose photon energy is not high enough to ionize or "charge" an absorbing molecule (i.e. human tissue). Nonionizing radiation is considered to be that part of the electromagnetic radiation spectrum with wavelengths greater than 10^{-7} meters and consists primarily of near ultraviolet radiation, visible radiation or light, infrared radiation, and radio frequency (RF) radiation. RF radiation accounts for the largest range of frequencies among the various types of nonionizing radiation and is used extensively to transmit radio, television, and radar signals. RF radiation has a frequency range of 10 kilohertz to 300 gigahertz.

Numerous RF radiation sources exist throughout Cape Canaveral AS. These are typically in the form of transmitting antennas which support various space and launch vehicle programs. RF radiation hazards can exist when there is sufficient power contained in the incident radiation from these antennas to cause damage to humans. Humans are affected when RF radiation agitates the molecules of the body, causing them to vibrate and rotate faster than normal. This accelerated motion produces heat. When exposure to RF radiation ends, the additional molecular agitation stops.

The human body's thermoregulatory system can compensate for heat produced at low levels of RF radiation. However, higher intensities of RF radiation over a prolonged period of time could cause heating that could not be adequately regulated. Thermal distress or damage could occur.

Standards to limit RF radiation hazards are expressed in the form of permissible exposure levels (PEL). A PEL is the exposure level in milliwatts per square centimeter (mW/cm^2) to which an individual may be repeatedly exposed, and which, under the conditions of exposure, will not cause detectable bodily injury regardless of age, gender, or child-bearing status. Air Force Occupational Safety and Health Standard 161-9 establishes PELs for RF radiation averaged over a six-minute exposure time based on the frequency of the emitted radiation. PELs are used to determine "safe distances" from RF sources beyond which RF radiation hazards will not occur.

Antennas located on the DPF, the NPF, the Block IIR SV, the Delta II LV, and at the various NAVSTAR GPS ground antenna stations will produce RF radiation during prelaunch processing activities.

3.7 IONIZING RADIATION

Ionizing radiation is photons or particles which have sufficient energy to produce ionization or "charging" in their passage through a substance. Ionizing radiation is considered to be that part of the electromagnetic radiation spectrum with wavelengths less than 10^{-7} meters and includes gamma rays, X-rays, alpha and beta rays, and far ultraviolet radiation. Hazards from ionizing radiation are most commonly associated with emissions from radioactive substances.

There are no naturally occurring radioactive substances at Cape Canaveral AS. However, the Block II SVs contain rubidium frequency standards operating as atomic clocks.

3.8 WATER QUALITY

Cape Canaveral AS is located on the Canaveral Peninsula, which is a barrier island between the Atlantic Ocean and the Banana River. The majority of ground surface at Cape Canaveral AS is composed of former sand dunes. The dunes typically facilitate rapid infiltration of runoff, since the surface soils generally consist of highly permeable sand and shell (USAF, 1992). Surface drainage generally flows west into the Banana River, even near the eastern side of the peninsula. None of the facilities used in prelaunch processing are within the 100-year flood plain.

3.8.1 Groundwater Quality

Two aquifer systems underlay Cape Canaveral AS, the surface aquifer and the Floridan aquifer. The surface aquifer system, which is composed generally of sand and marl, is under unconfined conditions and is approximately 70 feet thick. The water table in the surface aquifer is generally located a few feet below the ground surface. Recharge to the surface aquifer is principally by precipitation. Groundwater in the surface aquifer at Cape Canaveral AS generally flows to the west except along the extreme east coast of the peninsula (USGS, 1962).

A confining unit composed of clays, sands, and limestone separates the surface aquifer from the underlying Floridan aquifer. The confining unit is generally 80 to 120 feet thick. The relatively low hydraulic conductivity of the confining unit restricts the vertical exchange of water between the surface aquifer and the underlying confined Floridan aquifer.

The Floridan aquifer is the primary source of potable water in central Florida. The Floridan aquifer is composed of several carbonate units with highly permeable zones. The top of the first carbonate unit occurs at a depth of approximately 180 feet below ground surface, and the carbonate units extend to a depth of several hundred feet. Groundwater in the Floridan aquifer at Cape Canaveral AS is highly mineralized.

3.8.2 Surface Water Quality

Cape Canaveral AS is located in the Florida Middle East Coast Basin (United States Geological Survey Hydrologic Unit 030802020). The Middle East Coast Basin contains three major bodies of water in proximity to Cape Canaveral AS: the Banana River to the immediate west, Mosquito Lagoon to the north, and the Indian River to the west, separated from the Banana River by Merritt Island. All three water bodies are estuarine lagoons with circulation provided mainly by wind-induced currents.

Studies indicate that ambient conditions in the Banana River, Indian River, and Mosquito Lagoon are typical of estuarine waters, with the exception of some areas affected by point source loading (FDEP, 1992b; BC, 1991). Dissolved oxygen levels are generally higher than 6.0 milligrams per liter (mg/L), and the biochemical oxygen demand is less than 3.0 mg/L. Waters tend to be slightly basic, with pH near 8.0, and have good buffering capacity as indicated by alkalinities that are generally higher than 150 mg/L. Nutrient and chlorophyll levels are typical of an estuarine setting. Levels of aluminum, silver, and iron have been reported in excess of state criteria, but seem to be indicative of background concentrations due to their widespread distribution as well as the high level of organic particulate matter found in the area (BC, 1991).

The Florida Department of Environmental Protection has classified water quality in the Middle East Coast Basin as "poor to good" based on the physical and chemical characteristics of the waters as well as whether they meet their designated use under Florida Administrative Code (FAC) 17-3. The upper reaches of the Banana River adjacent to Cape Canaveral AS and the lower reaches of Mosquito Lagoon have generally good water quality due to lack of urban and industrial development in the areas. Lower reaches of the Banana River and Indian River, upper reaches of Mosquito Lagoon, and eastern portions of the Indian River along Merritt Island are classified as fair. Areas of poor water quality exist along the western portions of the Indian River near the City of Titusville and in Newfound Harbor near Sykes Creek in southern Merritt Island. Fair and poor areas are influenced primarily by wastewater treatment plant effluent discharges and urban runoff (FDEP, 1992b). Beginning in 1995, discharge of wastewater effluent to the Banana and Indian Rivers will no longer be permitted.

Several water bodies in the Middle East Coast Basin have been designated Outstanding Florida Water (OFW) in FAC 17-3, including most of Mosquito Lagoon and the Banana River, Indian River Aquatic Preserve, Banana River State Aquatic Preserve, Pelican Island National Wildlife Refuge, and Canaveral National Seashore (FDEP, 1992b). The OFW designation affords water bodies the highest level of protection, and any compromise of ambient water quality is prohibited. Additionally, the Indian River Lagoon System has been designated an Estuary of National Significance by the Environmental Protection Agency. Because of these designations as well as other Florida regulations designed to minimize wastewater discharges and urban runoff in the area, water quality in the Middle East Coast Basin is expected to improve.

In April 1994, the Cape Canaveral AS storm water pollution prevention plan was finalized. The National Pollutant Discharge Elimination System general storm water permit has not been issued as of the date of this assessment. Storm water discharges are also regulated by the Saint Johns River Water Management District.

3.9 BIOLOGICAL COMMUNITIES

3.9.1 Cape Canaveral AS

Near-natural conditions have been retained at Cape Canaveral AS by restricting activities on the station. The majority of the complex consists of vegetation indigenous to the Florida coastal scrub

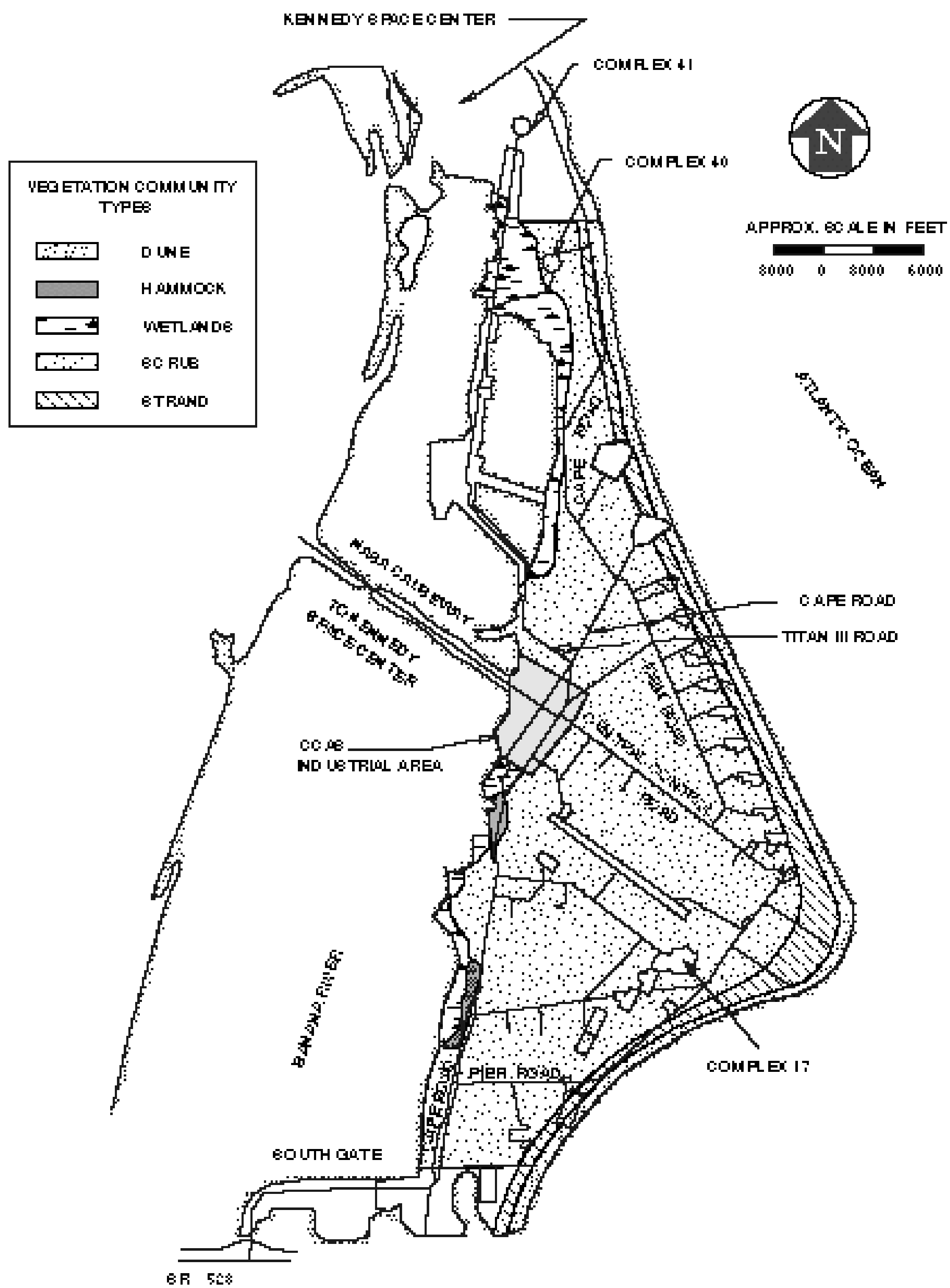


FIGURE 17
VEGETATION COMMUNITIES AT CAPE CANAVERAL AIR STATION

(9,400 acres), coastal strand (2,300 acres), and coastal dune (800 acres) plant communities. Wetlands at Cape Canaveral AS represent a minor percentage of the total land area, with 20 acres of freshwater wetlands, 450 acres of mangrove swamp, and 140 acres of salt marsh (George, 1987). Hammocks at Cape Canaveral AS are small in size, totaling less than 200 acres. The remaining acreage is covered primarily with launch and support facilities. Figure 17 shows vegetation communities at Cape Canaveral AS.

The coastal scrub community is characterized by dense growths of scrub vegetation, such as myrtle oak (*Quercus myrtifolia*), live oak (*Q. virginiana*), saw palmetto (*Serenoa repens*), Chapman oak (*Q. chapmanii*), and stoppers (*Eugenia* spp.) that have developed nearly impenetrable thickets, forming clumps of vegetation separated by bare sand. In profile, this community varies in height from less than one up to six meters. Coastal scrub is a single layer, with limited herbaceous groundcover. This community appears in a temporary stage that may develop into dry flatwoods, sand pine scrub, or a dry coastal hammock (George, 1987; Layne, 1978).

Coastal scrub also develops (succeeds) into coastal woodland. Coastal woodland is found throughout Cape Canaveral AS. Coastal woodland is included in the aforementioned acreage estimate for coastal scrub because of the similarity of appearance. Coastal woodland is characterized by two layers of vegetation: an upper closed canopy and a lower shrub layer. Live oak, Chapman oak, red bay (*Persea borbonia*), and Hercules club (*Zanthoxylum clava-herculis*) form the canopy and may reach heights from 5 to 15 meters. Saw palmetto and immature oaks form the shrub layer. An herb layer is usually absent.

Coastal scrub and coastal woodland provide excellent cover for wildlife species such as the white-tailed deer, armadillo, beach mouse, bobcat, feral hog, Florida mouse, raccoon, rabbit, gopher tortoise, and numerous bird, lizard, and snake species. Saw palmetto and oak species are a good foraging source when fruiting.

The coastal strand community occurs immediately inland of the coastal dunes and is composed of a thicket of dense woody shrubs. The strand displays a single layer of vegetation that varies from one to four meters in height and includes species of cabbage palm (*Sabal palmetto*), saw palmetto, and tough buckthorn (*Bumelia tenax*). Coastal strand relief on Cape Canaveral AS varies from flat to slightly ridged terrain where old dune lines have been succeeded by continued deposits of sand from the ocean.

Mammal, reptile, and bird species that inhabit the coastal strand are about the same as those found in the coastal scrub community described above.

The coastal dune community includes the area from the high-tide line to a point between the primary and secondary dune crest, and within the salt-spray zone. This zone is delineated by the interior limit of sea oats (*Uniola paniculata*) growth. The coastal dune community appears as a single layer of grass, herbs, and dwarf shrubs. Plant species commonly found in this community are sea grape (*Coccoloba uvifera*), partridge pea (*Cassia fasiculata*), sea oats, and broomsedge (*Sporobolus virginicus*). Sea oats has been listed as a state species of special concern. Florida Statute 370.41 prohibits the disturbance or removal of sea oats. In addition, saw palmetto may be found in areas that experience severe erosion.

Mammal and bird species found in coastal scrub and coastal strand habitats also inhabit the coastal dune community, with the addition of the southeastern beach mouse. The dune areas at Cape Canaveral AS provide nesting habitat for sea turtles from early May until the end of October.

Table 7 Special Status Species Associated with Cape Canaveral AS

Scientific Name	Common Name	STATUS[1] USFWS[2]	FGFWFC[3]	Cape Canaveral[4]
Amphibians and Reptiles:				
Alligator mississippiensis	American alligator	T(S/A)	SSC	o
Caretta caretta caretta	Atlantic loggerhead turtle	T	T	o
Chelonia mydas mydas	Atlantic green turtle	E	E	o
Dermochelys coriacea	Leatherback turtle	E	E	o
Drymarchon corais couperi	Eastern indigo snake	T	T	o
Gopherus polyphemus	Gopher tortoise	UR2	SSC	o
Lepidochelys kempi	Atlantic ridley turtle	E	E	o
Nerodia fasciata taeniata	Atlantic salt marsh snake	T	T	n/o
Rana areolata	Gopher frog	UR2	SSC	n/o
Birds:				
Ajaia ajaja	Roseate spoonbill	--	SSC	o
Aphelocoma coerulescens coerulescen	Florida scrub jay	T	T	o
Charadrius melodus	Piping plover	T	T	o
Dendroica kirtlandii	Kirtland's warbler	E	E	n/o
Egretta thula	Snowy egret	--	SSC	o
Egretta tricolor	Louisiana heron	--	SSC	o
Ethene cuniculeria	Burrowing owl	--	SSC	o
Falco peregrinus tundrius	Arctic peregrine falcon	T	T	o
Falco sparverius paulus	Southeastern American kestrel	UR2	T	n/o
Florida oaerules	Little blue heron	--	SSC	o
Grus canadenis pratensis	Florida sandhill crane	--	T	o
Haematopus palliatus	American oyster catcher	--	SSC	o
Haliaeetus leucocephalus	Bald eagle	E	T	o
Mycteria americana	Wood stork	E	E	o
Pandion haliaetus	Osprey	--	SSC	o
Pelecanus occidentalis	Brown pelican	--	SSC	o
Polyborus plancus audubonii	Audubon's crested caracara	T	T	n/o
Sterna antillarum	Least tern	--	T	o
Mammals:				
Peromyscus floridanus	Florida mouse	UR2	SSC	o
Peromyscus polionotus niveiventris	Southeastern beach mouse	T	T	o
Trichechus manuatus latriostris	West Indian manatee	E	E	o

Table 7, continued

Scientific Name	Common Name	Status[1]	Listing Agency[5]	Status at Cape Canaveral[4]
Plants:				
Acroatichum danaeifolium	Giant leather fern	T	FDA	o
Asclepias curtissii	Curtis milkweed	E	FDA	n/o
Cocoa nuvifera	Coconut palm	T	FDA	o
Avicennia germinans	Black mangrove	SP	FCREA	o
Azolla caroliniana	Mosquito fern	T	FDA	o
Ernodea littoratis	Beach creeper	T	FDA	o
Elophia alta	Wild coco	T	FDA	o
Hymenocallis latifolia	Broad-leaved spiderlily	UR	USFWS, FNAI	o
Peraea borbonia var. humilis	Dwarf redbay	UR	USFWS, FNAI	n/o
Opuntia compressa	Prickly pear cactus	T	FDA	n/o
Opuntia stricta	Prickly pear cactus	T	FDA	o
Osmuda regalis var. spectabilis	Royal fern	C	FDA	n/o
Remirea maritima	Beach star	E	FDA, FNAI	o
Scaevola plumeria	Scaevola	T	FDA	o
Tillandsia simulata	Wildpine; air plant (unnamed)	T	FDA	n/o
Tillandsia utriculata	Giant wildpine; giant air plant	C	FDA	o

1 E = Endangered; T = Threatened; T(S/A) = Threatened due to Similarity of Appearance; SSC = Species of Special Concern; UR2 = Under review, but substantial evidence of biological vulnerability and or threat is lacking; C = Commercially Exploited.

2 U.S. Fish and Wildlife Service

3 Florida Game and Freshwater Fish Commission

4 o = observed; n/o = not observed

5 Listing agencies: FDA = Florida Department of Agriculture and Consumer Services; FCREA = Florida Committee on Rare and Endangered Plants and Animals; FNAI = Florida Natural Areas Inventory; USFWS = United States Fish and Wildlife Service

Three wetland community types (freshwater marsh, mangrove swamp, and salt marsh) are found on Cape Canaveral AS.

The hammock communities on Cape Canaveral AS are characterized by three layers of vegetation: a tree layer with a closed canopy, a shrub layer, and an herb layer. A herb layer is comprised of vegetation that does not develop persistent woody tissue. Tree species of red bay, live oak, Chapman oak, and cabbage palm may reach heights from 5 to 20 meters. Shrub species such as saw palmetto and stopper have profiles from 0.5 to 3 meters in height in this community. An herbaceous layer of vegetation is always present, but the extent of its development is determined by light, water, and soil conditions.

Hammock communities on Cape Canaveral AS are located in areas with historically stable soils. These sites are normally on the interior sides of barrier strands and on higher portions of the undulating Cape Canaveral AS terrain (George, 1987). Scrub communities throughout Cape Canaveral AS appear to be in transition toward hammock types and dry scrub oak woodlands. Hammocks at Cape Canaveral AS are inhabited by the same wildlife species associated with adjacent coastal scrub.

Thirty listed animal species are associated with Cape Canaveral AS, as shown in Table 7. US Fish and Wildlife Service (USFWS) and Florida Game and Fresh Water Fish Commission (FGFWFC) status and sightings are included in this table. Sea turtles and turtle hatchlings are affected by exterior lights. To minimize impacts to sea turtles, Cape Canaveral AS has implemented a lighting policy (included as Appendix A) for management of exterior lights at the installation. This policy requires the use of low-pressure sodium lights unless prohibited by safety or security purposes.

3.9.2 Launch Complex 17

A potential Region Of Influence (ROI) was identified for the proposed launches as a one-half mile radius surrounding the launch complex, based on previous launch vehicle assessments at Cape Canaveral AS. Typical species observed within the ROI are listed on Table 8. Preliminary review of existing vegetation mapping in the vicinity of the launch complex identified the dominant vegetation as coastal scrub community and coastal woodland community. The distinction between the two systems as previously described is a difference in the height of the vegetation and the openness of the canopy. The western portion of the ROI consists primarily of coastal woodland whereas the eastern portion of the ROI up to Pier Road supports a more open coastal scrub community. This portion of the ROI also displays signs of being recently burned. Controlled burns are implemented throughout much of Cape Canaveral AS using prescribed schedules in accordance with the control burning plan. These burns are important for improving and preserving wildlife habitat as well as for reducing the occurrence of uncontrolled fires and enhancing security visibility. The vegetation on the east side of Pier Road is characterized as coastal strand with dune vegetation along the beach interface. Figure 18 shows the vegetation communities within the ROI.

These vegetative communities are partitioned into discrete units by the presence of line-of-site clear zones, roads, and widely dispersed industrial complexes. These clear zones provide an ecotone effect between the adjacent scrub/woodland community and a predominantly herbaceous grassy community. An ecotone is a transition area between adjacent ecological communities usually containing species from both communities. Commonly observed species within the grassy community include broomsedge (*Andropogon virginicus)*, prickly pear cactus (*Opunti spp)*, giant ragweed (*Ambrosia artemisifolia)*, cordgrass (*Spartina patens*), gopher apple (*Licania michauxii)*, groundsel (*Baccharis halimifolia*) and crownbeard (*Verbesina virginica*). Bahia grass was the dominant species bordering the road shoulder vegetation and the industrial buildings. The transition zone between the grassy community and the forested community includes wax myrtle, stoppers (*Eugenia* spp.), groundsel, and Brazilian pepper (*Schinus terebinthifolius*). These species provide a nearly impenetrable shrub/scrub layer.

Aquatic and wetland habitats occupy a portion of the study area. Within the study area, these habitats include four isolated emergent wetlands and a major east-west drainage canal. These habitats support a wide variety of aquatic plants and animals, including the American alligator, a

Table 8 Typical Plant Species Near Launch Complex 17

Scientific Name	Common Name	Coastal Dune/Strand	Coastal Scrub	Coastal Woodland	Clearing
Trees/shrubs					
Baccharis halimifolia	Groundsel		l		l
Callicarpa americana	American beautyberry		l	l	
Cassia fasiculata	Partridge pea	l			
Coccoloba uvifera	Sea grape	l	l		
Diospyros virginiana	Persimmon			l	
Eugenia spp.	Stopper		l	l	
Ilex vomitoria	Yaupon holly		l		
Juniperus silicicola	Southern red cedar			l	
Licania michauxii	Gopher apple			l	l
Morus rubra	Red mulberry			l	
Myrica cerifera	Wax myrtle		l	l	l
Persea borbonia	Red bay		l	l	
Quercus chapmanii	Chapman oak		l	l	
Quercus myrtifolia	Myrtle oak		l	l	
Quercus pumila	Runner oak		l		
Quercus virginiana	Live oak		l	l	
Rhus copallina	Winged sumac		l		
Sabal palmetto	Cabbage palm		l	l	
Schinus terebinthifolius	Brazilian pepper			l	
Serenoa repens	Saw palmetto		l	l	l
Zanthoxylum clava-herculis	Hercules club		l	l	
Vines					
Parthenocissus quinquefolia	Virginia creeper		l	l	
Smilax spp.	Cat briar		l	l	
Toxicodendron radicans	Poison ivy		l	l	l
Vitis aestivalis	Summer grape		l	l	
Vitis rotundifolia	Wild grape		l	l	
Herbs					
Ambrosia artemisifolia	Giant ragweed				l
Andropogon virginicus	Broomsedge		l		l
Carex spp.	Yellow sedge				l
Cenchrus incertus	Sandspur				l
Eupatorium spp.	Dog fennel		l		l
Lantana camara	Lantana		l		l
Lobelia cardinalis	Cardinal flower			l	
Mimosa strigillosa	Sensitive plant				l
Opuntia spp.	Prickly pear cactus		l		l
Physalis angulata	Ground cherry				l

Table 8, continued

Scientific Name	Common Name	Coastal Dune/Strand	Coastal Scrub	Coastal Woodland	Clearing
Spartina patens	Cordgrass		I	I	I
Uniola paniculata	Sea oats	I			
Epiphytes					
Tillandsia recurvata	Ball moss		I	I	
Tillandsia usneoides	Spanish moss			I	

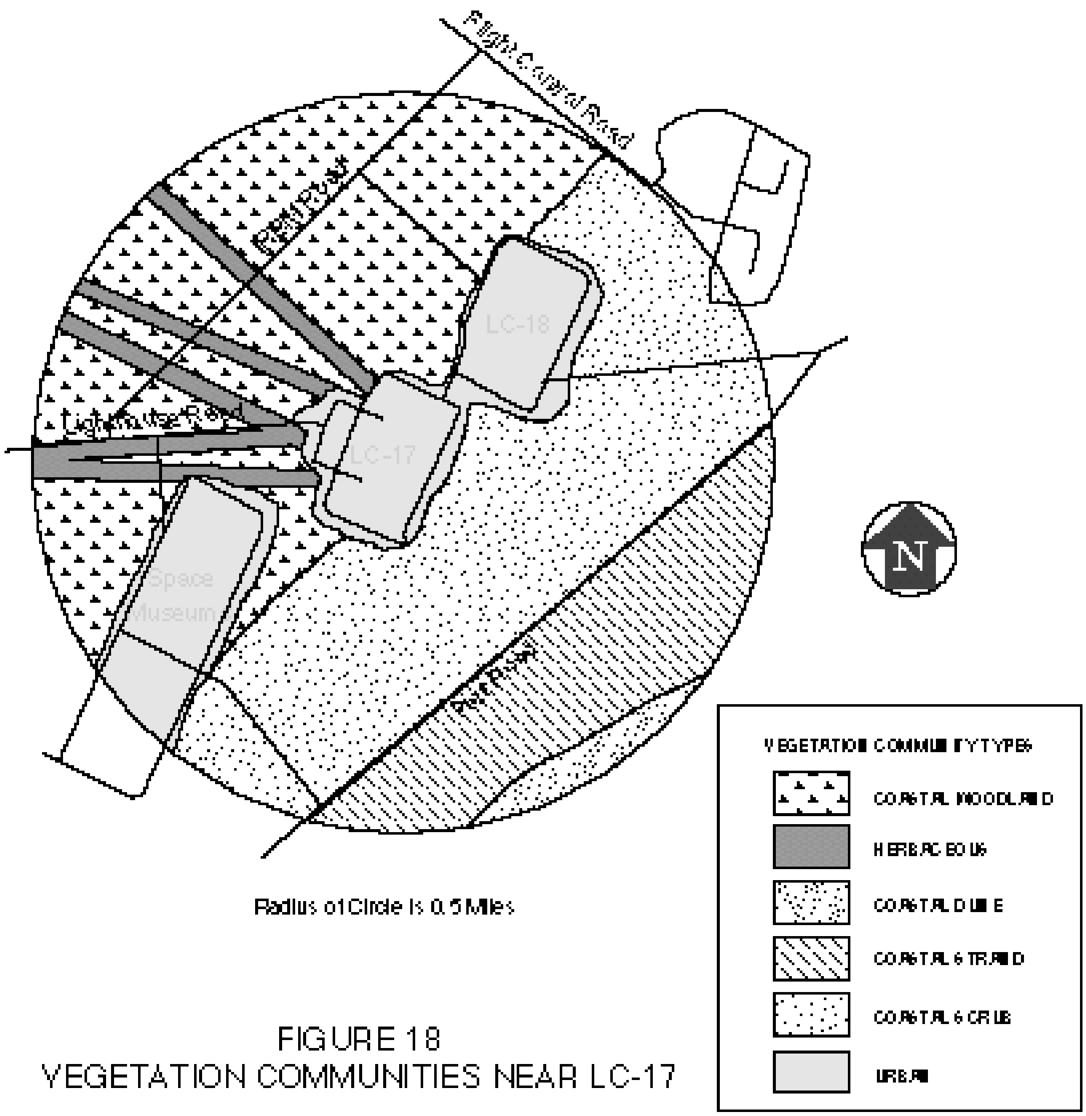


FIGURE 18
VEGETATION COMMUNITIES NEAR LC-17

threatened species. The four isolated wetlands are vegetated primarily by cattails with Carolina-plains willow, wax myrtle, and groundsel bush along the edge of the system. These systems are small and appear to have originated as borrow areas for adjacent construction sites. Plant species observed during the site reconnaissance that were associated with the east-west canal included cattail, common three-square bulrush, and giant bulrush, with Carolina-plains willow, Brazilian pepper, groundsel, wax myrtle, wild grape, and pepper vine along the banks.

3.9.3 Launch Complex 36

The terrestrial vegetation communities bordering the eastern perimeter of LC-36 include coastal strand and mixed oak/saw palmetto coastal scrub. Vegetation bordering the remainder of LC-36 includes mixed oak/saw palmetto, willow swamp, and disturbed land, a 5-acre wetland south of LC-36A, and an 11-acre borrow pit pond to the northeast (USAF, 1991c). These latter areas are manmade.

Around LC-36 is a dense canopy of vegetation approximately 15 feet tall that is composed of live oak, myrtle oak, red bay (*Persea borbonia*), Brazilian pepper, tough buckthorn, saw palmetto, salt bush, wax myrtle, and wild grape (*Vitis rotundifolia*). Variable components of the canopy include cabbage palm (*Sabal palmetto*) and snowberrry (*Chiococca alba*). In the back dune zone, yaupon holly (*Ilex vomitoria*) occurs under live oak/cabbage palm canopies. Manmade disturbances also exist within the canopy, exposing open and sparsely vegetated sandy soils. Ground cover species include prickly pear (*Opuntia spp.*) and wiregrasses (*Aristida spp.*) (USAF, 1991c).

The shoreline of the 11-acre borrow pit pond northeast of LC-36A is dominated by common wetland plants, including cattails and a low mat of pennywort (*Hydrocotyle umbellata*), paspalum grass (*Paspalum* sp.), beak-rush (*Rhynchospora sp.*), and other grasslike plants. Other taller plants include willow, Brazilian pepper, wax myrtle, and leather fern (*Acrostichum danaefolium*). Observed bird species include anhinga (*Anhinga anhinga*), common moorhen (*Gallinula chloropus*), and great egret (*Casmerodium alba*) (USAF, 1991c).

The 5-acre wetland south of LC-36A is dominated by a dense cover of willow and cattails, with lesser portions of Brazilian pepper. Other plant species include arrowhead (*Sagittaria lancifolia*), match-heads (*Lippia nodiflora*), bulrush (*Scirpus validus*), pepper vine (*Ampelopsis arborea*), broomsedge (*Andropogon spp.*), sand cordgrass (*Spartina bakerii*), sawgrass, and swamp mallow (*Kosteletzkya virginica*) (USAF, 1991c).

Wildlife communities in the vicinity of LC-36A are typical of those associated with backdune and coastal scrub habitats. Gopher tortoises and their burrows were observed. In the 5-acre wetland, adult and immature alligators (*Alligator mississippiensis*) have been observed (USAF, 1991c).

The beach east of LC- 36 has been used by loggerhead turtles as a nesting ground, along with Atlantic green turtles (USAF, 1991c).

Bird species include Carolina wren (*Thryothorus ludovicianus*), mockingbird (*Mimus polyglottus*), mourning dove (*Zenaida macroura*), ground dove (*Columbina passerina*), red-bellied woodpecker (*Melanerpes carolinus*), downy woodpecker (*Picoides pubescens*), blue jay (*Cyanostitta cristata*), red-tailed hawk (*Buteo jamaicensis*), white-eyed vireo (*Vireo griseus*), starling (*Sturna vulgaris*), rufous-sided towhee (*Pipilo erythrophthalmus*), and cardinal (*Cardinalis cardinalis*). Florida scrub jays have been observed just outside the perimeter fence (USAF, 1991c).

Mammals include opossum (*Didelphus virginiana*), eastern cottontail (*Sylvilagus palustris*), raccoon (*Procyon lotor*), white-tailed deer (*Odocoileus virginiana*), and bobcat (*Felis rufus*) (USAF, 1991c).

The area within the launch complex is maintained and contains no significant ecological communities (USAF, 1991c).

3.10 CULTURAL RESOURCES

Cape Canaveral AS has been the subject of numerous intensive historic and archaeological surveys in recent years. Among these surveys have been studies by Resource Analysts, Inc., for the Air Force (Barton and Levy, 1984; Levy, Barton, and Riordan, 1984) and more recent and ongoing cultural resource evaluations for National Register eligibility conducted by the Environmental Resources Planning Section of the US Army Corps of Engineers, Mobile, Alabama.

LC-17. LC-17 was among 21 launch complexes identified as potentially eligible for the National Register of Historic Places (Barton and Levy, 1984).

LC-36. LC-36 is within an area identified a the historic site of Canaveral Town (Sites BR238, CC22), a development that was planned in 1924. Some of the road system and planned structures were built. Although the sites have been severely disturbed by construction activities, undisturbed remnants of the development may exist west of LC-36 (Levy, Barton, and Riordan, 1984).

LC-36 was among 21 launch complexes identified as potentially eligible for the National Register of Historic Places (Barton and Levy, 1984). A memorandum of agreement between the Air Force, the Florida State Historic Preservation Officer, and the Advisory Council on Historic Preservation dated February 1, 1989, required documentation prior to any alternation, dismantling, demolition, or removal action that could affect LC-36.

None of the facilities that will be used for SV processing operations are more than 50 years old, the normal criteria for consideration for the National Register of Historic Places.

3.11 NOISE

The primary noise generators at Cape Canaveral AS prelaunch processing sites are support equipment, vehicles, and air conditioners. Occasionally, increased noise levels are experienced on a short-term basis when launches occur at one of the launch complexes. Ambient conditions in the prelaunch processing areas are typical of those for an urban commercial business or light industrial area.

3.12 SOCIOECONOMICS

3.12.1 Demography

Prior to 1950 the population of Brevard County was predominantly rural. Activation of Cape Canaveral AS in the 1950s brought military personnel into the county. From 1950 to 1960, the total population of Brevard County grew from 23,500 to 111,500. In the 1990 census, Brevard County's population was 398,978. The preliminary projected 1995 population for Brevard County is 452,737, a 13.5 percent increase (University of Florida, 1992). Principal urban centers are located in the cities of Melbourne (61,295), Titusville (39,738), Palm Bay (65,015), and Cocoa (17,724) (BCRCD, 1988). By the year 2000, the county's population is projected to reach 504,263, an increase of about 11.4 percent over current levels (University of Florida, 1992).

Most military personnel at Cape Canaveral AS and Patrick AFB live in Brevard County. About 95 percent of Air Force civilian contractor personnel live in Brevard County. The remainder live in Orange County, Indian River County, and other nearby counties. Most of the people working on the base are employed by companies involved in launch vehicle testing and space launch operations. These employees live in surrounding communities. Cape Canaveral AS currently has a work force of 7,500 persons.

3.12.2 Housing

In 1990, there were 185,150 housing units in Brevard County. Vacancy rates over Brevard County averaged 12.2 percent, with a vacancy rate of 29.2 percent in the Cape Canaveral area. The average household in Brevard County in 1991 included 2.42 persons (University of Florida, 1992). There are no permanent residents at Cape Canaveral AS. The nearest significant residential areas are Cocoa Beach and Merritt Island.

3.12.3 Economy

The total labor force in Brevard County in 1991 was 199,929, and the unemployment rate was 7.1 percent (University of Florida, 1992). In addition to resident employees, many people commute from surrounding areas to work in the county. Services, manufacturing, retail trade, and government-related enterprises are the principal means of employment. Major employers are the Kennedy Space Center, Port Canaveral, Cape Canaveral AS, and aerospace firms.

The total personal income of Brevard County residents in 1990 was $7.1 billion. The 1990 average annual salary in Brevard County was $22,119 (University of Florida, 1992).

3.12.4 Schools

Public schools in Brevard County are part of a county-wide, single-district school system with seventy-three schools and over 60,421 students in the 1992-1993 academic year. The school system has been growing since 1982, and capacity has been exceeded in some parts of central Brevard County. Growth in the district is expected to average 4 percent through 1996, the last year of school board projections.

3.12.5 Public Safety

Police departments in the five municipalities of central Brevard County have 2.36 officers per 1,000 people, and fire protection has 2.17 full-time officers per 1,000 people (CBAEDC, 1992). Police and fire services at Cape Canaveral AS are provided by the launch base support contractor and include mutual agreements with other jurisdictions, particularly the city of Cape Canaveral and Kennedy Space Center, and Brevard County. Disaster control is performed in accordance with 45 SW OPlan 355-1, Disaster Preparedness Operations Plan.

3.12.6 Health Care

Cape Canaveral AS is equipped with a dispensary operated under a joint contract (National Aeronautics and Space Administration and Air Force) to handle accident cases, physical examinations, and emergencies involving the work force. Additional medical services are available at the Air Force Space Command Hospital, Patrick AFB, and at three hospitals in the Cocoa Beach area. The three offsite hospitals have a total of 625 beds. There are mutual aid agreements with NASA and Brevard County for catastrophic events, and Brevard County Disaster control is performed in accordance with 45 SW OPlan 355-1, Disaster Preparedness Operations Plan.

3.12.7 Transportation

Transportation in the region is served by highway, rail, airport, and harbor facilities. Federal, state, and local roads provide highway service for Brevard County. Principal routes are Interstate 95, US Highway l, and State Routes A1A, 407, 520, and 528. Bridges and causeways link the urban areas on the beaches to Merritt Island and the mainland. The Florida East Coast Railway affords rail service to the county, with a main line through the cities of Titusville, Cocoa, and Melbourne. Spur rail lines serve other parts of the county, including Cape Canaveral AS. Several commercial and general aviation airports are located in the vicinity of Cape Canaveral AS, the closest being Melbourne Regional Airport, approximately 30 miles south of the base. Port Canaveral, located at the southern boundary of Cape Canaveral AS, is the area seaport. Industrial and commercial facilities are located at the port, and cruise ship use is increasing.

The Cape Canaveral AS road system, which is linked to the regional highway system by the NASA Causeway to the west, State Route 402 to the north, and the Cape Canaveral AS south gate and State Highway A1A to the south, serves launch complexes, support facilities, and industrial areas. An airstrip near the center of the base is used by government aircraft and for delivery of launch vehicles and spacecraft (USAF, 1992). Cape Canaveral AS is closed to the public.

3.13 UTILITIES

3.13.1 Water Supply

The city of Cocoa provides potable water from the Floridan aquifer to central Brevard County. Maximum daily capacity is 44 million gallons per day (mgd), and the average daily consumption is 25 mgd (CBAEDC, 1992). Cape Canaveral AS receives its water supply from the city of Cocoa and uses an average of 0.64 mgd (Burkett, 1994). To support launches, the water supply distribution system at Cape Canaveral AS was constructed to provide peak capacities of up to 30,000 gallons per minute for 10 minutes.

3.13.2 Wastewater Treatment

Cape Canaveral and its neighboring cities (Cocoa, Cocoa Beach, and Rockledge) are served by separate municipal sewer systems. Unincorporated areas of central Brevard County are served by several treatment plants. Cape Canaveral AS carries out its own sewage disposal with a sewage treatment plant in the industrial area, Trident missile chemical treatment plant, package plants, and numerous septic tanks (USAF, 1992). A new consolidated wastewater treatment plant for Cape Canaveral AS is currently under construction.

3.13.3 Electricity

Florida Power and Light (FPL) supplies electricity to Brevard County. Cape Canaveral AS is serviced by FPL through a 240/138-kilovolt switching station.

3.14 ORBITAL DEBRIS

Orbital debris consists of material left in Earth orbit from the launch, deployment, and deactivation of spacecraft. Orbital debris is normally classified into four categories: inactive payloads, discarded rocket bodies, operational debris (objects released intentionally such as ejection springs and lens caps, or those released accidentally such as gloves or tools), and fragmentation debris. Fragmentation is caused by the explosion of rocket bodies or the collision of objects (rocket bodies, payloads, and/or debris). The location, size, and mass of the orbital debris cloud varies with time, and there are uncertainties with regard to the extent of the problem, particularly with regard to objects less than ten centimeters (cm) in diameter.

Orbital debris is a concern because the proliferation of objects in space is increasing the risk of collision between debris and operational spacecraft. The effects of impacts between orbiting objects depends on the mass and the relative velocity of the objects. For a collision between a spacecraft and an object less than 0.01 cm, the effect is primarily surface pitting and erosion. For objects between 0.01 and 1.0 cm, structural damage can result, depending on the design of the SV. Collisions with objects greater than 1.0 cm can be catastrophic.

Almost half of the objects orbiting the Earth have come from vehicle fragmentation: propulsion related explosions, intentional explosions (antisatellite tests), and collisions. Historically, the largest uncontrolled addition to orbital debris has been the breakup of upper stages. The dominant cause of these breakups appears to have been pressure-vessel failure through deflagration of hypergolic propellants, stress failure of the vessels, or reduction of pressure-vessel integrity by collision with meteoroids or other space objects (Kessler, 1989).

The space around the earth in which SVs operate is generally divided into three regimes: Low Earth Orbit (LEO), Medium Earth Orbit (MEO), and Geosynchronous Earth Orbit (GEO). LEO is at altitudes less than 2,000 kilometers (km) with orbital periods less than 3.75 hours. MEO is intermediate between LEO and GEO. GEO is occupied by objects orbiting at an altitude of 35,863 km with an orbital period of approximately twenty-four hours. Geostationary Earth orbit is a further subset of GEO in which an object orbits with an angular rotation speed equal to that of the Earth and is stationary with respect to a point on the Earth's surface (NSC, 1989; USOTA, 1990).

NAVSTAR GPS SVs are placed in inclined, circular, 12-hour, MEO (half-geosynchronous) at altitudes of approximately 20,379 km. The NAVSTAR GPS program and the Russian Global Navigation Satellite System (GLONASS) are the first major users of MEO (NSC, 1989).

The Air Force Space Command (AFSPC) currently maintains a catalog of more than 7,000 tracked objects in space that are 10 centimeters (cm) and larger: 5,923 in LEO, 683 in MEO, and 453 in GEO, including approximately 100 active satellites (NSC, 1989; USOTA, 1990). Only 400 of these objects are operational satellites. These objects are tracked and monitored by the Department of Defense's (DOD) Space Surveillance Network. The National Aeronautics and Space Administration estimates that there are between 35,000 and 150,000 objects in the 1 to 10 cm range, and 3 to 40 million objects under 1 cm in size (AIAA, 1992c).

AFSPC Regulation 57-2 implements the DOD policy of minimizing the impact of space debris on military operations. Under this regulation, "Design and operations of DOD space tests, experiments, and systems will strive to minimize or reduce accumulation of space debris consistent with mission requirements."

3.15 SAFETY

The primary safety regulation at Cape Canaveral AS is 45th Space Wing Regulation 127-1, Range Safety. This regulation establishes the framework within which safety issues are addressed, referencing other safety regulations and requiring the preparation of various safety plans. Additional important regulations are Air Force Regulation 127-100, "Explosives Safety Standards"; MIL-STD-1522A, "Standard General Requirements for Safe Design and Operation of Pressurized Missile and Space Craft"; MIL-STD-454, Requirement I, "General Requirements for Electronic Devices"; MIL-STD-1576, "Electroexplosive Subsystem Safety Requirements and Test Methods for Space Systems"; Air Force Occupational Safety and Health (AFOSH) Standard 127-XX, Safety Series; and AFOSH Standard 161-XX, Medical Series.

As indicated in Section 3.1.1, the meteorological environment at Cape Canaveral AS is conducive to numerous lightning strikes.

SECTION 4.0

ENVIRONMENTAL CONSEQUENCES AND CUMULATIVE IMPACTS

4.1 AIR QUALITY

4.1.1 Local Air Quality

4.1.1.1 Prelaunch Emissions

Proposed Action. Air pollutant sources associated with processing the NAVSTAR GPS Block IIR satellites will be located at the Defense Satellite Communications System Processing Facility (DPF), the NAVSTAR Processing Facility (NPF) (used for overflow SV storage only), the Propellant Conditioning Facility (PCF) (used to store propellant transfer equipment only), the GPS ground antenna site, and the Missile Research Test Building (MRTB). Air pollutant sources associated with processing the Delta II LV will be located at the NPF, the MRTB, the Propellant Servicing Facility (PSF), Area 55, Area 57, Hangar M, Delta Mission Checkout (DMCO), the Horizontal Processing Facility (HPF), and Launch Complex 17 (LC-17). All of these facilities are existing.

Sources at the DPF will include a 4,000-gallon diesel Aboveground Storage Tank (AST), a boiler, oxidizer and fuel scrubbers, and small amounts of Isopropyl Alcohol (IPA) used for wipe cleaning (less than 10 gallons annually). Florida Department of Environmental Protection (FDEP) Rule 17-210.300(3)(b), Florida Administrative Code (FAC) exempts from permitting requirements steam generators operating no more than 400 hours/year, having a total heat input individually or collectively equaling 100 million Btu/hr, or less and fired by natural gas and/or fuel oil containing no more than 1.5 percent sulfur. The boiler at the DPF was found to be exempt from permitting requirements (Hawkins, 1993).

Monopropellant hydrazine will be loaded into the SV at the DPF. Fuel and oxidizer loading at the DPF is permitted by FDEP permit AC05-208825.

Sources at the NPF will include a Kewanee 1,800,000-Btu/hr hot water boiler, a 2,000-gallon diesel Underground Storage Tank (UST), a back-up diesel generator, and small amounts of IPA used for wipe cleaning (less than 10 gallons annually). There is also a hydrazine sump outside the NPF to contain emergency spills. No hydrazine loading occurs at the NPF for the proposed action. FDEP operation permit AO05-201125 authorizes operation of fourteen boilers at Cape Canaveral AS, including the 54-hp Kewanee boiler at the NPF.

Use of the PCF at LC-14 for storage of propellant transfer equipment has been previously assessed (USAF, 1988a). It was found that no fumes or gases will be emitted as a result of normal storage. Emergency response procedures are in place to contain an accidental spill.

Sources at the GPS ground antenna site at Cape Canaveral AS will include limited use of corrosion control paints (approximately 2 to 3 cans per year), a 50-gallon diesel AST, and a back-up generator.

A stationary source of combustion emissions at the MRTB will be a Smith

212,000 Btu/hr boiler. The boiler at the MRTB was found to be exempt from permitting (Hawkins, 1993).

The PSF will be a source of hydrazine emissions from loading the nutation control system on the LV. FDEP construction permit AC05-209868 authorized construction of the PSF. During all phases of propellant loading and propellant transfer equipment cleanup at the PSF, hydrazine vapors are vented to a 3-inch stainless steel pipe extending to an elevation 20 feet above roofline and 43 feet above grade, on the southeast wall of the PSF (FDEP, 1992a). The gaseous nitrogen system is connected to this vent system and controlled by a separate control panel. There are no external mitigating devices used at the PSF for propellant loading operations (FDEP, 1992a). By issuance of the permit, the FDEP found that these emissions would not adversely affect air quality.

Other stationary sources at the PSF will include a Carr 423,000-Btu/hr boiler and a 1,000-gallon horizontal diesel AST. The boiler was found to be exempt from permitting (Hawkins, 1993).

Sources at Area 55 will include outside IPA degreasing operations, a bench-top paint booth (coatings for corrosion control only), a 500-gallon gasoline AST, and an outside hazardous materials storage area (mostly 55-gallon drums of Methyl Ethyl Ketone [MEK], IPA, mineral spirits naphtha, and engine oil). At Facility 1305G, there will be a horizontal 250-gallon IPA AST, a 55-gallon IPA storage drum, and an aluminum table used for degreasing and acid etching operation. FDEP construction permit AC05-205790 authorized construction of the acid etching and degreasing operation to clean parts in support of the Delta rocket program at Facility 1305.

In Area 57, paints, lacquers, adhesives, lubricating oils, and MEK will be used at Facility 50803. Approximately 1 pint of solvent is used every four months. The facility also has a flex hose citric cleaner degreaser. Minimal VOCs are emitted from the degreaser (less than 10 pounds per year).

Hangar M will be a source of IPA, MEK, toluene, and xylene which are used for wipe cleaning (less than 0.1 tons VOC per year). It also has a Bio-T flex hose citric degreaser. The degreaser would emit less than 10 pounds of VOCs per year. The battery shop in Hangar M uses small amounts of coatings and solvents for corrosion control (less than 10 gallons per year).

The DMCO will be a limited source of IPA and MEK. The solvents will be used for wipe cleaning.

The HPF may be a minor source of particulates and metal fumes (less than 0.1 tons per year). The facility has a machine shop with drills and presses, and a welding area. There is a ventilation system that is used to control dust and fumes inside the machine shop and welding area. There is, however, no particulate control on the exhaust to the atmosphere. These operations are not performed on a regular basis. These minor emissions would not adversely affect air quality.

The HPF will emit VOCs from its DeVilbiss model XCF-416 paint arrestor paint booth. The booth is equipped with filters to capture particulates (solids in the coating) from overspray and is permitted under FDEP operating permit AO05-232618. Coatings include epoxy primers and enamels. Painting is done 3-4 hours/day when in progress. Approximately two gallons will be used each month. IPA and MEK will be used for wipe cleaning only. The facility contains drills and presses, and a welding area. The ventilation system will vent the minor amounts of particulates produced by these processes to the atmosphere without filtering. These minor emissions would not adversely affect air quality.

Potential sources of emissions from LC-17 will include Aerozine-50 and N_2O_4 vapors from launch vehicle fueling. LC-17 is designed to accommodate propellant loading operations involving Aerozine-50 and N_2O_4 using Propellant Transfer Sets (PTS). Mobile packed column scrubbers will be used to control fuel and oxidizer vapors generated during propellant loading operations. These handling systems will operate under FDEP operating permit AO05-236505. The portable packed column fuel vapor scrubber provides an Aerozine-50 destruction efficiency of 100 percent. The portable packed column oxidizer scrubber has a nitrogen oxide reduction efficiency of approximately 98 percent.

The Delta II contractor is prohibited from using Class I ODCs under its contract with the Air Force. The DPF uses freon 22 for its air conditioning.

The potential effects of permitted sources on air quality are evaluated by the FDEP during the permitting process. The permit requirements reflect the results of the FDEP analysis of emission levels that would not adversely affect air quality.

FDEP air permits are not typically required for stand-by (back-up) generators because of their intermittent use and negligible contribution to air emissions. Emissions from exempt sources are expected by FDEP to have no adverse effect on ambient air quality.

FDEP air permits are not required for the boilers at facilities that will be utilized for the proposed action except for the boiler at the NPF, which has been permitted. Emissions from these exempted boilers are expected by FDEP to have a nominal effect on air quality.

Since most of the fuel tanks have limited usage and utilize diesel (supply back-up generators or boilers), tank emissions are estimated to be less than 10 pounds per year (USAF, 1994). These emissions would be essentially undetectable and would not adversely affect air quality.

The quantities of coatings and solvents that will be used for corrosion control and wipe cleaning at the GPS ground antenna site, Area 55, Area 57, and Hangar M are so small (i.e., on the order of 1 pint solvent/2 months and 1 spray can coating/year) that potential VOC emissions are considered to be minor (less than 0.1 tons per year). Likewise, the amount of VOC that will be emitted from solvent wipe cleaning at the DPF, NPF, DMCO, and HPF is minimal.

Although the Cape Canaveral AS area is in attainment for the National Ambient Air Quality Standards (NAAQS) and not subject to the Clean Air Act conformity requirements, the conformity regulations include "de minimis" amounts that are not expected to adversely affect the status of an area that is nonattainment. For VOC and particulate emissions, the de minimis amounts for moderate nonattainment areas are 100 tons each. The sum of all emissions for prelaunch processing operations is substantially less than these thresholds. Therefore, even if the Cape Canaveral AS area were in nonattainment, the prelaunch processing operations would emit de minimis amounts that should not adversely affect air quality.

In conclusion, the anticipated air emissions from SV and Delta II LV processing are not expected to violate the NAAQS, the Florida ambient air quality standards, or any FDEP air toxics regulations. Assumptions regarding minor emission quantities are based on studies performed inventorying air emissions from similar sources at other installations. FDEP indicated that there are no ongoing enforcement actions or compliance problems at the installation (FDEP, 1994).

Atlas Launch Vehicle. Prelaunch processing effects would occur from three backup electric generators, a paint spray booth, and propellant loading systems (USAF, 1989c).

The backup electric generators are permitted by FDEP. FDEP has determined that operation of permitted sources in accordance with permit operating parameters will produce no adverse effects on ambient air quality. Total estimated annual emissions would be as follows (USAF, 1989c):

Table 9 Atlas Backup Generator Emissions

Pollutant	Tons per Year
Nitrogen oxides	9.3
Carbon monoxide	2.0
Volatile organics	0.7
Particulate matter	0.7
Sulfur dioxide	0.6

Sandblasting and painting would be performed in a paint-spray booth with a filtered vent system. Volatile organic compounds and particulate matter would be generated, and the booth was permitted by the FDEP (USAF, 1989c).

The RP-1 fueling system is a closed system and adverse effects on air quality are not expected to occur.

Approximately 210 pounds of hydrazine would be loaded into the reaction control system of the Centaur II and the roll control system on the Atlas II interstage. Venting from the hydrazine loading system would occur through a scrubber that has been permitted by the FDEP (USAF, 1989c).

The potential effects of permitted sources on air quality are evaluated by the FDEP during the permitting process. The permit requirements reflect the results of the FDEP analysis of emission levels that would not adversely affect air quality.

No Action. Cape Canaveral AS accommodates other space launch programs unrelated to the proposed action that would continue in use for the foreseeable future. The activities associated with these programs have environmental consequences which have been included in the baseline environmental conditions (Section 3). Under the no-action alternative, prelaunch processing operations for other space launch activities would continue to be performed.

4.1.1.2 Launch Emissions

In this section, the results of sampling and modeling studies will be presented and the potential effects on humans will be addressed. The potential effects on biological communities will be addressed in Section 4.9. The potential effects on water quality will be addressed in Section 4.8.

Proposed Action. During liftoff, six of the nine solid rocket motors and the first stage engine will be ignited. The anticipated combustion products from the solid rocket motors at the exhaust nozzle exit are presented in Table 10. The primary products will be aluminum oxide (Al_2O_3), carbon monoxide (CO), hydrochloric acid or hydrogen chloride (HCl), nitrogen oxides (NO_x), water (H_2O), and carbon dioxide (CO_2).

In the lower atmosphere, the primary detectable products would be Al_2O_3, HCl, CO, and H_2O. Because of the initial high temperatures and abundant oxygen, the carbon monoxide should rapidly oxidize to CO_2.

The anticipated combustion products at the core vehicle first stage exhaust nozzle are shown in Table 11. In the lower atmosphere, H_2O and CO_2 would be the main products since CO should rapidly oxidize to CO_2.

These exhaust products would be distributed along the trajectory of the LV, with the greatest initial concentration at ground level due to the low initial velocity of the LV. This concentration is called the launch cloud. The launch cloud will rise from the launch pad due to thermal buoyancy, move downwind, and disperse with time.

Table 10 Solid Rocket Motor Combustion Products

Combustion Product	Weight Fraction
AlCl	0.0003
AlClO	0.0001
$AlCl_2$	0.0002
$AlCl_3$	0.0001
Al_2O_3	0.3774
CO	0.2237
CO_2	0.0187
Cl	0.0028
HCl	0.2076
H	0.0002
OH	0.0002
H_2	0.0237
H_2O	0.0626
N_2	0.0824

$AlCl_x$ Aluminum chlorides
Cl Atomic chlorine
H Atomic hydrogen
OH Hydroxide anion
H_2 Hydrogen molecule
N_2 Nitrogen molecule
Source: USAF, 1988b

There are two principal areas of concern related to the effects of the launch cloud. First, the cloud constituents may have an effect on humans and plant and animal life downwind. The effects on humans will be considered in this section and effects on plant and animal life will be considered in Section 4.9. Second, precipitation scavenging of a launch cloud by rain may produce localized acid rain which could adversely affect nearby land or water areas. Acid rain effects will be considered in Sections 4.8 and 4.9. The primary constituent of concern in the launch cloud is HCl.

Table 11 Core Vehicle First Stage Combustion Products

Combustion Product	Weight Fraction
H	0.0015
H_2	0.0099
O	0.0059
O_2	0.0133
OH	0.0350
H_2O	0.2522
CO	0.4388
CO_2	0.2433

O Atomic oxygen
O_2 Oxygen molecule
Source: USAF, 1988b

In the event of a catastrophic failure, conflagration and/or deflagration would occur. Conflagration is a failure mode in which there is burning of the solid propellants; deflagration is a failure mode in which there is burning of the hypergolic propellants. Although much of the solid and hypergolic propellants would be burned in either failure mode, emissions would include the constituents from a normal launch and dispersed propellants, including hydrazine, nitrogen tetroxide, and unsymmetrical dimethylhydrazine (UDMH). The health hazard qualities of these chemicals are summarized in Table 12 (ACGIH, 1993; 29 CFR 1910.1000; NIOSH, 1990; NRC, 1985a, NRC, 1985b; NRC, 1987).

For purposes of this analysis, the initial diameter of the launch cloud will be assumed as approximately 200 meters at ground level (NASA, 1973). The area directly impacted by flame from the rocket exhaust is approximately 80 meters in diameter (Swarner, 1994). The launch cloud rises rapidly and surface exposure to the cloud immediately after launch will be assumed to occur for approximately two minutes for this analysis. Surface exposure downwind of the launch complex will occur for longer periods at substantially lower concentrations. The

Table 12 Health Hazard Qualities of Hazardous Launch Emissions

Compound	EEGL	SPEGL	PEL	STEL	TLV	IDLH
Dimethyl Hydrazine (UDMH) (ppm)		0.24 for 1 hr 0.12 for 2 hr 0.06 for 4 hr 0.03 for 8 hr 0.015 for 16 hr 0.01 for 24 hr	0.5 (skin)		0.5 (skin)	50
Hydrazine (ppm)		0.12 for 1 hr 0.06 for 2 hr 0.03 for 4 hr 0.015 for 8 hr 0.008 for 16 hr 0.005 for 24 hr	0.1 (skin)		0.1 (skin)	80
Hydrochloric Acid or Hydrogen Chloride (ppm)	100 for 10 min 20 for 1 hr 20 for 24 hr	1 for 1 hour 1 for 1 day	5 (ceiling)		5 (ceiling)	100
Nitrogen Tetroxide as NO_2 (ppm)		1 for 1 hr 0.5 for 2 hrs 0.25 for 4 hrs 0.12 for 8 hrs 0.06 for 16 hrs 0.04 for 24 hrs		1	3	50

EEGL Emergency Exposure Guidance Level - Advisory recommendations from the National Research Council for Department of Defense for an unpredicted single exposure.

SPEGL Short-term Public Emergency Guidance Level - Advisory recommendations from the National Research Council for Department of Defense for an unpredicted single exposure by sensitive population.

PEL Permissible Exposure Limit - Occupational Safety and Health Administration standards averaged over 8-hour period, except for ceiling values which may not be exceeded in workplace.

STEL Short Term Exposure Limit - Occupational Safety and Health Administration standards averaged over 15-minute period in workplace.

TLV Threshold Limit Value - Recommendations of the American Conference of Governmental Industrial Hygienists.

IDLH Immediately Dangerous to Life or Health - Air concentration at which an unprotected worker can escape without debilitating injury or health effect.

above assumptions are based on a review of previous studies and conversations with personnel involved in the launch process. The studies are referenced below.

Effluent sampling and model development regarding the characteristics of the launch cloud were performed in the 1970's for a Delta 1914 (a predecessor to the Delta II 7925) and several launches of Titan III LVs (APCA, 1983; NASA, 1973; NASA, 1974). This work was performed to quantify the potential effects of the Space Shuttle program. Additional work has been performed for the Space Shuttle program. The results of Space Shuttle testing are not considered directly applicable to the Delta II 7925 LV because of the disproportionate amount of the solid rocket propellant (2,214,000 pounds of propellant) and the use of water for sound suppression by the Space Shuttle. The large quantities of water used by the Space Shuttle at launch (approximately 300,000 gallons in 25 seconds), the manner in which it is applied for sound suppression, and the quantity of water in the effluent from the main engine create a launch cloud that contains a substantially higher concentration of water in both gas and aerosol form than the launch cloud from the Delta II. HCl dissolves readily in water and the HCl in the Space Shuttle launch cloud is in both aerosol (in water particles) and gaseous form, with deposition occurring from the aerosol form. The Delta II LV launch cloud contains primarily gaseous HCl, and deposition is considered negligible (Berlinrut, 1994).

The Delta LV launch occurred on November 9, 1972. Six Castor II solid rocket motors were used on this LV at liftoff, containing a total of 49,400 pounds of propellant (the six solid rocket motors on the Delta II 7925 LV that ignite at liftoff contain a total of 155,292 pounds of propellant). The launch cloud rose rapidly to a height of approximately 550 meters four minutes after launch and had a horizontal diameter of approximately 500 meters at that time (NASA, 1973). Model calculations predicted that the centroid of the launch cloud would stabilize at a height of 747 meters. At 202 seconds after launch, a sampling aircraft flew through the launch cloud at an altitude of 396 meters and recorded an HCl concentration of 10 parts per million (ppm) (NASA, 1974). Subsequent flythroughs at 310 seconds and 865 seconds at altitudes of 701 meters and 914 meters, respectively, recorded HCl concentrations less than 10 ppm and 0 ppm, respectively. Additional sampling runs at an altitude of 183 meters along the projected cloud path recorded no HCl. The study indicated that these results were qualitative and probably low.

Ground monitoring stations recorded levels of HCl downwind of the launch complex at concentrations below 2 ppm as far as five kilometers distant. Particulates increased by a factor of three over ambient conditions to a peak of approximately 190 micrograms per cubic meter at a station 3.18-kilometers downwind. Particulate levels increased by smaller quantities at other stations (NASA, 1974).

The two solid rocket motors on the Titan III LV contain a total of 926,000 pounds of propellant (AIAA, 1991). The launch clouds from eight Titan III launches were sampled by aircraft from 1974 to 1978. Typically, the aircraft would penetrate the launch clouds within two to four minutes after launch and fly in and out of the launch cloud over a prolonged period. For the three with the most comprehensive HCl data, the peak measured concentrations were approximately 30 ppm at the beginning of the data sets, with concentrations decreasing over time. The launch clouds for two of the launches stabilized at an altitude of approximately 1,200 meters (APCA, 1983).

The launch cloud from one of the Titan III launches encountered rain from a large convective storm approximately 20 to 30 minutes after launch. The HCl in the launch cloud was abruptly depleted and rain with a pH of less than 1.5 occurred over an area of approximately 7 square kilometers.

The Air Force uses the Rocket Exhaust Effluent Dispersion Model (REEDM) to determine the concentration and areal extent of launch cloud emissions from LVs. For this assessment, Air Force personnel from 45 SW/SESL ran REEDM for the Delta II 7925 LV alone for a nominal launch case (normal launch mode) for four different weather scenarios (four runs). The model was also run for the LV alone, the LV with the Block II/IIA SV, and the LV with the Block IIR SV for two failure modes (conflagration and deflagration) and four different weather scenarios (twenty-four runs). A total of twenty-eight runs was performed. Selected output from the model runs is included in Appendix B.

For the nominal and conflagration scenarios only maximum HCl concentrations in the launch cloud were considered. For the deflagration scenario, hydrazine, nitrogen tetroxide, and UDMH concentrations were considered. These scenarios represent normal and catastrophic failure launches, and the maximum resultant concentrations were used as the most conservative values for the risk comparison. REEDM output has been shown to correctly predict the direction, but to overpredict the distance and area impacted by launch cloud constituents. Because negligible surface deposition of HCl is associated with the Delta II 7925 LV, REEDM was used to predict launch cloud concentrations and not surface deposition rates (Berlinrut, 1994).

Maximum launch cloud HCl concentrations predicted by REEDM for the nominal launch mode range from 0.2 to 2 ppm from 5 to 20 kilometers (3.1 to 12.4 miles) downwind. The maximum peak HCl concentration produced under the conflagration scenario is 2.66 ppm (4.04 milligrams per cubic meter [mg/m^3]) at 2 kilometers (1.2 miles) from the launch pad. The maximum peak HCl concentration produced under nominal conditions is 1.64 ppm (2.49 mg/m^3) at 12 kilometers. The maximum concentrations produced under the deflagration scenario for hydrazine, UDMH, and nitrogen tetroxide were 0.058 ppm, 0.029 ppm, and 0.68 ppm, respectively, at 17 kilometers (10.56 miles). Figures 19 through 23 show the predicted concentrations of these constituents at ground level downwind from the launch pad.

Unprotected individuals within 100 meters of the launch pad during a normal launch would likely be killed or injured due to heat and high levels of HCl. Prior to launch, a 6,500-foot clear zone will be established around the launch pad with all unprotected personnel removed from the area. The only personnel within the clear zone will be in the protected and sealed blockhouse at LC-17. Additionally, a 2,780-foot blast danger zone will be established. In the event of a catastrophic launch failure, no personnel will be in the blast area except those in the blockhouse, which was designed to protect personnel in this circumstance.

Under normal or catastrophic launch scenarios, HCl concentrations would not be hazardous except in the immediate vicinity of the launch pad for approximately two minutes after launch or near the centroid of the launch cloud for a short time after the launch. The launch cloud would be several hundred meters above ground level, depending on meteorological conditions. These hazardous concentrations near the centroid of the launch cloud would persist for an estimated 10 minutes, but could occur for shorter or longer periods depending on meteorological conditions. Airplanes are not allowed near the Cape Canaveral AS area during launches. Personnel are cleared from the areas where potentially hazardous concentrations would occur prior to launch, and there should be no hazard to humans associated with HCl from the rocket exhaust.

For the propellants that would be dispersed to the air in the event of a catastrophic launch failure, hazardous concentrations would not occur except in the immediate vicinity of the launch complex. Since personnel will be cleared from the area prior to launch, except for those in the sealed and protected blockhouse, there should be no hazard to humans from dispersed propellants in the event of a catastrophic launch failure.

Atlas Launch Vehicle. The Atlas II LV uses the same propellant for the booster and sustainer section as the Delta II LV. However, the vehicle does not require the use of solid rocket motors which are the source of the constituents of concern for

Concentration of HCl at Ground Level from Normal Launch

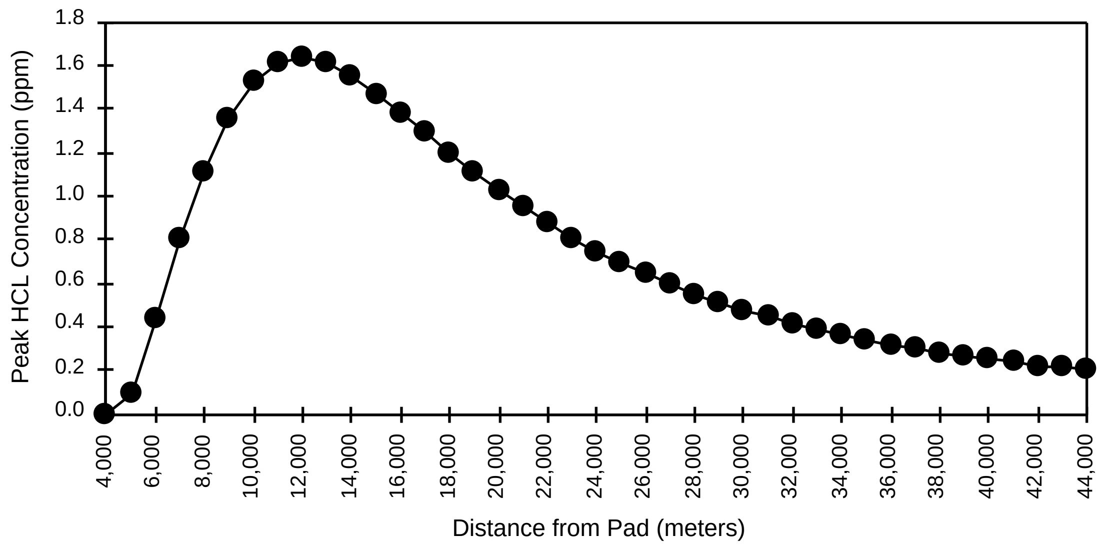


FIGURE 19

Concentration of HCl at Ground Level from Conflagration Destruct

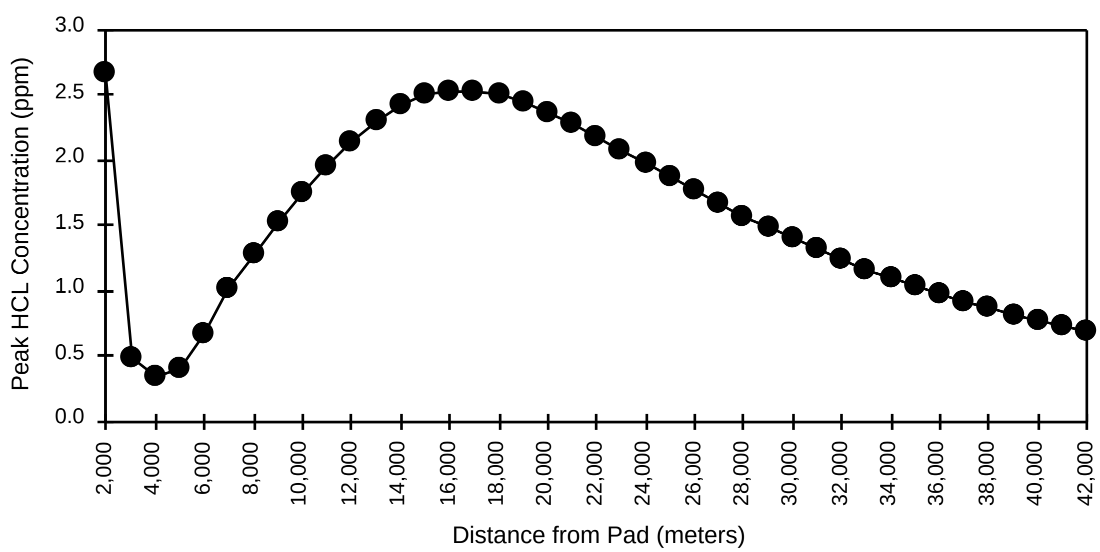


FIGURE 20

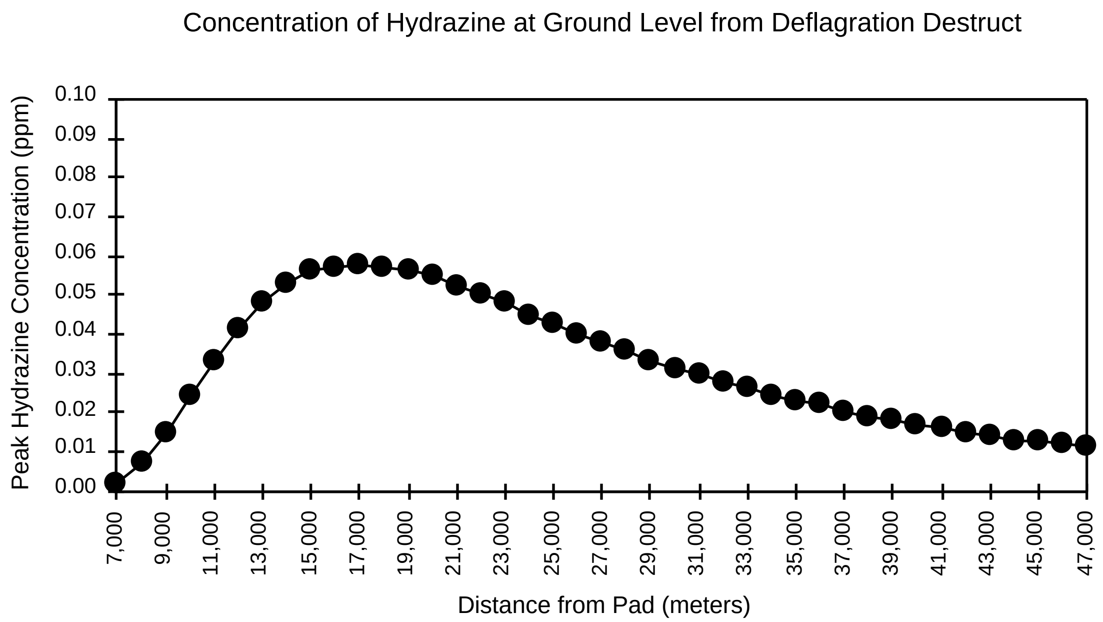


FIGURE 21

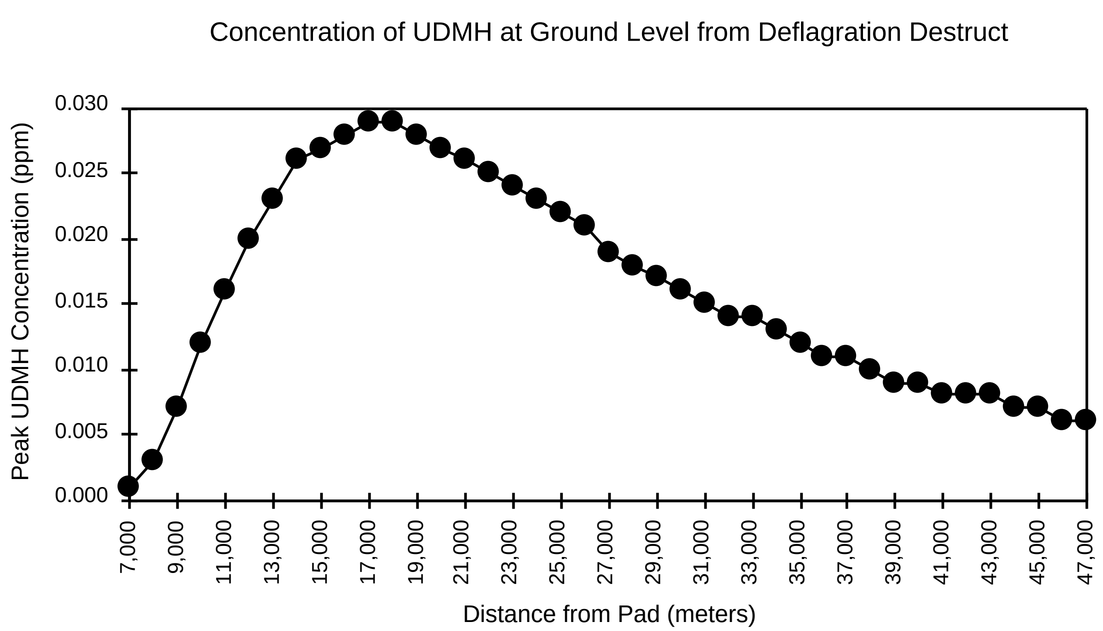


FIGURE 22

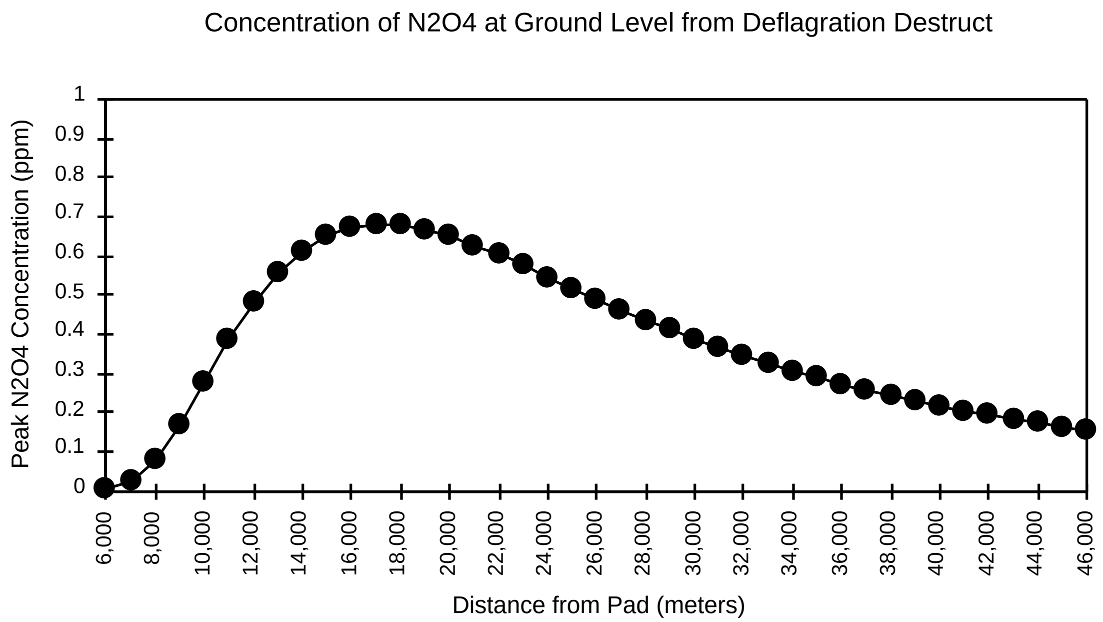


FIGURE 23

the Delta II LV. The combustion products are shown in Table 13:

Table 13 Atlas II Combustion Products

Combustion Product	Weight Fraction
H	0.0015
H_2	0.0099
O	0.0059
O_2	0.0133
OH	0.0350
H_2O	0.2522
CO	0.4388
CO_2	0.2433

Source: USAF, 1989c

A comparison of the Atlas II emissions with the Delta II LV shows that the weight fractions are identical. The only combustion product of concern would be carbon monoxide, which should rapidly oxidize to carbon dioxide due to the abundant oxygen and high exhaust temperatures (USAF, 1989c). The Centaur II upper stage would emit water vapor as its primary exhaust product.

In the event of a catastrophic launch failure, the same constituents would be produced after initiation of the destruct system.

No Action. Cape Canaveral AS accommodates other space launch programs unrelated to the proposed action that would continue in use for the foreseeable future. The activities associated with these programs have environmental consequences which have been included in the baseline environmental conditions (Section 3). Under the no-action alternative, launches of Delta II LVs will continue to occur in support of other programs.

4.1.1.3 Overseas Stations

The only sources of air emission from the Diego Garcia station would be minor amounts of VOCs from paint, solvents, and adhesives (less than 10 gallons per year) and a backup generator. Emissions from the backup generator are estimated as follows:

Table 14 Annual Emissions from Diego Garcia Backup Generator

Pollutant	Tons
Nitrogen Oxides	0.52
Carbon Monoxide	0.11
Sulfur Oxides	0.03
Particulates	0.04
Carbon Dioxide	19.40
Aldehydes	0.01
Hydrocarbons	0.04

The only sources of emissions from the Kwajalein Atoll facility are minor amounts of VOCs from paint, solvents, and adhesives (less than 10 gallons per year).

The GPS facilities at Kaena Point only include a monitor station, and are a minor part of the Kaena Point Satellite Tracking Station (KPSTS). VOC emissions for the monitor station are estimated as less than 5 pounds per year. The KPSTS facility includes four backup generators and a boiler that runs continuously. Emissions from the four backup generators are estimated as follows, with the amount attributable to the GPS program assumed as five percent:

Table 15 Annual Emissions from Kaena Backup Generators

Pollutant	Tons	GPS Portion
Nitrogen Oxides	4.14	0.21
Carbon Monoxide	0.90	0.04
Sulfur Oxides	0.28	0.01
Particulates	0.30	0.01
Carbon Dioxide	155.21	7.76
Aldehydes	0.06	0.00
Hydrocarbons	0.34	0.02

The boiler operates continuously throughout the year, and emissions are estimated as follows:

Table 16 Annual Emissions from Kaena Backup Boiler

Pollutant	Tons	GPS Portion
Particulates	0.06	0.00
Sulfur Dioxide	2.37	0.12
Sulfur Trioxide	0.03	0.00
Carbon Monoxide	0.15	0.01
Nitrogen Oxides	1.66	0.08
VOCs	0.02	0.00

4.1.1.4 Clean Air Act Conformity

Since the proposed action will occur in an area that is in attainment for the NAAQS, the general conformity rules, included in 40 Code of Federal Regulation (CFR) Parts 6, 51, and 93, would not apply.

4.1.2 Stratospheric Ozone

Proposed Action. In a recent study conducted for a commercial Delta II launch facility (DBEDT, 1992), the four phases of a launch operation were evaluated for O_3 as well as greenhouse impacts. These phases that could affect stratospheric O_3 are: facility operations, tropospheric emissions from the launch vehicle, stratospheric emissions from the launch vehicle, and deposition of materials and gases from the launch vehicle and/or SV during reentry.

Since the time scale for mixing in the troposphere is less than the life cycle (decades) of most ODCs, these compounds are usually well mixed in the lower atmosphere. They eventually cycle between the troposphere and stratosphere where the compounds are dissociated by UV radiation in the stratosphere and react with O_3. Since no Class I ODCs will be used under the proposed action, ground facility operations are not anticipated to affect stratospheric ozone.

For the tropospheric emissions phase, it was assumed that the troposphere extended 15 km above the Earth's surface. Although the tropopause nominally occurs at 12 km at midlatitudes, significant amounts of ozone do not occur in the stratosphere below 15 km (Aerospace, 1994a). The average global stratospheric ozone depletion rates for the types of chemicals emitted were calculated as a percent O_3 reduction per ton of exhaust emissions. The relevant depletion rates were 2.5 x 10^{-5} percent reduction for each ton of Cl emitted and 1.0 x 10^{-6} percent reduction for each ton of nitrogen oxides emitted (DBEDT, 1992). The quantity of ODCs emitted into the troposphere during a Delta II launch was estimated to be 15.1 tons of HCl and 6 tons of N_2O (DBEDT, 1992). For the launch of 21 Delta II LVs, a total of 317.1 tons of HCl and 126 tons of N_2O would be emitted to the troposphere, and the consequent global reduction in stratospheric ozone is estimated as 7.93 x 10^{-3} percent and 1.26 x 10^{-4} percent, respectively.

For the stratospheric emissions phase, the quantity of ODCs emitted by a Delta II LV between 15 km and 50 km was estimated to be 9.0 tons of HCl and 3.6 tons of N_2O (DBEDT, 1992). For the launch of 21 Delta II LVs, a total of 189 tons of HCl and 75.6 tons of N_2O would be emitted to the stratosphere, and the consequent global reduction in stratospheric ozone is estimated as 4.73 x 10^{-3} percent and 7.56 x 10^{-5} percent, respectively.

Recent work evaluating the impacts of homogeneous and heterogeneous reactions on stratospheric O_3 has been conducted (TRW, 1994). The evaluation of homogeneous mechanisms involved the study of deorbiting debris entering the stratosphere at hypersonic speed generating gas phase species harmful to O_3. Harmful gases are produced by the high temperature between the bow shock and the body and as pyrolysis products from spacecraft paint or ablation materials. Pyrolysis is the decomposition or transformation of a compound by heat, and ablation is the removal of material from the surface of a body by decomposition or vaporization. It was estimated that one stratospheric O_3 molecule per one billion per day would be destroyed by the material-bound nitrogen mechanism and one part per ten billion per year by the thermal mechanism. The species of concern was nitric oxide.

The evaluation of heterogeneous mechanisms addressed the direct orbital decay of large and small particles as well as the stripping of small particles from the surfaces of larger space objects by aerodynamic drag forces during reentry. To determine the depletion of stratospheric O_3, the orbital debris population and debris flux into the stratosphere were estimated. The resultant ozone depletion by heterogeneous mechanisms is estimated to be small: 10,000-100,000 years to destroy one percent of the stratospheric O_3.

Consensus is that continuing destruction of stratospheric O_3 would lead to increased UV-B radiation resulting in potential damage to human health and the environment. The risks from O_3 depletion include increases in skin cancer and cataracts, suppression of the human immune response system, damage to crops and aquatic organisms, increased formation of ground-level smog, and accelerated weathering of outdoor plastics. Recent scientific reports state that O_3 depletion over Antarctica appears to be the direct result of increased concentrations of man-made chlorinated and brominated compounds, that the potential exists for significant O_3 depletion in the Arctic, and that O_3 concentrations in the mid-latitudes have been reduced over the last decade (NASA, 1990b). It is speculated that low O_3 concentrations in the mid-latitudes may be caused by the effects from the eruption of Mt. Pinatubo in the Philippines. These low O_3 concentrations could result from the injection of aerosol particles into the stratosphere which provide surfaces for accelerated O_3 depletion through heterogeneous chemistry involving chlorine and bromine species. Aerosols in the stratosphere may also cause an increase in stratospheric temperature and, therefore, lead to faster ozone-depleting reactions. (58 FR 65018-65082)

In addition to global reductions in O_3, it has been suggested by researchers that significant local ozone depletion is possible due to reactions of Cl contained in the HCl. Solid Rocket Motor (SRM) fuel typically consists of aluminum, ammonium perchlorate, and a polymer matrix. Major exit plane combustion products from ammonium perchlorate/aluminum SRMs are hydrogen chloride (HCl), aluminum oxide (Al_2O_3), water (H_2O), hydrogen (H_2), carbon monoxide (CO), and carbon dioxide (CO_2). It has also been suggested that Al_2O_3 may lead to O_3 reduction by providing surfaces for heterogeneous reactions that release active Cl, whose primary source is CFCs. Heterogeneous chemistry is a new and rapidly developing field and is complex compared to homogeneous or gas phase chemistry. More study will be required before it is fully understood.

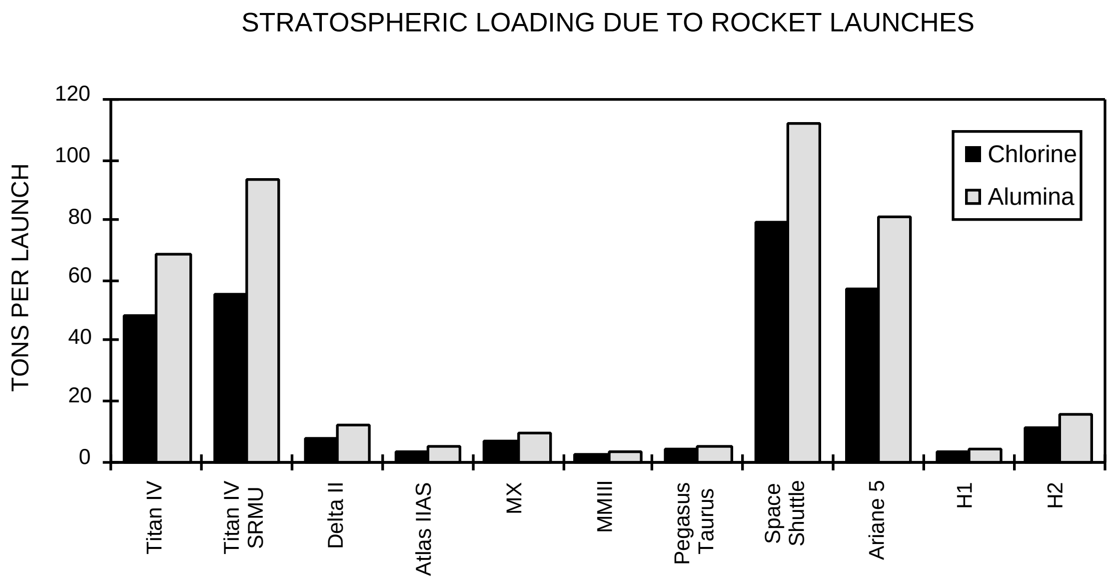
Measurements have shown a reduction in local O_3 of greater than 40 percent below background in the exhaust path of a Titan III solid rocket 13 minutes after launch and at an altitude of 18 km. Also, calculations have shown a greater than 80 percent loss of O_3 within 1 km of the exhaust plume one to three hours after launch (Denison et al, 1994). Studies on the impact of space launch operations on O_3 depletion are continuing. Further research is ongoing to quantify the effects of O_3 depletion.

Figure 24 shows stratospheric loading of Cl and Al_2O_3 for launch vehicles used by various countries with space programs (Aerospace, 1994a). Figures 25 and 26 show stratospheric loading of Cl and alumina from worldwide launch activities (Aerospace, 1994a). With reference to Figures 25 and 26, it should be noted that as the release of ODCs into the troposphere diminishes because of the provisions in the CAA, injection of Cl and Al_2O_3 directly into the stratosphere from launch activities will increase.

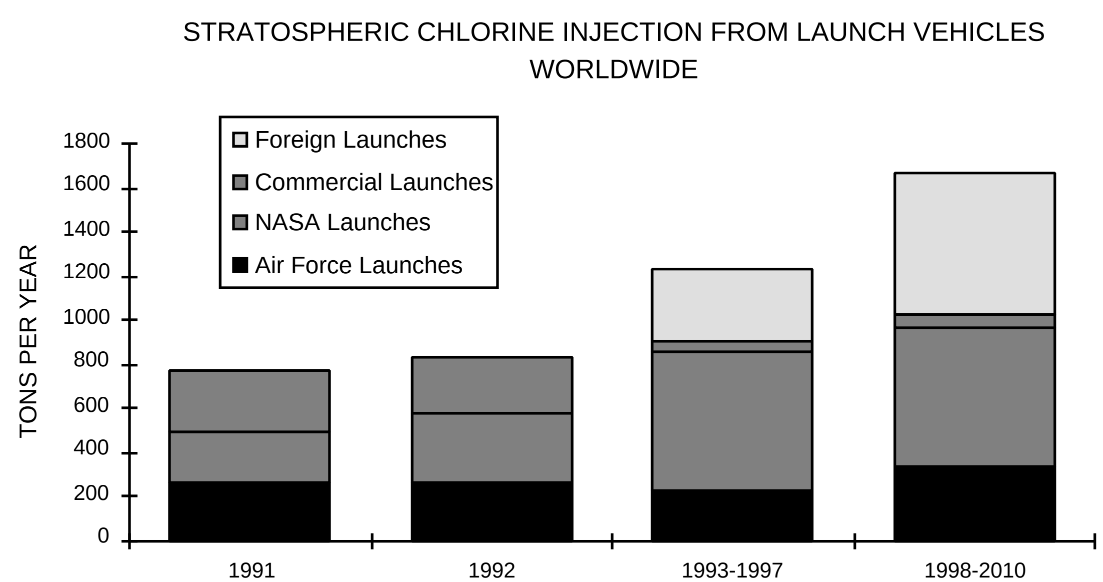
Further research needs to be done on launch activities as sources of stratospheric ozone depleters. Not enough is known about the reactions, chemistry, and mixing of rocket emissions. Rocket plume ozone depletion potential needs to be better characterized. Heterogeneous mechanisms and reaction rates need to be tested in the lab, and findings then need to be included in the models. Actual measurement data is needed to verify and refine the predictive models. The Air Force and other agencies are funding research into all of these areas.

Changes in the levels of stratospheric ozone, which result in an increased incidence of UV-B radiation at the surface of the Earth, have given rise to concerns about a wide variety of health and environmental effects, including increases in incidences of human cancers and cataracts, and suppression of human immune systems, to name a few (EPA, 1988b; NASA, 1978). Estimating changes in these areas of concern from stratospheric ozone depletion is difficult due to uncertainties in estimating baseline ozone depletion and translating these depletions to the increased incidence of UV-B radiation at the surface of the Earth, and a lack of understanding of the various human and environmental dose/response mechanisms. For non-cancer related effects, uncertainties are such that the impacts from the proposed action cannot be numerically estimated.

A major effort over the last several decades has been to understand the results of human epidemiologic studies that have investigated the relationship between various forms of skin cancer and increased UV-B radiation. The EPA has used the results of these studies to support its rulemaking on the protection of stratospheric ozone, concluding that it may be reasonably anticipated that an increase in UV-B radiation caused by a decrease in the ozone column would result in increased incidences of cutaneous



LAUNCH VEHICLE
FIGURE 24



YEAR
FIGURE 25

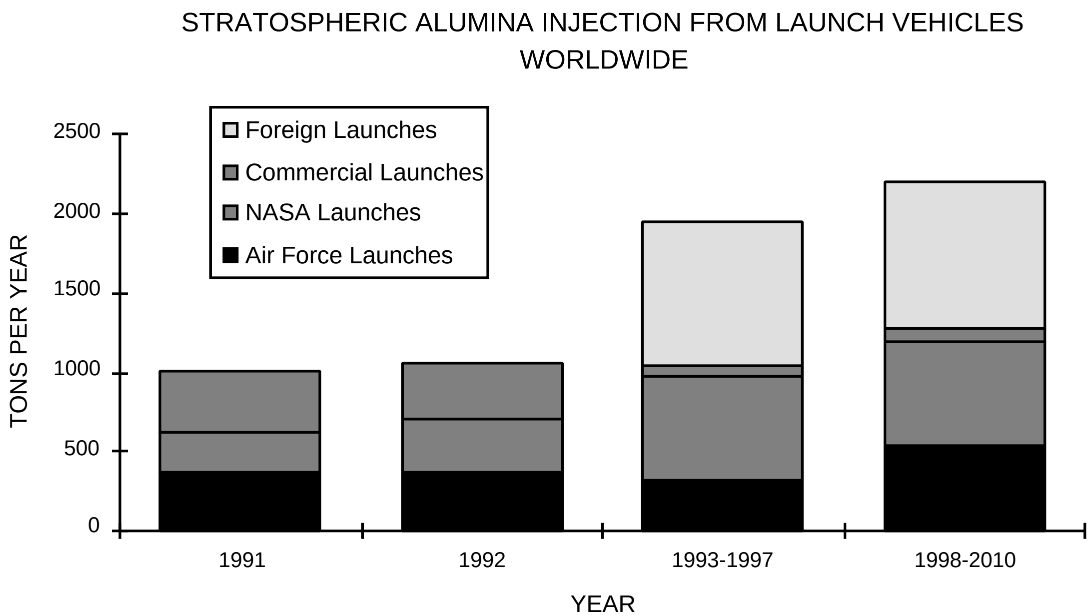


FIGURE 26

malignant melanomas (potentially mortal skin cancers). In addition to the conclusions reached by EPA, other analyses have been published which acknowledge the adverse relationship between reduced stratospheric ozone and increased cancer incidences (Shea, 1988; Van Der Leun, 1986).

The total annual tropospheric and stratospheric emissions of ozone depleting compounds resulting from 21 Delta II launches could reduce the stratospheric ozone by up to 0.013 percent, adding the percentages calculated earlier in this section. Using points taken from the EPA approach, the 0.013 percent reduction in stratospheric ozone that could result from the proposed action would increase the UV-B radiation by as much as 0.065 percent. Using the approximate one-to-one correspondence between increases in UV-B radiation and cancer incidences that EPA has derived from past analysis, would result in an increase in melanomas of the same magnitude. Given the current annual incidence rate for melanoma of ten per 100,000 persons (USAF, 1989d), the proposed action would raise this rate to approximately 10.0065. This translates to an increase in the risk level of 0.065 per one million persons, which is considerably below the commonly acceptable level of one excess cancer per one million persons used for environmental risk analysis (Anderson, 1983). In addition to melanomas, increases in UV-B may cause increases in the incidence of other types of skin cancers, such as basal cell squamous and carcinomas, which are rarely fatal.

Atlas Launch Vehicle. The main contributor to stratospheric ozone are SRMs. The Atlas II includes no SRMs, and its ozone depleting potential is negligible.

No Action. Cape Canaveral AS accommodates other space launch programs unrelated to the proposed action that would continue in use for the foreseeable future. The activities associated with these programs have environmental consequences which have been included in the baseline environmental conditions (Section 3).

4.2 HAZARDOUS MATERIALS

Proposed Action. Hazardous material types used during SV and LV activities are forecasts provided by the contractors for each. Since the Block IIR SV is a new program, forecasts of hazardous materials are based on similar existing satellite programs such as the NAVSTAR GPS Block II/IIA program and the Defense Satellite Communication System (DSCS) program. Forecasts of hazardous materials for the Delta II LV are based primarily on existing operations.

Most hazardous materials used for SV and LV processing are shelf-life items, such as paints, solvents, and lubricants, which are used in small quantities on an as-needed basis. Specific amounts of these types of materials used in each program vary greatly with need and little or no records are kept of purchases or use of these materials. Cape Canaveral AS plans to implement a hazardous materials pharmacy system designed to improve tracking of small-quantity items such as these. More extensive records are available for bulk-quantity hazardous materials, such as propellants and oxidizers, mainly due to known physical characteristics of the vehicles (e.g., a known propellant tank size) and special conditions of use or storage (e.g., some propellants must be requested from the JPC when needed, allowing the JPC to track how much is used).

Materials are typically classified as hazardous based on one or more of four major characteristics: toxicity, ignitability, reactivity, and corrosivity. The potential impacts to humans and the environment associated with transporting, storing, and dispensing hazardous materials are primarily a reflection of these characteristics. Toxicity is the tendency of a material to affect the health of a living organism through chemical interaction with the organism's biological systems. Ignitability is the capability of a material to cause fire when exposed to a specific environmental stimulus such as friction, absorption of moisture, or spontaneous chemical changes. Reactivity is a characteristic of certain materials which causes them to readily undergo violent change under a chemical or physical stimulus such as exposure to air, water, a strong heat source, or a strong oxidizer. Corrosivity describes one material's ability to degrade another material, and is typically a characteristic of highly acidic or alkaline materials. Other characteristics of hazardous materials exist, but most apply to special circumstances. For example, cryogens, such as liquid nitrogen, would be considered hazardous due to their extremely low temperature.

The following paragraphs describe the potential impacts associated with hazardous materials used during SV and LV processing and at GPS ground stations. Materials are grouped and described according to the classification (propellants, solvents, etc.) assigned to each by the SV and LV contractors. Estimates of the quantities of hazardous materials used are based on available information provided by the respective contractors. Impacts of hazardous materials on specific environmental media, such as air, and impacts associated with safety issues are presented in more detail in other appropriate subsections of Section 4.

All hazardous materials used for SV processing, LV processing, and at ground antenna stations shall be transported, stored, and dispensed in accordance with Occupational Safety and Health Administration (OSHA) 29 CFR 1926, and Air Force Occupational Safety and Health (AFOSH) Standards 127-XX (Safety) and 161-XX (Health), as well as applicable federal, state, and local regulations governing the transport, storage, and use of hazardous materials. These regulations consider the inherent danger of hazardous materials to health, safety, and the environment, and if hazardous materials are handled according to regulations, minimal impacts should occur. There are no known compliance problems with the SV and LV contractor operations that would support the proposed action. In general, aside from minor air emissions associated with solvents, coatings, and adhesives use, no other impacts are expected from the normal use of hazardous materials under the proposed action in accordance with applicable regulations.

Hazardous materials that will be used during SV processing are summarized in Table 17. Propellants represent the most potentially dangerous group of hazardous materials used during SV processing. Propellants have potential impacts associated with all four hazard characteristics. Hydrazine is toxic, highly reactive, ignitable, and corrosive, and the solid rocket propellant used in the apogee kick motor (AKM) is toxic, reactive, and ignitable. Hydrazine will be stored at Fuel Storage Area 1 (FSA-1) and delivered to the Defense Satellite Communications System Processing Facility (DPF) in approved containers by the Joint Propellants Contractor (JPC) when needed. Approximately 206 pounds of hydrazine will be used per mission. Hydrazine vapor emissions will be controlled by a packed-column air scrubber at the DPF. After hydrazine transfer takes place, empty containers will be returned to FSA-1 (Ulshafer, 1994). AKMs will be stored at FSA-2 and, upon request, transferred to the Missile Research Test Building for cold soak and thence to the Nondestructive Test Laboratory (NTL) for x-ray inspection. From the NTL, the AKM will be delivered to the DPF by the JPC for mating with the SV. Each AKM will contain approximately 2,010 pounds of solid rocket propellant. During hydrazine and AKM handling, all applicable safety standards (evacuation of nonessential personnel, use of protective gear) shall be in force to mitigate health and safety hazards, and no impacts are anticipated if these standards are followed during normal propellant processing.

Table 17 Hazardous Materials Associated with Block IIR SV Processing

Propellants:	**Protective Coatings:**
Monopropellant hydrazine	Colloidal Silica Thickener
AKM solid rocket propellant	Epoxy hardener
	Epoxy primers and topcoats
Process Liquids:	Epoxy resin
Citric acid, 14% (fuel scrubber solution)	
Photographic film developing fluid (AKM X-rays)	**Process Gases and Cryogens:**
Photographic film fixer (AKM X-rays)	Gaseous argon
	Gaseous helium
Oils and Lubricants:	Gaseous nitrogen
Aerokroil spray lubricant	Liquid nitrogen
Chevron AW Machine Oil 150	
Dow Corning #111 grease	**Solvents and Cleaning Materials:**
Krytox Grease 240AC/250AC	Acetone
Krytox Oil, GPL-100 Series	Genesolv-D
Mobil DTE Oil - heavy medium	Isopropyl alcohol
Molykote #44 Grease	Lacquer thinner
Texaco Regal Oil R&O 32	Methyl ethyl ketone

Source: Ulshafer, 1994b.

Process liquids used during SV processing will include film developer and film fixer, which are used at the NTL during x-ray inspection of the AKM, and citric acid solution, which is used at the DPF as scrubber liquor for the hydrazine packed-column air scrubber. All three represent potential hazards associated with toxicity. Additionally, the citric acid solution has a potential hazard associated with its corrosivity. Approximately 18 gallons of film fixer and 10 gallons of film developer will be necessary to process x-rays for one mission. Both are used by trained professionals inside a photo processing laboratory and accidental ingestion or release to the environment is unlikely. Approximately 800 gallons of citric acid solution will be used in the scrubber at the DPF. Citric acid solution will be contained in the air scrubber and will not be accessible to the environment or to human contact. Trained personnel dispensing citric acid solution into the scrubber will take all precautions, including the use of protective wear, to ensure they are not exposed. No impacts are expected during SV processing from the normal use of process liquids.

Oils and lubricants will be used at the DPF for general maintenance during SV processing. All will be stored in small amounts in approved petroleum, oil, and lubricant (POL) storage lockers. Quantities needed will vary, and supplies will be ordered and maintained as necessary. Oils and lubricants would have potential hazards associated with toxicity if ingested or released to the environment. However, impacts to human health and the environment are unlikely from normal use of these materials if they are dispensed and stored in accordance with applicable health and safety standards.

Protective coatings will also be used in small amounts (generally less than 1 gallon per mission) during SV processing. These materials present potential hazards due to their toxicity and ignitability. Typical use of coatings during SV processing will release small amounts of volatile constituents as part of the drying process. All coatings will be used in well-ventilated areas to prevent concentration of hazardous vapors. Additionally, necessary safety precautions will be taken to prevent the ignition of vapors. When not in use, coatings will be stored in approved flammable materials storage lockers. Supplies will be ordered and maintained as necessary. With the exception of minor air emissions, no other impacts are anticipated from the normal use of protective coatings and resins during SV processing.

Process gases will be used at the DPF during SV processing for fuel line purging and miscellaneous operations which require pressurized gases. All have potential impacts associated with reactivity and ignitability. Process gases are stored under high pressure and can react violently and explosively when exposed to air through a container puncture or when exposed to an ignition source. To minimize this danger, pressurized gases are contained in thick metal cylinders designed to withstand punctures and prevent exposure to ignition sources. In addition, the gases will be stored in designated approved storage areas when not in use to further minimize the potential for hazard. Cryogenic liquid nitrogen is considered a potential hazard due to the extreme low temperature at which it is stored and used. Standard health and safety precautions will be taken when using liquid nitrogen to ensure that personnel are not exposed. No impacts are expected from the normal use of process gases and cryogens during SV processing.

Solvents and cleaning materials will be used in small quantities (generally less than one gallon each per mission) at the DPF and NPF for miscellaneous wipe cleaning and thinning of coatings. All are volatile and can be expected to release small amounts of vapors in the immediate area where they are used. Solvents and cleaning materials will be used in well-ventilated areas to prevent buildup of vapors, and precautions will be taken to prevent ignition of vapors. With the exception of isopropyl alcohol, all solvents and cleaning materials will be stored in small quantities in approved flammable materials storage lockers. Isopropyl alcohol, used for wipe cleaning of surfaces on the SV, will be stored in a single 55-gallon container located in an isolated storage room in the DPF. This room is equipped with its own fire suppression system. Supplies will be ordered and maintained as needed. With the exception of nonadverse impacts to air quality, normal use of solvents during SV processing is not expected to present other effects.

Several of these compounds or their constituents are targeted chemicals on the Environmental Protection Agency 17 (EPA-17) priority pollutant list of industrial toxics. This list was developed to identify chemicals used throughout industry that are judged to be of the greatest concern due to their toxicity and effect on the environment. Air Force Materiel Command Regulation 500-13, which incorporates the Air Force action memorandum regarding pollution prevention, dated January 7, 1993, commits the Air Force to reducing purchases of EPA-17 industrial toxics in 1996 by 50 percent from the 1992 baseline. Additionally, the EPA has established a voluntary reduction program, called the 33/50 program, which aims to promote voluntary reduction of EPA-17 priority pollutants by 50 percent in 1995 with an interim goal of 33 percent by 1992. EPA-17 chemicals used during SV processing include methyl ethyl ketone (used as a pure solvent) and toluene and xylene (typical constituents of lacquer thinner). These chemicals will be used only in small quantities (generally less than one gallon per mission) at the DPF for miscellaneous cleaning and thinning.

Hazardous materials used during Delta II LV processing are summarized in Table 18. Propellants and oxidizers represent the most potentially dangerous groups of hazardous materials used during LV processing, and will have potential hazards associated with toxicity, reactivity, ignitability, and corrosivity. Monopropellant hydrazine will be used in the third stage nutation control system and Aerozine-50 and nitrogen tetroxide will be used in the second stage propulsion system. As with SV processing, hydrazine, Aerozine-50, and nitrogen tetroxide will be delivered to the appropriate facilities by the JPC as needed.

For the third stage nutation control system, the JPC will deliver hydrazine to the Propellant Servicing Facility (PSF) from FSA-1 in an approved container and will retrieve the empty container and the flush waste container when fueling activities are complete. Approximately 6 pounds of hydrazine will be required per launch for the nutation control system. Transfer of hydrazine to the nutation control system will release hydrazine vapors to the air. Any impacts associated with this release are discussed in section 4.1.1.1.

For second stage propellant and oxidizer loading, Aerozine-50 and nitrogen tetroxide will be delivered to Launch Complex 17 (LC-17) from FSA-1 by the JPC in separate Propellant Transfer Sets (PTS) and transferred to the second stage on the launch pad. The PTSs will control the release of Aerozine-50 and nitrogen tetroxide vapors to the atmosphere. After transfer, the PTSs will be flushed and returned to FSA-1 by the JPC. Each launch will require 4,614 pounds of Aerozine-50 and 8,669 pounds of nitrogen tetroxide for the second stage.

Rocket Propellant 1 (RP-1) and liquid oxygen will be required for the first stage propulsion system and will be stored at LC-17. RP-1 will be stored at both launch pads in two 6,500-gallon storage tanks per pad. Approximately 66,504 pounds of RP-1 will be required per launch. Liquid oxygen (LOX) will be stored in a single 27,350-gallon tank at LC-17 which supplies both launch pads. Approximately 146,070 pounds of LOX will be required per launch. Loading of RP-1 and liquid

Table 18 Hazardous Materials Used During Delta II LV Processing

Propellants:
- Aerozine-50
- Hydrazine
- RP-1
- Solid rocket propellant

Oxidizers:
- Liquid oxygen
- Nitrogen Tetroxide

Solvents:
- Acetone
- Anhydrous ethyl alcohol
- Cetylalcohol
- Cleaning solvent
- Denatured ethyl alcohol
- Douglas solvent #1
- Douglas solvent #2
- Ethyl alcohol
- FTC solvent (60% IPA/40% MEK)
- Isopropyl alcohol
- Methyl alcohol
- Methyl ethyl ketone
- Methylene chloride
- Naphtha
- Toluene
- Xylene

Coatings:
- Alkyd gloss coating
- Black ink
- Dope (Cellulose acetate butyrate)
- Lacquer (TT-L-50)
- Lacquer thinner
- Marking lacquer
- Offset printing ink
- Penetrant developer
- Penetrant, LOX compatible
- Poly paint
- Primer adhesive
- Red oxide primer
- Semi-gloss alkyd coating
- Silkscreen ink
- Stencil marking ink
- Torque dye
- White conductive paint

Adhesives and resins:
- Adhesive
- Adhesive primer
- Aluminum silicone coating
- Anti-fogging compound
- Anti-fogging solution
- Anti-static agent
- Anti-static coating
- Black potting compound
- Black silicone adhesive
- Blue liquid silicon primer
- Blue silicone primer
- Catalyst F
- Compound mold seal
- Corrosion preventative
- CRC 3-36 metal protectant
- CRC Metal protectant
- CU11 corrosion inhibitor
- Curing agent
- DC Primer 1204
- Dow Corning compound
- Duct sealer
- Electrical adhesive paste
- Epoxy
- Epoxy adhesive
- Epoxy hardener
- Epoxy insulation ablative
- Epoxy primer coating
- Epoxy resin hardener
- FR primer coating
- Hardener
- Hysol EA956
- Loctite #635
- Loctite #640
- M-Bond 600 adhesive
- Pliobond adhesive
- Poly anchoring compound
- Poly coating
- Poly coating, black
- Poly prime
- Polysulfide sealant
- Polyurethane adhesive
- Potting compound
- Primer epoxy polyamide
- Red RTV silicone
- Red silicone adhesive
- Retaining compound
- RTV 11 silicone compound
- RTV 88 adhesive
- RTV 88 silicone
- RTV 142 sealant
- RTV catalyst
- RTV silicone sealant
- Rubber cement adhesive
- Sealant
- Silicone adhesive
- Silicone adhesive/sealant
- Silicone compound
- Silicone primer
- Silicone rubber adhesive
- Silicone rubber sealant
- Silicone sealant
- Soldering flux
- Solid film lubricant
- Super glue
- Thermal coating
- Thermal joint silicone
- Thread locking compound
- Thread locking primer
- Thread locking sealant
- Thread sealant primer
- Thread sealing compound
- White silicone coating
- Zirconium oxide cement

Compressed gases:
- Acetylene
- Argon
- Helium
- Nitrogen, dry
- Oxygen
- R-22 refrigerant

Oils and Lubricants:
- Anti-seize petrolatum
- Apiezon N grease
- ATC-44108-1 lubricant
- ATC-44159 lubricant
- Automotive lubricant
- Bendix celvacence lubricant
- Braycote 601
- Corrosion preventative
- Fluoroglide lubricant
- Graphite anti-seize thread cmpd.
- Hydraulic fluid
- Krytox lubricant
- Lubribond A
- Lubribond K
- Lubribond N
- Lubricant grease
- Lubricant grease, Krytox
- Lubricant grease, RBO140-014
- Lubricant oil
- Lubricant, Krytox
- Lubricant, MS-22
- Lubricant, RBO140-012
- Lubricating grease
- Lubricating oil
- Molycote C lubricant
- Rust lick lubricant
- Silicone grease
- Silicone lubricant
- Silicone valve lubricant
- Solid film lube
- Solid film oxygen lubricant

Corrosives:
- Acetic acid, glacial
- Alodine 600 coating
- Alodine 1200 coating
- Catalyst #9
- Chromic acid
- Etchant
- Formic acid stripper
- Hydrofluoric acid
- Nitric acid
- Pasa jell 101

Table 18, continued

Corrosives (continued):	Other:	Explosive/Ordnance:
Pasa jell 105	Amway cleaner	All ordnance items hazardous
Pasa jell 105M	Glycerin	
Phosphoric acid compound	Leak test fluid, LOX	
Potassium hydroxide, battery	Sodium bicarbonate	
Sodium hydroxide	Sodium dichromate	
Sulfuric acid	Welding rods/wires	
Teflon etchant		

Source: MDA, 1994.

oxygen into the first stage will be done by closed system to prevent release of vapors to the atmosphere.

Solid rocket propellant will be used in both the third stage motor and the nine solid rocket boosters on the first stage of the LV. The third stage motor will require approximately 4,431 pounds of solid rocket propellant and each solid rocket booster will require approximately 25,885 pounds of solid rocket propellant. Both the third stage motor and the solid rocket boosters are delivered to Cape Canaveral AS with the solid propellant in place. The third stage motor will be transferred by the JPC to the NPF from FSA-2 after x-ray processing for mating with the payload attach fitting. The nine solid rocket boosters will be transported to LC-17 from storage at Area 57 and attached to the first stage of the LV at the launch pad.

Propellant and oxidizer loading activities for all stages shall comply with OSHA and AFOSH standards for safety and health to minimize the potential for hazards. With the exception of hydrazine air emissions at the PSF, no other impacts are expected from the normal handling of propellants and oxidizers associated with the LV.

Solvents will be used in small quantities throughout LV processing at Area 55, Area 57, Hangar M, the Delta Mission Check Out (DMCO) facility, the Horizontal Processing Facility(HPF), and LC-17, for wipe cleaning and degreasing. On average, quantities used will be limited to less than one gallon of each solvent per month, although the specific quantity of solvent used at any one time will vary with the type of cleaning operation. Isopropyl alcohol will be the most commonly used solvent. A 250-gallon aboveground storage tank at Area 55 will be used to store and dispense isopropyl alcohol for use at all processing facilities. Other solvents will be stored in small quantities at the area of use in approved flammable materials storage lockers. All solvents can be expected to release minor amounts of volatile constituents to the air in the immediate areas in which they are used. Solvents will be used in well-ventilated areas to prevent a buildup of hazardous vapors, and precautions will be taken to prevent exposure of vapors to ignition sources. Aside from minor air emissions, no other impacts are expected from the normal use of solvents during LV processing.

Coatings will be used during LV processing at the HPF, Area 55, and sporadically in other areas, to provide corrosion control of various parts and launch equipment. Primary coating operations will be done in a permitted paint booth at the HPF. Approximately two gallons of various enamels and primers will be used each month in this booth. A small bench-top paint booth at Area 55 will be used for minor spray coating and touch up painting. Other areas will use coatings in small quantities as necessary for touch up painting. The use of coatings in all areas will release volatile constituents to the atmosphere as part of the drying process. Impacts associated with coating emissions are presented in section 4.1.1.1. No other impacts are expected from the normal use of coatings during LV processing.

Adhesives will be used in small amounts in all LV processing facilities as necessary for bonding LV components and general maintenance and repair. Perishable adhesives will be kept in a refrigerated storage locker at Area 55 and retrieved by other facilities from this location as needed. Nonperishable adhesives will be stored in approved flammable materials storage lockers at each facility. Quantities used will vary with the intended task, and supplies will be maintained as necessary. Adhesives will release small amounts of volatiles in the immediate area of use. Precautions will be taken to prevent inhalation and fire hazards. Other than minor air emissions, no other impacts are expected from the normal use of adhesives during LV processing.

Compressed gases will be used primarily at the HPF for welding operations and at LC-17 and other facilities as necessary for fuel line purging and miscellaneous processes requiring pressurized gases. All compressed gas cylinders will be stored in approved storage areas to minimize the potential for puncture and exposure to ignition sources. Quantities of compressed gases used will vary with the activity (e.g., number of welding operations), and supplies will be maintained on an as-needed basis. No adverse impacts are expected from the normal use of compressed gases during LV processing.

Oils and lubricants will be used throughout LV processing facilities as needed for general maintenance. Approved POL storage sheds will be maintained to store oils and lubricants for use at Area 55 and LC-17. Smaller POL storage lockers will be used at other locations for storage of limited quantities of these materials. Quantities needed for processing will vary, and supplies will be ordered and maintained as necessary. The normal use of these materials during LV processing is not expected to present adverse impacts.

Corrosive materials will be used primarily in Area 55 for metals cleaning and etching. A laboratory at Area 55 maintains a process tank line with bulk-quantity acid solutions used for metals etching and acid washes. The process tank line consists of one 143-gallon tank containing a hydrofluoric acid and nitric acid mixture, and four 107-gallon tanks containing a nitric acid solution, a hydrofluoric acid, nitric acid, and chromic acid mixture, a phosphoric acid solution, and an alodine 1200 solution, respectively. The batteries for the LV will require approximately 1.2 gallons of potassium hydroxide which will be stored at the battery laboratory in Hangar M. Other corrosives will be used in small amounts at various processing facilities for miscellaneous cleaning and etching. Corrosives will be adequately contained in tanks or other structures (e.g., battery cases) to prevent release. Precautions will be taken, including the use of protective clothing, to minimize potential hazards associated with the toxicity and corrosivity of corrosive materials. No adverse impacts to human health or the environment are expected from the normal use of corrosives during LV processing.

Explosive ordnance used on both the SV and the LV will present potential safety risks associated with accidental explosions. Safety hazards from accidental explosions are described in section 4.15.

EPA-17 industrial toxics used during LV processing will include methyl ethyl ketone, toluene, and xylene. Toluene and xylene are used as pure solvents and are also found in lacquer thinner and some coatings. All materials containing these constituents will be used in small amounts and stored in approved storage lockers when not in use.

Contractors for the SV and LV will participate in the hazardous materials pharmacy being implemented at Cape Canaveral AS. Additionally, both are establishing tracking systems for hazardous materials purchased outside of the Cape Canaveral AS pharmacy.

The GPS ground antenna station located at Cape Canaveral AS maintains one POL storage cabinet in the radome structure that will be used to store small amounts of hazardous materials for area maintenance and upkeep. Materials will include cleaning solvents, touchup paints and lacquers, lubricant grease, motor oil, and lawn care products. Other than minor air emissions associated with the use of solvents and coatings, no impacts are expected from the normal use of hazardous materials at the ground antenna station at Cape Canaveral AS. Toluene (a cleaning solvent) and xylene (coating constituent) are the only EPA-17 industrial toxics that will be used at the facility. Their use will be limited to the small amounts of solvents and coatings used at the facility.

Hazardous material spill prevention and control for SV and LV prelaunch processing activities and activities at the Cape Canaveral AS ground antenna facility shall be in accordance with 45th Space Wing Operations Plan 19-1.

The GPS ground antenna station located at Diego Garcia will use small amounts of various unspecified coatings, thinning solvents, and oils and lubricants as needed for corrosion control and maintenance of antenna gear mechanisms. These materials will be stored in approved flammable materials storage lockers and POL storage lockers to minimize the potential for fire and spills. Coatings and thinning solvents can be expected to release small quantities of volatiles during use. Other than these minor air emissions, no other impacts are expected from the normal use of hazardous materials at the site.

Hazardous material spill prevention and control for activities at the Diego Garcia ground antenna facilities shall be in accordance with Naval Support Facility Area Oil and Hazardous Substance Pollution Contingency Plan.

The GPS ground antenna station at Kwajalein Atoll will use various unspecified coatings, corrosion removers, and thinning solvents as necessary for corrosion control at the antenna facilities. Use of all of these materials is estimated to be less than 10 gallons per year total. Additionally, approximately 1.25 gallons of lubricating grease will be used per year for the antenna gears (Tovey, 1994). All hazardous materials shall be stored in approved flammable materials storage lockers or POL storage lockers to minimize the potential for fires and spills. The corrosion control materials will release small quantities of volatile constituents in the immediate area of use. Aside from minor air emissions, no other impacts are anticipated from the occasional use of hazardous materials at the site.

Hazardous material spill prevention and control for activities at the Kwajalein Atoll ground antenna facilities shall be in accordance with applicable US Army (the host unit) hazardous substance pollution contingency measures for the US Army Kwajalein Atoll installation.

The GPS monitor station at Kaena Point Satellite Tracking Station, Hawaii, will store and use small quantities of various hazardous materials, including cleaners, cleaning solvents, adhesives, coatings, and oils and lubricants, which will be used as needed for general maintenance and upkeep. All products will be stored in approved flammable materials storage lockers and POL storage lockers located in each of the five buildings at the facility. In general, quantities of each material stored per cabinet will be limited to less than one gallon, with the exception of grease and gear oil. These materials are necessary for regular lubrication of the antenna gear mechanisms and will be stored in five gallon containers. Quantities used will vary, but are anticipated to be less than one gallon of each material per six month period. Use of solvents, adhesives, and coatings is expected to release small amounts of volatiles in the area of use. Other than these minor releases, no other impacts are expected from the normal use of hazardous materials at the site.

Hazardous material spill prevention and control for activities at the Kaena Point monitor station facilities shall be in accordance with applicable US Air Force Pacific Air Forces (the host command unit) hazardous substance pollution contingency measures.

Toluene, xylene, and methyl ethyl ketone found in many coatings, solvents, and adhesives, are predicted to be the only EPA-17 industrial toxics used at the three overseas ground antenna stations. However, their use is expected to be small (less than one gallon per year) due to the sporadic use of the materials in which they are contained.

Atlas Launch Vehicle. None of the previous environmental assessments relative to Atlas LV processing at Cape Canaveral AS identified specific potentially hazardous materials that would be used, except for materials associated with processing of the solid rocket motors for the Atlas IIAS (USAF, 1989c; USAF, 1991c). Since there are no solid rocket motors on the Atlas II, these materials are not applicable to the current assessment.

The main difference between the Atlas II and the Delta II LVs relates to the upper stages since the main stages of both LVs use RP-1 and liquid oxygen as propellants. The second stage of the Delta II uses Aerozine-50 and nitrogen tetroxide and the third stage is a solid rocket motor. The upper stage of the Atlas II is a Centaur II using liquid hydrogen and oxygen as a propellant.

Cleaning and assembly operations for the Atlas II would utilize similar solvents, adhesives, and paints. The Aerozine-50 and nitrogen tetroxide of the Delta II would not be present for processing of the Atlas II. From the standpoint of hazardous materials used in prelaunch processing, the Atlas II would overall use fewer hazardous materials. Quantities of materials would be similar.

Hazardous material spill prevention and control for Atlas II prelaunch processing shall be in accordance with 45th Space Wing Operations Plan 19-1.

No Action. Cape Canaveral AS accommodates other space launch programs unrelated to the proposed action that would continue in use for the foreseeable future. The activities associated with these programs have environmental consequences which have been included in the baseline environmental conditions (Section 3). Under the no-action alternative, hazardous materials use at Cape Canaveral AS would be decreased. Since the SV would not be processed, the hazardous materials described previously for the SV would not be used. Hazardous materials used during Delta II processing would continue to be used in support of other SVs, but amounts would be decreased due to 21 fewer launches from 1996 to 2003.

4.3 HAZARDOUS WASTE

Proposed Action. Hazardous materials associated with Block IIR SV and Delta II LV processing can potentially generate hazardous waste. The contractors for the Block IIR SV and the Delta II LV are responsible for identification, containerization, labeling, and accumulation of hazardous wastes in accordance with all applicable federal, state, and local regulations, and with 45th Space Wing (45 SW) Operations Plan (OPlan) 19-14. All hazardous wastes generated from SV and LV activities will be transported, treated, stored, and disposed (or arrangements made for disposal) by the Joint Propellants Contractor (JPC).

Predicted hazardous waste streams for Block IIR SV processing activities are presented in Table 19. Hazardous waste predictions for SV activities assume three missions per year and are based on typical waste streams for similar SV programs.

Table 19 Forecast of Annual Hazardous Wastes Associated with Block IIR SV

Waste Description	Estimated Volume of Waste (gal)
Hydrazine flush waste (<2% hydrazine and <15% citric acid) - non hazardous	150
Pads, wipes, vinyl tape, and other solids contacting hydrazine	21
Vacuum pump hydrocarbon oil contaminated with hydrazine vapors	3
Solvent waste	<1

Hydrazine flush waste, considered non-hazardous waste, is included in Table 19 because it is typically handled and stored in a similar manner to hazardous wastes. The JPC will test all hydrazine flush waste to ensure it is non-hazardous and provide neutralization as necessary. Hydrazine flush waste will be contained in an approved 55-gallon container, temporarily accumulated in the waste propellant area until it is retrieved by the JPC, and disposed of as non-hazardous waste. The waste propellant area is a satellite accumulation point located outside the DPF (Ulshafer, 1994). The contractor for the Block IIR SV program will have waste minimization strategies in place to minimize the amount of excess propellant disposed of as rinsate waste.

Wipes, pads, tape, and other solid materials which come into contact with hydrazine will be accumulated in a 14-gallon drum in the waste propellant area outside the DPF. Full containers will be collected by the JPC and disposed of as hazardous waste. Hydrocarbon oil contaminated with hydrazine vapors and miscellaneous solvent waste constitute less than three percent of the hazardous waste generated during SV processing and will be disposed of as hazardous waste by the JPC (Ulshafer, 1994a).

In addition to the waste streams listed in Table 19, a hydrazine vent scrubber at the DPF contains a 14 percent citric acid scrubber liquor to control hydrazine vapors from propellant loading operations. The scrubber liquor will be replaced in the scrubber by the JPC when the neutralizing capacity of the liquor is reached (determined by monitoring the pH). Spent hydrazine scrubber liquor is handled and stored in the same manner as hazardous waste until it can be tested by the JPC to ensure complete neutralization and verify that it is non-hazardous. Spent scrubber solution is typically found to be non-hazardous and is disposed of by the JPC through the wastewater collection system or an alternative method of non-hazardous waste disposal.

X-ray film processing at the Nondestructive Test Laboratory (NTL) will generate rinse water with high concentrations of silver. The rinse water stream is routed through a silver recovery unit to remove silver and render the waste stream non-hazardous. The waste stream is then discharged to grade in accordance with a Florida Department of Environmental Protection permit (Castlen, 1994).

Block IIR processing will generate an estimated total of 1,330 pounds of hazardous waste per year. This represents an increase of 0.32 percent over the current hazardous waste generation rate of 411,668 pounds per year (includes current Block II/IIA program) at Cape Canaveral AS.

Forecast annual hazardous waste streams for Delta II LV processing are summarized in Table 20. Estimated volumes of hazardous waste assume three launches per year in support of the Block IIR program. The largest quantities of hazardous wastes are typically from the acid etching facility in Area 55. Waste acid solutions from this facility are collected directly from etching tanks and disposed of by the JPC as hazardous wastes due to their high acidity

Table 20 Forecast of Annual Hazardous Wastes Associated with Delta II LV in Support of Block IIR SV

Waste Description	Estimated Volume of Waste (gal)
Aerozine-50 fuel flush solution with acetic acid (non-hazardous wastes)	675
Alodine wastewater	150
Aqueous acid mixture rinse water (oxidizer rinsate)	400
Aqueous solution of nitric acid (50%) and hydrofluoric acid (5%)	150
Aqueous solution of nitric acid and chromic acid	150
Battery changeout (lithium)	<5
Battery changeout (mercury)	<5
Battery changeout (nickel-cadmium)	<5
Defective aerosol cans	5
Flush empty hydrazine containers with water (non-hazardous wastes)	360
Hydrazine disposal, spills, or leaks	5
Hydrazine wipes	20
Hydrocarbon fuels and halogenated solvents	15
Isopropyl alcohol waste (> 24 %, flashpoint <73 F)	50
Isopropyl alcohol waste (> 24 %, flashpoint >73 F to <141 F)	150
Nitrogen tetroxide oxidizer system rinsate (non-hazardous wastes)	675
Rinsing nitrogen tetroxide containers, spills, or splashes	5
Used solvent wipes	138
Waste isopropyl alcohol and phosphoric acid solution	150
Waste liquid mercury	250 grams
Waste paints and solvents	100
Wipes, filters, grease contaminated with TCLP metals	55

Source: MDA, 1994.

and metals content. Other wastes, such as solvent wipes and paint waste, will be accumulated at a satellite accumulation point at the location of generation and will be disposed of by the JPC as hazardous wastes. The contractor for the Delta II LV maintains eight satellite accumulation points located throughout the various processing facilities. When 55 gallons of a particular waste are accumulated at one of the satellite accumulation points, the waste is moved to the 90-day storage facility in Area 55 within 72 hours in accordance with 45 SW OPlan 19-14. Hazardous wastes can be stored at the 90-day storage facility for up to 90 days until the JPC can retrieve them for treatment and disposal.

Aerozine-50 and nitrogen tetroxide rinsate streams associated with second stage propellant loading at LC-17 are included in Table 20 for reference but are not considered hazardous wastes. The constituents of Aerozine-50, unsymmetrical dimethylhydrazine and hydrazine, are not listed as acute toxic hazardous wastes in 40 CFR 261.31, 261.32, or 261.33(e). Therefore, under 40 CFR 261.7, empty containers or lines that held these wastes are not hazardous wastes. Approximately 225 gallons of Aerozine-50 rinsate will be generated per launch. The JPC will test the rinsate, provide neutralization as necessary to ensure the rinsate is non-hazardous, and dispose of the rinsate as non-hazardous waste. Nitrogen tetroxide, as a dimer of nitrogen dioxide, is listed as an acute hazardous waste in 40 CFR 261.33(e). Transfer equipment, containers, and lines at LC-17 which held nitrogen tetroxide are not considered hazardous waste since all are triple rinsed in accordance with 40 CFR 261.7. Triple rinsing effectively removes the pollutant from the equipment under the definition set forth in 40 CFR 261.7. The first three rinses of equipment, containers, and lines which held nitrogen tetroxide are considered hazardous since nitrogen tetroxide is an acute hazardous waste. However, an EPA treatability variance ruling, which is specific to oxidizer flushing activities at LC-17, allows the JPC to neutralize nitrogen tetroxide rinsate and discharge it to the wastewater collection system after testing to ensure that the rinsate has been rendered non-hazardous. The LV contractor will have waste minimization strategies in place to minimize the amount of excess propellant and oxidizer disposed as rinsate waste.

Delta II LV processing in support of the Block IIR program is expected to generate approximately 11,185 pounds of hazardous waste per year. This represents approximately 2.72 percent of the total hazardous waste generation of 411,668 pounds per year (includes current Delta II processing) at Cape Canaveral AS.

Combined waste from Block IIR SV and Delta II LV processing will be approximately 12,515 pounds. Delta II support for the Block IIR will begin in 1996 at the conclusion of Delta II support for the existing Block II/IIA. Because launch schedules are similar for the two programs, hazardous waste streams for the Delta II LV are not predicted to change the total amount of hazardous waste generated at Cape Canaveral AS. When the Block II/IIA SV program ends in 1995, approximately 1,870 pounds of hazardous waste per year will be eliminated. Since Block IIR missions generating hazardous waste at 1,330 pounds per year will not begin until 1996, the net decrease in hazardous waste at Cape Canaveral AS will be 540 pounds per year or 0.13 percent below the current rate of 411,668 pounds per year.

The GPS ground antenna station at Cape Canaveral AS will generate little, if any, hazardous waste. Most of the hazardous materials at the site will be consumed during use. Potential hazardous wastes might be empty containers with residual solvents or coatings, solvent or coating containers whose shelf life has expired, and used lubricants which can be recycled. Total hazardous waste generated at the antenna station is not expected to exceed more than one gallon per year. Any hazardous waste generated will be collected and disposed or recycled by the JPC in accordance with 45 SW OPlan 19-14, Petroleum Products and Hazardous Waste Management Plan.

The Diego Garcia GPS ground antenna station will generate hazardous waste streams similar to those for the Cape Canaveral AS ground station, mainly from unused or residual hazardous materials. Hazardous waste quantities are expected to be minimal (generally less than one gallon per year) due to the small amount of hazardous materials used at the site. All hazardous wastes generated at the site will be disposed of by the US Navy as the host organization in accordance with Naval Support Facility Diego Garcia Instruction 5090.1, dated 13 October 1992, which is the hazardous waste management plan for Diego Garcia.

The Kwajalein Atoll GPS ground antenna station will generate approximately one gallon of hazardous paint thinner waste per year. This waste will be 100 percent reclaimed and reused by the installation at Kwajalein Atoll. All hazardous waste at Kwajalein Atoll is handled, transported, and disposed or reclaimed by the US Army as the host organization in accordance with Hazardous Waste Management Plan for US Army, Kwajalein, Marshall Islands.

Hazardous waste generated at the Kaena Point GPS monitor station will consist of approximately five gallons of various liquids, presumably expired or residual solvents and coatings. This waste will be disposed of by the support organization for the 15th Air Base Wing (ABW) in accordance with 15 ABW Hazardous Waste Management Plan.

Atlas Launch Vehicle. Hazardous materials associated with Atlas II LV processing generate hazardous waste. The contractor for the Atlas II LV would be responsible for identification, containerization, labeling, and accumulation of hazardous wastes in accordance with all applicable federal, state, and local regulations, and with 45 SW OPlan 19-14. All hazardous wastes generated from Atlas II LV activities would be transported, treated, stored, and disposed by the JPC.

Over the period 1986 to 1990, the following annual quantities of hazardous waste were generated in support of Atlas LV processing for all Atlas types (USAF, 1991c). No Atlas II LVs were launched during that period, but four Atlas LVs of previous types were launched (AIAA, 1991b).

Table 21 Atlas LV Hazardous Waste Amounts

Waste Type	Average Annual Amount (gallons)
Alcohol	213
Lithium chloride	100
Oil	650
Plating Solution	49
Paint	163
Sealant	0
Solvent	635
RP-1	70
Mixed	202
Total	2,100

Since these amounts are annual amounts for four launches, the estimated total Atlas II hazardous waste produced per launch is 525 gallons. For a launch rate of three per year in support of the NAVSTAR GPS program, the estimated hazardous waste generation for the Atlas II LV would be 1,575 gallons per year. Assuming a conversion of 8 pounds per gallon of hazardous waste, the annual hazardous waste generation rate would be 12,600 pounds, which would be 3.1 percent of the current hazardous waste production rate at Cape Canaveral AS.

No Action. Cape Canaveral AS accommodates other space launch programs unrelated to the proposed action that would continue in use for the foreseeable future. The activities associated with these programs have environmental consequences which have been included in the baseline environmental conditions (Section 3). Under the no-action alternative, hazardous waste generation at Cape Canaveral AS would be decreased from the baseline described in Section 3.3. Since the SV would not be processed, the hazardous waste amounts described previously for the SV would not be generated. Hazardous waste generation by Delta II processing would continue in support of other SVs, but amounts would decrease due to 21 fewer launches from 1996 to 2003.

4.4 SOLID WASTE

Proposed Action. Solid waste will be generated by Block IIR SV and Delta II LV processing activities as well as by personnel associated with those activities. Drums and dumpsters are used for temporary storage of solid waste. Containers are removed or emptied by the Cape Canaveral AS solid waste contractor. The Block IIR SV contractor plans to participate in the white paper and aluminum can recycling program in place at Cape Canaveral AS. The Delta II LV contractor is currently participating in the recycling effort, although recycled amounts are not available. Participation in this program will reduce the total solid waste that would have been generated by each contractor.

Assuming 50 permanent Block IIR SV personnel (discussed in Section 4.12), a design solid waste generation rate of 3 pounds per person per day, and 260 working days per year, SV personnel would generate an estimated 19.5 tons of solid waste per year (tpy). In addition, SV processing activities would generate less than 0.5 tons of solid waste per year for a total solid waste generation rate of approximately 20 tpy. This represents an increase of 0.70 percent over the current solid waste generation rate of 2,876 tpy for Cape Canaveral AS. When the NAVSTAR GPS Block II/IIA program ends in 1995 approximately 50.9 tpy of solid waste will be eliminated (100 personnel, no recycling program). Since Block IIR missions will not begin until 1996, there would be a net decrease in solid waste generation at Cape Canaveral AS of 30.9 tpy or 1.1 percent.

Delta II LV activities to support Block IIR SVs will begin in 1996 at the conclusion of Block II/IIA SV support activities. Therefore, solid waste generation rates for Delta II LV personnel and processing activities supporting Block IIR SVs would remain similar to current rates. LV personnel and processing activities generate approximately 105.3 tons of solid waste per year. This represents approximately 3.5 percent of the total solid waste generation at Cape Canaveral AS.

Solid waste generated at the Cape Canaveral AS ground antenna station will be minimal. Assuming five permanent personnel at the facility, approximately two tons of solid waste will be generated per year. This waste will be disposed of by the solid waste contractor for Cape Canaveral AS. The Cape Canaveral AS antenna site will participate in the base's aluminum can and paper recycling program.

The Diego Garcia GPS ground antenna station will generate small amounts of solid waste which will be disposed of in dumpsters and collected by the US Navy's support organization. Assuming five permanent personnel at the site, approximately two tons of solid waste will be generated per year.

Solid waste generated at the GPS ground antenna station at Kwajalein Atoll is estimated to be approximately 300 pounds per year. This waste will be collected by the US Army's support organization and will be disposed of by incineration with subsequent landfilling of the ash. The Kwajalein Atoll antenna site will participate in an aluminum can recycling program.

Solid waste generated at the Kaena Point GPS monitor station will be approximately two tons per year, assuming five permanent personnel at the site. Solid waste generated at the site will be collected by the 15th Air Base Wing support organization and taken to a municipal landfill for disposal. The Kaena Point antenna site will recycle paper, aluminum cans, and glass bottles.

Atlas Launch Vehicle. Specific solid waste generation rates were not included in previous assessments. The projected number of personnel to support Atlas II launches is 80 (USAF, 1989c). Using the same assumptions regarding solid waste generation as the Delta II LV, the 80 personnel would contribute approximately 31.2 tons of solid waste annually. Assuming an additional 30 tons related to LV processing activities, the total annual solid waste generated would be 64.2 tons, which is approximately 2.2 percent of the current annual solid waste generated at Cape Canaveral AS.

No Action. Cape Canaveral AS accommodates other space launch programs unrelated to the proposed action that would continue in use for the foreseeable future. The activities associated with these programs have environmental consequences which have been included in the baseline environmental conditions (Section 3). Under the no-action alternative, solid waste generation at Cape Canaveral AS would decrease from the baseline described in Section 3.4 since the Block II/IIA program would be completed and there would be no replacement program. With 21 fewer launches over the 1996 to 2003 time period, solid waste associated with Delta II LV processing activities would be decreased. Since other SVs use the Delta II LV, there would be no decrease in Delta II launch personnel and no decrease in personnel solid waste generation.

4.5 POLLUTION PREVENTION

Proposed Action. No Class I ozone-depleting chemicals (ODC) are used in the Block IIR processing facilities. The air-conditioning systems use Freon-22 refrigerant, a Class II ODC considered to be much less harmful than other Class I refrigerants due to its lower ozone-depleting potential. Small quantities (generally less than one gallon per mission) of materials that contain EPA-17 targeted industrial toxics will be used during SV processing.

The Delta II LV contractor has currently initiated certain pollution prevention measures. All Class I ODCs, including 1,1,1-trichloroethane, halon, and Freon-113 refrigerant, have been eliminated or are currently being eliminated from processing activities. The use of two EPA-17 industrial toxics, trichloroethylene and 1,1,1-trichloro-ethane, has been eliminated. Other materials containing EPA-17 toxics will be used in small quantities. The Delta II LV contractor plans to implement its own pharmacy-style hazardous materials tracking system in order to better control the use of potential polluting substances.

The NAVSTAR GPS Block IIR and the Delta II MLV III program will comply with the Pollution Prevention Management Plan (PPMP) that will be developed by Cape Canaveral AS. Compliance with the PPMP will minimize pollution and meet the regulatory requirements relative to pollution prevention.

The GPS ground antenna station at Cape Canaveral AS will also comply with the PPMP to be developed. The only Class I ODC currently used at the facility is a halon fire suppression system which is scheduled to be replaced. The EPA-17 industrial toxics toluene and xylene will be used at the site only in small quantities.

The Diego Garcia GPS ground antenna station will comply with all applicable US Navy pollution prevention regulations. No Class I ODCs are currently known to be used at the site. If Class I ODCs are determined to be used at the site, they shall be replaced in accordance with EPA Class I ODC reduction regulations. EPA-17 industrial toxics (xylene and toluene found in coatings and solvents) are used only in small quantities.

The GPS ground antenna station at Kwajalein Atoll will comply with the pollution prevention techniques set forth in HAZMIN Plan for the US Army, Kwajalein Atoll, Marshall Islands. Personnel at the site will be routinely trained on proper handling of hazardous materials and waste in order to minimize pollution. The station is currently testing refrigerant substitutes for Freon-12 in the air conditioning system and Halon substitutes for the fire suppression system. All materials containing EPA-17 toxics will be used in small quantities.

The Kaena Point GPS ground antenna station will comply with 15th Air Base Wing pollution prevention regulations. Personnel will be adequately trained in methods for reducing pollution and waste at the site. No Class I ODCs are known to be used at the site. Toluene and xylene, found in coatings and solvents, are the only EPA-17 industrial toxics used at the site and will be used only in small quantities.

Atlas Launch Vehicle. Specific information regarding pollution prevention activities of the Atlas II contractor was not presented in previous assessments which predate pollution prevention initiatives.

As with the Delta II program, the Atlas II contractor would comply with the Pollution Prevention Management Plan (PPMP) that will be developed by Cape Canaveral AS. Compliance with the PPMP will minimize pollution and meet the regulatory requirements relative to pollution prevention.

No Action. Cape Canaveral AS accommodates other space launch programs unrelated to the proposed action that would continue in use for the foreseeable future. The activities associated with these programs have environmental consequences which have been included in the baseline environmental conditions (Section 3). Under the no-action alternative, the Block IIR program would not be initiated and pollution associated with the Block IIR program would not be generated. The pollution prevention measures utilized by the Delta II LV contractor would continue. All individuals or organizations at Cape Canaveral AS shall comply with the PPMP under development.

4.6 NONIONIZING RADIATION

Proposed Action. Table 22 summarizes the transmitting characteristics for the antennas associated with the proposed action. There are three types of transmitting antennas on the Block IIR SV. The two S-band antennas (cross dipole design) transmit telemetry, tracking, and command information, the UHF transmitting element sends data to other orbiting spacecraft, and the L-band array transmits navigational data to the ground. The five transmitting antennas on the Delta II LV provide telemetry and tracking information for the individual stages of the launch vehicle.

There are a total of four antennas on the roof of the NAVSTAR Processing Facility (NPF) capable of transmitting: two 6-foot-diameter parabolic antennas; one 4-foot parabolic antenna; and one omnidirectional antenna. Omnidirectional antennas radiate with equal strength in all directions. The omnidirectional antenna was first used 7 years ago to test the interface capability between the NAVSTAR GPS Block I and Block II SV systems. This antenna has been used only once since that time, and is not currently in use. All of the signals from NPF antennas are continuous emission (Skinner, 1993), neither pulsed nor rotating. The single 8-foot antenna on the roof of the Defense Satellite Communication System Processing Facility (DPF) is also continuous emission (Fragula, 1993).

GPS ground antennas at Cape Canaveral AS, Diego Garcia, and Kwajalein Atoll provide communication with the GPS constellation. The Kaena Point, Hawaii, ground antenna is a receive-only antenna and will not produce RF radiation. All transmitting antennas have similar transmitting characteristics and are enclosed in radomes to protect them from the environment.

The radio frequency (RF) radiation hazard analysis for the antennas is based on Air Force Occupational Safety and Health (AFOSH) Standard 161-9, which establishes maximum Permissible Exposure Limits (PEL) of RF radiation for Air Force and contract workers in restricted areas and for the general public in nonrestricted areas. All PEL standards presented in AFOSH Standard 161-9 are the result of extensive RF radiation research and testing. Maximum PEL standards, expressed as power densities in milliwatts per square centimeter (mW/cm^2), are used along with the peak antenna power and the antenna gain to calculate a "safe distance" from each antenna beyond which no hazard to humans will occur.

AFOSH Standard 161-9 recommends a maximum PEL of 10 mW/cm^2 for

Table 22 Summary of Transmitting Antenna Characteristics

Antenna Type/Size	Quantity	Band	Operating Frequency (MHz)	Peak Power to Transmitter (W)	Antenna Gain (dB)
NAVSTAR Block IIR Satellite[1]					
Cross Dipole	2	S	2,227.50	3.5	8.0
UHF Element	1	UHF	300.00	112	4.0
L-Band Array	1	L1	1,575.42	35	12.8
		L2	1,227.60	10	11.3
		L3	1,371.05	15	11.3
Delta II Launch Vehicle[2]					
First Stage	1	S	2,244.50	4	2.35
Second Stage	1	S	2,241.50	4	2.35
Upper Stage (Belly)	1	S	2,252.50	10	5.0
Upper Stage (Fairing)	1	S	2,252.50	10	5.35
C-Band Transponder	1	C	5,765.00	1	8.12
DSCS Processing Facility[3]					
Parabolic Dish/8-ft	1	S	1,815.74	0.00032	32.0
NAVSTAR Processing Facility[4]					
Parabolic dish/6-ft	1	L1	1,575.42	40	27.0
		L2	1,227.60	10	24.8
		L3	1,381.05	20	25.9
Parabolic dish/6-ft	1	S	1,783.74	10	28.0
Parabolic dish (TT&C)/4-ft	1	S	2,227.50	4	26.5
Omnidirectional	1	L1	1,575.42	40	1.0
		L2	1,227.60	10	1.0
		L3	1,381.05	20	1.0
GPS Ground Antenna Station, Cape Canaveral AS[5]					
Parabolic Dish/32-ft	1	S	1,783.74	2,100	42.3
GPS Ground Antenna Station, Diego Garcia[6]					
Parabolic Dish/32-ft	1	S	1,783.74	2,100	42.3
GPS Ground Antenna Station, Kwajalein Atoll[7]					
Parabolic Dish/32-ft	1	S	1,783.74	2,100	42.3

1 MMA, 1993
2 MDA, 1993b
3 Fragula, 1993
4 Skinner, 1993
5 Barnes, 1994
6 USAF, 1990d
7 Tovey, 1994

personnel in restricted areas where the antenna operating frequency is greater than 1,000 megahertz (MHz). For restricted areas where frequencies are less than 1,000 MHz, the maximum PEL recommended is a function that varies with the actual antenna frequency. A PEL of 5 mW/cm^2 is recommended for the general public in unrestricted areas where the antenna frequency is greater than 1,500

MHz. For unrestricted areas where frequencies are below 1,500 MHz, a frequency-dependent function similar to the one for restricted areas is used.

Table 23 presents a summary of safe distances for each antenna on the NAVSTAR Block IIR SV, Delta II LV, and associated ground facilities, as calculated using methods recommended in AFOSH Standard 161-9.

The limiting RF radiation safe distance for antennas on the NAVSTAR GPS Block IIR SV is for the UHF element. The PEL distance for this antenna is 5 feet for unrestricted areas and 3 feet for restricted areas. The entire SV will be enclosed in a RF antenna shield during system testing. The RF antenna shield will reduce the amount of RF radiation produced during transmissions to less than 5 mW/cm^2. No RF radiation hazard will be associated with any of the antennas on the Block IIR SVs because of the short PEL distances and the enclosure of the SV in a RF antenna shield during system testing.

No RF radiation hazards will be associated with testing antennas on the Delta II LV because the PEL distance for all antennas for both unrestricted and restricted areas is less than 1 foot. Personnel in the various launch vehicle processing facilities shall remain more than one foot from the launch vehicle during antenna testing to avoid exposure to RF radiation. The small PEL distances are due primarily to the low operating power of the antennas.

No RF radiation hazard will be associated with the antenna mounted to the roof of the DPF because the PEL distance for both unrestricted and restricted areas is less than 1 foot. The area within the 1-foot safe distance is in open space and not accessible to personnel. This small PEL distance is due to a maximum power output from the transmitter of less than 1 mW.

The highest RF radiation emission from the antennas on the roof of the NPF would be from the 6-foot parabolic (L-band) antenna. The PEL distance for this antenna is 22 feet for unrestricted areas

Table 23 Summary of RF PEL Safe Distances

Location	Antenna	Unrestricted Distance (ft)	Restricted Distance (ft)
Navistar Block IIR Satellite	Cross Dipole	<1	<1
Navistar Block IIR Satellite	UHF Element	5	3
NAVSTAR Block IIR Satellite	L-Band Array	4	3
Delta II Launch Vehicle	First Stage	<1	<1
Delta II Launch Vehicle	Second Stage	<1	<1
Delta II Launch Vehicle	Upper Stage (Belly)	<1	<1
Delta II Launch Vehicle	Upper Stage (Fairing)	<1	<1
Delta II Launch Vehicle	C-Band Transponder	<1	<1
DSCS Processing Facility	8-ft Parabolic	<1	<1
NAVSTAR Processing Facility	6-ft Parabolic (L-band)	19	14
NAVSTAR Processing Facility	6-ft Parabolic	11	8
NAVSTAR Processing Facility	4-ft Parabolic (TT&C)	6	4
NAVSTAR Processing Facility	Omnidirectional	<1	<1
Ground Antenna Station, Cape Canaveral AS	32-ft Parabolic	782	553
Ground Antenna Station, Diego Garcia	32-ft Parabolic	782	553
Ground Antenna Station, Kwajalein Atoll	32-ft Parabolic	782	553

and 13 feet for restricted areas. No RF radiation hazard will be associated with this antenna or the other antennas on the roof of the NPF because all antenna azimuths and stops are fixed and transmissions will be horizontally directed from roof level. The center-of-beam areas directly in front of the NPF antennas are in open space and not accessible.

Unrestricted and restricted PEL distances for the GPS ground antenna at Cape Canaveral AS are relatively large (782 ft and 553 feet, respectively) due to the high operating power associated with the antenna. During normal communications with SVs on orbit, no RF radiation hazard will be associated with this antenna because of a fixed stop which does not allow the antenna to radiate below five degrees. The center-of-beam area directly in front of the antenna is in open space and not accessible. However, during prelaunch processing for the SV, the antenna will radiate at approximately two degrees elevation toward the DPF to test the SV receiving antennas. At this elevation, there is the potential for workers in any facilities within the calculated safe distance to be exposed to RF radiation. The only facility identified within the calculated safe distance is the antenna control facility (building 39761A) immediately adjacent to the antenna radome . A RF radiation survey was conducted with the antenna radiating at peak power at two degrees elevation toward the control building. This survey revealed that acceptable radiation levels could be exceeded only on the roof of the building under these conditions. During prelaunch activities the antenna will be facing away from the control building toward the DPF, and azimuth stops will be in place to prevent the antenna from radiating toward the control building. Additionally, because the antenna is not radiating over orbital distances during prelaunch activities, it will use a power setting lower than peak power. Furthermore, it is standard policy to prohibit access to the roof of the control building during prelaunch activities. For these reasons, no RF radiation hazard is expected from the normal operation of the antenna below five degrees during prelaunch activities.

The restricted and unrestricted distances for the Diego Garcia GPS ground antenna are 782 feet and 553 feet, respectively. During standard operation of the antenna at a five-degree transmission elevation, no RF radiation hazard would be present. The center-of-beam area directly in front of the antenna is in open space and not accessible. A RF radiation hazard survey conducted for a nearby antenna at Diego Garcia with similar physical and transmitting characteristics indicates that the GPS antenna could potentially produce hazardous RF radiation levels on facility rooftops within the calculated safe distances if the antenna is operated at its minimum transmitting elevation of two degrees (USAF, 1990d). Present policy at Diego Garcia is to restrict personnel from being on the roofs of any on-site buildings or performing any work above a height of 13 feet with the transmitter active. Signs and warning lights are located on applicable facilities to warn personnel when a hazardous condition is present.

The Kwajalein Atoll GPS ground antenna also has unrestricted and restricted PEL safe distances of 782 feet and 553 feet, respectively. A RF radiation hazard survey conducted for the antenna reveals that no facilities within the calculated safe distances would be exposed to hazardous levels of RF radiation even at the lowest possible transmitting elevation of four degrees (Tovey, 1994).

Birds in the beam of a transmitting antenna would be subjected to RF radiation. The AFOSH standards are based on experimental animal studies that determined maximum values of the Specific Absorption Rate (SAR) at which animals were not harmed. The SAR is the rate at which RF energy is absorbed by an animal and is expressed in watts per kilogram (W/kg). The AFOSH standards included a safety factor of ten and are based on a SAR of 0.4 W/kg averaged over a six-minute period.

Based on conservative assumptions regarding bird weight, cross-sectional area, flight speed, and beam width, a flying bird would not be harmed by RF radiation as it crossed the beam of a transmitting antenna. A bird that roosted in the beam of an antenna would experience discomfort from RF radiation-induced heat and move from the beam area (Polk & Postow, 1986).

Atlas Launch Vehicle. The Atlas II launch vehicle will use S-band and C-band antennas which operate at approximately 2,000 Megahertz (MHz) and 6,000 MHz, respectively. The S-band antenna will be used for transmitting telemetry information and the C-band antenna will be used as a beacon transponder. Information regarding peak power and gain of the antennas was not presented in previous assessments. Because the antennas perform similar functions as those on the Delta II launch vehicle, it was assumed that antenna gains and peak power for the Atlas antennas would also be similar. Table 24 presents PEL safe distances associated with the antennas on the Atlas II. As with the Delta II antennas, all antennas on the Atlas II launch vehicle will have safe distances of less than one foot. Due to this short distance, no impacts from these antennas are anticipated. Personnel shall remain outside the 1-foot safe distance during prelaunch activities.

No Action. Cape Canaveral AS accommodates other space launch programs unrelated to the proposed action that would continue in use for the foreseeable future. The activities associated with these programs have environmental consequences which have been included in the baseline environmental conditions (Section 3). Under the no-action alternative, there would be a reduction in transmissions associated with SV prelaunch processing. Because the Delta II LV supports other programs, RF radiation would continue to be emitted. Ground antenna stations would continue to emit RF radiation to support the existing NAVSTAR GPS satellite constellation.

Table 24 Atlas LV RF PEL Safe Distances

Antenna	PEL Safe Distance (ft)
1. S-Band	Restricted: <1
Frequency: 2,000 MHz	
Gain: 2.35 dB	Unrestricted: <1
Peak power: 4 W	
2. C-Band	Restricted: <1
Frequency: 6,000 MHz	
Gain: 8.12 dB	Unrestricted: <1
Peak power: 1 W	

4.7 IONIZING RADIATION

Proposed Action. The navigation payload contains an atomic clock with one cesium and two rubidium frequency standards that are used to maintain accurate time and carrier frequencies. 10 CFR 20 provides regulations for protection against ionizing radiation.

The cesium frequency standard uses cesium-133. This is a stable (nonradioactive), natural source that emits neither radiation nor thermal energy.

Each rubidium frequency standard contains approximately 200 micrograms of rubidium Beta particles will not penetrate through the glass cell walls that contain the rubidium, and gamma radiation is not emitted. The total activity of each standard would be approximately 16 picocuries. If both frequency standards were broken and ingested into the body, the dose would total $5x10^{-5}$ millirems/year, which is a negligible dose (MMA, 1993). For unrestricted areas, the maximum dose must not exceed 500 millirems/year. The quantities of rubidium and radiation levels are less than the lowest levels at which the use would be regulated by 10 CFR 20.

All of the rubidium associated with GPS IIR SVs will be launched into space and ultimately end in orbits with an estimated life in excess of 1,000 years. The total from all projected GPS Block IIR SVs is 8.4 milligrams.

Atlas Launch Vehicle. The Atlas II LV does not contain ionizing radiation sources.

No Action. Cape Canaveral AS accommodates other space launch programs unrelated to the proposed action that would continue in use for the foreseeable future. The activities associated with these programs have environmental consequences which have been included in the baseline environmental conditions (Section 3). Under the no-action alternative, the insertion of 9.6 milligrams of rubidium into orbit with eventual reentry would not occur.

4.8 WATER QUALITY

Proposed Action. Block IIR SV processing activities will take place within structures and precautions will be taken to prevent and control spills of hazardous materials in accordance with 45th Space Wing (45 SW) Operations Plan (OPlan) 19-1.

Actions associated with Delta II LV processing and launch that could potentially affect water quality include the following:

- Discharge of deluge water from the catchment basin to grade at Launch Complex 17
- Propellant leaks on the launch pad or storage areas
- Spent suborbital stages (containing residual propellants) and jettisoned hardware from normal flights falling into the ocean
- Exhaust cloud deposition of hydrochloric acid and aluminum oxide in surface waters
- Catastrophic launch failure resulting in deposition of propellants in surface waters.

Beginning approximately four minutes prior to launch, water will be directed at the surface of the launch pad for cooling. Approximately 29,500 gallons of deluge water will be generated per launch. This water will be collected in a flume directly beneath the launch vehicle and routed to a lined catchment basin. Deluge water in the catchment basin will be tested to determine its hazard potential. If the deluge water meets state and Federal discharge criteria, it will be released to grade in accordance with an industrial wastewater discharge permit (discussed in Section 4.13.2). If discharge criteria are not met, the water in the catchment basin will be neutralized before release to grade. If water quality is still unacceptable, the deluge water will be treated or disposed in accordance with applicable regulations governing the disposal of hazardous wastes. Deluge water from Delta II launches has been acceptable for discharge to grade and has not been disposed of as hazardous waste.

Ground water recharge to the surface aquifer underlying Cape Canaveral AS would increase due to the percolation of the 29,500 gallons of deluge water. The water would flow west toward the Banana River. Because deluge water is released in accordance with an approved discharge permit, no adverse effects to the water quality of the unconfined aquifer or the Banana River are expected from discharge of the deluge water. The unconfined aquifer is not used as a major water source at Cape Canaveral AS.

Propellant or oxidizer leaks at the launch pad or as a result of launch pad accidents will be prevented or controlled in accordance with 45 SW OPlan 19-1. All propellant and oxidizer storage tanks at LC-17 are located within concrete containment structures designed to retain 110 percent of storage tank volumes. Accidental leaks of propellants and oxidizers during loading at the launch pad will be caught in catchment tubs on the propellant transfer equipment or in the launch pad catchment flume.

Spent stages and jettisoned hardware from normal flight operations will contribute various metal ions and small amounts of residual propellant and oxidizers to the ocean. Due to the slow rate of corrosion in deep ocean environments, toxic concentrations of metals are not likely to occur near the hardware. Trace amounts of weakly soluble Rocket Propellant 1 will form a local surface film that will evaporate within a few hours. Trace amounts of soluble propellant and oxidizer will disperse rapidly in ocean waters. The solid rocket motors would contain trace amounts of ammonium perchlorate mixed in remnant HTPB binder. Ammonium perchlorate is moderately toxic and freely soluble in water, but would be released slowly to the ocean because of the binder.

The launch cloud for the Delta II LV is formed when exhaust products from the launch vehicle main engine and solid rocket motors combine with the deluge water aimed at the exhaust stream. Impacts on surface water quality from the launch vehicle exhaust cloud are a function of the composition of the exhaust cloud, duration of contact with the surface water, wind speed, wind direction, and other atmospheric conditions. The rapid ascent rate of the Delta II LV allows only the exhaust from the first few seconds of launch to form the launch cloud. The cloud will persist at Launch Complex 17 for a few minutes after launch and then move downwind of the launch complex. The launch cloud will not remain over any single location for more than a few minutes. The launch cloud may encounter surface waters of the Banana River or the Atlantic Ocean depending on the wind direction (USAF, 1988b).

The primary exhaust products of concern are hydrochloric acid (HCl) and aluminum oxide from the Delta II LV solid rocket motors. Studies of space shuttle exhaust (BC, 1990) show that short-term depression of surface water pH may result from direct contact with the exhaust cloud or through direct deposition of HCl as precipitation. The buffering capacity of nearby surface waters will tend to correct pH depressions within a relatively short time. The Delta II LV differs from the space shuttle in that its exhaust cloud is much drier (less water vapor) and smaller. Therefore, HCl will tend to remain in the exhaust cloud in a gaseous form, and is less likely to be deposited directly to surface waters as precipitation. Aluminum oxide is relatively insoluble at the pH of nearby surface waters, and it is unlikely that deposition will result in significantly elevated aluminum levels. Additionally, the high level of organic particulate matter in nearby surface waters is likely to aid in complexing much of the aluminum oxide that may be deposited.

In the event of a catastrophic failure, destruct mechanisms are initiated which rupture the propellant containers and cause explosive burning of the solid and liquid propellants. The primary combustion products of concern would be hydrochloric acid and aluminum oxide from the solid rocket motors, and unburned hydrazine, nitrogen tetroxide, unsymmetrical dimethylhydrazine (UDMH), and RP-1. Other primary combustion products would include water, carbon dioxide, and carbon monoxide, which would not negatively affect water quality.

The nature and scope of the effects from a destructive failure would vary with altitude. Within the initial few seconds after launch, destruction would affect LC-17 and its immediate vicinity, including surface waters. Because of the trajectory, later destruction would primarily affect marine waters. At higher altitudes, dispersion during the fall would increase the impact area, but lessen the concentration.

For a catastrophic failure, the main effects on water quality would relate to effects on the aquatic communities in surface water bodies. These effects are assessed in Section 4.9.

Since no new facilities will be constructed under the proposed action, storm water permits from the Saint Johns River Water Management District are not required. The existing facilities are covered under the Cape Canaveral AS storm water pollution prevention plan and will be permitted under the general National Pollutant Discharge Elimination System storm water permit that is in the approval process as of the date of this assessment.

Normal activities at the ground antenna stations at Cape Canaveral AS, Diego Garcia, and Kwajalein Atoll, and the monitor station at Kaena Point will not affect water quality in the respective areas. Typically, activities will be conducted in closed structures. All hazardous materials usage outside of buildings will comply with applicable hazardous materials spill plans for the respective sites described in section 4.2.

Atlas Launch Vehicle. Each launch of an Atlas II LV uses approximately 280,000 gallons of deluge water which percolates into the surface aquifer. This discharge is in accordance with a permit from the Florida Department of Environmental Protection (USAF, 1991c). Since the discharge is in accordance with a permit, no adverse effects on water quality are anticipated.

Propellant leaks at the launch pad or as a result of accidents would be controlled in accordance with 45 SW OPlan 19-1.

Parts of the LV that enter the ocean will slowly corrode and metal ions will be released to the water. Toxic levels are unlikely. Residual propellants would disperse quickly. Adverse water quality effects are not anticipated (USAF, 1989c; USAF, 1991c).

The constituents of the launch cloud would not adversely affect water quality.

A catastrophic launch failure would primarily affect aquatic communities. These effects are assessed in Section 4.9.

No Action. Cape Canaveral AS accommodates other space launch programs unrelated to the proposed action that would continue in use for the foreseeable future. The activities associated with these programs have environmental consequences which have been included in the baseline environmental conditions (Section 3). Under the no-action alternative, the effects on water quality would remain relatively the same as those described for the proposed action due to the other launches which occur at Cape Canaveral AS. However, the elimination of three launches per year from 1996 to 2003 would reduce the frequency of events that might impact water quality.

4.9 BIOLOGICAL COMMUNITIES

Proposed Action. Prelaunch processing of the SVs and LVs will occur in existing facilities that are currently used for these processes. No additional habitat will be disturbed.

The 21 launches under the proposed action would influence the local biological communities near Launch Complex 17 (LC-17). LC-17 already supports Delta II launches, and the proposed action would add approximately three launches per year. Launch effects would primarily be associated with the launch cloud emitted at launch or catastrophic launch failure and noise. Launch cloud constituents can directly affect biological communities through potentially hazardous concentrations and indirectly through precipitation scavenging of the HCl in the launch cloud, producing localized acid rain. The results of monitoring and modeling studies of launch vehicles are presented in Section 4.1.1.2, along with predicted concentrations of potentially hazardous launch cloud constituents and their potential for harm to humans under normal and catastrophic launch scenarios.

Most of the combustion products from the LV are released well above the ground surface and will not impact the local environment. The primary launch cloud constituent of ecological concern produced during normal launch conditions is hydrogen chloride (HCl). As discussed in Section 4.1.1.2, the occurrence of acidic deposition, which has the most potential for ecological impacts associated with the launch cloud, is negligible with the Delta II LV. Under the deflagration launch failure scenario, hydrazine, nitrogen tetroxide, and Unsymmetrical Dimethylhydrazine (UDMH) would also be released into the local environment and are considered for potential ecological effects.

As indicated in Section 4.1.1.2, the area directly impacted by flame from the rocket exhaust is approximately 40 meters in radius (Swarner, 1994). This reflects areas of high acidity from HCl in the rocket exhaust and grassy areas immediately around the launch pad that are burned by the exhaust. For purposes of this analysis, it is assumed that the initial radius of the launch cloud before it rises is approximately 100 meters at ground level (NASA, 1973). These distances are approximations and meteorological conditions at launch will cause variance from these values. The distance from either of the launch pads to the security road around LC-17 is approximately 170 meters, or 500 feet.

After liftoff, the hot launch cloud rises rapidly to several hundred meters in height and stabilizes, with the height a function of meteorological conditions. The stabilized launch cloud moves downwind and disperses with time. Acute effects to biological communities from the launch cloud would occur in the immediate vicinity of the launch pad and downwind as the launch cloud constituents disperse to ground level.

As discussed in Section 4.11.3, the Delta II LV contains the equivalent of approximately 200,000 pounds of Class 1.3 (mass-burn) explosives. Based on Air Force Regulation 127-100, the required separation distance from public traffic routes, inhabited buildings, or recreational areas would be 450 feet. For purposes of this assessment, it will be assumed that a catastrophic launch failure would adversely affect fauna within 450 feet of the launch pad.

Noise. For the proposed action, elevated noise levels would occur approximately three times per year and last for two to four minutes. Noise exceeding 95 decibels A-weighted (dBA) was found to cause hearing loss in fringe-toed lizards, desert kangaroo rats, and Couch's spadefoot toad. After a June 1989 Titan IV launch, Florida scrub jays did not respond to alarm calls. However, after a space shuttle launch and a March 1990 Titan IV launch, the scrub jays did respond to alarm calls (USAF, 1990e; USAF, 1991c). For Titan IV launches, 95 dBA levels of noise or higher are experienced up to 15 miles from the launch pad. For Delta II launches, the 95 dBA radius is approximately five miles.

Vegetation. Unpaved areas within LC-17 are grassed and will be mowed on a regular basis, at least two weeks prior to each launch. There are no trees or scrub inside the security road of the complex. Depending on meteorological conditions, grass up to 40 meters from the launch pad may be scorched by the rocket exhaust. This grass regrows from its roots after the launch burning (Swarner, 1994).

A catastrophic launch failure would likely increase the burned area beyond that anticipated with a normal launch, but acute vegetation impacts are not expected to extend beyond the area of the launch complex.

The maximum Rocket Exhaust Effluent Dispersion Model (REEDM) launch cloud HCl concentrations for modeled scenarios at ground level is 2.66 ppm at 2 kilometers under the conflagration scenario. Hydrogen chloride gas is readily retained by moist surfaces, and is known to injure sensitive plant species at concentrations above 5 ppm in 60-minute or longer exposures. The response of plants to shorter exposure times or multiple exposures is not known (NASA, 1980).

The relative sensitivity of 36 plant species has been investigated (NASA, 1980). Plants were classified according to foliar injury at increasing concentrations of HCl for 60 minute exposures as sensitive (<10 ppm), intermediate (<=10 ppm), moderately resistant (10 to 20 ppm), and resistant (20 to 40 ppm). Species present within one-half mile of the launch pad classified as moderately sensitive include arrowhead, groundsel, and pennywort. Species classified as intermediate include marsh elder, sea lavender, and switchgrass. Species classified as moderately resistant include cattail, muscadine, sea ox-eye and wax myrtle. Resistant species include Boston fern, camphor weed, fedder bush, primrose, and slash pine. Glasswort, sea oats, and smooth cordgrass did not show signs of injury. No species classified as sensitive (injured at <10 ppm HCl) are found within one-half mile of LC-17. No adverse effects from gaseous HCl in the launch cloud to plant communities are anticipated because of the low predicted concentrations for both normal and catastrophic launch scenarios and a low time of exposure (less than 10 minutes).

Most foliar damage from LV launch clouds results from deposition of acid aerosol on leaf surfaces and not from gaseous HCl (NASA, 1985a). HCl deposition is not anticipated from the Delta II except in the case of precipitation scavenging of the launch cloud or where moisture is present on the foliage of vegetation. If the launch cloud passes through the rainshaft of a storm cloud, the HCl in the launch cloud will be absorbed by raindrops, lowering the pH of the rain, and the acid raindrops will fall on vegetation and soil. Such an event would be rare, but has occurred for a Titan III launch (APCA, 1983). Similarly, if moisture is present on the foliage of vegetation in the path of the launch cloud, HCl will be absorbed by the moisture and can cause foliar injury.

Sensitivities of plant species near LC-17 to acid deposition range from most grasses and heavily cutinized plants, resistant; thin-leaved herbs, sensitive; and shrubs showing varied sensitivity but overall the most greatly affected. Provided the acidity of the rain was sufficiently high, foliar damage to sensitive species would occur. However, this would be an infrequent event and the affected vegetation would be expected to recover, based on deposition impacts on vegetation from Space Shuttle launches (AIAA, 1993). Because soils in the launch vicinity are well buffered by carbonates, adverse effects to soils are not anticipated. Moisture on vegetation foliage that is in the path of the launch cloud will absorb HCl from the cloud and the resultant acidification of the moisture can affect foliage. However, the predicted concentration of HCl in the launch cloud is sufficiently low that no damage is anticipated (NASA, 1980).

Al_2O_3 that may be deposited on vegetation would not be harmful (NASA, 1980).

Hydrazine has been found to be mutagenic in higher plants; 43 percent of Vicia faba exposed to 50 ppm in liquid applied at the root showed mutagenic effects (HSDB, 1994). No phytotoxicity data was available to compare the REEDM deflagration concentrations for UDMH or nitrogen tetroxide.

Insects. Insects in the immediate vicinity of the launch pad will be killed at launch, primarily due to flame and heat. The radius of impact is anticipated to be no more than 40 meters. In the event of a catastrophic launch failure, the area of adverse effect should be confined to the launch complex area.

Three insect species were tested for susceptibility to HCl at various concentrations and durations (NASA, 1980). These insects were the honey bee, corn earworm, and lacewing. At the concentrations predicted by REEDM, there should be no adverse effects on these species under any of the launch scenarios. Specific toxicity information on the effects of dispersed propellants or aluminum oxide on insects is not available.

Terrestrial Wildlife. Wildlife within 40 meters of the launch pad would be killed or injured during a normal launch by heat and debris. Up to 100 meters from the launch pad, it is anticipated that wildlife could experience some irritation from HCl concentrations in the launch cloud. In the event of a catastrophic failure, the impact area is anticipated to include the entire launch complex.

The launch complex is surrounded by a security fence and personnel are often present. The herbaceous vegetation within the complex and frequent mowing create a habitat with low value to wildlife. Significant populations of wildlife are not present within the launch complex.

Potential acute impacts from toxic chemicals in the launch cloud produced under nominal and conflagration launch scenarios are primarily from gaseous HCl. Hydrazine, UDMH, and nitrogen tetroxide produced during the deflagration scenario may also produce acute effects.

Because negligible acid deposition is anticipated for the Delta II LV, only toxic effects due to inhalation of ground cloud constituents are considered. No toxicity data is available for species present near LC-17, but toxicity data is available for selected test species. Rabbits and pigeons exposed to 100 ppm HCl for 6 hours daily for 50 days showed slight unrest and irritation of the eyes and nose and a slightly diminished hemoglobin content of blood (HSDB, 1994). An LC_{50} (the concentration of a constituent at which 50 percent mortality of test animals occurs) of 1,322 ppm HCl has been reported for unspecified mice exposed for 60 minutes (OHMTADS, 1994). An LC_{50} of 2,350 ppm HCl has been reported for unspecified rats exposed for 60 minutes (OHMTADS, 1994). An LC_{50} of 40,989 and 13,747 ppm, respectively, for rats and mice exposed for five minutes has also been reported (NRC, 1987). Numerous other studies for various test species had similar results (NRC, 1987). The concentrations are several orders of magnitude higher than the maximum HCl concentration contained in the launch cloud at ground level under any of the modeled launch scenarios.

Hydrazine is acutely toxic, a teratogen (causes developmental malformations), a neurotoxin (affects the nervous system), a carcinogen (causes cancer), and a mutagen (causes genetic mutation). Although toxicity information is not available for the specific species found near LC-17, test species including rats, mice, dogs, and monkeys have been extensively studied with regard to the effects of hydrazine (NRC, 1985b). Hydrazine produces acute effects at higher concentrations and has been shown to be carcinogenic in the mouse and the rat. Dogs exposed to 4-5 ppm of hydrazine vapor for six hours per day showed liver damage after one week. An inhalation LC_{50} of 570 ppm for four hours with sense organ effects, convulsion, and seizures has been reported for unspecified rats (RTECS, 1994). An inhalation LC_{50} of 252 ppm for four hours with sense organ effects, convulsion, and seizures has been also been reported for unspecified mice (RTECS, 1994). The recommendations by the National Research Council regarding short duration exposure concentrations for hydrazine (Section 4.1.1.2) are based on these animal studies, in particular on the potential carcinogenicity of hydrazine. In the event of a catastrophic launch failure, wildlife within the launch complex would likely be killed or injured. The predicted downwind concentrations and duration of exposure by wildlife to hydrazine would not be expected to adversely affect wildlife.

UDMH is toxicologically similar to hydrazine. Test species exposed to UDMH include mice, rats, dogs, and monkeys. As with hydrazine, the recommendations of the National Research Council for exposure limits are based on its potential carcinogenicity. The predicted downwind concentrations and duration of exposure by wildlife to UDMH would not be expected to adversely affect wildlife.

Nitrogen tetroxide is the dimer of nitrogen dioxide. In liquid form, nitrogen tetroxide predominates, but in gas form nitrogen dioxide is predominant, and the portion as nitrogen tetroxide is negligible. No toxicity information is available for wildlife species near LC-17, but the effects on mice, rats, hamsters, sheep, guinea pigs, dogs, and man have been studied (NRC, 1985a). At the concentrations predicted by REEDM, no adverse effects are anticipated.

Aquatic Communities. Since deposition from the launch cloud would be negligible, and only that portion of the launch cloud that actually contacted a water surface would provide constituents for solution, potential effects on aquatic communities are anticipated to occur only in the event of a catastrophic launch failure or if the launch cloud intercepted the rain shaft from a storm cloud over water.

HCl would affect aquatic communities by lowering the pH of the water. Depression of pH affects organisms utilizing gills for respiration. Fish kills resulting from acidification of shallow surface waters by deposition of HCl in the launch cloud have been observed following some shuttle launches (AIAA, 1993). Acidification was found to correspond with areas directly impacted by the launch cloud deposition and deluge water runoff from the launch pad. The acid mixes down the water column and the rate of mixing is driven by windspeed and direction. Levels of impact are variable and depend on meteorological conditions at the time of launch. Minimal effects were observed around the edges of the launch cloud and below shallow surface depths where buffering and dilution minimize effects. As indicated previously, deposition from a Delta II launch is negligible and acidification of surface water from HCl would only occur if a rain shower intercepted the launch cloud over water. Furthermore, only shallow waters would have the potential for fish kills since fish are able to avoid surface depression of pH if the water column is sufficiently deep (AIAA, 1993). The combination of events required to create such potential would occur rarely.

Aluminum oxide would not affect aquatic communities because the oxides are relatively insoluble at ambient pH values (USAF, 1991c).

Test aquatic species exposed to hydrazine include goldfish and daphnia pulex. The median lethal concentrations for a 24-hour period are 3.2 mg/L and 1.7 mg/L, respectively (USAF, 1975b). The recommended Maximum Acceptable Concentration (MAC) is 0.7 mg/L (NASA, 1978). If the total amount of hydrazine carried on the SV and LV were deposited in a water body, a cube of water with dimensions of 117.8 meters on each side would be required to reduce the concentrations to the MAC.

UDMH median lethal concentrations for a 24-hour period for goldfish and daphnia pulex are 69 mg/L and 32 mg/L, respectively (USAF, 1975b). The recommended MAC is 1.0 mg/L (NASA, 1978). If the total amount of UDMH carried on the LV were deposited in a water body, a cube of water with dimensions of 101.5 meters on each side would be required to reduce the concentrations to the MAC.

The median lethal concentration for a 24-period for goldfish exposed to nitric acid (produced from nitrogen tetroxide) is 320 mg/L (USAF, 1975b) and the MAC is 95 mg/L (NASA, 1978). Nitrogen tetroxide at atmospheric temperatures and pressures would convert to gaseous nitrogen dioxide and would not be expected to impact aquatic communities.

The recommended MAC for RP-1 fuel (kerosene) based on exposure of trout to gasoline is 40 mg/L (NASA, 1978). RP-1 fuel that entered a water body would not dissolve in the water (except for a small fraction), but would spread out in a surface film. This film could inhibit the ability of oxygen to penetrate into the water body and replenish oxygen used by aquatic organisms. In large water bodies, the film would dissipate within a matter of hours (USAF, 1988b). In small water bodies, the film would adversely affect the aquatic community.

The MAC for the ammonium perchlorate used as solid rocket fuel is 90 mg/L (NASA, 1978). If the total amount of ammonium perchlorate carried on the SV and LV were deposited in a water body, a cube of water with dimensions of 95 meters on each side would be required to reduce the concentrations to the MAC.

Large water bodies would be locally affected near the point of entry of these propellants up to a radius where dilution reduced the concentrations to nonhazardous levels. Small water bodies would be adversely affected by the deposition of these amounts of propellants. The destruct systems on the LV and SV are designed to cause combustion of the fuel, whether liquid or solid. The only circumstance where substantial quantities of propellant would be expected to enter water bodies would be a failure of one of the operational subsystems of the LV combined with a failure of the destruct subsystem. The destruct subsystem is designed to mitigate this potential.

Propellants in the launch cloud from a catastrophic failure would occur at nonhazardous concentrations in the air at ground level. These propellants would dissolve into water bodies that came into contact with the launch cloud. Given the nonhazardous concentrations in the air, the short time (minutes) during which a water body would be exposed to the launch cloud, and the limited area of the launch cloud where solution would occur at the water surface, the propellants dispersed in the launch cloud from a catastrophic failure would not adversely affect aquatic communities.

Threatened and Endangered Species. Four species that are given special protection or considerations by the US Fish and Wildlife Service (USFWS) and the Florida Game and Fresh Water Fish Commission (FGFWFC) may potentially occur within vegetative communities near LC-17. These are the Florida scrub jay (*Aphelocoma coerulescens*), the southeastern beach mouse (*Peromyscus polionotus niveiventris*), the gopher tortoise (*Gopherus polyphemus*), and the Florida mouse (*Permyscus floridanus*).

The Florida scrub jay typically inhabits scrub vegetation dominated by oaks with open sandy spaces and few or no large trees. The southeastern beach mouse is normally restricted to sand dunes mainly vegetated by sea oats and dune panic grass. It may also be found in adjacent scrub habitat. The gopher tortoise prefers deep sandy soils, an abundance of herbaceous ground cover, and generally an open canopy with a sparse shrub cover. The Florida mouse prefers dry conditions, an open tree stand, clumps of scrubby oaks and shrubs with scattered patches of bare ground, and sandy soils (USAF, 1990f).

Direct effects to any of these species at the launch complex are unlikely due to unsuitable habitat or ongoing disturbance.

Potential acute impacts to protected species could result from gaseous HCl produced under normal and catastrophic failure launch scenarios, and hydrazine, UDMH, and nitrogen tetroxide dispersed under the catastrophic launch failure scenario. No toxicity data is available for any of these species. As discussed in the previous paragraphs, concentrations and durations of exposure to these constituents are not anticipated to adversely affect wildlife, including special status species.

Although potential effects of lighting associated with facilities at Cape Canaveral AS is a concern for endangered sea turtles, a lighting policy for management of exterior lights and emphasis on the use of low-pressure sodium lights has been implemented. Lights which emit ultraviolet, violet-blue, and blue-green wavelengths disorient sea turtle hatchlings on the beach. The disoriented hatchlings move inland rather than seaward and suffer increased mortality. The lighting at the launch complex has been modified to conform to the lighting policy.

The proposed action will utilize existing facilities that will not be modified to support the program. No changes in the type of activities will occur, only changes in the frequency of occurrence. Therefore, consultation with the US Fish and Wildlife Service under Section 7 of the Endangered Species Act is not required (Gordon, 1994).

The overseas ground stations are all existing facilities with operations conducted indoors. Therefore, there should be no effects on biological communities except as discussed in Section 4.6 on nonionizing radiation.

Atlas Launch Vehicle. Prelaunch processing of the Atlas II LV will occur in existing facilities that are currently used for these processes. No additional habitat will be disturbed.

The Atlas II does not utilize solid rocket motors and the propellants are RP-1 (kerosene), liquid oxygen, and liquid hydrogen. The launch cloud from the Atlas II would not affect air quality and would not produce toxic substances that would damage vegetation or wildlife habitat (USAF, 1989c).

In the immediate vicinity of the launch pad (estimated diameter 80 meters), there would be acute impacts due to the flame from the launch. This would be within the perimeter of LC-36, which is a controlled and maintained environment with no significant ecological communities (USAF, 1991c).

Launches would generate intense short-term noise levels that could impair the hearing of animals near LC-36. The survival of individual animals that suffer hearing loss could be jeopardized (USAF, 1989c).

A catastrophic launch failure would cause acute effects within a greater radius than a normal launch. The distance to the edge of the launch complex from the pad is approximately 450 feet. Assuming an impact area similar to the Delta II (although solid rocket motors are not used on the Atlas II), acute effects would be confined within the perimeter of LC-36.

Aquatic communities would be affected in the event of an inflight failure within the first few seconds after launch. The destruct mechanisms would cause much of the propellant load to burn in the air. The constituent from the Atlas II that might cause effects would be the RP-1 fuel. In water, the RP-1 would create a surface film that would not affect oxygen transfer. This film would dissipate over a period of several hours to days (USAF, 1989c). Effects on marine communities are not anticipated because of the amount of dilution that would occur under foreseeable accident scenarios (USAF, 1991c).

LC-36 is in compliance with the Cape Canaveral AS lighting management plan to protect endangered sea turtles.

No Action. Cape Canaveral AS accommodates other space launch programs unrelated to the proposed action that would continue in use for the foreseeable future. The activities associated with these programs have environmental consequences which have been included in the baseline environmental conditions (Section 3). Under the no-action alternative, launches would still occur for other programs, but at a reduced rate.

4.10 CULTURAL RESOURCES

Proposed Action. No cultural resources would be affected by SV processing. All structures are less than 50 years old, and would not normally be considered eligible for the National Register of Historic Places. Additionally, none of the structures to be used for SV processing are relevant to the United States Department of the Interior's "Man in Space" program. None of the structures are near identified archaeological sites, and no construction or renovation of SV facilities will be conducted for the proposed action.

Launch Complex 17 (LC-17) is the only Delta II LV processing facility that may have cultural significance because of the number of launch vehicles which have used the facility. Ongoing studies by the U.S. Army Corps of Engineers indicate that LC-17 is eligible for the Natural Register. Due to the nature of a launch site, the area around the launch pads is highly disturbed and preservation will be difficult. If LC-17 is added to the National Register, efforts to preserve its significance would be focused on collection and compilation of historical information concerning the site rather than preservation of the actual structures (e.g. launch pads and towers). Routine maintenance of launch pads and towers after launches would not affect the potential historical significance of LC-17. No other Delta II LV processing facilities have actual or potential cultural significance (George, 1994). No construction or renovation of LV facilities will be conducted for the proposed action.

No disturbance of earth will occur. Therefore, archaeological resources will not be disturbed.

The Division of Historical Resources of the Florida Department of State reviewed the proposed action and concluded that there would be no effect on properties listed or eligible for listing in the National Register of Historic Places.

No facilities at the ground stations at Cape Canaveral AS, Diego Garcia, Kwajalein Atoll, and Kaena Point are known to be eligible for the National Register of Historic Places. Since no altering or renovation of structures will take place for the proposed action, future eligibility of structures at each of these site will not be compromised. No disturbance of earth will occur at any of these sites for the proposed action. Therefore, archaeological resources will not be affected.

Atlas Launch Vehicle. A memorandum of agreement between the Air Force, the State Historic Preservation Office, and the Federal Advisory Council on Historic and Archaeological Preservation specifies measures that are required to protect LC-36. The agreement indicates that the historic value of LC-36 exists in the engineering significance of its components. No alterations to LC-36 or ground-disturbing activities would be required. Therefore, there would be no effects on cultural resources.

No Action. Cape Canaveral AS accommodates other space launch programs unrelated to the proposed action that would continue in use for the foreseeable future. The activities associated with these programs have environmental consequences which have been included in the baseline environmental conditions (Section 3). There would be no difference between the proposed action and the no-action alternative because SV processing facilities would probably be utilized by other programs and Delta II LV processing facilities would continue to be used to launch SVs for other programs.

4.11 NOISE

The primary event sources considered are launch noise and a launch vehicle explosion on the pad or during early flight. Other minor noise sources are prelaunch processing operations.

4.11.1 Prelaunch Processing

Proposed Action. Noise sources in prelaunch processing areas, such as pumps and compressors, are minor compared to the launch noise of a Delta II rocket. Fabrication, assembly, painting, and other related operational activities will be conducted inside buildings. These activities are typical for an industrial facility and similar activities occur at different locations on Cape Canaveral AS. All necessary and feasible noise control mitigation measures will be implemented at the affected facilities to meet worker noise exposure limits as specified by the Occupational Safety and Health Administration (OSHA). Due to the distances involved, there will be no noise impact at sensitive receptor locations in public residential areas as a result of the normal prelaunch processing operations.

Atlas Launch Vehicle. Although prelaunch processing for the Atlas LV utilizes different facilities at Cape Canaveral AS than the Delta II, the overall circumstances are similar and there would be no noise impact at sensitive receptor locations.

No Action. Cape Canaveral AS accommodates other space launch programs unrelated to the proposed action that would continue in use for the foreseeable future. The activities associated with these programs have environmental consequences which have been included in the baseline environmental conditions (Section 3). Under the no-action alternative, no noise due to prelaunch processing for the IIR SVs would occur. However, the facilities would probably be used for other programs. Prelaunch processing for the Delta II LV would continue at a reduced rate.

4.11.2 Launch Noise

Proposed Action. The source of rocket launch noise is the interaction of the exhaust jet with the atmosphere in the combustion chamber, and post-burning of fuel-rich combustion products in the atmosphere. The emitted acoustic power from a rocket and frequency spectrum of the noise are related to the size of the rocket engine, its thrust level, and the specific impulse which relates to the selected propellants. A fully fueled Delta II weighs a little over 500,000 pounds. Noise will be generated by the first stage which is comprised of a main liquid engine, fueled by Rocket Propellant 1 and liquid oxygen, and the nine small solid rocket booster motors. Rocket propulsion systems generate acoustic energy fields that encompass a wide frequency spectrum (1 Hertz to 100,000 Hertz). Normally, a large portion of the total acoustic energy is contained in the low frequency end of the spectrum. Noise measurements conducted during launch of a Delta II indicate that the maximum sound pressure levels occurred between 10 to 200 Hertz (Aerospace, 1993).

Physically, sound pressure magnitude is measured and quantified using a logarithmic ratio of pressures whose scale gives the level of sound in decibels (dB). Because human hearing is not equally sensitive to sound at all frequencies, a frequency-dependent adjustment called A-weighting has been devised to measure sound in a manner similar to the way the human hearing system responds. The A-weighted sound level is expressed in dBA.

When sound levels are measured at distinct intervals over a period of time, they indicate the statistical distribution of the overall level in a community during that period. The most common parameter associated with such measurements is the energy equivalent sound level (L_{eq}). L_{eq} is a single-number sound descriptor representing the average sound level in a real environment, where the actual sound level varies with time.

Several methods have been devised to relate noise exposure over time to community response. The EPA has developed the day-night average sound level (L_{dn}) as the rating method to describe long term annoyance from environmental noise. L_{dn} is similar to a 24-hour L_{eq} A-weighted sound level, except that during the nighttime period (10 P.M. to 7 A.M.) a 10 dBA weighted penalty is added to the instantaneous sound level before computing the 24-hour average. The Air Force uses L_{dn} for evaluating community noise impacts.

For evaluating community noise impacts, a time-weighted noise level of 70 dBA L_{eq} is recommended by the Environmental Protection Agency (EPA) for the total general public as a noise exposure level that will not cause hearing damage (EPA, 1974). EPA has also stated that noise levels higher than 55 dBA L_{dn} in a residential area can cause annoyance and communication interference during outdoor activities.

For evaluating structural damage and window breakage due to launch noise and on-pad or early flight explosions, measurements taken at a historic mission during the launch of a Titan IIID at Vandenberg AFB indicate that the acoustic energy is not enough to cause any structural damage outside the 120 dB contour for a normal launch (USAF, 1975a).

Delta II LVs are routinely launched at Launch Complex 17 (LC-17), and actual noise measurements for a July 7, 1992, launch are available. A summary of these measured data are given in Table 25. At further distances, the proposed launches would yield approximate noise levels as shown in Table 26.

Table 25 Measured Delta II Overall and A-Weighted Sound Levels with Distance

Distance (feet)	OASPL[1] (dB)	SEL[2] (dBA)
1500	132	120
2000	132	118
3000	127	115

1 Overall Sound Pressure Levels

2 Sound Exposure Level

Table 26 Calculated Delta II Overall and A-Weighted Sound Levels with Distance

Distance (miles)	OASPL (dB)	SEL (dBA)
0.5	131	118
1.0	125	110
1.5	121	106
2.0	119	104
4.0	113	98
8.0	107	92
16.0	101	86

The predicted noise levels in the city of Cape Canaveral, about four miles away, would be approximately 98 dBA for Delta II launches from LC-17. On the southeast portion of Merritt Island, the launch noise would range from approximately 88 to 93 dBA. These levels would exceed ambient noise levels both day and night and exceed the EPA criterion. However, these noise levels will be for a very short time period, usually less than two minutes for the greater noise levels, and will occur approximately three time per year for the proposed MLV III Delta II launches. Such levels would not cause any hearing damage to residents. From an annoyance standpoint, there could be residents in the area who would find this short duration noise objectionable. Because many residents of the cities of Cape Canaveral and Merritt Island are accustomed to the activities at Cape Canaveral AS, the likelihood of complaints would be low.

The projected 120 dB overall sound pressure level contour for a Delta II launch is expected to be at a radius of one-half mile from LC-17. Therefore, the Delta II launches would not cause any off-base structural damage.

At launch, there is a 6,500-foot clear zone established around LC-17. Occupational Safety and Health Administration regulations do not permit unprotected exposure to impulse or impact noise levels in excess of 140 dB and exposure to noise levels of 115 dBA averaged over 15 minutes. Hearing protection for workers would not be required.

Atlas Launch Vehicle. Based on modeling results, the noise level during the launch of an Atlas II would be expected to reach a peak of 93 dBA at a distance of 3.1 miles from the launch site, which is the approximate distance to the Industrial Area of Cape Canaveral AS and the Space Museum next to LC-17. The closest area outside of Cape Canaveral AS is approximately 5.2 miles south (USAF, 1989c). Noise standards and levels that could produce damage, nuisance, or injury are discussed in the previous section, and this level of noise would not cause off-base annoyance, structural damage, or require hearing protection for workers. A 5,000-foot clear zone will be established for each launch.

No Action. Cape Canaveral AS accommodates other space launch programs unrelated to the proposed action that would continue in use for the foreseeable future. The activities associated with these programs have environmental consequences which have been included in the baseline environmental conditions (Section 3). Under the no-action alternative, there would be 21 fewer launches of Delta II LVs. This would be a change in frequency of launches, but Delta II launches would still occur from LC-17 for other DOD and commercial programs.

4.11.3 Explosion at Launch

Proposed Action. Theoretical calculations of overpressure and sound level that would be generated from the explosion of a Delta II LV on the launch pad were performed for this assessment. Based on Air Force explosive safety regulations (AFR 127-100, 1985), the nine solid rocket boosters would be equivalent to approximately 200,000 pounds of Class 1.3 (mass-burn) explosives. Therefore, the Delta II vehicle would have an explosive equivalency of about 200,000 pounds of Trinitrotoluene (TNT). Based on AFR 127-100, overpressures were calculated as shown in Table 27.

Table 27 Calculated Overpressure and Noise Equivalent of Delta II Explosion with Distance

Distance (feet)	Overpressure (psi*)	Noise Equivalent (dB)
500	0.250	158
1000	0.125	152
2000	0.063	146

* Pounds per square inch

Considering ground losses and atmospheric attenuation, the calculated overpressure and blast noise at the city of Cape Canaveral would not exceed 0.006 psi or 126 dB. While this blast noise level would be annoying, no structural or glass window pane damage would occur due to this overpressure. A high probability of window breakage would occur for overpressures of 0.05 pounds per square inch (144 dB) or greater due to an explosion.

If a Delta II LV exploded at an altitude of approximately 1,000 feet, an overall noise level of approximately 123 dB would be expected in the city of Cape Canaveral, without considering attenuation due to atmospheric absorption. At this altitude, a portion of the propellant would already have been burned, and the overpressure would be slightly less than an explosion on the launch pad. The effects at the city of Cape Canaveral would be similar to a launch pad explosion.

Atlas Launch Vehicle. Previous assessments did not address the potential effects of noise from an explosion at launch. The main explosives associated with LVs that could produce high levels of noise are the solid rocket motors. Since there are no solid rocket motors for the Atlas II LV and LC-36 is further from off-base receptors than LC-17, the Delta II launch complex, off-base noise levels should be lower than for the Delta II LV.

No Action. Cape Canaveral AS accommodates other space launch programs unrelated to the proposed action that would continue in use for the foreseeable future. The activities associated with these programs have environmental consequences which have been included in the baseline environmental conditions (Section 3). With 21 fewer launches, the chance of an explosion of a Delta II LV with resultant noise would be reduced, but launches of Delta II LVs will still occur.

4.12 SOCIOECONOMICS

Proposed Action. Approximately 100 military and contractor personnel are currently involved in prelaunch processing operations at Cape Canaveral AS related to the Block II/IIA SVs. Approximately 270 military and contractor personnel are currently involved in Delta II launches from Complex 17, including Block II/IIA SVs and other SVs that utilize Delta II LVs. The two combined represent approximately five percent of the 7,500-person work force at Cape Canaveral AS.

Under the proposed action, there would be no change in the number of personnel associated with Delta II launches. The Block IIR SVs will be provided by a different contractor than the II/IIA contractor, but the number of persons involved should be similar or less. The Block IIR contract is a launch-on-demand contract where 21 SVs will be launched as needed to replace existing SVs in orbit. Therefore, the number of personnel permanently located at Cape Canaveral AS would probably decrease. For purposes of this assessment, the assumption will be made that the number of permanent personnel will decrease to 50, and other personnel will be brought in from other locations as needed.

Therefore, the total work force at Cape Canaveral will decrease by approximately 50. Assuming 2.8 dependents per employee, the estimated population of Brevard County for 1995 would be decreased by 190. For the period 1990 through 1995, the population of Brevard County was estimated to increase by 13.5 percent, to 452,737 (University of Florida, 1992).

Personnel at the overseas ground stations generally average five per station. There would be no change from current operations and no effect on socioeconomics.

Atlas Launch Vehicle. Approximately 80 personnel are involved with the Atlas LV program at Cape Canaveral AS (USAF, 1989c). Additional personnel would not be anticipated.

No Action. Cape Canaveral AS accommodates other space launch programs unrelated to the proposed action that would continue in use for the foreseeable future. The activities associated with these programs have environmental consequences which have been included in the baseline environmental conditions (Section 3). For the no-action alternative, there would be a reduction in the Cape Canaveral AS work force of 100. This would decrease the work force by 1.3 percent and the Brevard County population by 390.

4.13 UTILITIES

4.13.1 Water Supply

Proposed Action. For each Delta II launch, approximately 29,500 gallons of deluge water will be used at the launch pad as the launch occurs. Deluge water is used for cooling during the launch, and drains into a holding pond.

Assuming a decrease in permanent SV personnel from 100 to 50 persons and a design water use of 50 gallons per day (gpd) per person, average water usage at Cape Canaveral AS would decline from 640,000 gpd to 637,500 gpd. Since the number of Delta II personnel will not change under the proposed action, there will be no effect on water supply from Delta II personnel.

Water usage at the GPS ground antenna station at Cape Canaveral AS will be approximately 250 gpd assuming five permanent personnel at the site. This represents less than 0.1 percent of the total daily water supply at Cape Canaveral AS.

Bottled water will be shipped to the GPS ground antenna station at Diego Garcia. Therefore, no impact to existing water supplies in the area is expected from activities at the antenna site.

The GPS ground antenna station at Kwajalein Atoll will use less than 100 gallons of water per year for basic housekeeping uses (Tovey, 1994). Maximum use of water by the six personnel at the site will be approximately 300 gpd. Water requirements for the antenna site are expected to have minimal impact on the water supply system maintained by the US Army on Kwajalein Atoll.

Water supply at the Kaena Point GPS ground antenna station will be obtained from a deep well located at the station. Water use at the site will be approximately 250 gpd assuming five permanent personnel. This represents approximately 6.2 percent of the total water requirement for the Kaena Point installation.

Atlas Launch Vehicle. For each Atlas II launch, approximately 280,000 gallons of deluge water is used. Assuming a launch rate of three per year, approximately 840,000 gallons of water would be used annually for launches. There would be no effect on water supply from Atlas II personnel since the program is existing and no additional personnel would be anticipated. Averaged over the course of the year, the daily use would increase from 640,000 gallons per day (gpd) to 642,300 gpd.

No Action. Cape Canaveral AS accommodates other space launch programs unrelated to the proposed action that would continue in use for the foreseeable future. The activities associated with these programs have environmental consequences which have been included in the baseline environmental conditions (Section 3). Under the no-action alternative, there will be 21 fewer launches over the 1996 to 2003 time period, and 619,500 gallons of deluge water for launches would not be used. Since other SVs use the Delta II LV, there would be no decrease in Delta II launch personnel and no decrease in Delta II LV personnel water use. The elimination of 100 positions (original amount used to process Block II SV) related to SV prelaunch processing would decrease the average water usage at Cape Canaveral AS from 640,000 to 635,000 gpd.

4.13.2 Wastewater Treatment

Proposed Action. No wastewater will be generated from SV processing aside from that generated by personnel. Effluent from the DPF is discharged to a 0.010

million gallon per day (mgd) extended aeration treatment plant (Facility Number 55860), and thence to two percolation ponds for disposal to the surface groundwater aquifer. Florida Department of Environmental Protection (FDEP) Permit D005-195237 authorizes the discharge of 0.010 mgd of effluent treated to a secondary level. The plant currently operates at approximately 25 percent of its capacity. Other SV processing facilities utilize individual septic systems to treat wastewater.

Assuming a design wastewater flow of 30 gallons per day (gpd) per person and 50 personnel associated with Block IIR SV processing, the total estimated wastewater flow would be 0.0015 mgd.

Wastewater will be generated both by Delta II LV personnel and processing activities. Domestic wastewater from LC-17 is discharged to an extended aeration wastewater treatment plant that operates under FDEP Permit D005-208196. The permit authorizes the discharge of 0.015 mgd of effluent treated to a secondary level. Treated effluent is discharged to the surface groundwater aquifer. The plant currently operates at 26 percent of its capacity.

Domestic wastewater from LV processing facilities in the industrial area, including Hangar M and the Delta Mission Checkout, discharges to the main wastewater treatment plant at Cape Canaveral AS. This trickling filter wastewater treatment plant is authorized under FDEP Permit D005-187095 to discharge 0.490 mgd of effluent treated to a secondary level. The plant currently operates at 45 percent of its capacity. The remainder of Delta II LV processing facilities use septic systems.

Assuming a design wastewater flow of 30 gpd and 270 personnel, the total estimated domestic wastewater flow attributable to Delta II LV personnel is 0.0081 mgd. Under the proposed action, there will be no change in Delta II LV personnel, and the wastewater flow will not change.

In addition to domestic wastewater, LV launch processing at LC-17 generates 29,500 gallons of deluge water per launch event. This deluge water is collected in a flume underneath the launch pad and directed to a lined catchment basin. FDEP Permit I005-204423 authorizes the discharge of this deluge water to the surface groundwater aquifer after neutralization and settling. Under the proposed action, current generation of deluge water will not change because the Delta II LV will begin to support the Block IIR SV immediately after it finishes its support of the Block II/IIA SV.

Wastewater generation at the Cape Canaveral AS ground antenna station will be approximately 150 gallons per day (gpd) assuming five permanent personnel. Wastewater at this facility will be treated by septic system.

The Diego Garcia GPS ground antenna station will generate approximately 150 gpd of wastewater assuming five permanent personnel. Wastewater at the site is disposed of via a temporary containment system located near the site. This system is pumped out twice daily and the wastewater taken to a treatment plant. No permanent system was ever installed at the antenna site because the site was originally intended to be unmanned.

Wastewater quantities at the Kwajalein Atoll GPS ground antenna station will be approximately 180 gallons per day from the six permanent personnel. Wastewater will be treated by the host installation's treatment plant which has a capacity of 450,000 gallons per day. Wastewater from the antenna site will represent less than 0.1 percent of the treatment plant capacity.

The Kaena Point GPS ground antenna station will generate approximately 250 gpd of wastewater assuming five permanent personnel. Wastewater treatment for all buildings at the site is by septic systems. Each septic system has adequate capacity to accommodate the wastewater loads.

Atlas Launch Vehicle. Assuming a design wastewater flow of 30 gpd and 80 personnel, the total estimated domestic wastewater flow attributable to Atlas II LV personnel is 0.00024 mgd. Under the proposed action, there would be no change in the number of Atlas II LV personnel, and the wastewater flow would not change. A small wastewater treatment plant at LC-36 provides for personnel at the complex (USAF, 1991c).

Deluge water is discharged without prior treatment to groundwater by percolation through the surface soils within the perimeter of LC-36 in accordance with a permit from the Florida Department of Environmental Protection (USAF, 1991c). The permit restrictions represent the results of the analysis by this agency of the pollutant levels that would not adversely affect water quality.

No Action. Cape Canaveral AS accommodates other space launch programs unrelated to the proposed action that would continue in use for the foreseeable future. The activities associated with these programs have environmental consequences which have been included in the baseline environmental conditions (Section 3). Under the no-action alternative, wastewater would not be generated from Block IIR personnel. Since the Delta II LV supports other SV programs, personnel would not be reduced and domestic wastewater flow would remain the same. With the elimination of three Delta II launches per year from 1996 to 2003, deluge water at LC-17 would be reduced by an estimated 88,500 gallons per year.

4.13.3 Electricity

Proposed Action. A drop in electricity usage would occur associated with the 50 SV processing personnel that would be eliminated. The facilities used by these personnel would probably be used by other programs at Cape Canaveral AS. There would not be a change in electricity usage associated with the Delta II program.

Atlas Launch Vehicle. There would be no change in electricity usage associated with the Atlas II LV program since it is an existing program.

No Action. Cape Canaveral AS accommodates other space launch programs unrelated to the proposed action that would continue in use for the foreseeable future. The activities associated with these programs have environmental consequences which have been included in the baseline environmental conditions (Section 3). A drop in electricity usage would occur associated with the 100 SV processing personnel that would be eliminated.

4.14 ORBITAL DEBRIS

Proposed Action. The solid rocket booster motors, the first stage, the interstage, and the payload fairing will fall into the Atlantic Ocean and not contribute to orbital debris. After separation from the upper stage, all remaining propellants in the second stage will be burned so that the second stage is placed in a lower orbit where reentry will occur in approximately two to three months. This depletion burn will reduce the risk of explosion and accelerate the reentry process. The third stage will be in a highly eccentric orbit with the perigee in Low Earth Orbit (LEO) and the apogee in Medium Earth Orbit (MEO). The orbital life of the third stage is assumed to be 60 to 70 years for this assessment (Smith, 1994). The third stage weighs approximately 274 pounds (MDA, 1993a), exclusive of propellant, which would add a total of 5,754 pounds of orbital debris. Delta II LVs incorporate stage separation device containment which minimizes debris from stage separation (AIAA, 1992c). The 21 Delta II third stages would increase the number of cataloged objects in Medium Earth Orbit

(MEO) by 3.1 percent or the number in LEO by 0.35 percent.

A total of twenty-one Block IIR SVs will be launched to replace existing Block II/IIA SVs of the GPS program. The launch weight is 4,480 pounds, which includes 2,010 pounds of solid rocket fuel for the apogee kick motor and 209 pounds of hydrazine. After the completion of its mission, the remaining mass would be 2,261 pounds. Therefore, approximately 47,481 pounds of orbital debris would result from the Block IIR SVs. The 21 IIR SVs will increase the number of cataloged objects in Medium Earth Orbit (MEO) by 3.1 percent.

NAVSTAR GPS SVs will share MEO with one other major SV constellation, the Russian Global Navigation Satellite System (NSC, 1989). Space debris in MEO has caused the least concern of the three main orbital regimes (USOTA, 1990), and no problems are anticipated for the near term. The spatial density of objects in MEO is low and few spacecraft have used MEO. However, since there is increasing use of MEO and the lifetime of debris in this orbit is extremely long, there could be concerns in the future. No single country is the primary contributor to orbital debris, and additional countries continue to develop launch programs. Although MEO is the orbital regime with the least concern, international efforts may be required in the future to address orbital debris associated with MEO. The long-term use of disposal orbits will eventually create debris bands that will require cooperation relative to collision avoidance between those countries using these orbits, and more sophisticated tracking capabilities. These debris bands would be below Geosynchronous Earth Orbit (GEO) and will be traversed by SVs that use GEO.

Measures to prevent and reduce space debris include:

- Expulsion of excess propellants and pressurants from LV upper stages and SVs after mission completion
- Designing LVs and SVs so that they are "litter-free" - i.e., separation devices, payload shrouds, and other expendable hardware are disposed of at altitudes where they do not become orbital or remain attached to the LV or SV by lanyards
- Providing electrical protection circuits to prevent battery explosions
- Deorbiting used SVs and LVs
- Boosting SVs into disposal orbits after operational life ends
- Boosting SVs to escape velocity
- Adding dedicated debris shielding
- Placing mission critical and potentially explosive components inside SVs
- Using materials that do not degrade into fragments
- Selecting launch windows using collision avoidance software programs

Recent analysis suggests that satellites in low to medium Earth orbits may require shielding by 2000 (Aerospace, 1994b). However, this analysis was focused primarily on LEO which has approximately nine times the number of cataloged objects as MEO in a smaller volume.

At the end of their operational life, Block IIR SVs shall burn all remaining propellant to move the SV to a disposal orbit, and the SV shall be positioned to minimize the exposure of the batteries to solar radiation. Sufficient fuel shall be reserved to move each SV to an orbit that is not used by active SVs. For the near-term, these measures will minimize the potential for collision with operational spacecraft. For the long-term, the proposed action will contribute to a problem which may eventually become significant.

Atlas Launch Vehicle. The main part of the Atlas II LV will fall back to the Earth and would not contribute to orbital debris.

The Centaur II upper stage would add to orbital debris.

No specific estimate for the orbital life of a Centaur II is available. For purposes of this assessment, the orbital life and orbit will be assumed to be similar to the third stage of the Delta II LV, which is approximately 60 to 70 years in an eccentric orbit with the perigee in LEO and the apogee in MEO. Exclusive of propellants, the weight of a Centaur II is 4,500 pounds (AIAA, 1991b). Therefore, the 21 Centaur II upper stages would increase the debris in orbit by 94,500 pounds. The number of cataloged objects in Medium Earth Orbit (MEO) would increase by 3.1 percent or the number in LEO would increase by 0.35 percent.

No Action. Other space programs unrelated to the proposed action would continue for the foreseeable future. The activities associated with these programs have environmental consequences which have been included in the baseline environmental conditions (Section 3). Under the no-action alternative, no additional debris related to the GPS program will be deposited in orbit. However, other programs, both United States and foreign, will continue to deposit debris.

4.15 SAFETY

Proposed Action. In addition to the general safety regulations and standards enumerated in Section 3.15, GPS SV processing safety has been considered in the Missile System Prelaunch Safety Packages for the Delta II LV and the Block IIR SVs (MDA, 1993b; MMA, 1993) and safety plans for all hazardous processes. Safety concerns regarding SV and LV processing operations can generally be divided into injury to personnel and damage to property.

4.15.1 Injury to Personnel

Safety concerns include:

- Transport aircraft accidents
- Transport vehicle accidents during delivery of components
- Vehicle accidents during transport between facilities at Cape Canaveral AS
- Accidents during handling operations related to failure of support equipment or personnel errors
- Personnel contact with electrically charged components
- Exposure of personnel to hazardous levels of radio frequency radiation
- Execution of hazardous systems functions with personnel in unsafe location
- Execution of hazardous systems functions in incorrect sequence
- Failure of hazardous systems monitoring equipment
- Rupture of a pressurized component
- Personnel contact with heat sources including load resisters, infrared light sources, and high intensity lights
- Battery rupture and/or explosion
- Activation of ordnance devices or the solid rocket motors by accident or electrostatic discharge
- Rupture of hydrazine tanks or lines resulting in exposure to poisonous vapor or liquid, or explosion due to ignition or exposure to incompatible materials
- Rupture of Aerozine-50 tanks or lines resulting in exposure to poisonous vapor or liquid, or explosion due to ignition or exposure to incompatible materials
- Rupture of nitrogen tetroxide tanks or lines resulting in exposure to poisonous and reactive vapor or liquid
- Rupture of RP-1 tanks or lines resulting in explosion due to ignition
- Rupture of liquid oxygen tanks or lines resulting in exposure to freezing

liquid or evaporation to gaseous form and explosion due to ignition

- Catastrophic explosion of rocket on launch pad or prior to orbital insertion
- Deviation from flight path
- Unauthorized personnel in clear zones
- Structural failure during weight and balance test, and spin test
- Exposure to launch cloud
- Orbital reentry
- Tripping
- Sharp edges
- Noise.

4.15.2 Damage to Property

Safety concerns include:

- Transport aircraft accidents
- Transport vehicle accidents during delivery of components
- Vehicle accidents during transport between facilities at Cape Canaveral AS
- Excessive stress loads during transport or handling
- Accidents during handling operations related to failure of support equipment or personnel errors
- Inadvertent deployment of SV mechanisms within launch vehicle fairing
- Execution of system functions with safeguards not set
- Execution of system functions in incorrect sequence
- Battery rupture and/or explosion
- Improper equipment installation or cable connection
- Failure of monitoring equipment
- Contamination of the propellant systems by entry of particulate-contaminated gas
- Rupture of a pressurized component
- Electrostatic discharge
- Damage to the solid rocket motors during leak tests
- Damage to solar array panels during testing
- Transmission of improper or out-of-sequence signals
- Malfunction of batteries
- Activation of ordnance devices or the solid rocket motors by accident or electrostatic discharge
- Power surges
- Backup power and control failure
- Short circuiting from improper electrical connections
- Structural failure during weight and balance test, and spin test
- Improper installation in transporters
- Failure of environmental control during storage or transport
- Rupture of hydrazine tanks or lines resulting in explosion due to ignition or exposure to incompatible materials
- Rupture of Aerozine-50 tanks or lines resulting in explosion due to ignition or exposure to incompatible materials
- Rupture of nitrogen tetroxide tanks or lines resulting in oxidation of exposed vulnerable materials
- Rupture of RP-1 tanks or lines resulting in explosion due to ignition
- Rupture of liquid oxygen tanks or lines resulting in exposure to freezing liquid or evaporation to gaseous form and explosion due to ignition
- Catastrophic explosion of rocket on launch pad or prior to orbital insertion
- Deviation from flight path

- Insertion in improper orbit
- Damage to antennas during testing and assembly
- Premature reentry.

4.15.3 Risk Assessment and Mitigation

Proposed Action. Mishaps during air transport of the SV are unlikely since flight crews are constantly trained in operation and safety of the aircraft. Ground transport accidents are also unlikely because of the low speeds, precautions, and times when transport occurs.

At LC-17, clear zones are used at different stages of prelaunch preparation and during launch to protect personnel against catastrophic events. During hazardous operations, a 600-foot special clear zone is established. During the arming of the solid rocket boosters, a 700-foot firebrand zone is established. A 2,780-foot blast danger zone and a 6,500-foot launch danger area is established 80 minutes prior to launch. Areas offshore from Cape Canaveral AS are cleared prior to launch.

Orbital reentry of all components of the LV and SV will eventually occur, whether prematurely due to a substandard orbit or more than a thousand years in the future when the SV decays from its final parking orbit. The solid rocket boosters, the first stage, and the interstage will fall into the ocean. All remaining propellants in the second stage will be burned, and reentry will normally occur within two to three months. Reentry of the third stage is estimated to occur within sixty to seventy years.

Before launch, the solid rocket motor drop zone off Cape Canaveral AS is cleared of all shipping. The motors typically break in half before impact. The first stage, interstage, and payload fairing are all destroyed on reentry. Reentry of the second stage will be controlled so that the impact point is in the ocean. The third stage reentry will be uncontrolled (Swarner, 1994).

Two primary factors determine whether or not an object will survive reentry and strike the Earth: the melting point of its material and its ballistic coefficient. The ballistic coefficient is the mass of an object compared to its area. As an object reenters, friction with the atmosphere produces heat. Heating begins at approximately 80 nautical miles and the heating rate peaks at 30 to 45 nautical miles, depending on the ballistic coefficient of the object. The integrity of an object is maintained until its melting temperature is reached, and the ballistic coefficient of the object determines the maximum temperature that will be reached during reentry (Aerospace, 1992a).

Space and launch vehicles with an aluminum structure typically breakup at 42 nautical miles. The subsidiary objects resulting from this breakup will then be exposed to atmospheric drag, and their fate will vary depending on their material and ballistic coefficient. Aluminum objects with a ballistic coefficient of less than 15 pounds per square feet (lb/ft^2) will generally survive. Propellant and pressurant tanks made from titanium will generally survive reentry intact, regardless of ballistic coefficient, because of titanium's high melting temperature (Aerospace, 1992a).

Therefore, certain components of the GPS SV and the Delta II LV are likely to survive reentry. For those objects with a high ballistic coefficient that survive reentry, the results of a person being struck, whether in a building or not, would probably be fatal. Those objects with a lower ballistic coefficient would probably produce injury or death. To date there have been no injuries or fatalities from reentering objects. Over the period 1958 to 1991, NASA indicated that 14,831 payloads and debris objects reentered the atmosphere (NASA, 1991). The daily average individual risk from reentering objects computed by the Aerospace

Corporation is substantially smaller than such hazards as work accidents, lightning, air carrier accidents, or smallpox vaccinations, and is comparable to that of being struck by a meteorite (meteor that survives to Earth impact). The only reported incident of a meteorite striking a person occurred in 1954 when a woman was bruised by a stone meteorite that crashed through the roof of her house (Aerospace, 1992a). Assuming an increase in the number of reentering objects would increase the risk on a proportional basis, a 100-fold increase in objects with a consequent 100-fold increase in risk would produce a daily average individual risk still substantially less than any of the hazards mentioned previously.

The safety concerns listed in previous sections have been considered in planning for prelaunch processing and launch. Detailed procedures and training for all hazardous processes have been or are being prepared and implemented. Launch constraints based on wind speed and direction are in effect, with lower wind speed required for southerly and southeasterly winds. The 45th Space Wing Director of Safety will review and approve all safety procedures.

Additional precautions are taken to ensure that the risk from lightning strikes is reduced. All facilities on Cape Canaveral AS incorporate lightning arresting devices for protection against lightning strikes.

Atlas Launch Vehicle. The Atlas II LV operates under similar guidelines to the Delta II LV and safety plans have been prepared to meet the foreseen contingencies (USAF, 1989c). The Atlas II has no solid rocket motors which their associated explosion hazard, and the propellants are less hazardous than those used for the Delta II.

No Action. Cape Canaveral AS accommodates other space launch programs unrelated to the proposed action that would continue in use for the foreseeable future. The activities associated with these programs have environmental consequences which have been included in the baseline environmental conditions (Section 3). A minor reduction in risk would occur under the no-action alternative due to the reduction in number of SVs and LVs processed and launched at Cape Canaveral AS.

4.16 CUMULATIVE IMPACTS

Cape Canaveral AS accommodates various ongoing space programs. The environmental effects associated with these programs have been included in the baseline environmental conditions (Section 3). Additional space programs that are reasonably foreseeable include Alert, Locate, and Report Missiles (ALARM), Brilliant Eyes (BE), and replenishment satellites for the Defense Satellite Communication System (DSCS). Of these three programs, DSCS is the only one whose final configuration is known. For ALARM and BE, assumptions regarding the final configuration of the program will be made as necessary to assess cumulative impacts. It is also assumed that no new facilities will be required at Cape Canaveral AS to accommodate these programs.

For purposes of this assessment, it is assumed that the ALARM SVs will be launched using the Titan IV Solid Rocket Motor Upgrade (SRMU). The environmental effects of the Titan IV SRMU have been previously assessed (USAF, 1990e), and a FONSI signed. It is also assumed that there will be an overlap with the GPS IIR program of two SV launches from Cape Canaveral AS (one per year for the last two years of the Block IIR program).

The final number of BE SVs is unknown, as is the LV. For purposes of this assessment, it is assumed that there will be an overlap with the GPS IIR program of nine SV launches from Cape Canaveral AS (three per year for the last three years of the Block IIR program) and that the Atlas II will be used as the LV.

Six replenishment DSCS SVs will be launched during the same time period as the GPS IIR program (one per year) using the Atlas II LV. The environmental effects of the Atlas II LV have been previously assessed (USAF, 1991c).

4.16.1 Air Quality

The ALARM, BE, and DSCS programs would use existing prelaunch processing facilities with backup generators and boilers that have already been included in the baseline environmental conditions in Section 3. Additional volatile organic compound emissions would occur primarily from the use of solvents, coatings, and adhesives during prelaunch processing of each SV. These amounts are small and estimated to total no more than 0.5 tons per year, cumulatively. Each launch is a discrete event and air emissions from a launches would be dispersed before the next launch occurred.

The cumulative chlorine emissions to the stratosphere from LVs worldwide are shown on Figure 25. Assuming an annual chlorine deposition rate of 1,700 tons for the period 1998 to 2010, and a reduction in global ozone of 2.5×10^{-5} percent reduction for each ton of Cl, annual chlorine depletion due to launch activities would be 0.0425 percent. To produce an additional one excess cancer per one million persons, a 0.2 percent reduction in ozone would be necessary. The most important contributors of chlorine during that time period are the Space Shuttle, Titan IV, and Ariane V LVs. The deployment of new LVs designed to reduce chlorine deposition to the stratosphere would substantially reduce the forecast ozone depletion.

4.16.2 Hazardous Materials

The ALARM, BE, and DSCS programs are assumed to use similar types and quantities of hazardous materials as those used for the Block IIR program. During the last two years of the Block IIR program when all four programs will be operating simultaneously, there will be an increased demand for hazardous materials at Cape Canaveral AS. As with the Block IIR program and the Delta II LV program, the impacts associated with hazardous materials for the ALARM, BE, and DSCS programs, including the Atlas II LV for BE launches, will be limited to minor air emissions from the use of small quantities of solvents, coatings, and adhesives. No other impacts from the use of hazardous materials in the new programs are expected if hazardous materials are used in accordance with applicable safety, health, and environmental regulations.

4.16.3 Hazardous Waste

The Delta II program will generate approximately 11,185 pounds of hazardous waste per year in support of the Block IIR SV. The Block IIR SV program will generate approximately 1,330 pounds of hazardous waste per year, or approximately 444.3 pounds of hazardous waste per mission. Assuming that hazardous waste generation rates for each mission of the ALARM, BE, and DSCS programs will be similar to those for the Block IIR program, annual hazardous waste generation for these programs will be 444.3 pounds for ALARM, 13,930 pounds for BE (including the Atlas II LV), and 444.3 pounds for DSCS. The combined amount from all four SV programs operating at one time (the last two years of the Block IIR program), including launch vehicles, would be 27333.6 pounds per year. Because Delta II LV hazardous waste generation in support of the Block IIR SV will be approximately the same as its current generation in support of the Block II/IIA SV, hazardous waste from the Delta II LV will not cumulatively change the overall hazardous waste generation at Cape Canaveral AS from its current rate. Therefore, the net change in hazardous waste generation at Cape Canaveral AS will be an increase of 16,148.6 pounds, or 3.9

percent, per year based on the current total hazardous waste generation of 411,668 pounds per year.

4.16.4 Solid Waste

The Delta II LV program will generate approximately 105.3 tons per year (tpy) of solid waste in support of the Block IIR SV. The Block IIR program will generate approximately 20 tpy of solid waste, or about 6.7 tons per mission. Assuming that the ALARM, BE, and DSCS programs will generate similar amounts of solid waste per mission, approximate annual solid waste generation for these programs will be 6.7 tpy for ALARM, 20 tpy for BE, and 6.7 tpy for DSCS. Atlas II LV processing for the BE SVs would add an additional 64.2 tpy. The combined solid waste from all four SV programs (including launch vehicles) will be 222.9 tpy during the last two years of Block IIR operation. However, solid waste predicted for Delta II LV support of the Block IIR will not change from current rates and will therefore not affect the overall solid waste generation at Cape Canaveral AS. The net change in solid waste generation at Cape Canaveral AS from the cumulative operation of all four SV programs with launch vehicles will be an increase of 117.6 tons, or 4.1 percent, per year over the current solid waste generation rate of 2,876 tpy.

4.16.5 Pollution Prevention

The ALARM, BE, and DSCS programs are assumed to use similar types and quantities of hazardous materials as those used for the Block IIR program, including the use of limited amounts of EPA-17 industrial toxics. Cumulatively, the four programs, including launch vehicles, are predicted to use less than 15 gallons per year of materials that contain EPA-17 industrial toxics. All new programs will comply with the Pollution Prevention Management Plan (PPMP) that will be developed by Cape Canaveral AS. Compliance with the PPMP will minimize pollution and meet the regulatory requirements relative to pollution prevention.

4.16.6 Nonionizing Radiation

Each SV processed under the ALARM, BE, and DSCS programs is assumed to have antennas similar to those on the Block IIR SV. The limiting safe distance for antennas on the Block IIR SV is 5 feet; however, the SV will be placed in a radiation shield during testing to prevent exposure of personnel to hazardous levels of RF radiation. If radiation shields or antenna hats are not used during processing of ALARM, BE, and DSCS SVs, personnel will need to remain at least 5 feet away from the SVs during antenna testing. Since the respective SVs and LVs for each program are considered separate sources of RF radiation, there is no cumulative (additive) impact from RF radiation for the different sources.

4.16.7 Ionizing Radiation

None of the LVs carry sources of ionizing radiation. Assuming that each of the SVs contained two frequency standards with 200 micrograms of rubidium each, a total of 6.8 milligrams would be used in addition to the 8.4 milligrams carried on the Block IIR SVs. The total would be distributed among 38 different SVs, limiting the potential for any additive effects. There would be no health risks.

4.16.8 Water Quality

As with the Block IIR program, activities associated with the ALARM, BE, and DSCS programs are not expected to affect to water quality. The nature of space vehicle processing requires that the majority of activities take place within structures, where the potential for impacts from spills or leaks is minimal. The Delta II LV will not contribute any cumulative changes to water quality above the current baseline because the frequency of launches to support the Block IIR SV will be roughly the same as the current frequency of launches to support the

Block II/IIA SV. Precautions will be taken to prevent and control spills of hazardous materials for all programs in accordance with 45th Space Wing Operations Plan 19-1.

4.16.9 Biological Communities

SV processing would occur in existing facilities and biological communities would not be affected. The LVs are existing types with active launch programs at different launch complexes. Therefore, the biological communities near the complexes are already disturbed due to the existing launch programs. A higher cumulative launch rate would increase the frequency of disturbance near these complexes, but not change the area of disturbance.

4.16.10 Cultural Resources

The ALARM, BE, and DSCS programs would use existing facilities at Cape Canaveral AS. No changes to launch complexes which may be eligible for the National Register of Historic Places are anticipated. Therefore, no impacts to historical resources are expected. Because no disturbance of earth is anticipated for any of the programs, archaeological resources would not be impacted.

4.16.11 Noise

For SV and LV prelaunch processing, all necessary and feasible noise control mitigation measures will be implemented at the affected facilities to meet worker noise exposure limits as specified by the Occupational Safety and Health Administration (OSHA). Due to the distances involved, there will be no noise impact at sensitive receptor locations in public residential areas as a result of the normal prelaunch processing operations.

Each launch is a discrete event which is scheduled so that launches do not occur at the same time. Therefore, there would be no cumulative noise impact from launches.

4.16.12 Socioeconomics

The DSCS program is an existing program at Cape Canaveral AS, and additional personnel would not be required for the replenishment SVs. The Atlas II LV program that would launch the BE SVs is also existing, and additional personnel would not be required. Assuming that the ALARM and BE programs will each require 50 additional personnel, the work force at Cape Canaveral AS would cumulatively increase by 50, accounting for the decrease of 50 attributable to the Block IIR program. Assuming 2.8 dependents per employee, the estimated 1995 population of Brevard County would increase by 190. The 1995 estimate of population for Brevard County is 452,737, exclusive of these additions.

4.16.13 Utilities

Water use for the Block IIR program will be 2,500 gallons per day (gpd) based on 50 permanent personnel. Assuming that the required personnel for the ALARM, BE, and DSCS programs will be roughly the same as those for the Block IIR program, each of these three programs will also use approximately 2,500 gallons of water per day. Due to a reduction of personnel in the GPS program from 100 to 50 (discussed in section 4.12), the water demand at Cape Canaveral AS will decrease from the current 640,000 gpd to a baseline of 637,500 gpd at the beginning of the Block IIR program. The cumulative actions of the ALARM, BE, and DSCS programs will increase water use at Cape Canaveral to 645,000 gpd, or 1.2 percent above the baseline of 637,500 gpd. The Delta II LV will not contribute any change to overall water use at Cape Canaveral AS because the water demand for Block IIR support will be the same as the current water demand for Block II/IIA support.

Wastewater generation for the Block IIR program will be 1,500 gpd based on fifty permanent personnel. Assuming the same number of personnel will be required for the ALARM, BE, and DSCS programs, the wastewater generated from each will also be approximately 1,500 gpd. The simultaneous operation of all four programs will increase wastewater generation at Cape Canaveral AS by 6,000 gpd. Currently, all major treatment facilities at Cape Canaveral AS have adequate capacity to handle the cumulative load. Wastewater generation rates from Delta II LV processing in support of the Block IIR SV will not change from current rates in support of the Block II/IIA SV. Therefore, the Delta II LV will not contribute any net increase to current wastewater generation rates at Cape Canaveral AS.

Electricity usage should not vary substantially from the existing baseline conditions since existing facilities would be used.

4.16.14 Orbital Debris

For purposes of this assessment, it will be assumed that the end of life average weight for the BE, ALARM, and DSCS SVs is 3,000 pounds. Therefore, including the Block IIR SV mass, a total of 98,481 pounds of orbital mass from SVs would be added. The orbits for these SVs are unknown. Assuming placement in Medium Earth Orbit (MEO), the number of cataloged objects in this orbit would increase by 5.6 percent. If the 17 additional SVs were placed in Low Earth Orbit (LEO), the number of objects in LEO would increase by 0.3 percent. Placement in Geosynchronous Earth Orbit would increase the number of objects in that orbit by 3.8 percent.

The mass of orbital debris would increase by 40,500 pounds due to the nine Centaur II upper stages for the BE Atlas II LV. Assuming these Centaur II vehicles would occupy orbits as discussed in Section 4.14, the number of cataloged objects in MEO would increase by an additional 1.3 percent.

4.16.15 Safety

With the increased number of potentially hazardous processes, the risk of accidents will increase. All operations at Cape Canaveral AS are subject to the safety regulations and standards referenced in Section 3.15. In addition, safety for each of the programs will be considered in individual missile system prelaunch safety packages. All hazardous processes will be analyzed and safe procedures established in safety plans. The 45th Space Wing Director of Safety will review and approve all safety procedures.

SECTION 5.0

REGULATORY REVIEW AND PERMIT REQUIREMENTS

5.1 AIR QUALITY

The Florida air pollution control program is managed by the Florida Department of Environmental Protection (FDEP) under authority of the Florida Air and Water Pollution Control Act and the Environmental Protection Act. FDEP administers the air pollution program in Brevard County. The Brevard County Office of Natural Resources is under contract to FDEP for ambient air quality monitoring in the county.

The Clean Air Act (CAA) gives states the authority to establish air quality rules and regulations. The rules and regulations must be equivalent to, or more stringent than, the federal program. The state of Florida has adopted the National Ambient Air Quality Standards (NAAQS) except for sulfur dioxide. A more stringent standard has been adopted by Florida.

The state has developed a State Implementation Plan (SIP) as required by Section 110 of the CAA to provide for the implementation, maintenance, and enforcement of NAAQS. The SIP is a collection of regulations, provisions, procedures, strategies, policies, and data which outlines a policy to reduce emissions, improve air quality, and regain attainment status.

The regulations detailed in the CAA and contained in the SIP are embodied in the permitting programs conducted by FDEP. To ensure the protection of the public health, safety, and welfare, FDEP requires permits for construction and operation of any installation considered to be a source of air pollutants. The policy inherent in the permits program is to protect the air quality existing at the time air quality standards were adopted or to upgrade or improve the quality of the air within the state.

Toxic air pollutants are chemicals that are known to or are suspected of causing cancer or other serious health effects, including damage to the respiratory or nervous systems, birth defects, and reproductive effects. Air toxics include metals, other particles, and certain vapors from fuel and other sources. The Clean Air Act Amendments of 1990 authorize USEPA to set standards requiring facilities to sharply reduce routine emissions of air toxics.

Currently, the state of Florida regulates air toxics through the development of No Threat Levels (NTL). An NTL is the ground level ambient concentration of a pollutant to which a person may be exposed and not experience any detrimental effects. The levels were developed as part of a strategy to control the release of toxic pollutants to a no threat level and are, as such, health based standards.

5.2 HAZARDOUS MATERIALS

Hazardous materials use and management is regulated by the Toxic Substance Control Act (TSCA), the Occupational Safety and Health Act (OSHA), Air Force Occupational Safety and Health (AFOSH) standards 127-XX (Safety) and 161-XX (Health), the Emergency Planning and

Community Right-to-Know Act (EPCRA), and the Florida Right-to-Know Act (Section 252). The implementing regulations for these acts require personnel using hazardous materials to be aware of the possible dangers, know the location of material safety data sheets for all hazardous materials they will be working with, and have the appropriate personal protective equipment for the particular hazardous materials. It is the contractor's responsibility to comply with these acts and regulations.

Executive Order 12856, signed 4 August 1993, requires federal facilities previously exempt from EPCRA section 313 reporting requirements to begin reporting no later than for the 1994 calendar year. The executive order also requires compliance with the reporting requirements of EPCRA, sections 301 through 312. The Superfund Amendments and Reauthorization Act (SARA) was passed in 1986. Title III of SARA was the EPCRA, which added significant public notification and reporting requirements to the Comprehensive Environmental Response, Compensation, and Liability Act, notably the toxic chemical release inventory reporting.

Government contractors have always been subject to regulation under TSCA and EPCRA.

5.3 HAZARDOUS WASTE

Hazardous waste management at Cape Canaveral AS is regulated under 40 CFR Parts 260 through 270; the Florida Solid and Hazardous Waste Management Act Section 403; and FDEP Rule 62-730, FAC. These regulations are implemented at Cape Canaveral AS through FDEP hazardous waste permit H005-185569 and 45 SW Operations Plan (OPlan 19-14), Petroleum Products and Hazardous Waste Management Plan. Cape Canaveral AS has retained specific contractors to manage their permitted hazardous waste storage facilities, and to arrange for offsite disposal.

Cape Canaveral AS holds Florida Department of Environmental Regulation hazardous waste management permit number H005-185569, pursuant to Section 403.722, Florida Statutes. This permit allows management of hazardous waste in designated areas of Cape Canaveral AS in accordance with 40 CFR 264 and 265. USAF operations on Cape Canaveral AS are identified by EPA identification number FL2800016121.

5.4 SOLID WASTE

Solid waste management at Cape Canaveral AS is regulated under the Florida Solid and Hazardous Waste Management Act (Section 403), the Florida Used Oil Management Regulations, 62-710, and 45 SW OPlan 19-14. Cape Canaveral AS has retained specific contractors to manage their permitted solid waste storage facilities, and to arrange for offsite disposal.

5.5 POLLUTION PREVENTION

Pollution prevention is regulated and mandated by the Pollution Prevention Act of 1990, by the 7 January 1993 Action Memoranda on the Air Force Pollution Prevention Program and the Air Force Ban on Purchases of Ozone Depleting Chemicals, and by Executive Order 12856 (signed 4 August 1993).

The Pollution Prevention Act (PPA) presents Congressional findings on the need for pollution prevention and source reduction programs and declares "the national policy of the United States that pollution should be prevented or reduced at the source whenever feasible; pollution that cannot be prevented should be recycled in an environmentally safe manner whenever feasible." The PPA imposes additional source reduction and pollution prevention data reporting requirements for facilities required to file annual Toxic Release Inventory (TRI) forms under SARA Title III. This additional information includes:

- The quantity of the chemical entering any waste stream prior to recycling, treatment, or disposal

- The amount of the chemical from the facility which is recycled

- The source reduction practices used with respect to that chemical.

The Action Memoranda are incorporated in AFMCR 500-13 and mandate a reduction in the use of hazardous materials in existing systems by finding less hazardous materials and processes to substitute. They also require the development of installation pollution prevention plans by the end of 1992 which (1) establish baselines for the purchase of the EPA seventeen priority industrial toxic chemicals, ozone depleting substances, items containing recycled contents, and solid and hazardous waste disposal; (2) measure progress toward objectives; and (3) identify program projects needed to achieve the objectives. The regulation mandates reducing purchases of the EPA seventeen priority industrial toxics by 50 percent from the 1992 baseline by the end of 1996.

The six major objectives of AFMCR 500-13 are:

- Reduce the use of hazardous material in all phases of new weapons systems from concept through production, deployment, and ultimate disposal - find alternative materials and processes, and measure their life cycle costs.

- Reduce the use of hazardous materials in existing (deployed) weapons systems by finding less hazardous materials and processes and integrating them into Technical Orders, Military Specifications, and Military Standards.

- Reduce hazardous materials use and waste generation at installations (civil engineering, vehicle and aircraft maintenance, administrative facilities, family housing, etc.) and Government Owned Contractor Operated facilities.

- Acquire state of the art pollution prevention technologies, and distribute them throughout the Air Force.

- Apply new technology to pollution prevention; searching outside sources first, and conducting Air Force research where no alternatives exist.

- Establish an Air Force investment strategy to fund pollution prevention.

Executive Order 12856 requires federal facilities to implement pollution prevention programs and initiatives. This executive order requires federal agencies that were formerly exempt to comply with the TRI reporting requirements under SARA Title III and the PPA, develop a written pollution prevention strategy in accordance with sections 3-301 through 3-305 of the order, develop voluntary reduction goals of 50 percent for total releases of toxic chemicals to the environment and to off-site facilities for treatment and disposal, and encourage the development and testing of innovative pollution prevention technologies in partnership with the private sector. A written plan to achieve the voluntary reduction goals of 50 percent must be complete by 31 December 1995. These goals can be measured by reduction in either toxic chemical releases or toxic pollutants, as defined in the order.

Opportunity Assessments (OA) are a key to the implementation of Air Force Pollution Prevention (P2) projects. OAs will use the 1992 and 1993 waste generation baselines to define future P2 guidelines.

According to the CEQ and NEPA, agencies need to incorporate pollution prevention opportunities during planning.

5.6 NONIONIZING RADIATION

Organizations intending to procure, operate, or store systems or devices capable of producing nonionizing radiation at Cape Canaveral AS must adhere to the requirements and provisions enumerated in 45 SW Regulation 160-1, Radiation

Protection Program. The requirements and provisions of 45 SW 160-1 apply to any system or device determined by the 45 SW radiation protection officer to be capable of producing nonionizing radiation at potentially hazardous levels. This allows the 45 SW radiation officer to evaluate each source and to develop and implement specific radiation protection provisions. In addition, systems or devices capable of producing nonionizing radiation must comply with Air Force Regulation 127-100, AFOSH Standard 161-9, AFOSH Standard 127-8, and Technical Order 31Z-10-4.

5.7 WATER QUALITY

The Federal Water Pollution Control Act (FWPCA) of 1972, as amended by the Clean Water Act (CWA) and the Water Quality Act (WQA) of 1987, forms the legal framework to support maintenance and restoration of water quality. The FWPCA is commonly referred to as the CWA and establishes the National Pollutant Discharge Elimination System (NPDES) as the regulatory mechanism to achieve water quality goals by regulating pollutant discharge to navigable streams, rivers, and lakes.

The CWA has several goals including:

- The elimination of the discharge of pollutants into navigable waters.
- The attainment, as an interim goal, of water quality which provides for the protection and propagation of fish, shellfish, and wildlife and provides for recreation in and on the waters.
- The prohibition of the discharge of toxic pollutants in toxic amounts.
- The development and implementation of programs for the control of nonpoint sources of pollution.
- The prevention of adverse affects to wetlands.

The EPA issues NPDES wastewater discharge permits and storm water permits. The Corps of Engineers issues wetlands permits.

Florida statutes applicable to water quality issues include the Florida Air and Water Pollution Control Act, Florida Pollutant Discharge Prevention and Control Act, and Florida Surface Water Improvement and Management Act. Significant Florida regulations are encoded in Florida Administrative Code Chapters 62-3, 62-25, 62-28, 62-301, 62-302, 62-522, 62-611, and 62-660.

The FDEP issues permits for wastewater discharges and shares regulation of wetlands with the Saint Johns River Water Management District. The Saint Johns River Water Management District administers the storm water management program at Cape Canaveral AS. Septic tanks are regulated by the Brevard County Department of Health.

5.8 THREATENED AND ENDANGERED SPECIES

The federal Endangered Species Act (ESA) of 1973, as amended, extends legal protection to plants and animals listed as endangered or threatened by the US Fish and Wildlife Service (USFWS). Section 7(c) of the ESA authorizes the USFWS to review proposed major federal actions to assess potential impacts on listed species. According to Section 7(c) of the ESA, the Air Force, in consultation with the USFWS, must identify potential species in areas of concern.

The ESA of 1973, as amended (16 USC 1531 et seq.), is intended to prevent the further decline of endangered and threatened plant and animal species and to help in the restoration of populations of these species and their habitats. The act, which is jointly administered by the Department of Commerce and the Department of the Interior, requires that each federal agency consult with the USFWS to determine whether endangered or threatened species are known to exist or have critical habitats on or in the vicinity of the site of a proposed action.

5.9 CULTURAL RESOURCES

Section 106 of the National Historic Preservation Act of 1966, as amended, requires federal agencies to consult with the state historic preservation officer (SHPO) and the federal Advisory Council on Historic Preservation (ACHP) if proposed undertakings would affect resources of state, local, or national significance. These resources are identified in the NRHP and are maintained by the US Secretary of the Interior.

Through Section 106, a public interest process is established in which the federal agency proposing an undertaking participates along with the SHPO, the ACHP, interested organizations, and individuals. The process is designed to ensure that properties and the impacts on them are identified, and that alternatives to avoid or mitigate an adverse effect on property eligible for the NRHP are adequately considered in the planning process.

5.10 COASTAL ZONE MANAGEMENT

The Coastal Zone Management Act (CZMA) authorizes a state-federal partnership to ensure the protection of coastal resources. While Florida has specifically excluded federal facilities from the state's coastal zone, as required by Sections 305(b)(1) and 304(1) of the CZMA, the act requires that federal activities directly affecting the coastal zone and federal development projects located in or directly affecting the coastal area be consistent "to the maximum extent practicable" with the Florida Coastal Management Program (CMP). Therefore, the Florida CZMA requires consistency review of federal development projects and activities ". . . which significantly affect the coastal waters and the adjacent shorelands of the state" (380.23(3)(a), FS).

Of the Florida statutory authorities included in the CMP, impacts from GPS SV processing in the areas of historic preservation (chapter 267), living land and freshwater resources (chapter 372), and environmental control (chapter 403) are addressed in this EA.

SECTION 6.0

PERSONS AND AGENCIES CONSULTED

The following individuals were consulted during preparation of this environmental assessment.

6.1 UNITED STATES AIR FORCE

Cape Canaveral AS

Bailey, TSgt Jack (45 SPOS/DOD)
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Tasiemski, Capt Victor (45 SPOS/DOD)
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McLaughlin, Capt Stephen (SMC/CZSCO)
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6.2 FEDERAL , STATE, AND LOCAL AGENCIES

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6.3 OTHER ORGANIZATIONS

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Appendix A

Lighting Policy for Cape Canaveral Air Station

Appendix B

Selected REEDM Output

Section 1

Purpose of and Need for the Action

Section 2

Description of Proposed Action and Alternatives

Section 3

Affected Environment

Section 4

Environmental Consequences and Cumulative Impacts

Section 5

Regulatory Review and Permit Requirements

Section 6

Persons and Agencies Consulted

Section 7

References

Section 8

List of Preparers

Executive Summary

Table of Contents

Appendix A

Appendix B

Appendix C

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