Environmental Assessment for the Pegasus Expendable Launch Vehicle Program

at

Goddard Space Flight Center
Wallops Flight Facility
Wallops Island, Virginia

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SECTION 1.0 PURPOSE AND NEED

The National Aeronautics and Space Administration has prepared this environmental assessment (EA) according to the requirements of the National Environmental Policy Act (NEPA) of 1969, as amended (42 U.S. Code 4321 *et seq.*); the Council on Environmental Quality Procedural Provisions for Implementing the Procedural Requirements of NEPA (40 CFR Parts 1500-1508), and NASA's Procedures for Implementing NEPA (14 CFR Subpart 1216.3). This EA addresses the proposed activities at the National Aeronautics and Space Administration's (NASA) Goddard Space Flight Center/Wallops Flight Facility (GSFC/WFF) in support of the Pegasus Expendable Launch Vehicle (ELV) Program. The majority of Pegasus ELV activities at GSFC/WFF would occur on the main base (MB). Activities proposed include site preparation, Pegasus systems assembly, satellite systems assembly, Pegasus ELV and L-1011 aircraft mating, L-1011 operations, and Pegasus ELV launch from the L-1011. The Pegasus ELV would be transported by the carrier aircraft from the GSFC/WFF airport with actual launch of the ELV occurring somewhere over the Atlantic Ocean. The proposed launch missions would place satellites in orbit from release points over the Atlantic Ocean. The EA assumes a projected launch rate of approximately 12 per year. GSFC/WFF is located adjacent to the Atlantic Ocean in Accomack County, in the Commonwealth of Virginia (Figure 1.0-1). Reference 4 provides a general discussion of on-going activities at GSFC/WFF.

The Pegasus ELV is an Orbital Sciences Corporation (OSC) ongoing commercial space vehicle program designed as a small class ELV. Current users of the Pegasus ELV include the U.S. Air Force (USAF) Small Expendable Launch Vehicle Program and the NASA Small Expendable Launch Vehicle Services Program, however the Pegasus ELV program is not limited to these organizations. The Pegasus ELV has had four successful launches to date, all utilizing the NASA B-52 Carrier Aircraft. During all four missions, payload preparations as well as Pegasus systems assembly have been accomplished on the west coast at NASA/Dryden Flight Research Facility, Edwards Air Force Base (AFB), California. Three missions (5/5/90, 7/17/91, 4/25/93), with the B-52 carrier aircraft flight originating at Edwards AFB and operations controlled from the Department of Defense (DOD) Western Range (WR) at Vandenberg AFB, California, have been launched over the Pacific Ocean west of California. One mission (2/9/93), with the B-52 carrier aircraft flight (on launch day) originating at NASA/Kennedy Space Center (KSC) and operations control at GSFC/WFF, has been launched over the Atlantic Ocean east of Florida. The fifth Pegasus mission is scheduled for launch from the west coast in the fall of 1993.

The U. S. Government maintains both east and west coast facilities for satellite launch operations. West coast operations currently place satellites into high inclination orbits. Orbits requiring launching to the east, below approximately 65 degrees inclination can only be launched safely from the east coast. (GSFC/WFF would also launch satellites into high inclination orbits.) Use of the GSFC/WFF for east coast launch operations of the Pegasus ELV is based on commercial, USAF, and NASA program requirements. Pegasus operations at GSFC/WFF are also within the scope of the GSFC/WFF mission to support the launch of spacecraft into low Earth orbits. GSFC/WFF suitability as the east coast base of operations stems from the availability of the airport facilities, tracking and flight safety related facilities, experienced personnel with expertise in rocket systems, and an existing infrastructure capable of supporting satellite launch operations. KSC (as part of the Eastern Range [ER]) is also an east coast site; however, KSC's available launch rate is restricted due to launch support for the Space Transportation System (Shuttle), Atlas, Titan, and Delta Programs as well as other DOD support activities which may have higher priority than the Pegasus ELV program. Restrictions on launch support activities at GSFC/WFF are not as extensive.

The primary payloads of the Pegasus ELV would be small research or communications satellites. Some satellites would provide research and development opportunities to test sensors in space before incorporation into larger operational satellite systems. Other satellites would provide relatively inexpensive means to conduct basic research related to earth and space, or would orbit small relatively inexpensive communications systems to be used in variety of ways.

The Pegasus ELV program is consistent with the 1985 Commercial Space Launch Act (Public Law 98-575), which determined that development of a commercial ELV services program in the United States is in the national public interest.

Several existing environmental documents address various aspects of commercial ELV and Pegasus west coast operations:

- The U.S. Department of Transportation (DOT) 1986 Programmatic EA of Commercial ELV Programs (Reference 1) addresses the environmental consequences of commercial ELV launches. This EA focused on programmatic environmental consequences associated with commercial launches and did not address site specific impacts. The DOT does not specifically address Pegasus ELV activities; however, Pegasus does fit within the envelope of ELVs discussed in this EA.

- The USAF has prepared three EAs addressing west coast Pegasus ELV operations. The 1989 Pegasus Air-launched Space Booster EA (Reference 10), 1990 Supplement to the 1989 EDWARDS AFB Pegasus EA (Reference 11), and the 1991 Pegasus Precision Injection Kit (PI) EA (Reference 12) address environmental consequences of Pegasus operations at Edwards AFB. The 1989 and 1990 EAs address general operations and payload activity. The 1991 EA addresses an optional fourth stage motor now referred to as the Hydrazine Auxiliary Propulsion System (HAPS).

- OSC's 1992 EA (Reference 9) addresses Pegasus activities at Vandenberg AFB. The OSC EA relies heavily on the USAF's 1992 EA for the Taurus standard small vehicle program (Reference 13).

NASA has reviewed these existing EAs and has determined that they accurately and adequately describe the environmental consequences associated with commercial ELV and west coast Pegasus ELV activities and, hereby, incorporates their contents by reference.

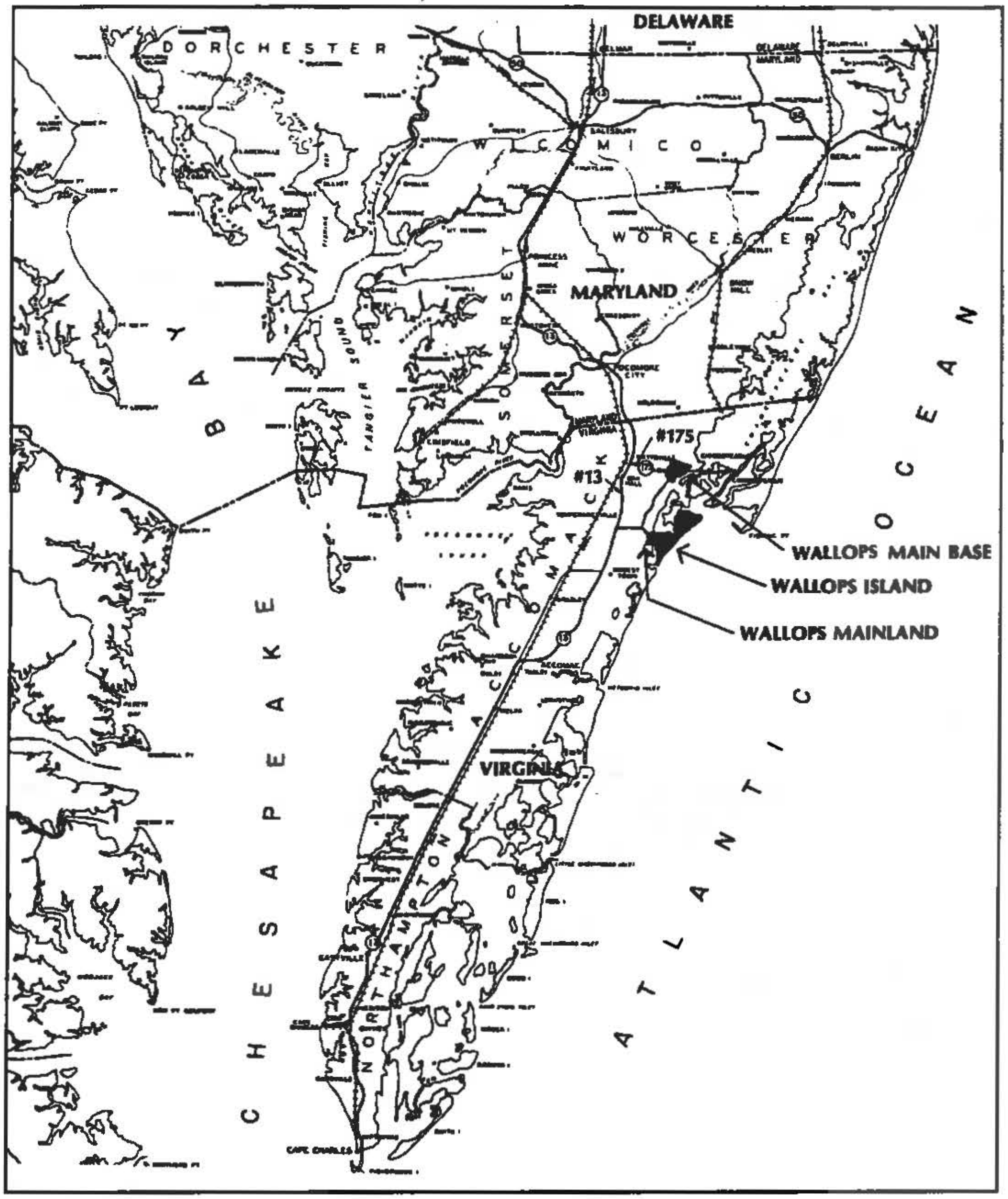


Figure 1.0-1: Goddard Space Flight Center/Wallops Flight Facility Vicinity Map

SECTION 2.0 ALTERNATIVES INCLUDING THE PROPOSED ACTION

2.1 PROPOSED ACTION

The proposed action includes both land-based and airborne operations of the Pegasus ELV program. A maximum of twelve (12) launches per year would be planned. The actual number of launches per year would vary depending on mission requirements.

The standard Pegasus ELV is a three stage rocket vehicle system (Figure 2.1-1) designed to orbit payloads in the 400 to 900 lb. weight range on various inclinations. The Pegasus XL ELV is six feet longer than the standard Pegasus ELV and carries an additional 8,000 pounds of solid propellant. Table 2.1-1 summarizes characteristics of both Pegasus ELVs. The Pegasus ELV relies entirely on solid rocket motors (SRM). Table 2.1-2 summarizes the propellant constituents of these SRMs.

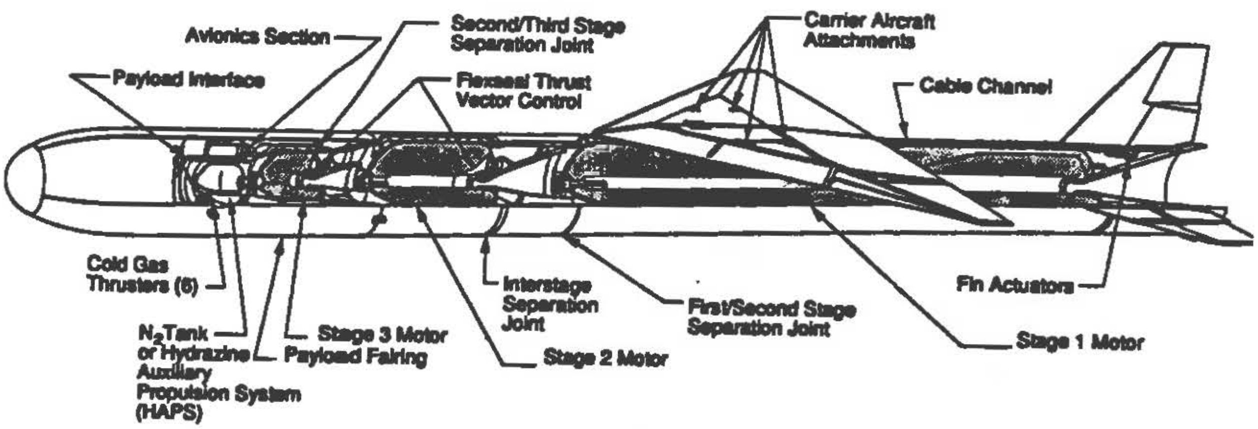


Figure 2.1-1: Standard Pegasus ELV Configuration

Both the standard Pegasus and Pegasus XL can be equipped with a fourth stage fueled with up to 160 pounds of the liquid propellant hydrazine (Reference 9 & 10). All previous west coast Pegasus ELV operations and some future operations involve a B-52 as the carrier aircraft. However, because of operational constraints at the GSFC/WFF airport, Pegasus ELV missions originating from GSFC/WFF would use an L-1011 as the carrier aircraft (Figure 2.1-2). Land-based Pegasus activities at GSFC/WFF would include site preparation, payload preparation and checkout, Pegasus assembly and payload mating, Pegasus ELV mating to the L-1011 carrier aircraft, and subsequent aircraft ground operations, takeoff, and departure from the GSFC/WFF airport control area. Some incidental L-1011 operations would be accomplished in support of general

Table 2.1-1: Pegasus ELV Motor Characteristics

PARAMETER Standard Motor Configuration (XL Motor Configuration)	UNITS	STAGE 1 MOTOR (XL)	STAGE 2 MOTOR (XL)	STAGE3 MOTOR (XL)
Overall Length	cm	888.0 (958.6)	265.7 (310.6)	133.9 (133.9)
Diameter	cm	127.5 (127.5)	127.5 (127.5)	96.5 (96.5)
Inert Weight	Kg	1,257(1) (1364(1)	343 (416)	126 (126)
Propellant Weight(2)	Kg	12,160 (15,052)	3,024 (3,938)	771 (771)
Total Vacuum Impulse(3)	KN-sec	35,108 (43,270)	8,666 (11,142)	2,183 (2,197)
Maximum Case Pressure	Kpa	7,378 (8,661)	6,764 (8,261)	4,585 (5,523)
Average Pressure	Kpa	5,840 (7,406)	5,826 (7,026)	3,785 (4,523)
Burn Time(3)(4)	sec	72.4 (68.0)	73.3 (67.1)	68.4 (64.4)
Maximum Vacuum Thrust(3)	kN	580.5 (714.8)	138.6 (197.1)	35.8 (38.3)
TVC Deflection	deg	N/A (N/A)	±3 (±3)	±3 (±3)

Notes:

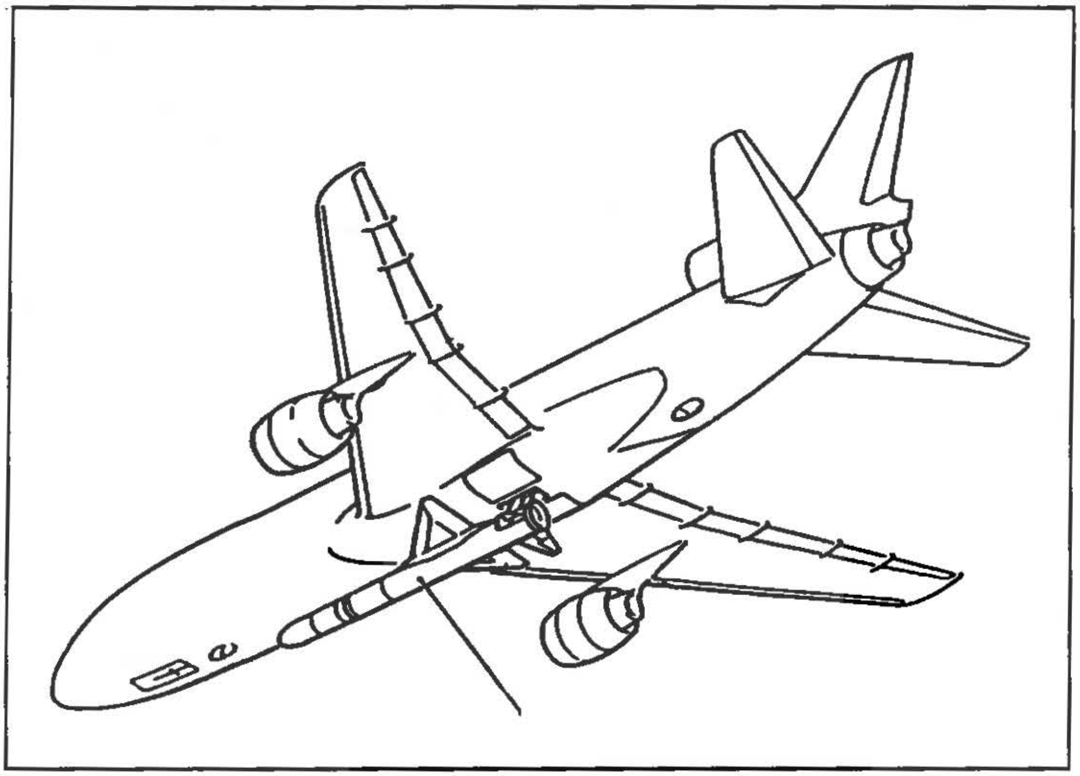
(1) Including Wing Saddle, Truss, and Associated Fasteners
(2) Includes Igniter Propellants
(3) At 21° C
(4) To 207 Kpa

SOURCE: Reference 9.

aircraft operations. Airborne activities would occur at a variety of oceanic locations outside the 12 mile territorial limit. The Pegasus ELV would be released from the L-1011 at an altitude ceiling of approximately 40,000 feet at a speed of Mach 0.8. Mission requirements would determine actual release altitude. Five seconds after release, the Pegasus ELV first stage would ignite and the ELV would begin its ascent profile

Table 2.1-2: Composition of Pegasus ELV Rocket Fuel

Constituent	Compound	Percent Composition (%WT)
Binder	Hydroxyl terminated polybutadiene (HTPB)	7.1
Fuel and Oxidizer	Aluminum (Al) Ammonium perchlorate (NH_4ClO_4)	19.0 69.0
Other	Compounds will vary due to motor manufacturing. Variations occur in, but are not limited to, stabilizers, oxidizers, binders, plasticizers, burn rate modifiers, curatives, catalysts, bonding agents, and processing aids.	4.9



Pegasus ELV

Figure 2.1-2: L-1011 Pegasus Carrier Aircraft

(Figure 2.3). Approximately 657 seconds after release of the Pegasus ELV by the carrier aircraft, the SRMs would be spent, separated, and remaining mission-specific systems would be inserted into orbit. The aircraft would return to an airport (most likely GSFC/WFF) after Pegasus ELV release, or when a situation occurred where postponing Pegasus release was required. Figure 2.1-3 shows a typical Pegasus ELV mission profile.

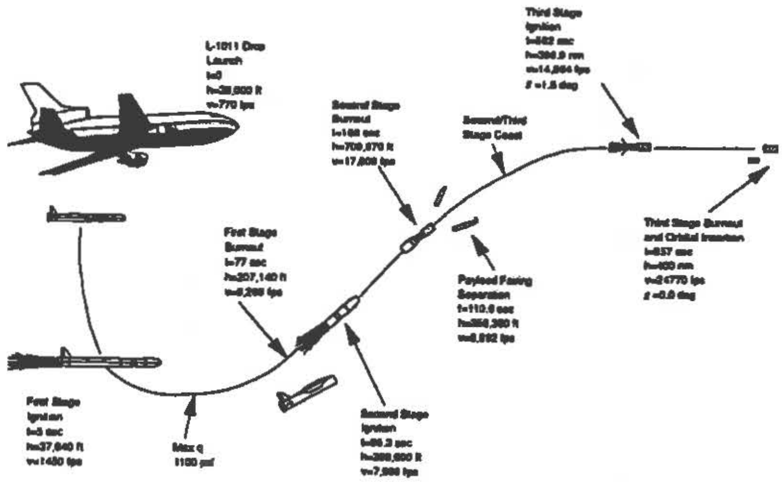


Figure 2.1-3: Typical Pegasus ELV Mission Profile

2.1.1 Pegasus Payloads

The Pegasus launch system is designed to carry a variety of payload modules. Payloads would typically be small communications systems with batteries, conventional mechanical and electronic components and contain non-hazardous materials. Payload components will vary depending on experimental design and mission requirements. Some payloads may use small quantities (<50 lbs) of hydrazine liquid propellant for orbital insertion and attitude control. If a proposed payload consists of toxic chemicals or biological materials with the potential to be released into the atmosphere, a supplemental EA would be prepared to address impacts due to these materials.

2.1.2 Land-based Activities

Long-term storage of the L-1011 Pegasus carrier aircraft would not occur at GSFC/WFF. Normal operations would require the L-1011 to arrive at WFF several days before a mission, return to GSFC/WFF for re-fueling after the launch, and then return to its home base. The L-1011 routine operations would not require support at the hot loading pad. Routine aircraft activities would include flights of the L-1011 for mission familiarization and practice as well as servicing and general maintenance. Practice flights may include carrying a simulated Pegasus ELV. Mission-related aircraft activities involving the Peasus ELV would occur at the hot-loading pad.

WFF's tracking and surveillance capabilities and equipment would be used for the Pegasus project. A payload processing area would be established for assembly and checkout of Pegasus payloads. A vehicle assembly building (VAB) would be used for hydrazine fueling when needed, and mating the Pegasus rocket with the payload. Two existing buildings on the GSFC/WFF MB, M-16 and M-20 would be retrofitted to meet the requirements of the payload processing and vehicle assembly activities. Both buildings are located in an area already designated for the storage of rocket motors (Figure 2.1.2-1), .

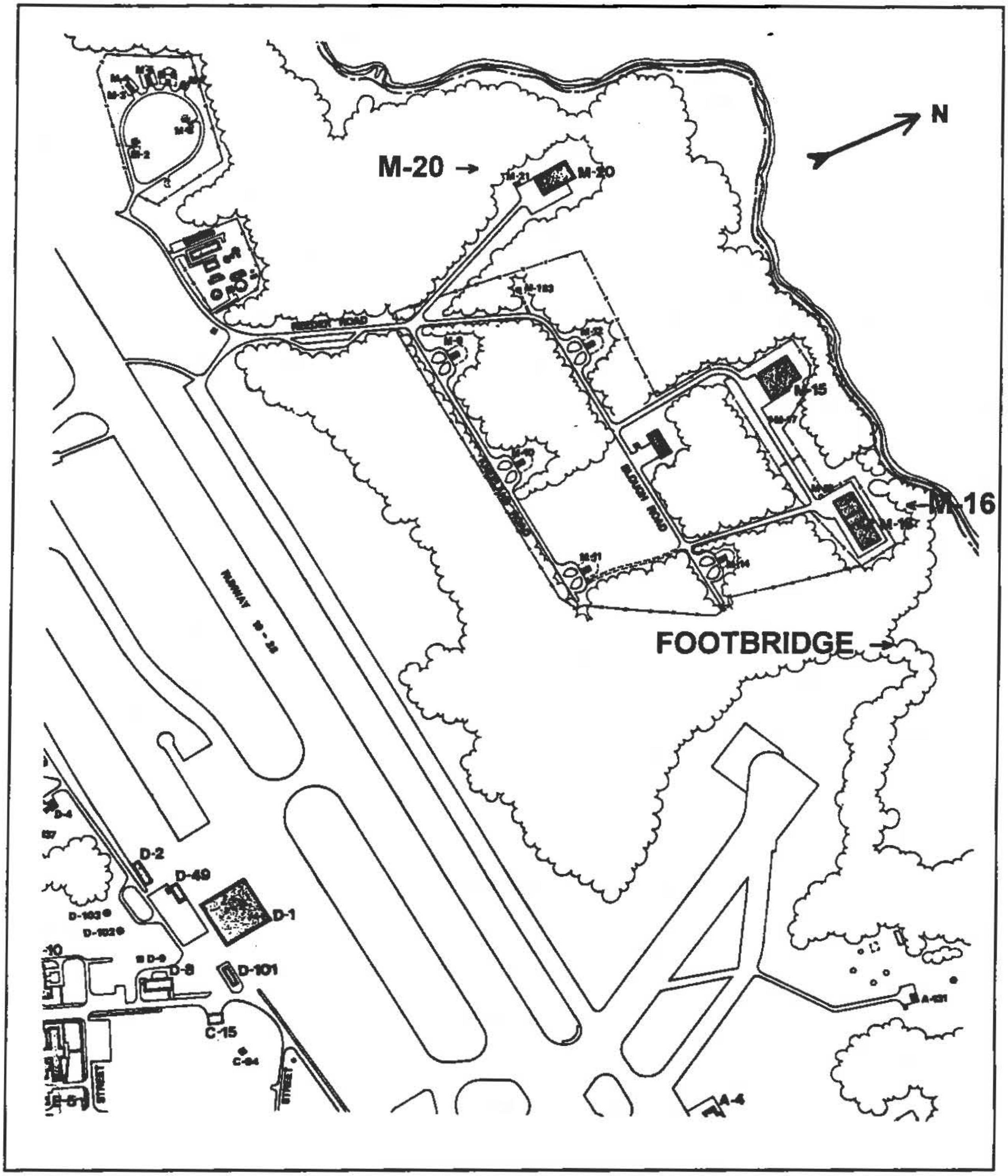
NASA currently uses Building M-20 for rocket motor storage, however, prior to the proposed modifications to this building NASA would remove the building's current rocket motor inventory. Approximately one-third of the M-20 building would house inert materials after building retrofit. The remaining two-thirds of the building would be used as the Pegasus ELV VAB. The VAB would be equipped with a hydrazine processing area for fueling payloads or the HAPS fourth stage, a secured storage area, and two clean tent areas for the assembly of two Pegasus vehicles. Reference 10 describes the Pegasus ELV assembly process which occurs in three steps: motor build-up, testing, and closeout. Small quantities of chemicals ranging from 16 ounce aerosol cans up to 1 gallon would be used during Pegasus ELV assembly (Table 2.1.2-1). Pegasus ELV activities at GSFC/WFF would not use any compounds containing chloroflurocarbons. Storage of small quantities of hazardous materials would occur in hazardous materials lockers in Building M-20. Bulk hazardous materials storage would be in the appropriate building.

Table 2.1.2-1: Pegasus ELV Assembly Materials

Material	Quantity
Triethylenetetramine RF-14 hardener™	0.029 L
RF 4000 resin™	< 1.9 L
Perchloroethylene	< 1.9 L
Epon (R) resin™	0.95 L
Potassium hydroxide	kit
Isopropyl alcohol	3.8 L
Woven graphite	1.0 - 1.4 m^2

SOURCE: Reference 9

Building M-16 is currently a storage building for inert hardware, and would be retrofitted to serve as a payload processing area. The payload processing area would consist of two clean rooms, each approximately 40-foot by 40-foot. The Pegasus payloads are primarily electronic. The remainder of building M-16 would continue to house NASA inert hardware. Up to two groups of payload personnel would operate out of the payload processing building depending upon program support requirements.



SOURCE: Reference 3

Figure 2.1.2-1: Map of the Rocket Storage Area at WFF

Construction activities associated with retrofitting the buildings would begin in the first quarter of Fiscal Year 1994. Security fences would be installed around existing magazine and bunker areas on Kneeland Road (M-9, M-10, M-11) to control access. Traffic control gates would be constructed to control access.

A force main would be installed to convey wastewater from Buildings M-16 and M-20 to the MB wastewater treatment plant (WWTP). The force main construction would involve approximately 1300 linear feet of trenching along existing roads. Telephone, control, and fiber optic cables would be installed in the same trench as the force main. Approximately 300 feet of telephone and fiber optic cable would be installed using a direct bury method in areas where no force main is required. The telephone and fiber optic cables would also connect between M-20, M-16, and the hot pad loading area, and then connect into the base wide cable system. The control cables would connect between M-16 and the hot pad loading area. A footbridge would be constructed from uplands to uplands across a small tributary to Little Mosquito Creek. This footbridge would allow quick access between the payload processing building (M-16) and the hot loading pad. The proposed action would require installation of wire and fiber optic cables from Building M-16 to the hot loading pad. NASA would attempt to attach these utility lines to the underside of the footbridge or suspend the lines between utility poles to avoid impacting wetlands in the vicinity of the tributary.

Vehicle access to the hot loading pad would be on existing roads and an airport taxiway. No new roads would be constructed as part of the proposed action; however, some of the existing roadways into the area would be realigned to facilitate movement of Pegasus ELV transport vehicles. The fully assembled Pegasus ELV would be transported by trailer, approximately 1.25 miles from M-20 to the hot loading pad. The transport route would be adjacent to the airport runway and isolated from inhabited buildings. No aircraft use of the adjacent runways would be allowed during the transport of the Pegasus vehicle.

2.2 DESCRIPTION OF ALTERNATIVE ACTIONS

2.2.1 Small Expendable Launch Vehicle Services (SELVS)

Launch of 400 - 900 lb payloads would be on either Scout, Conestoga, or Taurus launch systems. Each system is launched vertically from the ground on dedicated launch pads.

The Scout is a proven launch system and has been launched at GSFC/WFF many times. Currently there is one launch system remaining in inventory has been manifested with a payload. This Scout launch is not be scheduled at GSFC/WFF. The cost of procuring additional systems would be prohibitively high because manufacturing sites have been converted to other uses or no longer exist. Therefore the Scout is considered an unavailable alternative to the Pegasus ELV.

A launch vehicle that fits into the Conestoga family has been launched before, but is not equivelant to the present day Conestoga, and is not in an active inventory of launch systems in use. EER Systems, Incorporated, has two Conestoga missions planned for the near future from GFSC/WFF, but budgetary problems place these missions in jeopardy. No other providers of this system are known at this time.

The Taurus is a four stage design using existing rocket motors. The upper three stages consist of the Pegasus motors. The first stage booster is a newly designed motor that takes the place of the L-1011, and allows for ground launch of the Pegasus in place of an air launch from the L-1011. The launch system has not been launched. For payloads planning to use Pegasus, the delay associated with using the alternate Taurus launch system would be excessively long. For programmatic reasons the Taurus is not a viable alternative launch system.

2.2.2 West Coast vs. East Coast Alternative

Vandenberg AFB and Edwards AFB, both situated in California, would be alternate sites for staging Pegasus ELV launches on the west coast. KSC and Patrick AFB are alternate East Coast staging sites. Although many sites exist that can handle L-1011 aircraft operations, only a very small number of sites are suited to process rocket motors and satellite systems. Of the sites capable of processing rocket motors and satellites, the four above sites, and GSFC/WFF have experience with the Pegasus ELV systems. Therefore, the only reasonable sites considered are the five mentioned above.

Pegasus ELV operations have been conducted using Vandenberg AFB with payload and aircraft processing occurring at Edwards AFB. The release point has been located over the Pacific Ocean, west of Vandenberg. Inclinations of the Pegasus ELV orbits have been consistent with mission requirements. Future missions require inclinations of orbits that are not permitted from the west coast, i.e. the Pegasus ELV would be in thrusting phases of flight over the continental U.S. Mission requirements that include these inclinations can only be adaquately satisfied using east coast launch sites. Therefore, it would not be possible to satisfy all Pegasus ELV Program requirements unless launches are conducted from the east coast.

It should be noted that payload and Pegasus processing can be accomplished on the west coast, the aircraft can be loaded with the Pegasus ELV and ferried to the east coast where the launch can occur. This operation has resulted in a successful satellite launch. However, two situations occur in this scenario that place undo risk to the overall mission. First, the Pegasus ELV is subjected to many hours of aircraft flight at altitudes in excess of 35,000 feet. The temperature at this altitude is often below -50° Fahrenheit. Thermal cycling of rocket motors and sensitive scientific instruments and electronics greatly increases the likelihood of malfunctions, lowering success probabilities. Secondly, the aircraft must overfly the continental U.S. The risk to the general public associated with these overflights, while not significant, can be eliminated entirely by using east coast launch sites.

2.2.3 East Coast Alternatives

Kennedy Space Center (KSC), located on Merritt Island, Florida, would be an alternate east coast site for basing the Pegasus ELV operations and launch activities. KSC is located on the Atlantic Ocean and is one of the United States principal sites for launches of NASA space systems. The KSC Shuttle landing strip would be used for the take-off and landing of the L-1011 carrier aircraft. It is anticipated that some U.S. Air Force facilities at Patrick AFB would be required to support Pegasus ELV launches from KSC, particularly during the aircraft flight operations and release of Pegasus. The Pegasus ELV Program schedule would be incorporated into the KSC launch schedule. Because KSC is dedicated to launches of larger, more complex launch vehicles such as the Space Shuttle and Delta, meeting the Pegasus ELV Program schedule of 10 to 12 flights annually would be highly unlikely. Launching Pegasus ELV missions from KSC is not consistent with program requirements.

Patrick AFB would be considered a second east coast alternative to the proposed action. Patrick AFB facilities are, for the purposes of the Pegasus ELV program, fundamentally the same, and are adjacent to KSC. Scheduling constraints for launch opportunities would be virtually identical to operations conducted from KSC. Therefore, missions originating from Patrick AFB would not be consistent with Pegasus ELV program requirements.

2.2.4 No Action Alternative

The No Action alternative is to not use GSFC/WFF as a launch site for the Pegasus ELV. While this does not mean that orbital inclinations requiring east coast launches would not occur, the following adverse effects would be imposed on the Pegasus ELV Program:

1. Significantly fewer east coast launches would be made.

2. Orbital inclinations requiring east coast launches would be delayed and/or the number of launches would stretch the launch schedule over much longer time periods.

3. Overflights of the continental U.S. with the Pegasus ELV mounted to the L-1011 would be made, increasing the risk to the general public.

4. The transcontinental flight durations would increase the likelihood of malfunctions on the Pegasus and the payload due to thermal cycling.

SECTION 3.0 AFFECTED ENVIRONMENT

This section describes the existing environment at GSFC/WFF that *may be affected by or may affect* the proposed action. NASA has determined that the following environmental components would neither be affected by nor affect the proposed action: wild and scenic rivers, recreational resources, housing, population dynamics, or social institutions. This section is divided into subsections on Physical Components, Biological Components, and Socioeconomic Components.

The GSFC/WFF Environmental Resources Document (ERD) (References 6 & 8) provides a detailed discussion of GSFC/WFF's baseline environmental conditions; therefore, this section discusses only those environmental components directly related to the proposed action. Reference 7 also discusses environmental conditions Unless otherwise indicated References 6 and 8 are the reference documents for the information in this section.

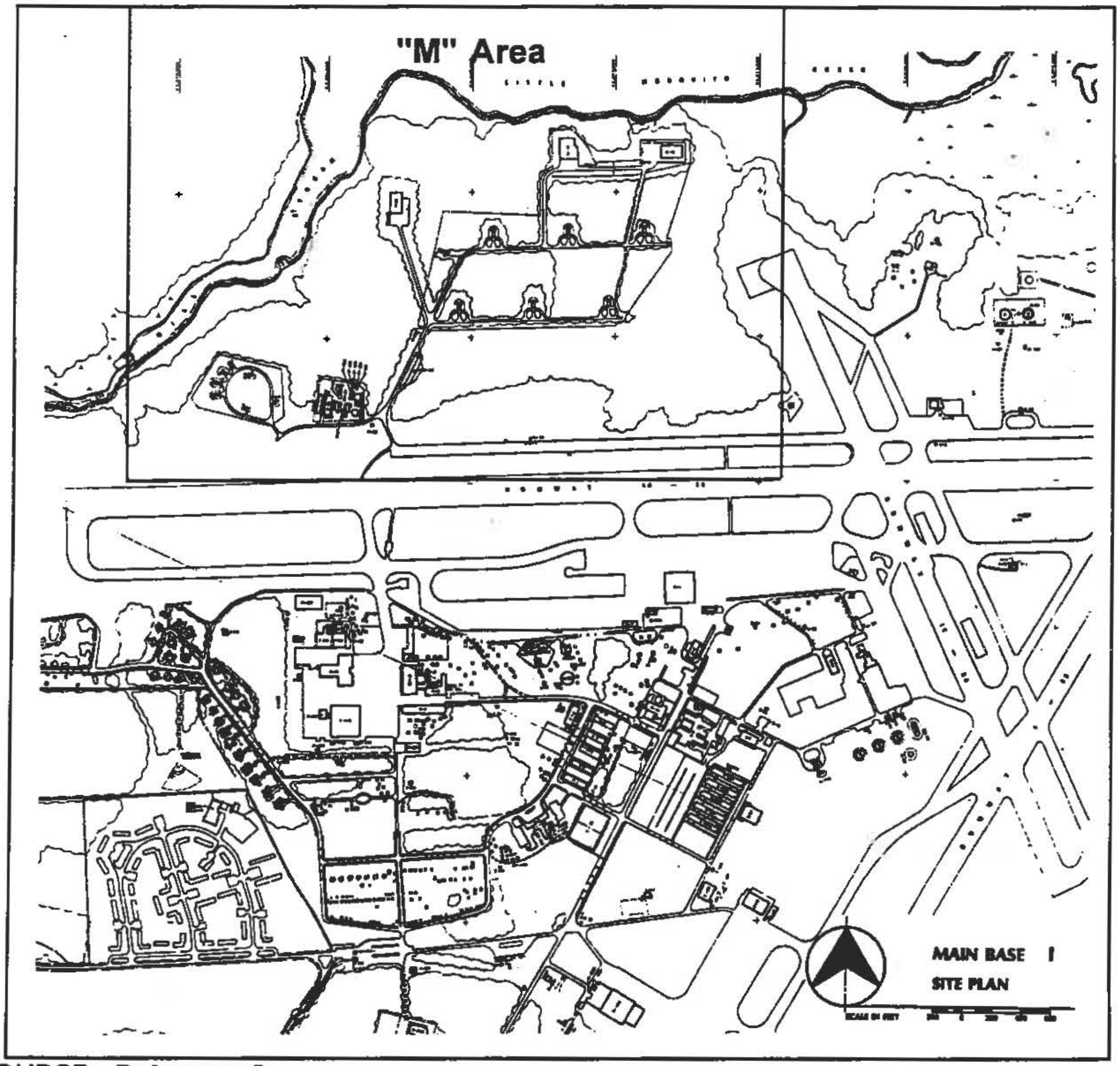
3.1 PHYSICAL COMPONENTS

The environmental components discussed in this section include land use, soils, water quality, wetlands and floodplains, air quality, noise, infrastructure, radiation, and solid waste.

3.1.1 Land Use

Accomack County has designated the GSFC/WFF MB as an industrial zone. Primary functions on the GSFC/WFF MB are administrative, engineering, operations associated with airport and launch range management, management of the balloon and sounding rocket programs, and operation of data acquisition and tracking equipment. GSFC/WFF MB activities in support of these functions include assembly of payload and rocket vehicle systems, rocket motor storage, and control center activities for all GSFC/WFF operations. The buildings proposed to house Pegasus operations lie on the northern portion of the GSFC/WFF MB, referred to as the "M" area (Figure 3.1.1-1). Tidally-influenced Little Mosquito Creek lies to the north of the M area just beyond NASA's property line. The M area is predominantly wooded with the exception of cleared areas for existing roads, buildings, and building buffer areas.

Airport runway 10/28 separates the M area from most Main Base activities. NASA designates this area for the storage of rocket motors and pyrotechnic devices. Buildings in the M area include earth covered bunkers, metal-frame storage buildings, and the GSFC/WFF MB wastewater treatment plant (WWTP).



SOURCE: Reference 3

Figure 3.1.1-1: Location Map of the "M" Area at GSFC/WFF

The GSFC/WFF airport is one of only two east coast airports completely owned and operated by NASA. The major use of the GSFC/WFF airport is as a research airport by aircraft from other NASA Centers, other Federal agencies, and private corporations. Tests for aircraft vary extensively, including noise testing, aircraft brake testing, friction measurements tests, and water injestion tests. Tables 3.1.1-1 and 3.1.1-2 provide summary airport use information for Calendar Year 1992. The largest aircraft to use GSFC/WFF's runway is a C-5A.

NASA establishes explosive hazard zones for all buildings containing explosive materials by computing explosive quantity distances based on the amount of explosives permitted to be stored at each building. The computed explosive hazard zones represent a safety buffer for

Table 3.1.1-1: Total GSFC/WFF Runway Use for Calendar Year 1992 (CY92)

Month	Runway 10/28	Runway 4/22	Runway 17/35	Ramp
January	112	138	62	0
February	9	81	18	0
March	280	240	63	26
April	256	312	84	31
May	190	277	123	3
June	243	430	148	45
July	250	420	75	18
August	199	481	18	0
September	0	719	0	12
October	188	198	58	0
November	193	176	58	53
December	154	114	42	6
Total	2074	3586	749	194
Percent Use	31.4%	54.3%	11.3%	2.9%

Table 3.1.1-2: GSFC/WFF Runway 10/28 and 04/22 Use by Aircraft type for CY92

Aircraft type	Runway 10/28	Runway 4/22
F-16	5.7%	11.1%
C-141	3.0%	8.4%
T-39	3.8%	6.2%
Total	12.5%	25.7%
P-3	5.4%	7.0%

inhabited areas. Figure 3.1.1-2 shows the existing quantity/distances (explosive hazard zones) for the M area buildings. Building M-20 can store a maximum of 100,000 pounds (45,360 kilograms) of Class 1.3 explosives (solid propellant rocket motors); however this building is currently emptyof rocket motors. NASA does not currently store explosive materials in Building M-16; however, this building lies within the explosive buffer zones of a nearby storage facility (M-15).

3.1.2 Infrastructure

Buildings M-16 and M-20 have existing electric utility connections for lighting, operation of the HVAC system and electrical outlet service. Neither building or the hot loading pad area has fiber optic cable service. The runway light system and tracking equipment also operate on electrical power.

The GSFC/WFF MB potable water system currently supplies Buildings M-16 and M-20. Each building has a septic tank for wastewater treatment.

The hot loading pad is equiped with electrical power and fire hydrant hookup.

Access to all buildings within the M area is via paved roads.

3.1.3 Water Quality

Little Mosquito Creek lies approximately 152.4 meters (500 feet) to the north of Building M-16; this creek is 182.9 meters (600 feet) north of Building M-20. This creek is the receiving stream for MB outfalls permitted under GSFC/WFF's existing Virginia Pollution Discharge Elimination System (VPDES) Permit. Stormwater runoff from these M area buildings typically percolates into the surrounding soils instead of flowing into Little Mosquito Creek.

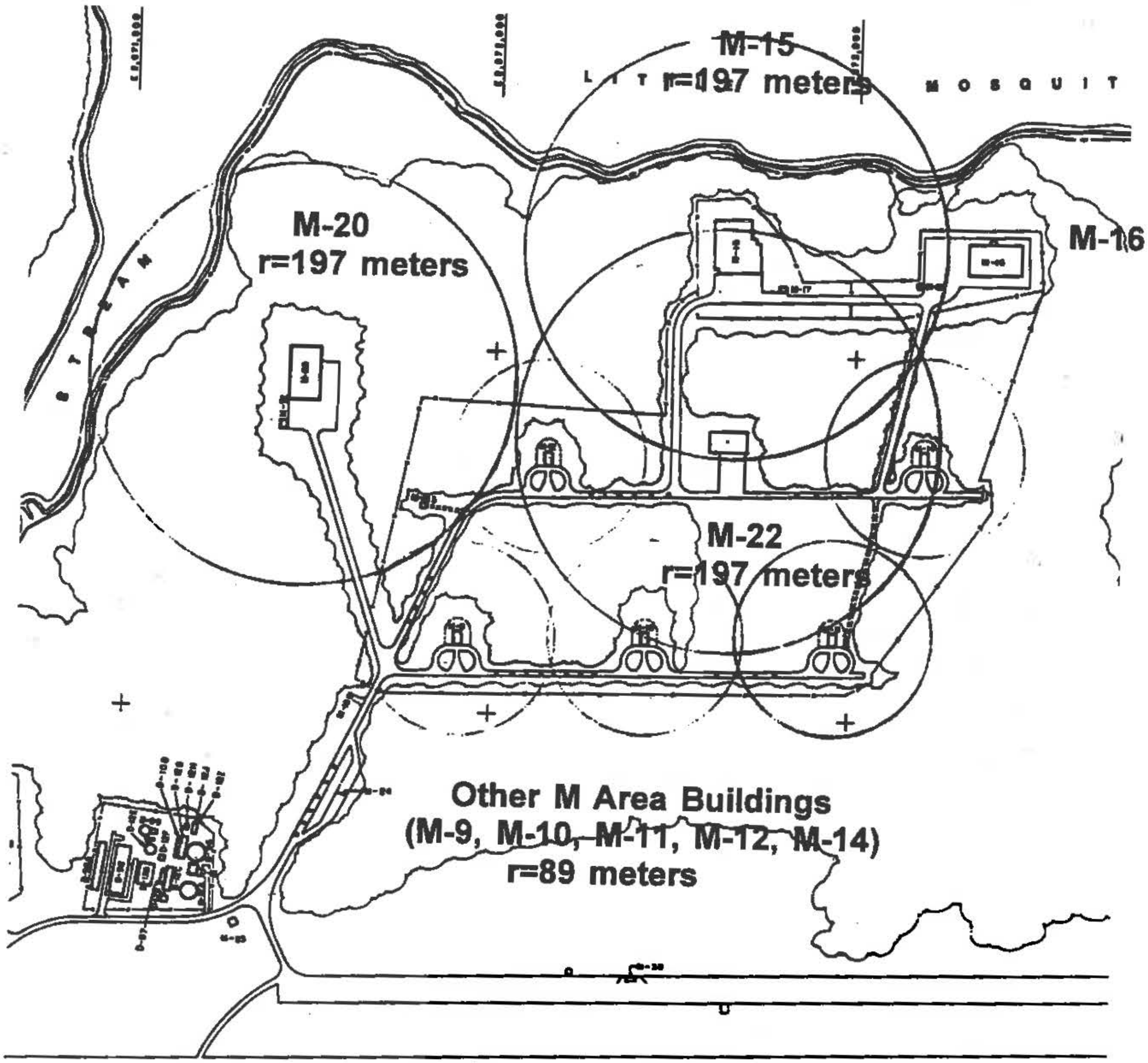
3.1.4 Soils

Soils in the M area are predominantly of the Bojac series. Bojac soils are highly erodible.

3.1.5 Wetlands and Floodplains

The GSFC/WFF ERD contains a detailed description of wetland and floodplain conditions in the vicinity of GSFC/WFF. Because of the complex nature of wetlands in the GSFC/WFF area, the ERD's description of wetlands relies upon the U.S. Fish and Wildlife Service (USFWS) National Wetlands Inventory. The ERD's description of floodplains relies on actual floodplain modeling.

Buildings M-16 and M-20, the hot loading pad and all GSFC/WFF runways occur in upland areas. A tributary to Little Mosquito Creek lies to the east of Building M-16 and separates the M area from the hot loading pad which is located adjacent to the end of Runway 17/35.



SOURCE: Reference 3

Figure 3.1.1-2. Existing M Area Rocket Motor Storage Quantity/Distances

NASA's preliminary wetland assessment of the area in the immediate vicinity of this tributary found this area to be a transition zone between a non-tidal freshwater floodplain bog and a tidal saltmarsh ecosystem. Obligate freshwater vegetation occurs upstream of the proposed footbridge crossing which will connect between M-16 and the hot loading pad; facultative wetland saltmarsh vegetation occurs downstream. The wetland area occupies a distance of approximately 100-150 feet (30.5-45.7 meters) in an east-west direction.

No portions of the proposed project area occur within the 100- or 500-year floodplains.

3.1.6 Air Quality

The GSFC/WFF ERD describes local climatological data and air quality data at GSFC/WFF. Outdoor ambient temperatures vary seasonally with a maximum of 105° Fahrenheit (40.6° Celsius) and a minimum of -4° Fahrenheit (-20° Celsius). The months of the greatest wind speed are February and March and the months of lowest wind speed are July and August. Accomack County (including GSFC/WFF) is an attainment area for all state and federal air quality standards.

Current activities in Buildings M-16 and M-20 do not require air permits from the Virginia Department of Environmental Quality (DEQ) Air Division (AD). Clean Air Act regulations exempt GSFC/WFF's current aircraft operations (including rocket launches) from regulatory action.

The GSFC/WFF ERD does not discuss upper atmospheric conditions. However, upper atmospheric chemistry and activities that contribute to ozone depletion continue to be an international concern. The highest concentrations of ozone exist in the atmospheric layer known as the Stratosphere, approximately 19.3 kilometers (12 miles) above the earth's surface (Figure 3.1.6-1). Stratospheric ozone has a blanketing effect that helps moderate the influx of harmful ultra-violet (UV) radiation from the sun. Current research indicates that depletion of stratospheric ozone allows more high energy Ultra-Violet (UV) radiation to reach the earth's surface. Research has further shown that over-exposure to UV radiation increases the incidence of skin cancer and cataracts, contributes to plant and crop damage, produces adverse effects on marine ecosystems, and stresses the human immune system.

3.1.7 Radiation

NASA currently does not have any radiation sources in the M area. NASA's nearest designated radio-frequency hazard zones surround the FPS-16 Radar and Instrument Landing System Localizer located approximately 0.25 miles (.0.4 kilometers) southeast of Building M-16. Communication and Navigation Systems are standard equipment for aircraft operating on and around the GSFC/WFF airport. These systems emit low level radio-frequency radiation.

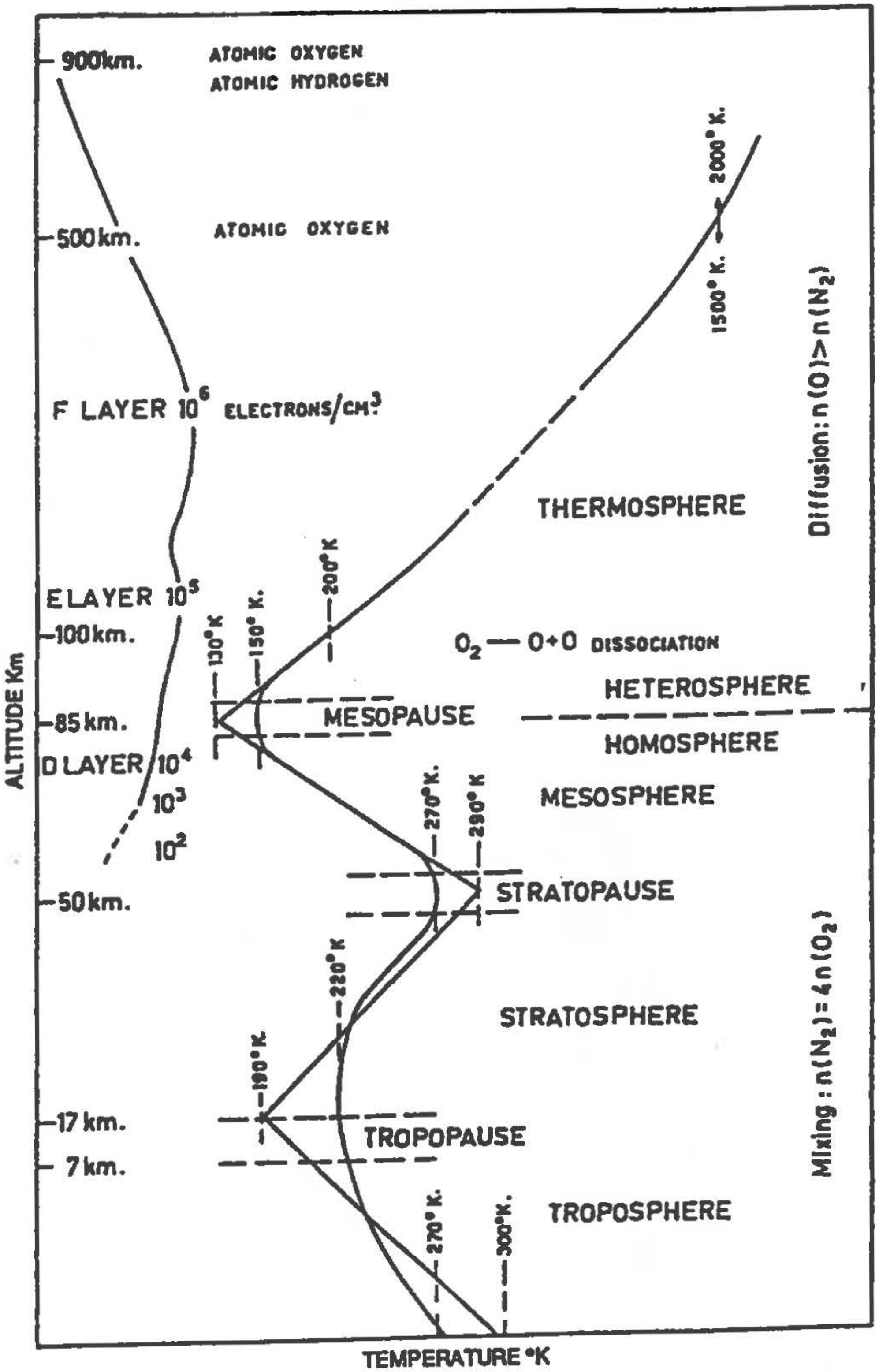
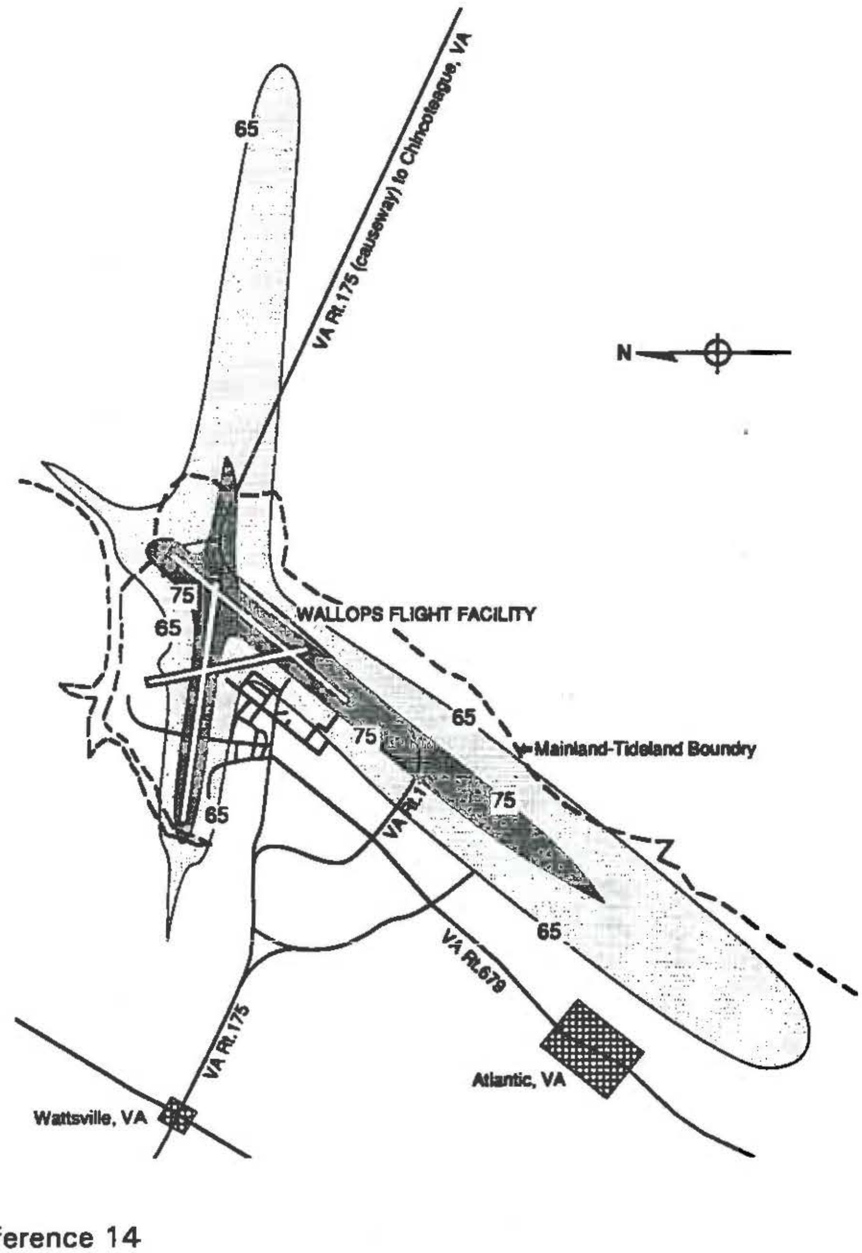


Figure 3.1.6-1: Layers of the Earth's Atmosphere

3.1.8 Noise

The main sources of noise at the GSFC/WFF MB include motor vehicle traffic and aircraft operations. The greatest source of noise to the surrounding community occurs from aircraft operations. However, aircraft operations generally occur intermittently and for short durations with flight paths usually occurring over marshland and farmland. Night flights from and into the airfield occur infrequently. Figure 3.1.8-1 indicates the noise contours for current aircraft usage of the GSFC/WFF airport.



SOURCE: Reference 14

Figure 3.1.8-1: Noise Contours for Current Aircraft Use of GSFC/WFF Airport

3.1.9 Solid Waste

The GSFC/WFF ERD describes solid waste (including hazardous waste) handling at GSFC/WFF. Solid wastes and hazardous wastes (HW) generated in the M area are handled consistent with the descriptions in the GSFC/WFF ERD.

Buildings M-16 and M-20 currently generate minimal quantities of solid waste.

NASA Management Instruction (NMI) 1700.8, Policy for Limiting Orbital Debris Generation, became effective April 5, 1993. This NMI applies to all NASA programs that have the potential of producing orbital debris. NASA's policy defines orbital debris as "payloads that can no longer perform their mission, rocket bodies and other hardware left in orbit, and fragmentation debris produced by failure or collision. NASA does not consider gases and liquids in free state to be orbital debris. The NMI requires specific projects in orbital space flight to employ design and operations practices limiting the generation of orbital debris in a manner consistent with mission requirements and cost-effectiveness. NASA encourages projects to complete debris generation potential calculations at the earliest possible stage of project planning. Program documentation for specific orbital projects contain these calculations and any applicable debris mitigation options.

3.2 BIOLOGICAL COMPONENTS

The resource components discussed in this section include vegetation, wildlife, and threatened and endangered species. The GSFC/WFF ERD provides a detailed description of the biological components at GSFC/WFF; however, actual field observations form the basis for most of the following resources descriptions.

3.2.1 Vegetation

The M area occupies a heavily wooded area of the GSFC/WFF MB. Loblolly pines, *Pinus virgineanus*, are the predominant tree species in this area. Mowed lawn areas occur in the immediate proximity of the explosive storage magazines in the M area. Predominant vegetation along the banks of Little Mosquito Creek is saltmarsh cordgrass, *Spartina alterniflora*, and other obligate wetlands plant species. Plants in the vicinity of the proposed footbridge between building M-16 and the hot loading pad ranges from obligate freshwater to facultative saltmarsh vegetation.

3.2.2 Wildlife

Wildlife typical to the rest of the GSFC/WFF MB occur in the M area. Numerous species of song birds occur in this area. Mammals occurring in this area include rabbits, grey squirrels, red fox, and white-tail deer. Little Mosquito Creek contains typical estuarine fauna such as blue crabs and killifish.

3.2.3 Threatened and Endangered Species

M area personnel have frequently observed bald eagles, *Haliaeetus leucocephalus*, in the vicinity of Buildings M-20 and M-16. In June 1993, NASA identified an active bald eagle nest on the GSFC/WFF MB. The nest's location is within a 0.25 mile (0.4 kilometer) radius of the proposed Pegasus construction activities. No proposed or designated critical habitat areas occur on the GSFC/WFF MB.

3.3 SOCIOECONOMIC COMPONENTS

The resource components discussed in this section include employment, health and safety, and cultural resources. The GSFC/WFF ERD contains a detailed description of socioeconomic components for GSFC/WFF.

3.3.1 Employment

GSFC/WFF is one of the largest employers on the Eastern Shore of Virginia. The Fiscal Year 1992 budget for this facility was 130 million dollars.

3.3.2 Health and Safety

The GSFC/WFF ERD describes the human health and safety measures in place for all activities at GSFC/WFF. GSFC/WFF's 24-hour plant protective services maintains security, fire protection, and emergency medical services at the facility. Three GSFC/WFF organizations; the Ground and Flight Safety Section, the Airport Operations Section's Aviation Safety Officer, and the Safety, Environmental, and Security Office (SESO); establish health and safety requirements for all activities at the facility. The Ground and Flight Safety Section determines hazard safety zones for explosive storage, ionizing and non-ionizing radiation, liquid propellant handling, etc. This section also approves ground and flight safety plans for all GSFC/WFF projects. Projects prepare these plans according to the requirements of Goddard Management Instruction (GMI) 1771.1, Range Safety Policies and Criteria for Goddard Space Flight Center (GSFC)/Wallops Flight Facility (WFF). The USAF Space Command routinely tracks all objects in near Earth orbit greater than 3 cm. This information for all habitated spacecraft is used to ensure that the probability of collision is minimized. The SESO approves health and safety plans for all construction contracts at GSFC/WFF.

3.3.3 Cultural Resources

No sites listed on, or eligible for listing on, the National Register of Historic Places occur in the vicinity of the M area. The M area does not contain any National Natural Landmarks.

SECTION 4.0 ENVIRONMENTAL CONSEQUENCES

This section provides the scientific and analytical basis for comparison of the alternatives presented in Section 2.0. This section discusses the direct, indirect, and cumulative effects of the proposed action on the environmental components discussed in Section 3.0. This section also discusses any mitigation measures that would be employed for the proposed action alternative. References 9, 10, 11, and 12 discusses environmental consequences associated with Pegasus ELV activities. Reference 1 discusses general environmental consequences of commercial ELV activities. NASA believes that these six reference documents adequately and accurately describe non-site specific environmental consequences associated with Pegasus ELV activities; therefore, only those environmental consequences not addressed in these EAs will be discussed in the following section. Reference 15 provides additional discussion on the environmental consequences of hydrazine.

4.1 PHYSICAL COMPONENTS

This section discusses the environmental effects on the components of the physical environment introduced in Section 3.0.

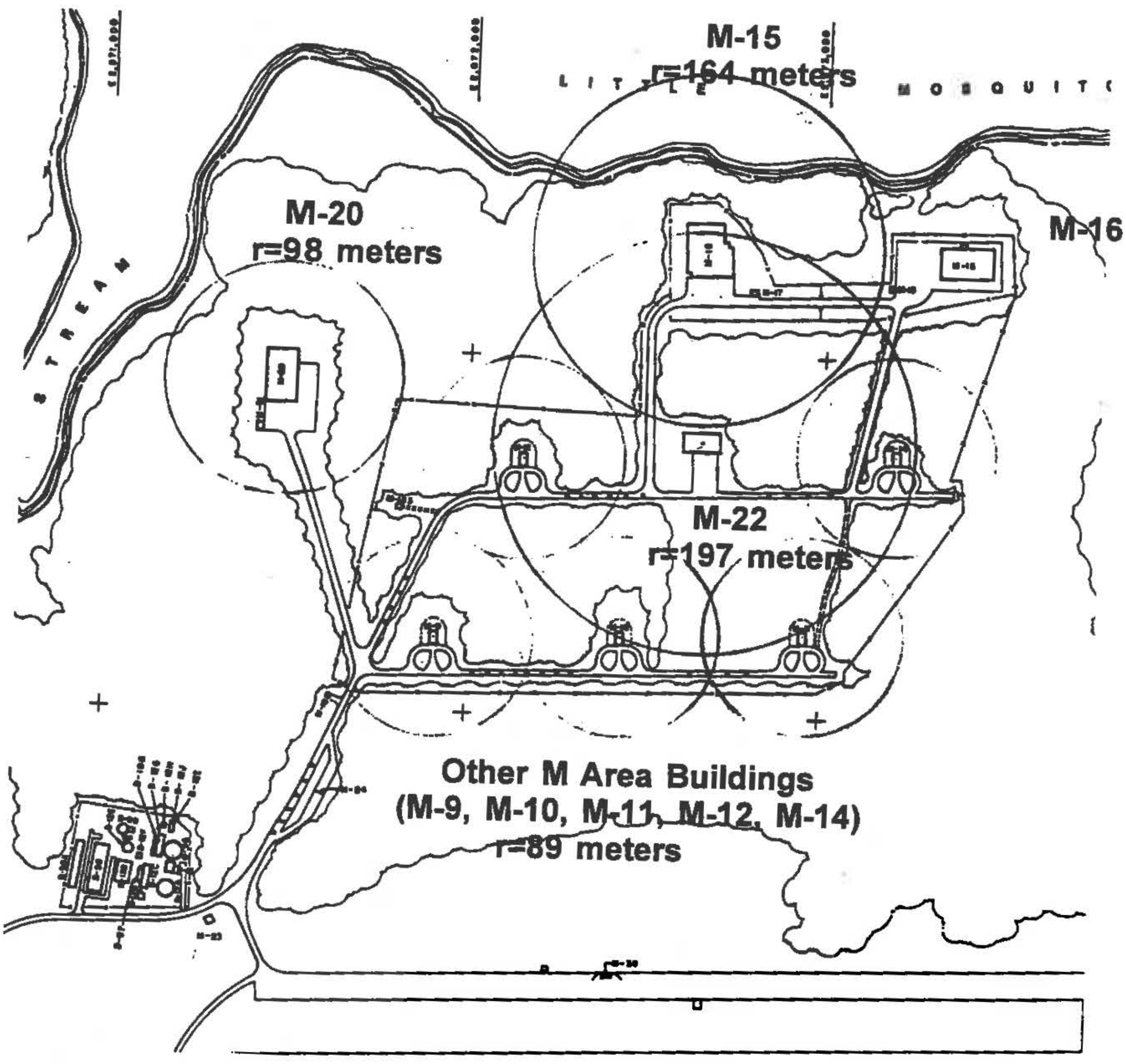
4.1.1 Effects on Land Use

4.1.1.1 Proposed Action

The proposed action would not alter land use at GSFC/WFF. The M area would continue to be designated an explosive storage area. Buildings M-16 and M-20 would continue to store inert hardware in portions of the buildings; Building M-20 would be used on a limited basis for ELV assembly. M-16 would be reclassified as an inhabited building because personnel would occupy this facility during payload processing. Safety hazard areas would be redefined for the M area based on the Pegasus related activities that would occur in this area. Figure 4.1.1.1-1 shows the safety hazard areas that would be defined in the M area for the proposed action.

The most substantial change to the M area would be the increase in human activity, largely concentrated around each four-week period prior to a mission launch. On a more regular basis there may be between two to ten people working at the payload processing facility. Access to the M area would be restricted to necessary personnel through the use of security gates and special issue badges.

Pegasus ELV missions would be coordinated with other GSFC/WFF missions according to established range scheduling procedures. Pegasus ELV missions would not differ from typical airport activities. With a maximum of twelve missions per year proposed to originate from GSFC/WFF, flights of the Pegasus carrier aircraft from GSFC/WFF would be consistent with current airport use at the facility.



SOURCE: Reference 3

Figure 4.1.1.1-1: M Area Rocket Motor Storage Quantity/Distances with Pegasus ELV Operations

The passive character of the proposed footbridge and use of the existing hot loading pad area would be compatible with the isolated nature of the environment surrounding it. Construction of the footbridge would not alter existing wetlands. Use of the footbridge would be limited to accessing the hot loading pad during mating of the Pegasus ELV to the L-1011.

4.1.1.2 No Action Alternative

The No Action Alternative would not alter existing land use on the WFF MB.

4.1.2 Infrastructure

4.1.2.1 Proposed Action

The proposed action would require minor infrastructure improvements.

Energy use nor potable water consumption in the M area would not substantially increase due to the presence of Pegasus ELV activities.

Use of Buildings M-16 and M-20 for Pegasus ELV activities would require construction of a force main to the MB WWTP. NASA would close the existing septic tanks and drainfields at these two buildings according to established regulatory requirements. Rerouting wastewaters from these buildings would eliminate a potential source of groundwater and/or surface water contamination and would also serve to increase the quality of sewage at the MB WWTP.

The proposed action would require NASA to install fiber optic, control, and telephone cables in the M area and to the hot loading pad and would result in a infrastructure improvement in the area.

Pursuit of the proposed action would require minor modification to the existing roads into the M area. Most of the roadwork would occur along previously disturbed terrain with minimal disturbance to wooded areas.

4.1.2.2 No Action Alternative

The no action alternative would not alter energy use or potable water consumption in the M area.

Buildings M-16 and M-20 would continue to discharge wastewaters into septic tanks. Continued discharge into septic tanks would continue to present a potential source of surface water and/or groundwater contamination. NASA considers probability of such contamination highly unlikely. In 1992, NASA conducted laboratory analyses of the septic tanks and drainfields as part of an Environmental Protection Agency (EPA) Underground Injection Control (UIC) investigation. Results of these analyses indicated that both the septic tanks and drainfields in the M area were free of contaminants regulated under the Safe Drinking Water Act.

4.1.3 Water Quality

4.1.3.1 Proposed Action

Construction of a force main to the MB WWTP to carry domestic wastewater from M-16 and M-20 would not appreciably increase the average daily flow of this facility. This force main would carry only domestic wastewaters and would; therefore,not require GSFC/WFF to modify its existing VPDES permit.

Utility and road improvements in the area would introduce the potential for sedimentation into surface waters adjacent to the M area. NASA would minimize sedimentation due to soil erosion by employing appropriate erosion and sediment control techniques consistent with VR 625-02-00, Erosion and Sediment Control Regulations, and the Erosion and Sediment Control Ordinance for Accomack County, Virginia.

The potential for releases into the environment from spills occurring within Buildings M-16 and M-20 would be minimal. Buildings M-16 and M-20 would not contain floor drains so spills inside these buildings would have no conveyance to the environment. The potential for hydrazine spills would be minimal. GSFC/WFF has extensive experience with hydrazine storage and fueling operations on GSFC/WFF's barrier island launch facility. The hydrazine storage facility on Wallops Island is located immediately adjacent to Hog Creek. GSFC/WFF has never experienced a release to the environment from hydrazine operations on Wallops Island. Hydrazine fueling operation would employ a spill pan at all stages of the operation. In the unlikely event of a hydrazine spill, NASA would activate the Hydrazine Contingency Plan prepared for Pegasus ELV activities.

The only potential for releases to the environment outside Buildings M-16 or M-20 would be during delivery or removal of hazardous materials from these buildings. With the exception of hydrazine, most of these materials would be used in very small quantities. Deliveries and removals would follow established procedures for the handling of hazardous materials. In the unlikely event of a spill during such activity, spills would probably be contained to the paved surfaces surrounding the buildings. Any spills off of these paved areas would be absorbed almost immediately by the sandy soils. The GSFC/WFF Fire Department would continue to be notified of any spills in the M area.

4.1.3.2 No Action Alternative

The no action alternative would not pose a potential for sedimentation to occur.

Continued reliance on septic systems for wastewater treatment at Buildings M-16 and M-20 would continue to present a remote potential to impact water quality. This potential would be no greater than that for any typical septic system elsewhere on the Eastern Shore of Virginia.

The no action alternative would not pose any substantial threat for release to the environment from the minimal amounts of liquid hazardous materials used in the M area.

4.1.4 Soils

4.1.4.1 Proposed Action

Road and force main construction as well as cable installation would disturb soils in the M area. NASA's use of appropriate soil erosion and sediment control techniques as described in Section 4.1.3 would minimize soil erosion as a result of this disturbance.

4.1.4.2 No Action Alternative

The no action alternative would not impact soils in the M area.

4.1.5 Wetlands and Floodplains

4.1.5.1 Proposed Action

Modifications to Buildings M-16 and M-20 would not impact wetlands or floodplains since these buildings are located above wetland and floodplain boundaries. Construction of the force main and road modifications would also occur in uplands.

Construction of the footbridge would place the supports of the bridge on uplands to avoid any potential wetlands impacts. Figure 4.1.1.1-1 shows the proposed location of the bridge. NASA would attempt to use this bridge or utility poles placed in uplands as the conveyance for utility lines to the hot loading pad. However, the timing of construction activities may require NASA to take the utility lines to the hot loading pad through the wetland area along the tributary to Little Mosquito Creek. Placing the utility lines across the wetlands area would not alter the existing elevations in this area. This action would be covered by Corps of Engineers (COE) Nationwide Permit #12, 33 CFR 330.5(a)(12). Actions covered under this nationwide permit do not require notification to the COE; however, State and local agencies may have additional jurisdiction over such a project. NASA would consult with the appropriate agencies to determine the need for obtaining State and/or local permits for the action.

Impacts to wetlands from an actual Pegasus ELV launch would be highly unlikely. The only potential for such an impact would occur in the event of mission failure immediately after take-off of the Pegasus carrier aircraft. Section 4.3.2.1 discusses the safety controls that NASA would use for Pegasus flights from GSFC/WFF that would minimize any possibility of such an occurrence.

4.1.5.2 No Action Alternative

The no action alternative would not impact wetlands or floodplains.

4.1.6 Air Quality

4.1.6.1 Proposed Action

Construction activities would not present a source of air quality impact.

Activities associated with Pegasus ELV vehicle assembly in Building M-20 and Pegasus ELV payload processing in Building M-16 would not pose a substantial potential for air quality impacts at GSFC/WFF. Neither building would have fume hoods or other point sources for air emissions. The minimal amounts of hazardous materials (with the exception of hydrazine) used during vehicle assembly and payload processing would not be a source of air emissions.

Although current plans do no call for use of the Hydrazine Auxiliary Propulsion System (HAPS) motor for Pegasus ELV flights originating from GSFC/WFF, future launches may require use of the HAPS to achieve mission requirements. Future spacecraft (payloads) carried into orbit by the Pegasus ELV may also require hydrazine for attitude control. Unplanned release of hydrazine during hydrazine fueling operations would pose a potential impact to ambient air quality at GSFC/WFF. Therefore, NASA would plan numerous safeguards to address the risk of spills and leaks when handling hydrazine. NASA would attempt to perform all hydrazine fueling operations on weekends or on weekdays during non-business hours. Hydrazine fueling would occur in an appropriate safety enclosure in Building M-20. Building M-20's hydrazine leak alarm would be operational at all times that hydrazine would be present in the building. GSFC/WFF personnel's experience with hydrazine use for several programs at projects on Wallops Island would minimize any potential for releases to the environment. All hydrazine fueling operations would be performed according to a hydrazine safety plan developed specifically for Pegasus ELV projects. This safety plan would address all possible ground accident scenarios.

A typical scenario for hydrazine fueling operations follows. Trained technicians wearing Self-Contained Atmospheric Protective Ensemble (SCAPE) suits would perform all hydrazine fueling operations. During fueling operations, technicians would monitor wind directions. Should a spill occur, these wind directions would be used to establish a downwind evacuation zone. NASA would establish the evacuation zone based on the current American Conference of Governmental and Industrial Hygienists (ACGIH) Threshold Limit Values (TLV). The size of the evacuation zone would depend upon wind speeds, ambient temperatures, and air stability classes. GSFC/WFF Plant Protection Services would coordinate any necessary evacuations.

Exhaust emissions from the Pegasus ELV carrier aircraft, even at a maximum of twelve Pegasus missions per year originating from GSFC/WFF, would not present a substantial increase in aircraft exhaust emissions at GSFC/WFF.

Air emissions from actual launch of the Pegasus ELV have been described in ReferenceS 9, 10, and 11. Reference 12 discusses air emissions from the HAPS motor. Actual launch of the Pegasus ELV would continue to be over open ocean. NASA has reviewed the discussions of ELV launch air emissions in the afore-mentioned EAs and has determined that these EAs adequately and accurately describe potential air emissions associated with Pegasus ELV launches originating from GSFC/WFF. Emissions from the Pegasus ELV would be highly localized, extremely short duration, and would occur at an altitude that would readily facilitate exhaust dissipation. An annual maximum of 12 Pegasus launches originating from GSFC/WFF coupled with the fact that actual launch trajectories would be highly variable would reduce any potential for cumulative air quality impacts from Pegasus ELV launches.

The Pegasus ELV program would not use any stratospheric ozone-depleting chemicals during vehicle assembly or payload processing.

A 1991 Congressional Research Services (CRS) report (Reference 2) reported that launch vehicle exhaust emissions have a potential for increasing ozone-depleting chlorine compounds; however, such emissions were considered to be highly localized and transient in nature. The report concluded that ozone levels normalize within a short period of time following launch vehicle emissions. This CRS report focused on large ELVs such as the NASA Space Shuttle booster system that use several orders of magnitude more solid rocket propellant that the Pegasus ELV uses. Therefore, Pegasus ELV exhaust emissions would present even less of a potential impact to stratospheric ozone than emissions from a Space Shuttle launch.

4.1.6.2 No Action Alternative

The only potential for air quality impacts from the no action alternative would be in the event of a catastrophic fire involving rocket motors stored in the M area. In such an unlikely event, emission products would readily dissipate and not pose any long-term impact to air quality in the vicinity of GSFC/WFF.

4.1.7 Radiation

4.1.7.1 Proposed Action

Construction in the M area would not interfere with the operation of radio-frequency devices or other sources of radiation at GSFC/WFF. Construction in support of Pegasus ELV activities would not introduce any new sources of radiation into Buildings M-16 or M-20.

Pegasus assembly and checkout and payload assembly and checkout may involve operation of radio frequency devices. However, these assembly and checkout activities as well as the actual Pegasus launch activities would use GSFC/WFF authorized radio frequencies and, therefore, would not interfere with operation of radio-frequency devices.

4.1.7.2 No Action Alternative

The no action alternative would not impact or be impacted by non-ionizing radiation sources at GSFC/WFF.

4.1.8 Noise

4.1.8.1 Proposed Action

Construction activities in the M area associated with remodeling of Buildings M-16 and M-20, utility line installation, footbridge construction, and road realignment would create temporary noise increases in the M area. Because of the isolated location of the M area, construction related noise would be virtually inaudible outside the immediate vicinity of this area. Construction related noise may produce startle effects to the wildlife in the area; however, wildlife would quickly habituate to this noise.

The proposed action would use a Lockheed L-1011 aircraft as the carrier aircraft for the Pegasus ELV. The aircraft meets the FAA class III noise requirements with a take-off flight limit level acoustics approximately 1.0 KHz, and a peak flight limit level free flight acoustics of approximately 108 dB for aircraft take-off and 117 dB for free flight acoustics.

The United States Army Environmental Hygiene Agency (USAEHA) compared noise contours for GSFC/WFF's existing aircraft use with the proposed action's projected annual number of 48 L-1011 flights (Reference 14). L-1011 noise levels did not differ substantially from those for other aircraft currently flying from the GSFC/WFF airport. Table 4.1.8.1-1 compares the A-weighted day-night level (ADNL) noise contour data for the proposed action with the current aircraft noise levels at GSFC/WFF. Graphically, noise contours for the proposed action are virtually indentical to the noise contours for existing aircraft use of the GSFC/WFF airport shown in Figure 3.1.8-1. Flight of an L-1011 into or out of the GSFC/WFF airport would not create additional noise impacts. Current plans do not call for basing the L-1011 at GSFC/WFF.

Table 4.1.8.1-1: Comparison of Proposed and No Action Alternative Aircraft Noise Levels

ADNL Contour	Proposed Action Area (ha)	No Action Alternative Area (ha)	Difference (ha)
65	1292.77	1292.59	0.18
75	259.97	259.93	0.04

SOURCE: Reference 14

4.1.8.2 No Action Alternative

The no action alternative would not produce additional noise impacts. Noise contours for aircraft using the GSFC/WFF airport would continue to be as indicated in Figure 3.1.8-1.

4.1.9 Solid Waste

4.1.9.1 Proposed Action

Construction activities would generate the greatest source of non-hazardous waste. NASA would require construction contractors to minimize the amount of solid waste generated through prudent purchasing, reuse, and other waste minimization techniques.

Pegasus ELV program vehicle assembly and payload processing would generate limited quantities of solid waste. Non-hazardous solid wastes generated would not appreciably add to the amount of solid waste currently generated at GSFC/WFF. White paper waste would be recycled as part of the GSFC/WFF white paper recycling program. The GSFC/WFF Environmental Branch would handle the disposal of hazardous waste generated by the ELV program according to Department of Environmental Quality Regulations. The Pegasus ELV program would attempt to minimize the amount of hazardous waste generation.

Solid waste generation during actual rocket launches is a growing concern. The various stages of the ELV do produce solid waste. All rocket flight trajectories are planned such that rocket motor casings from spent stages fall into open ocean. These casings contain inert materials and pose no threat to the environment. As with all rocket launches originating at GSFC/WFF, NASA would calculate casualty expectations for land overflights and water impact areas. Land impact of spent rocket motor casings or debris from a command destruct or explosion due to catastrophic failure of a Pegasus ELV would be extremely remote.

Pegasus ELV launches would attempt to minimize orbital debris according to the requirements of NMI 1700.8. The number of orbiting satellites have increased the potential for in-orbit collisions. Such a collision would present a potential for increased orbital debris. Reference 1 concluded that the majority of debris from an in orbit collision would burn up completely on reentry into the Earth's atmosphere. The USAF Space Command routinely tracks all objects greater than 3 cm in near Earth orbit. This tracking information would be used for launch planning to minimizes the potential for such collisions.

4.1.9.2 No Action Alternative

Under the no action alternative, Buildings M-16 and M-20 would continue to produce minimal amounts of solid waste.

4.2 BIOLOGICAL COMPONENTS

This section discusses the potential impacts of the alternatives presented in section 2.0 on the biological components discussed in Section 3.0.

4.2.1 Vegetation

4.2.1.1 Proposed Action

Construction activities in the M area would disturb some of the existing vegetation in the area. Road realignment and utility line construction may require some tree clearing. Tree removal would be limited to those determined to be a direct obstacle to free movement of the rocket motor trailer and construction activities. NASA anticipates that total acreage of trees to be removed would be less than 0.25 acre (0.1 hectare). Vegetation would be reestablished by either planting or natural means along all areas upon completion of construction. Minimal potential impacts to biological resources are anticipated due to the proposed Pegasus ELV Program operations and construction activities. The proposed force main trenching would occur along the shoulder of existing roads between buildings M-16, M-20, and the wastewater treatment plant. The roadway shoulders are generally cleared of vegetation, and whatever vegetation is there, can be easily re-established. Sediment and erosion control practices would be used where needed during construction to minimize top soil loss.

Construction of the footbridge would place the supports of the bridge on uplands and would have minimal impact to vegetation.

4.2.1.2 No Action Alternative

The no action alternative would not impact vegetation in the vicinity of the M area.

4.2.2 Wildlife

4.2.2.1 Proposed Action

Construction related noise may produce temporary startle effects in the immediate vicinity of the construction activity. Construction may temporarily disturb wildlife in the area. Since construction activities would be of extremely short duration (probably less than six months), construction activities would not produce any long-term impacts to wildlife in the area. Construction would not alter existing wildlife habitat.

The greatest potential impact to wildlife would occur during a catastrophic hydrazine spill anywhere in the Pegasus operations area. Hydrazine is a carcinogen and can be toxic through both dermal contact and inhalation. However, Pegasus ELV hydrazine safety plan would minimize the likelihood of a hydrazine spill associated with Pegasus activities.

Reference 12 indicated that a hydrazine release would not permanently damage the local biological environment, since hydrazine dissolves in a cloud-like path becoming more dilute over distance and time. Hydrazine would remain in soil media where a spill had contact, longer than in air (where it disperses) or water (where it dissolves). Laboratory experiments indicated that a hydrazine concentration of 500 micrograms per gram in soil, completely disappeared in eight (8) days.

An increase of up to forty-eight (48) aircraft flights per year (an allowance of four flights per mission) associated with Pegasus activities at GSFC/WFF would not be a substantial increase in aircraft operations. Pegasus aircraft flights would not impact wildlife at GSFC/WFF.

4.2.2.2 No Action alternative

Continued use of the M area for rocket motor storage under the no action alternative would not impact wildlife in the M area.

4.2.3 Threatened and Endangered Species

4.2.3.1 Proposed Action

The only known state or federally listed threatened or endangered species within a one-half mile radius of the Pegasus ELV activities at GSFC/WFF is the federally endangered bald eagle, *H. leucocephalus*.

In accordance with the requirements of Section 7 of the Endangered Species Act (ESA), NASA consulted with the USFWS during the summer of 1992 regarding potential impacts to federally listed species. NASA also afforded the VDACS and VDGIF an opportunity to comment on state listed species. These regulatory agencies indicated that the Pegasus ELV Program would not impact federally or state listed species since none were known to occur in the project vicinity (Appendix A). When NASA identified the exact location of this active bald eagle's nest on the GSFC/WFF MB in the spring of 1993, NASA reopened the Section 7 consultation process with the USFWS. NASA will submit a biological assessment according to the requirements of the ESA to USFWS. The USFWS has advised that any new activities within 0.25 mile (0.4 kilometer) of the eagle's nest would require consultation with USFWS. NASA would not begin any construction in support of Pegasus ELV activities until completion of the ESA Section 7 process. NASA would attempt to complete all construction activities within 0.4 km of the nest to minimize impacts; however, NASA does not anticipate that construction activities or other Pegasus ELV activities within 0.25 mile (0.4 kilometer) of the nest would impact this protected species.

4.2.3.2 No Action Alternative

Continued use of the M area for storage of Class 1.3 explosives would not impact threatened or endangered species in the vicinity. Use of the GSFC/WFF airport at its current operational level would not impact protected species on the GSFC/WFF MB.

4.3 SOCIOECONOMIC COMPONENTS

This section describes the environmental consequences of the alternatives presented in Section 2.0 upon the socioeconomic resources discussed in Section 3.0.

4.3.1 Employment

4.3.1.1 Proposed Action

Construction activities in support of the Pegasus ELV Program at GSFC/WFF would create temporary employment opportunities.

Actual Pegasus vehicle assembly, payload processing, and launch operations would not appreciably increase employment opportunities at GSFC/WFF. GSFC/WFF typically assigns a cadre of support personnel from its existing workforce to support launch vehicle programs. Pegasus ELV operations at GSFC/WFF would follow this typical scenario. OSC and other groups associated with a specific Pegasus ELV launch project, such as OSC launch support personnel, would bring their own personnel to GSFC/WFF to support the project. OSC may maintain one or two full-time, on-site personnel for the duration of the program.

Project personnel visiting GSFC/WFF would typically be in the area for approximately two weeks pre-launch. Media, VIPs, and the public may also visit the area for various Pegasus ELV launches. The maximum annual launch rate of 12 Pegasus missions from GSFC/WFF would create a potential increase in the economic base in the surrounding community.

4.3.1.2 No Action Alternative

The no action alternative would not increase employment opportunities at GSFC/WFF.

4.3.2 Health and Safety

4.3.2.1 Proposed Action

All construction activities in support of Pegasus ELV activities at GSFC/WFF would follow health and safety plans approved by the GSFC/WFF SESO.

GSFC/WFF would require detailed ground and flight safety plans prepared according to the requirements of GMI 1771.1 for each Pegasus ELV mission. These safety plans would describe the procedures to be used throughout Pegasus ELV assembly, payload processing, and actual ELV launch. Mission requirements would determine the actual contents of project specific safety plans. The plans would ensure maximum safety to health, welfare, and the environment without compromising mission success.

4.3.2.2 No Action Alternative

Under the no action alternative NASA would continue to use the M area for the storage of Class 1.3 explosives. The GSFC/WFF airport would continue to operate. Existing safety procedures would continue to maximize safety of operations in the M area and at the GSFC/WFF airport.

4.3.3 Cultural Resources

According to the requirements of Section 106 of the National Historic Preservation Act, GSFC/WFF consulted with the Virginia Department of Historic Resources (VDHR) regarding potential impacts of the proposed Pegasus ELV Program on cultural resources. The VDHR determined "the proposed undertaking would have no effect on historic properties" (Appendix A).

4.4 SUMMARY OF ENVIRONMENTAL CONSEQUENCES

Table 4.4-1 presents a summary of the environmental consequences of each of the alternatives presented in Section 2.0. Plus signs denote potential beneficial environmental consequences and minus signs denote potential adverse environmental consequences.

Table 4.4-1. Summary of Environmental Consequences

ENVIRONMENTAL COMPONENTS	PROPOSED ACTION	NO ACTION ALTERNATIVE
Physical		
Land Use	None	None
Infrastructure	+	None
Water Quality	Minimal +	Minimal -
Soils	Minimal -	None
Wetlands & Floodplains	None	None
Air Quality	None	None
Radiation	None	None
Noise	None*	None*
Solid Waste	None	None
Biological		
Vegetation	Minimal -	None
Wildlife	None	None
Threatened & Endangered Species	None	None
Socioeconomic		
Employment	Minimal +	None
Health & Safety	None	None
Cultural Resources	None	None

*NOTE: Noise levels for the proposed action and the no action alternative would not differ from current noise levels at GSFC/WFF.

SECTION 5.0 REFERENCES

1. DOT. 1986. Programmatic Environmental Assessment of Commercial Expendable Launch Vehicle Programs. U. S. Department of Transportation, Office of Commercial Space Transportation, Washington, DC.

2. Moteff, J.D. 1991. Rockets and ozone: should alternative technologies be developed? Congressional Research Service Publication.

3. NASA. 1988. Goddard Space Flight Center Facilities Master Plan, Volume 3, Wallops Flight Facility. GSFC/WFF.

4. NASA. 1988. Wallops: A Guide to the Facility. GSFC/WFF.

5. NASA. 1990. Environmental Assessment for the Sounding Rocket Program Campaign at the U.S. Army Kwajalein Atoll. Space Physics Division, NASA Office of Space Science and Applications.

6. NASA. 1990. Wallop Flight Facility Environmental Resources Document. NASA Technical Memorandum No. 100774. GSFC/WFF.

7. NASA. 1993. Draft Supplemental Environmental Impact Statement for the Sounding Rocket Program. GSFC/WFF.

8. NASA. 1993. Draft Goddard Space Flight Center/Wallops Flight Facility Environmental Resources Document (in preparation). GSFC/WFF.

9. Orbital Sciences Corporation. 1992. Environmental Assessment for the Orbital Sciences Corporation Commercial Launch Services Program at Vandenberg Air Force Base, California. Prepared by OSC for the 30th Space Wing, Vandenberg AFB, CA.

10. USAF. 1989. Pegasus Air-Launched Space Booster Environmental Assessment. Headquarters Space Systems, Los Angeles AFB.

11. USAF. 1990. Supplement to the Pegasus Air-Launched Space Booster Environmental Assessment. Edwards AFB, Western Test Range, CA.

12. USAF. 1991. Pegasus Precision Injection Kit Supplemental Environmental Assessment. Edwards AFB, Western Test Range, CA.

13. USAF. 1992. Environmental Assessment of the Taurus Standard Small Vehicle Program. Vandenberg AFB, CA.

14. USAEHA. 1993. Environmental Noise Consultation No. 52-34-Q2CS-93: Environmental Noise Contours for Wallops Island Flight Facility, Wallops Island, Virginia.

15. USN. 1991. Environmental Assessment for the Execution of the Firebird Program at Wallops Flight Facility. Space and Naval Warfare Systems Command, PMW-145, Washington, DC.

SECTION 6.0 LIST OF PREPARERS

Jay Brown, Aerospace Engineering Technician, Operations Division EA Representative, Goddard Space Flight Center/Wallops Flight Facility, BA Psychology; 19 Years Launch Operations, 12 Years Experience Rocket Performance Analysis, 4 Years Experience NEPA Compliance and Document Preparation

Pamela Whitman, Environmental Protection Specialist, Pegasus EA Team Leader, Goddard Space Flight Center/Wallops Flight Facility, BS Biology, MS Biology; 15 Years Experience in Biology and Environmental Sciences, 5 Years Experience NEPA Compliance and Document Preparation

SECTION 7.0 LIST OF AGENCIES AND PERSONS CONSULTED

Wetlands (preliminary discussions of regulatory requirements for crossing tributary to Little Mosquito Creek):

U.S. Army Corps of Engineers, Norfolk District, Eastern Shore Field Office, General Delivery, Accomac, Virginia, 23301

Virginia Marine Resources Commission, Habitat Management Division, P.O. Box 756, Newport News, Virginia, 23230

Commonwealth of Virginia, Department of Environmental Quality, Water Division, P.O. Box 11143, Richmond, Virginia, 23230

Threatened and Endangered Species*:

U.S. Fish and Wildlife Service, Fish and Wildlife Enhancement, Mid-County Center, U.S. Route 17, P.O. Box 480, White Marsh Virginia, 23183

Commonwealth of Virginia Department of Agriculture and Consumer Services, Division of Product and Industry Regulation, P.O. Box 1163, Richmond, Virginia, 23209

Commonwealth of Virginia Department of Game and Inland Fisheries, 4010 West Broad Street, P.O. Box 11104, Richmond, Virginia, 23230-1104

Cultural Resources*:

Commonwealth of Virginia, Department of Historic Resources, 221 Governor Street, Richmond, Virginia, 23219.

*Refer to Appendix A for copies of correspondence pertaining to threatened and endangered species and cultural resources.

APPENDIX A REGULATORY AGENCY CORRESPONDENCE

United States Department of the Interior

FISH AND WILDLIFE SERVICE
FISH AND WILDLIFE ENHANCEMENT
MID-COUNTY CENTER, U.S. ROUTE 17
P.O. BOX 480
WHITE MARSH, VIRGINIA 23183

TAKE PRIDE IN AMERICA

August 24, 1992

Mr. Terry M. Potterton
National Aeronautics and
Space Administration
Wallops Island Flight Facility
Wallops Island, Virginia 23337

Re: Pegasus Vehicle, Hazardous Waste Staging, and Rocket Motor Storage, Wallops Island, Virginia

Dear Mr. Potterton:

This responds to your June 8, 1992 request for information on the presence of species that are Federally listed or proposed for listing as endangered or threatened that may be impacted by the Pegasus small expendable launch vehicle, construction of a new hazardous waste staging facility and a new rocket motor storage building at Wallops Island, Accomack County, Virginia. Please note that your letter did not arrive at our office until July 9, 1992. Your letter indicated that four projects were to be reviewed, however only information on the three projects referenced above was provided. We have reviewed the information you enclosed and are providing comments in accordance with provisions of the Endangered Species Act (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.).

The Federally listed endangered and threatened species known to occur at Wallops Island are the peregrine falcon (*Falco peregrinus*) and piping plover (*Charadrius melodus*). The Pegasus small expendable launch vehicle is not likely to impact either of these species since actual launches will occur over the ocean and no new construction will be required. Construction of the new hazardous waste staging facility at Wallops Main Base will not impact either of these species since construction is not on the island. Construction of the new rocket motor storage building is unlikely to impact either species since it is located more than one-half mile from the peregrine nest and the beach area used by plovers.

This response relates only to endangered species under our jurisdiction. It does not address other U.S. Fish and Wildlife Service concerns under the Fish and Wildlife Coordination Act or other legislation. If you have any questions or need further assistance, please contact Cindy Schulz of this office at (804) 693-6694.

Sincerely,

For Karen L. Mayne
Supervisor
Virginia Field Office

CLINTON V. TURNER
COMMISSIONER

COMMONWEALTH of VIRGINIA

C. KERMIT SPRUILL, JR.
DIRECTOR

DEPARTMENT OF AGRICULTURE AND CONSUMER SERVICES
Division of Product and Industry Regulation
P. O. Box 1163, Richmond, Virginia 23209

July 15, 1992

Terry M. Potterton
Associate Chief, Health, Safety
and Security Office
Goddard Space Flight Center
Wallops Flight Facility
Wallops Island, VA 23337

RE: Endangered and Threatened Species in the Vicinity of Three Projects at Wallops Flight Facility

Dear Mr. Potterton:

This letter is in response to your request for information on state listed threatened or endangered plant or insect species in the vicinity of the three projects (SELV Project, Waste Staging Facility, Rocket Motor Storage Building) at the Wallops Flight Facility, Wallops Island, VA. To date, there are no known state listed endangered or threatened plant or insect species in the areas outlined on the maps that your submitted.

The Virginia Department of Agriculture and Consumer Services has jurisdiction over state listed plant and insect species only. Additional information on unique geologic formations, rare habitat and species, and candidates proposed for listing can be obtained from Mr. Chris Ludwig at the Division of Natural Heritage (804)786-7951. This information should be readily available from their database.

Thank you for your interest in the endangered or threatened plant and insect species in Virginia. If you have any questions or need any additional information, please contact me.

Sincerely,

John R. Tate
Office of Plant Protection
Endangered Species Coordinator

cc: Chris Ludwig
Sarah Pugh

COMMONWEALTH *of* VIRGINIA

Department of Game and Inland Fisheries

September 11, 1992

Ms. Pamela Whitman
Goddard Space Flight Center
Wallops Flight Facility
Wallops Island, Virginia 23337

Re: Assessment of Environmental Impact for three projects at Wallops Flight Facility (WFF)
Accomack County
ESSLOG # 4724

Dear Ms. Whitman:

We have reviewed the preliminary assessment of impacts upon endangered or threatened species of three proposed projects at Wallops Flight Facility. The following comments are submitted in accordance with provisions of the National Environmental Policy Act, and under authority of Title 29.1 (Game, Inland Fisheries and Boating) of the Code of Virginia. Based on our review of the material submitted, we do not anticipate significant adverse impacts upon endangered or threatened species to result from Project #1, Pegasus small expendable launch vehicle (SELV) project, or Project #2, construction of a new hazardous waste staging facility. Similarly, we do not anticipate significant impacts upon the peregrine falcon hacking tower and nest site, located approximately 1/2 mile from the proposed construction site, to result from Project #3, construction of a new rocket motor storage building. We do request that you continue to coordinate with the Department regarding the Project #3 construction schedule, so that we can avoid any potential impacts upon this federally endangered species. Thank you for the opportunity to comment on this preliminary environmental assessment. Please call me if we may be of further assistance.

Sincerely,

Raymond T. Fernald, Manager
Environmental Services Section

RTF/mbm

4010 WEST BROAD STREET, P.O. BOX 11104, RICHMOND, VA 23230-1104
(804) 367-1000 (V/TDD) *Equal Opportunity Employment Programs & Facilities* FAX (804) 367-9147

COMMONWEALTH of VIRGINIA

Hugh C. Miller, Director

Department of Historic Resources
221 Governor Street
Richmond, Virginia 23219

TDD: (804) 786-1934
Telephone (804) 786-3143
FAX: (804) 225-4261

August 18, 1992

Terry M. Potterton
Associate Chief, Health, Safety & Security Office
Goddard Space Flight Center
Wallops Flight Facility
Wallops Island, VA 23337

RE: New Rocket Storage Building, Wallops Island; VDHR # 92-1583-F
Pegasus Launch Vehicle (SELV), Wallops Island; VDHR # 92-1581-F

Dear Mr. Potterton:

Thank you for your letter of July 8, 1992 describing the above mentioned projects. Our staff has completed review of the project. Based on the information submitted, we have determined that the proposed undertaking will have no effect on historic properties.

Thank you for the opportunity to comment on this project. You have met the requirements of Section 106 of the National Histori8 Preservation Act of 1966, as amended. If you have any questions regarding staff review of the undertaking, or if we can provide further assistance, please contact Mary Harding Sadler or Antony F. Opperman.

Sincerely,

Bruce J. Larson
Project Review Supervisor