# DRAFT

# ENVIRONMENTAL IMPACT STATEMENT

# EVOLVED EXPENDABLE LAUNCH VEHICLE PROGRAM

DECEMBER 1997

## COVER SHEET

## DRAFT ENVIRONMENTAL IMPACT STATEMENT
## EVOLVED EXPENDABLE LAUNCH VEHICLE PROGRAM

a. Responsible Agency: U.S. Air Force

b. Cooperating Agency: Federal Aviation Administration (FAA)

c. Proposed Action: Implementation of the Evolved Expendable Launch Vehicle (EELV) Program

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e. Designation: Draft Environmental Impact Statement (DEIS)

f. Abstract: This DEIS has been prepared in accordance with the National Environmental Policy Act to analyze the potential environmental consequences of the Proposed Action and the No-Action Alternative. The Proposed Action is the development, deployment, and operation of EELV systems. EELV systems would replace current Atlas IIA, Delta II, and Titan IVB launch systems and are intended to meet the requirements of the U.S. government National Executable Mission Model (NMM), both medium and heavy lift, at a lower launch cost than the present expendable launch systems. The proposed launch locations for the program are Cape Canaveral Air Station (AS), Florida, and Vandenberg Air Force Base (AFB), California. Under the Proposed Action, three concepts were examined. Concepts A and B depict each of the two EELV contractor concepts. The number of launches analyzed for each of these concepts includes the government NMM, plus 16 commercial launches per year. Under Concept A/B, there is no distinction between government and commercial flights. For the analysis, each contractor is assumed to launch 50 percent of the combined total of EELV flights.

The No-Action Alternative would be a decision not to proceed with the EELV program. The Atlas IIA, Delta II, and Titan IVB launch vehicles would support space launches to meet the requirements of the NMM.

The DEIS includes analyses of potential impacts to local community (employment and population), land use and aesthetics, transportation, utilities, hazardous materials and hazardous waste management, health and safety, geology and soils, water resources, air quality (upper and lower atmosphere), noise, orbital debris, biological resources, cultural resources, and environmental justice.

Under the Proposed Action, the number of direct and indirect jobs, and population associated with launch activities at both installations, would increase temporarily. Thereafter, employment and population associated with launch activities would decline as the requirement for jobs associated with current launch programs declines. No impacts to land use, utility systems, or transportation networks are anticipated. Although quantities of hazardous materials utilized and hazardous waste generated may increase under the Proposed Action (due to the addition of commercial launches) over No-Action Alternative levels, both installations have appropriate management procedures in place in compliance with applicable regulations; therefore, no impacts are expected. No Class I ozone-depleting substances (ODSs) would be utilized under the Proposed Action; the use of Class II ODSs would be minimized or eliminated. Proposed Action construction activities at both installations would be coordinated with installation personnel to minimize impacts to remediation activities and the EELV program schedule. At both installations, procedures are in place to respond to unplanned launch events. Installation personnel and the general public are not predicted to be at risk during normal or aborted launches.

Appropriate erosion control measures (proper construction practices and compliance with permit requirements) would be implemented to reduce the potential for impacts to soils, geology, and water resources. A Storm Water Pollution Prevention Plan would be required at both

installations. Under both concepts, deluge water would be retained after launch and managed or treated in accordance with installation requirements. Under Concepts B and A/B, as well as the No-Action Alternative, temporary deposition of hydrochloric acid (HCl) and aluminum oxide associated with some commercial launches may result in a brief acidification of surface waters; however, no long-term impacts are expected.

During construction activities, there would be a short-term, temporary increase of local concentrations of criteria pollutants. Peak launch year emissions would not be sufficient to jeopardize the attainment status for criteria pollutants at either installation. EELV systems would have lower emissions per launch than No-Action Alternative systems, and no adverse impacts are anticipated. Because Vandenberg AFB is within an area designated by the U.S. Environmental Protection Agency as in nonattainment for ozone, EELV activities must comply with Clean Air Act requirements mandating that federal actions comply with the applicable State Implementation Plan to achieve attainment. Under Concept A, launches would produce no estimated emissions of ODSs, and therefore would not contribute to any degradation of the stratospheric ozone layer. For some Concept B and A/B commercial launches and for some No-Action Alternative launches involving use of solid rocket motors, alumina particulates and chlorine compounds would be emitted into the stratosphere; however, these amounts would be minimal, and no adverse impacts are expected. Launch and sonic boom noise would be short-term and temporary, and no impacts to structures or humans are anticipated. A small, incremental contribution to the existing orbital debris population could occur under the Proposed Action and the No-Action Alternative; however, all EELV program vehicles would be designed to minimize orbital debris.

At both installations, impacts to vegetation and wildlife would be minimal. At Vandenberg AFB, short-term impacts could occur to wildlife exposed to sonic booms; launches require a marine mammal take permit from the National Marine Fisheries Service; permit requirements may include monitoring during launches. Wetland areas that could be affected by Proposed Action construction activities would be mitigated in accordance with permit requirements. Dredging activities at the South Vandenberg AFB Boat Dock area would require a permit. Construction associated with the Proposed Action at Cape Canaveral AS would not affect any National Register of Historic Places (National Register)-listed or eligible prehistoric or historic archaeological sites, or archaeologically sensitive areas. No traditional resources have been identified in the Area of Potential Effect (APE) at either installation. Under Concept B, one facility that would require modification (Hangar C) may possess historical significance; a determination is pending. Mitigations, if required, would be developed in consultation with the Florida State Historic Preservation Officer. Construction associated with Concept B at Vandenberg AFB would occur at Space Launch Complex-6, which is an archaeologically sensitive area. Ground-disturbing activities would require archaeological and Native American monitoring. Because no construction or facility modifications are proposed under the No-Action Alternative, there would be no effects to historic properties. Activities associated with the Proposed Action and the No-Action Alternative would not cause disproportionately high and adverse impacts to low-income and minority populations.

# SUMMARY

## PURPOSE OF AND NEED FOR ACTION

The primary requirement of the Evolved Expendable Launch Vehicle (EELV) program is to provide the capability for lifting medium (2,500 to 17,000 pounds) and heavy (13,500 to 41,000 pounds) payloads to orbit according to the National Executable Mission Model (NMM) for government space launches at lower recurring costs than those of current expendable systems. The EELV would replace current Atlas IIA, Delta II, and Titan IVB launch vehicles meeting the NMM. The launch vehicle would support military, intelligence, and civil contractor launches and would be DoD's source of expendable medium and heavy space lift transportation to orbit through 2020.

The Air Force has prepared this environmental impact statement (EIS) to provide information on the potential impacts resulting from the development and operation of EELV systems. Because commercial launches are included in the Proposed Action, the Federal Aviation Administration (FAA) is serving as a cooperating agency in the preparation of this EIS.

## ALTERNATIVES INCLUDING THE PROPOSED ACTION

**Proposed Action.** The Air Force is considering participation in the continued development and deployment of EELV systems. These systems would be unmanned, expendable space launch systems evolved from existing systems. The EELV family of vehicles would consist of medium launch vehicles (MLVs) and heavy launch vehicles (HLVs).

Cape Canaveral Air Station (AS), Florida, and Vandenberg Air Force Base (AFB), California are the only locations within the United States that currently provide space launch capabilities to support the EELV program. Both the MLV and HLV would be designed so that all launch vehicle configurations could be launched from both locations.

As a result of the Air Force implementation of EELV, one or more contractors may use EELV systems to launch commercial payloads. The proposed government and commercial launch activities for both contractors are discussed and their impacts analyzed.

The government portion of the EIS mission model is based on the Air Force Space Command (AFSPC) NMM. Information included in the AFSPC NMM for both the east and west coasts includes vehicle types and proposed payload. The commercial portion of the mission model used in this EIS was created using commercial forecasts from the AFSPC NMM, the Commercial Space Transportation Advisory Council (COMSTAC) projections, and FAA estimates. The projected peak launch rate at Cape Canaveral AS would be achieved in 2015, and the projected peak launch rate at Vandenberg AFB would be achieved in 2007.

This EIS analyzes three options for implementing the Proposed Action. Concepts A and B depict each of the two EELV contractor concepts: that of

the Lockheed Martin Corporation and that of McDonnell Douglas Aerospace, a wholly owned subsidiary of the Boeing Company. The number of launches analyzed for each of these concepts includes the government NMM, plus 16 commercial launches per year. Under these concepts, only one of the two contractors would continue to develop and use an EELV system. The third option, Concept A/B, depicts a scenario under which both contractors would continue with the development and use of EELV systems. Under Concept A/B, no distinction is made between government and commercial flights. For the EIS analysis, each contractor is assumed to launch 50 percent of the combined total of EELV flights.

Under Concept A, Space Launch Complex (SLC)-41 at Cape Canaveral AS and SLC-3W at Vandenberg AFB would be utilized for EELV launches. Under Concept B, SLC-37 at Cape Canaveral AS and SLC-6 at Vandenberg AFB would be utilized for EELV launches. In addition to the launch complexes, other facilities at both locations would be utilized for both concepts. All of the facilities used for Concept A and Concept B activities would be utilized under Concept A/B.

**No-Action Alternative.** The No-Action Alternative would be a decision not to proceed with the development and deployment of the EELV program. The Atlas IIA, Delta II, and Titan IVB launch vehicles would continue to support space launches to meet the requirements of the government portion of the NMM. These launch vehicles would provide DoD's source of expendable medium and heavy spacelift transportation to orbit through 2020. The No-Action Alternative does not include analysis of commercial launches.

## SCOPE OF STUDY

In order to establish the context in which environmental impacts may occur, potential changes in population and employment, land use and aesthetics, transportation, and utility services are discussed, as are issues related to current and future management of hazardous materials and wastes. Additionally, health and safety issues are examined. Potential impacts to the natural environment are evaluated for geology and soils, water resources, air quality, noise, orbital debris, biological resources, and cultural resources. Potential environmental justice impacts to minority and/or low-income populations that could occur as a result of the EELV program are also considered.

## SUMMARY OF ENVIRONMENTAL IMPACTS

Following is a brief description of potential environmental impacts of the Proposed Action and No-Action Alternative. Options for mitigating potential adverse environmental impacts that might result from development and operation of EELV systems are presented and discussed, where applicable.

## LOCAL COMMUNITY

### Proposed Action

The number of direct and indirect jobs, and population associated with launch activities at both installations, would increase temporarily during construction

activities. Thereafter, employment and population associated with launch activities would decline as the requirement for jobs associated with current launch vehicle programs declines. This decline in employment and population would be very small in comparison to projected regional growth around both installations.

**No-Action Alternative**

Under the No-Action Alternative, the number of direct and indirect jobs would remain at 1997 levels through 2015. Population and employment in the region are projected to increase through 2015.

## LAND USE AND AESTHETICS

**Proposed Action**

Incompatible land uses would not result from implementation of the EELV program. A federal coastal zone consistency determination would be required for EELV activities at both installations. At Vandenberg AFB, more frequent annual beach closures are expected from EELV launch activities because of the increased number of launches (due to the addition of commercial launches) over the No-Action Alternative.

**No-Action Alternative**

Under the No-Action Alternative, no construction or facility modification would occur. The number of annual beach closures at Vandenberg AFB would be similar to that of current closures.

## TRANSPORTATION

**Proposed Action**

During construction activities, project-related traffic would increase slightly over No-Action Alternative levels. During the operational phase of the EELV program, project-related traffic is expected to decline, and no impacts are anticipated.

**No-Action Alternative**

Under the No-Action Alternative, project-related traffic would continue at existing volumes, and no impacts are expected.

## UTILITIES

**Proposed Action**

During construction activities, utility consumption would increase slightly over No-Action Alternative levels; however, all systems would continue to operate within capacity. During the operational phase, utility usage on the installations would increase. However, utility usage associated with existing launch vehicle programs would decline, and the EELV-related increases

would be minimal in comparison to regional growth; therefore, no impacts are expected.

**No-Action Alternative**

Under the No-Action Alternative, no changes in current utility consumption are expected. All systems would continue to operate within capacity, and no impacts are anticipated.

## HAZARDOUS MATERIALS AND WASTE

**Proposed Action**

Under Concept A, total hazardous materials and propellant usage is expected to increase over No-Action Alternative levels; per launch usage is expected to decrease. Activities would be conducted in accordance with existing regulations for the use and storage of hazardous materials. Solid rocket motors would not be used for Concept A activities, thus eliminating the need for storage of solid propellant. Hazardous waste generation would increase over 1996 amounts due to the increased number of launches (due to the addition of commercial launches) over the No-Action Alternative. The types of waste would be similar in nature to wastes currently handled by both installations. No Class I ozone-depleting substances (ODSs) would be used for Concept A activities.
Under Concept B, total hazardous materials usage is expected to decrease from No-Action Alternative levels; however, the amount of propellants stored would increase. Activities would be conducted in accordance with existing regulations for the use and storage of hazardous materials. Hazardous waste generation would increase over 1996 amounts due to the increased number of launches (due to the addition of commercial launches) over the No-Action Alternative. The wastes would be similar in nature to wastes routinely handled by both installations. No Class I ODSs would be used for Concept B activities.

Construction activities associated with Concepts A and B at both installations would be coordinated with Installation Restoration Program personnel to minimize impacts to remediation activities and the EELV program schedule.

Under Concept A/B, total hazardous materials and propellants usage and hazardous waste generated would increase at both installations as a result of the increased number of launches (due to the addition of commercial launches) over the No-Action Alternative. Other aspects of hazardous materials and waste management would be a combination of the effects described for Concepts A and B.

**No-Action Alternative**

Under the No-Action Alternative, types and amounts of hazardous materials utilized and hazardous wastes generated would be similar to those associated with current launch programs.

## HEALTH AND SAFETY

### Proposed Action

At both installations, procedures are in place for unplanned launch events, fire protection, alarm, fire suppression, flight termination, and explosive safety. Installation personnel and the general public are not predicted to be at risk during normal or aborted launches.

### No-Action Alternative

Under the No-Action Alternative, both installations would continue to implement current health and safety procedures. Installation personnel and the general public are not predicted to be at risk during normal or aborted launches.

## GEOLOGY AND SOILS

### Proposed Action

Construction activities would uncover and disturb soils, increasing the potential for wind and water erosion; appropriate measures to control soil erosion would be implemented, and no adverse impacts are expected. At Vandenberg AFB, new facilities and facility modifications would incorporate earthquake-resistant design to meet requirements for Seismic Zone IV, and no adverse impacts are anticipated. In addition, under Concept B and Concept A/B, the South Vandenberg AFB boat dock area would be dredged. The dredging would be performed to its previous depth in a previously dredged area, thus eliminating impacts to undisturbed sediments.

### No-Action Alternative

Under the No-Action Alternative, no changes to existing launch programs would take place. No ground disturbance would occur, and no impacts are expected.

## WATER RESOURCES

### Proposed Action

Under Concept A, peak-year deluge water requirements would represent a decrease from No-Action Alternative levels. Under Concepts B and A/B, peak-year deluge requirements would increase over No-Action Alternative levels (due to addition of commercial launches). EELV activities would not affect the quantity of water available to the installations or to the surrounding areas, or increase the amount of water withdrawn from groundwater resources. A Storm Water Pollution Prevention Plan would be required at both installations. Under both concepts, deluge water would be retained after launch and managed or treated in accordance with installation requirements.

Concept B and Concept A/B dredging activities at the South Vandenberg AFB Boat Dock would require a permit. Under Concepts B and A/B, deposition of hydrochloric acid (HCl) associated with the use of solid rocket motors for some launches (commercial missions only) may result in a brief

acidification of surface waters; however, no long-term impacts are expected. Adverse impacts to surface water and groundwater are not anticipated.

**No-Action Alternative**

Under the No-Action Alternative, deluge water requirements would not impact the quantity of water available to either installation. Existing launch vehicles use some solid rocket motors, so impacts would be similar to those described for solid rocket motors for Concept B. Adverse impacts to water resources are not anticipated.

## AIR QUALITY (LOWER ATMOSPHERE)

**Proposed Action**

During construction activities, there would be an increase of local concentrations of criteria pollutants. However, these emissions would be temporary and short-term and would not jeopardize either region's attainment status for these pollutants. Application of water during ground-disturbing activities and efficient scheduling of equipment use would mitigate impacts during construction. Launch vehicle preparation and assembly activities would create short-term air emissions. EELV systems would have lower emissions than the current launch vehicle systems, on a per launch basis, and no adverse impacts are expected.

Because Vandenberg AFB is within an area designated by the U.S. Environmental Protection Agency (EPA) as in nonattainment for ozone, EELV program activities must comply with Clean Air Act requirements mandating that federal actions comply with the applicable State Implementation Plan to achieve attainment.

**No-Action Alternative**

Under the No-Action Alternative, nitrogen oxides ($NO_x$) emissions would be lower than those projected for the Proposed Action. This difference could be due, in part, to the smaller number of launches analyzed under the No-Action Alternative. No adverse impacts are expected.

## AIR QUALITY (UPPER ATMOSPHERE)

**Proposed Action**

Under Concept A, launches would produce no estimated emissions to the stratosphere of any ODSs, and therefore would not contribute to any degradation of the stratospheric ozone layer. Under Concept B, launches that involve use of solid rocket motors (commercial missions only) would produce emissions of alumina particulates and chlorine compounds into the stratosphere; however, compared to baseline and No-Action Alternative emissions to the stratosphere, these amounts would be minimal, and adverse impacts are not anticipated.

**No-Action Alternative**

The emissions of alumina particulates and chlorine into the stratosphere would be greater under the No-Action Alternative than emissions resulting from the Proposed Action because of the larger number of launches utilizing solid rocket motors. However, these emissions are minimal compared to worldwide emissions of alumina particulates and chlorine compounds to the stratosphere, and no adverse impacts are anticipated.

## NOISE

### Proposed Action

Launch noise associated with EELV launches would be short-term and temporary. No human or structural impacts are anticipated. Sonic boom footprints for Cape Canaveral AS launches are far offshore over the Atlantic Ocean. At Vandenberg AFB, sonic booms could occur over the Channel Islands, and one proposed Concept A launch trajectory would result in a sonic boom over a portion of the California coastline. However, because of the small amplitude of the boom, no impacts are expected.

### No-Action Alternative

Under the No-Action Alternative, noise and sonic boom exposure would be similar to current launch operation levels, which are comparable to those described under the Proposed Action. No impacts from noise and sonic boom are anticipated.

## ORBITAL DEBRIS

### Proposed Action

A small, incremental contribution to the existing orbital debris population could occur under all EELV concepts through fragmentation of upper stages. However, EELV program vehicles would be designed to minimize size and quantity of orbital debris.

### No-Action Alternative

The No-Action Alternative launch vehicles would continue to contribute to the orbital debris population.

## BIOLOGICAL RESOURCES

### Proposed Action

At both installations, impacts to vegetation and wildlife would be minimal. Launch noise and sonic booms associated with EELV launches would be infrequent, short-term, and temporary. No noise impacts to wildlife are anticipated at Cape Canaveral AS. Temporary, minor impacts to sensitive species (startle effects) would occur from sonic booms at Vandenberg AFB; launches require a marine mammal take permit from the National Marine Fisheries Service. Permit requirements may include monitoring during launches.

At Cape Canaveral AS, any changes to artificial light sources would be designed to minimize impacts to sea turtles.

Under Concept A, the potential loss of jurisdictional wetlands at SLC-41 and at assembly facilities sites would be mitigated, as required, through appropriate permits. Mitigations could include replacement, protection, restoration, or avoidance. At Vandenberg AFB, proposed construction activities at SLC-3 have been designed to avoid the wetland present at the site.

Under Concept B, effects of HCl deposition from solid rocket motors at both installations would be minimal and temporary; pre- and post-launch monitoring would be conducted to assess long-term effects. At Cape Canaveral AS, vegetation impacts associated with clearing scrub jay habitat for construction of the Horizontal Integration Facility south of SLC-37 would be compensated under the Cape Canaveral AS Scrub Jay Habitat Compensation Plan. The potential loss of jurisdictional wetlands at SLC-37 would be mitigated, as required, through appropriate permits. Impacts to the southeastern beach mouse east of SLC-37 from fire and heat from the flame duct could be mitigated through a trapping and relocation effort and through habitat restoration. Prior to construction activities, a biological survey would be conducted to identify and relocate gopher tortoises at SLC-37.

Under Concept B at Vandenberg AFB, construction of the security fence at SLC-6 would disturb a 25-foot by 60-foot arroyo wetland and a Section 404 permit may be required. Dredging activities at the South Vandenberg AFB Boat Dock area would require a permit.

Implementation of Concept A/B is expected to result in a combination of the effects described previously for Concepts A and B.

### No-Action Alternative

Under the No-Action Alternative, the continued use of some solid rocket motors would result in temporary deposition of HCl, but effects on biological resources from such deposition would be minimal. Other direct effects to vegetation and wildlife would be similar to those discussed for Concepts A and B.

## CULTURAL RESOURCES

### Proposed Action

Construction associated with the Proposed Action at Cape Canaveral AS would not affect any National Register of Historic Places (National Register)-listed or eligible prehistoric or historic archaeological sites, or archaeologically sensitive areas. Under Concept B, one facility that would require modification (Hangar C) may possess historical significance; a determination is pending. Mitigations, if required, would be developed in consultation with the Florida State Historic Preservation Officer (SHPO). No traditional resources have been identified in the Area of Potential Effect (APE).

Construction associated with Concept A at Vandenberg AFB would not affect any National Register-listed, eligible, or potentially eligible prehistoric or historic archaeological sites. Construction associated with Concept B at Vandenberg AFB would occur at SLC-6, which is an archaeologically sensitive area. Ground-disturbing activities would require archaeological and Native American monitoring. Under Concept A, Building 8510 has been determined to be eligible to the National Register of Historic Places under the Cold War historic context; however, no modifications are required at this facility and no adverse impacts are anticipated. No traditional resources have been identified in the APE.

**No-Action Alternative**

Under the No-Action Alternative, existing facilities would continue to support the current launch vehicle programs. However, no new construction or facility modifications have been proposed; therefore, no effects on historic properties are expected.

## ENVIRONMENTAL JUSTICE

Activities associated with the Proposed Action would not cause disproportionately high and adverse impacts to low-income and minority populations.

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# 1.0 PURPOSE OF AND NEED FOR ACTION

This environmental impact statement (EIS) examines the potential for impacts to the environment as a result of the development, deployment, and operation of Evolved Expendable Launch Vehicle (EELV) systems. The proposed launch locations for the EELV program activities are Cape Canaveral Air Station (AS), Florida, and Vandenberg Air Force Base (AFB), California. For the purposes of this document, EELV systems consist of one or more families of vehicles that could replace Atlas IIA, Delta II, and Titan IVB launch vehicles. A glossary of terms, acronyms, and abbreviations used in this document is provided in Appendix A.

## 1.1 PURPOSE AND NEED

In 1994, representatives from the defense, intelligence, civil, and commercial space sectors developed a Space Launch Modernization Plan (SLMP) to evaluate national space launch systems and to improve the United States' launch capability. The SLMP contained four alternatives for the modernization of the United States' space launch capabilities:

- Sustain existing launch systems
- Evolve current expendable launch systems (EELV)
- Develop a new, expendable launch system
- Develop a new, reusable launch system.

On August 5, 1994, the President signed the National Space Transportation Policy, tasking the Secretary of Defense to provide an implementation plan for improvement and evolution of the current Expendable Launch Vehicle fleet. On October 25, 1994, the Deputy Secretary of Defense signed the National Space Implementation Plan for National Space Transportation Policy, which identified the EELV program as the Department of Defense's (DoD's) solution for reducing the cost of launches.

The primary governmental requirement of EELV systems is to provide the capability for lifting medium (2,500 to 17,000 pounds) and heavy (13,500 to 41,000 pounds) payloads to orbit according to the National Executable Mission Model (NMM) for government space launches at lower recurring costs than those of current expendable systems.

## 1.2 DECISION TO BE MADE

The Air Force will decide whether to participate in the development and operation of EELV systems. Participation may include funding development of EELV systems, purchase of launch vehicles or services, and/or Air Force authorization of the use of government property.

## 1.3 SCOPE

This document has been prepared in accordance with the National Environmental Policy Act (NEPA) of 1969, the Council on Environmental Quality (CEQ) regulations implementing NEPA, Air Force Instruction (AFI) 32-7061, and DoD Regulation 5000.2R.

### 1.3.1 Public Participation Process

The public participation process provides an opportunity for public involvement in the development of an EIS. The Notice of Intent (NOI) (Appendix B) to prepare an EIS for the development and deployment of the EELV program was published in the Federal Register on February 19, 1997. Notification of public scoping was also made through the local media, as well as through letters to federal, state, and local agencies and officials, and interested groups and individuals.

The scoping period for the EELV program began on February 19, 1997. The Air Force held two public meetings during the scoping period to solicit comments and concerns from the general public: at Cape Canaveral, Florida, on March 11, 1997, and in Lompoc, California, on March 13, 1997. In addition to verbal comments accepted at these meetings, written comments were received during the scoping process. The Air Force used these comments, as well as NEPA requirements and information from previous Air Force programs, to determine the scope and direction of studies/analyses to accomplish this EIS.

This draft EIS (DEIS) was filed with the U.S. Environmental Protection Agency (EPA). The DEIS will be circulated for public review and comment for at least 45 days (Appendix C). All substantive written comments, as well as oral comments received at the public hearings, will be addressed in the final EIS (FEIS). The FEIS will be filed with the U.S. EPA; the Air Force may publish a Record of Decision (ROD) after a 30-day FEIS review period.

### 1.3.2 Scope of the EIS

This EIS is limited to the consideration of government and commercial activities directly associated with the EELV systems (e.g., construction, operation). The environmental effects of payloads that would utilize these systems to reach orbit shall be addressed, as required, under separate NEPA documentation that would be prepared for each of the satellite programs.

As a part of the scoping process, the Air Force made the decision to include analysis of the potential commercial launch operations of each of the two EELV contractors described in this EIS. It is likely that any contractor selected to conduct government EELV activities would also request use of the same facilities and EELV vehicle to launch commercial payloads. Therefore, to provide a complete analysis of potential environmental impacts of the implementation of the EELV program, Section 2.1 describes both the proposed government and commercial launch activities. It should be noted that although this analysis includes commercial launch operations, these operations may be increased, reduced, or modified depending on the actual commercial markets. Additional NEPA documentation may be required.

The Commercial Space Launch Act of 1984 (Public Law [P.L.] 98-575), as codified, 49 United States Code (U.S.C.) Subtitle IX, Ch. 701, Commercial Space Launch Activities (CSLA), declares that the development of commercial launch vehicles and associated services is in the national and economic interest of the United States. To ensure that launch services provided by

private enterprises are consistent with national security and foreign policy interests of the United States and do not jeopardize public safety and safety of property, the Department of Transportation (DOT) is authorized to regulate and license U.S. commercial launch activities. Within DOT, the Secretary's authority under CSLA has been delegated to the Federal Aviation Administration (FAA). Because licensing launch operations is considered to be a major federal action subject to the requirements of NEPA, the FAA Office of the Associate Administrator for Commercial Space Transportation must assess the potential environmental impacts of an applicant's proposed actions. Because of the addition of commercial activities, the FAA is serving as a cooperating agency in the preparation of this EIS. The FAA may use this EIS to document its NEPA requirement.

Other facilities would be utilized for manufacturing and/or operational and developmental testing and evaluation in support of the EELV systems. These facilities (including facilities belonging to contractors) and their operation are independent of this proposed government action. Operational test and evaluation activities would be limited to data gathering associated with operational launches; there would be no separate launches for testing purposes only.

## 1.4 RELEVANT FEDERAL PERMITS, LICENSES, AND ENTITLEMENTS

The representative federal permits, licenses, and entitlements that may be required of the EELV program are presented in Appendix D. More detailed discussions of environmental regulations are provided in the appropriate resource sections of Chapters 3.0 and 4.0.

# 2.0 ALTERNATIVES INCLUDING THE PROPOSED ACTION

This section describes the Proposed Action and the No-Action Alternative. The Proposed Action (Section 2.1) is implementation of the EELV program. The No-Action Alternative (Section 2.2) involves the continuation of current launch vehicle systems to meet the requirements of government spacelift transportation programs under the NMM.

## 2.1 DESCRIPTION OF THE PROPOSED ACTION

The U.S. Air Force is considering participation in the continued development and deployment of EELV systems to replace current Atlas IIA, Delta II, and Titan IVB launch systems. The EELV systems are intended to meet the requirements of the U.S. government NMM, both medium and heavy lift, at a lower launch cost than the present expendable launch systems. The EELV System Performance Document (SPD) identifies additional requirements and goals that must be implemented by the contractors for development of the EELV system (Appendix E). The EELV would be DoD's source of expendable medium and heavy spacelift transportation to orbit through 2020. EELV systems would provide capabilities to launch unmanned DoD, National Aeronautics and Space Administration (NASA), and other payloads to orbit. Cape Canaveral AS and Vandenberg AFB are the only locations within the United States that currently provide space launch capabilities sufficient to support EELV systems.

The 45 Space Wing (SW) manages Cape Canaveral AS, conducts East Coast space and missile launch operations, and manages the Eastern Range (ER), which provides continuous and complementary instrumentation coverage over a broad portion of the Atlantic Ocean. The 30 SW manages Vandenberg AFB, conducts West Coast space and missile operations, and manages the Western Range (WR), which provides continuous and complementary instrumentation coverage over a broad portion of the Pacific Ocean.

As a result of the Air Force implementation of the EELV program, one or more contractors may use EELV systems to launch commercial payloads. For this reason, both government and commercial use of EELV systems are analyzed in this EIS. A combined government/commercial mission model was developed for this purpose.

The government portion of the EIS mission model, based on the Air Force Space Command (AFSPC) NMM (dated July 1997), includes the total number of DoD and NASA space vehicle launches scheduled through 2020. Information in the AFSPC NMM for both the east and west coasts includes vehicle types and proposed payload. The commercial portion of the mission model used in this EIS was created using commercial forecasts from the AFSPC NMM, the Commercial Space Transportation Advisory Council (COMSTAC) projections, and FAA estimates. The projected peak launch rate at Cape Canaveral AS would be achieved in 2015, and the projected peak launch rate at Vandenberg AFB would be achieved in 2007.

This EIS analyzes three options for implementing the Proposed Action. Concepts A and B depict each of the two contractor EELV concepts: that of the Lockheed Martin Corporation (described as Concept A in Section 2.1.1) and that of McDonnell Douglas Aerospace, a wholly owned subsidiary of the Boeing Company (described as Concept B in Section 2.1.2). Both of these proposed systems are evolved from current launch vehicle systems. The number of launches analyzed under both concepts for the EIS includes the government NMM, plus 16 commercial launches per year. Under these concepts, only one of the two contractors would continue to develop and use an EELV system. The third option, Concept A/B (described in Section 2.1.3), depicts a scenario under which both contractors would continue with the development and use of EELV systems. Under Concept A/B, no distinction is made between government and commercial flights. For the EIS analysis, each contractor is assumed to launch 50 percent of the combined total of EELV flights.

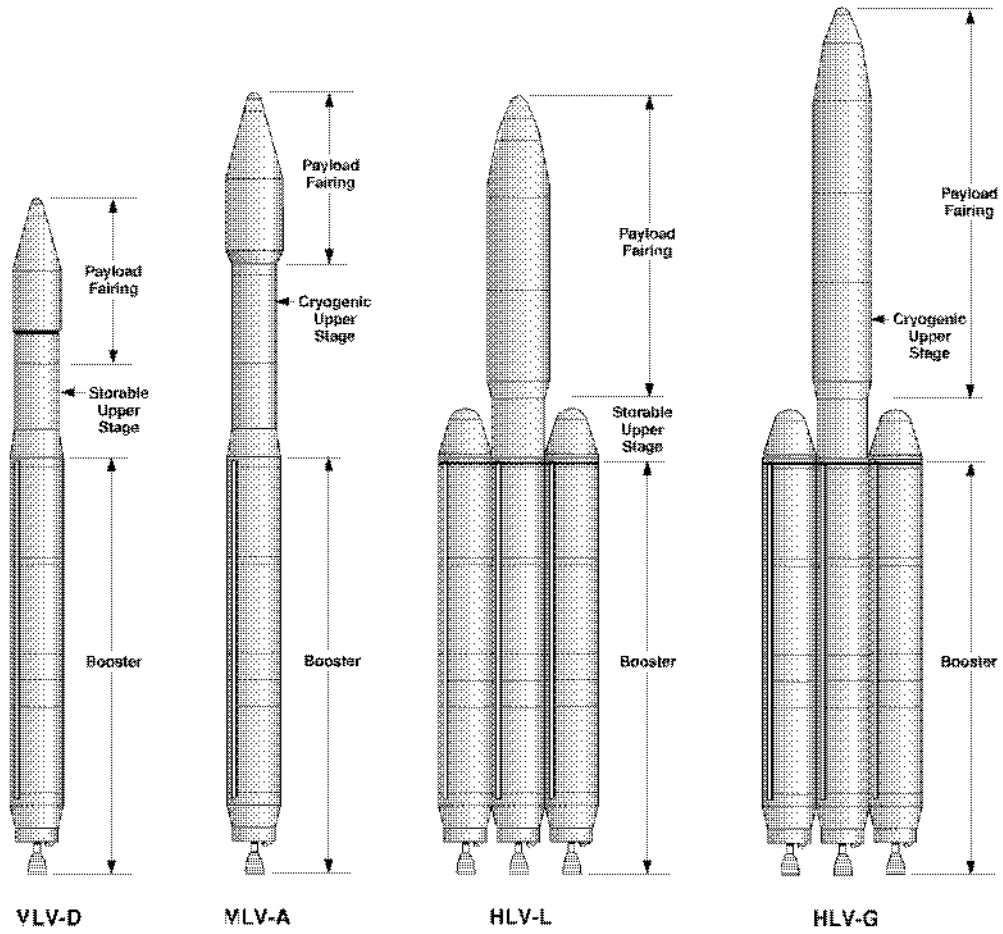
Predicting a precise EELV mission model for both government and commercial flights through the life of this dynamic program is difficult. These mission models are the most accurate estimates that can be made at this time and are intended to identify the range of activities that may occur with implementation of the EELV program.

### 2.1.1 Concept A

Under Concept A, the contractor would use Space Launch Complex (SLC)-41 at Cape Canaveral AS and SLC-3W at Vandenberg AFB for EELV system activities, as well as other facilities at both locations.

The following is a general description of the launch vehicle and facility requirements for Concept A. Specific descriptions for implementation of this concept at Cape Canaveral AS and Vandenberg AFB follow the general description. Construction would include modifications to existing facilities and construction of new facilities. Most of the components (boosters, upper stages, and avionics modules) would be assembled before shipment to the launch site (i.e., Cape Canaveral AS or Vandenberg AFB) in flightworthy condition.

**2.1.1.1 Launch Vehicle Concept.** The EELV family of vehicles would consist of two configurations of medium lift variant (MLV) (MLV-D and MLV-A) and two configurations of heavy lift variant (HLV) (HLV-L and HLV-G) as shown in Figure 2.1-1. MLVs would use one booster; HLVs would use three boosters. MLV-D and HLV-L configurations would use a Storable Upper Stage (SUS), while MLV-A and HLV-G configurations would use a Cryogenic




**EXPLANATION**

HLV Heavy Lift Variant

MLV Medium Lift Variant

**Concept A Launch Vehicle Concept**

NOT TO SCALE

**Figure 2.1-1**

EELV/045

Upper Stage (CUS). Table 2.1-1 provides data for the launch vehicle components.

**Table 2.1-1. Launch Vehicle Components, Concept A**

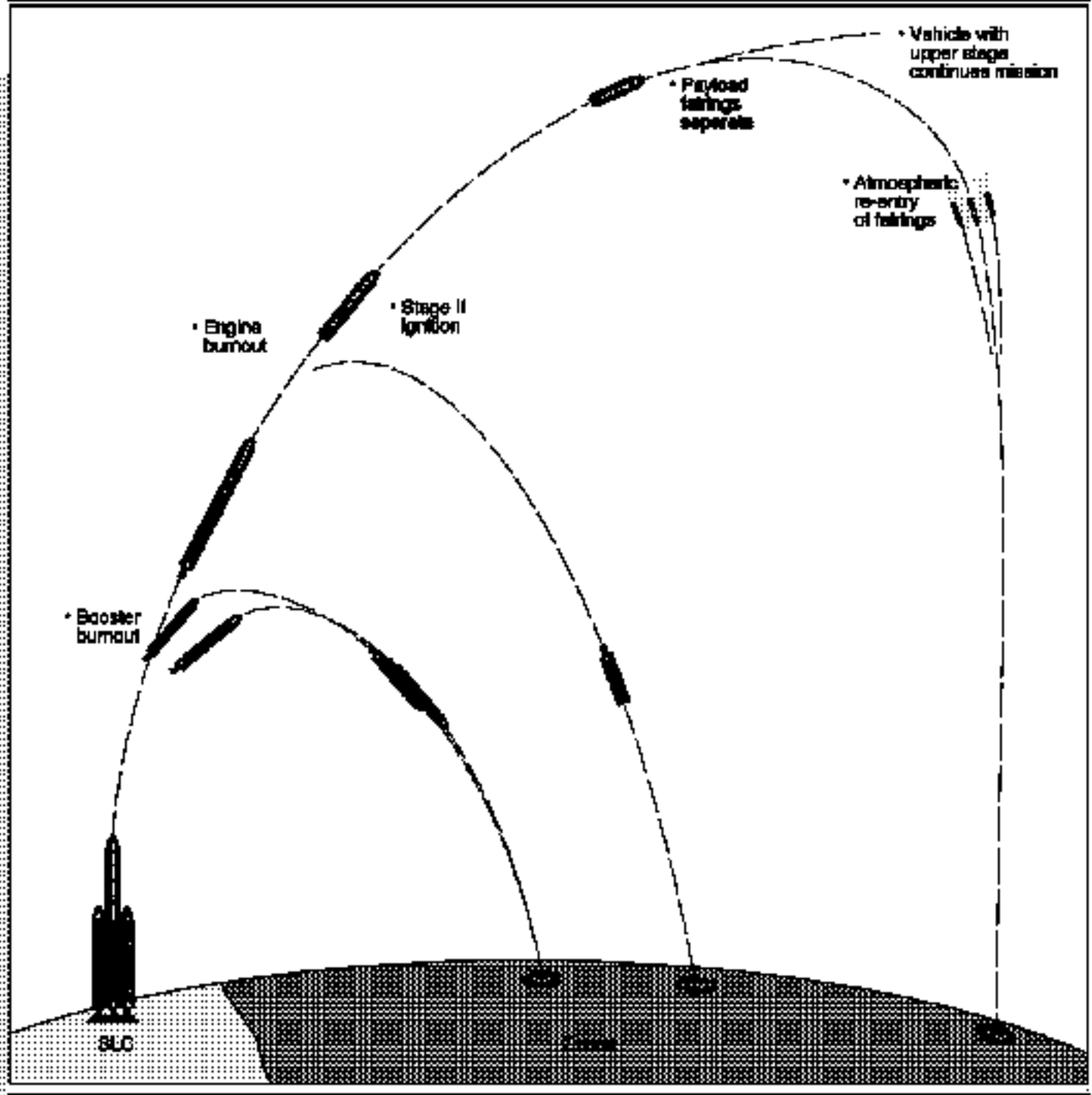
| Launch Vehicle Component | Launch Vehicle | Propellant (lbs) | Fueling Location | Reaction Control System (lbs) | RCS Loading Location |
|---|---|---|---|---|---|
| Booster | MLV | RP-1 (<200,000)<br>$LO_2$ (<500,000)<br>PG-2 (<100) | Launch Pad | NA | NA |
| Booster (3 per vehicle) | HLV | RP-1 (<600,000)<br>$LO_2$ (<1,500,000)<br>PG-2 (<300) | Launch Pad | NA | NA |
| CUS | MLV-A/HLV-G | $LH_2$ (<8,000)<br>$LO_2$ (<40,000) | Launch Pad | $N_2H_4$<br>MLV (<200)<br>HLV (<400) | Assembly Facility |
| SUS | MLV-D/HLV-L | MMH (<11,000)<br>$N_2O_4$ (<20,000) | Launch Pad | $N_2H_4$<br>MLV (<200)<br>HLV (<200) | Assembly Facility |

CUS = Cryogenic Upper Stage
HLV = heavy lift variant
lbs = pounds
$LH_2$ = liquid hydrogen
$LO_2$ = liquid oxygen
MLV = medium lift variant
MMH = monomethyl hydrazine
NA = not applicable
$N_2H_4$ = anhydrous hydrazine
$N_2O_4$ = nitrogen tetroxide
PG-2 = triethyl boron/triethyl aluminum
RCS = reaction control system
RP-1 = rocket propellant-1 (kerosene fuel)
SUS = Storable Upper Stage

All Concept A launch vehicles would use the Russian-designed RD-180 booster engine, which is fueled by kerosene fuel (rocket propellant [RP-1]) and liquid oxygen ($LO_2$) and ignited by triethyl boron/triethyl aluminum (PG-2). Avionics would be used for guidance, power, telemetry, ordnance separation, and range safety. The Flight Termination System (FTS) would provide the capability for range safety personnel to terminate a vehicle undergoing erratic flight before it could endanger people and property.

Figure 2.1-2 shows a representative launch vehicle ascent sequence. After they are expended, the boosters would fall into the ocean and would not be recovered. The payload fairings would separate from the vehicle prior to orbit and fall into the ocean; they would not be recovered. The upper stage (CUS or SUS) of the space launch vehicle boosts the satellite into orbit, where the launch vehicle separates from the satellite. Residual propellant within the CUS would be vented to minimize orbital debris caused by breakup.

**2.1.1.2 Primary Support Structures.** Various support structures and equipment would be necessary to process and launch the vehicle. These would consist of structures at the proposed launch complex (i.e., SLC-41 or SLC-3W), as well as facilities and utilities located elsewhere on the launch




**EXPLANATION**

SLC Space Launch Complex

**Representative Ascent Sequence**

NOT TO SCALE

**Figure 2.1-2**

site. The primary support structures and equipment that would be required at both Cape Canaveral AS and Vandenberg AFB are described in the following paragraphs. Facility locations at each launch site are described for Cape Canaveral AS in Section 2.1.1.6 and for Vandenberg AFB in Section 2.1.1.9.

**Unloading Facilities.** Flight hardware transported by truck would be unloaded to the appropriate processing facilities or to storage facilities until needed for launch. Hardware delivered by cargo aircraft would be unloaded at the airstrips at both locations.

**Storage Facilities.** The EELV program would require storage of flight hardware to meet launch responsiveness requirements.

**Vehicle Processing Facilities (VPFs).** These facilities would be used for booster and upper-stage processing (e.g., installation of interstage adapters, payload fairings, and booster nose cones; installation of batteries and destruct ordnance into the upper stages and boosters).

**Payload Processing Facilities (PPFs).** Preprocessed and fueled payloads would be encapsulated within these facilities; payload processing and encapsulation would occur within existing PPFs. The payload would be inspected at these facilities; any final assembly and checkout would be conducted, and, if required, storable propellant would be loaded on the payload.

**Assembly Facilities.** The launch vehicle would be assembled on the launch platform associated with the assembly facility. The fuel servicing systems, including vapor abatement as required, support all off-pad hydrazine load and emergency detanking operations. Other services that would be provided in this facility include transferring gaseous nitrogen ($GN_2$) and gaseous helium (GHe) into the launch vehicle for reaction control and systems verification. When vehicle assembly is complete, the launch system would be moved on rails to the launch pad for propellant loading, final check out, and launch.

**Launch Pad.** Each launch pad would consist of a deck, launch platform rails, hardpoints and tiedowns, vehicle servicing connections to the launch platform, pad water systems, and equipment housing. The launch pad would also contain launch exhaust ducts that direct the exhaust flame from the launch vehicle for safe dispersal away from the launch deck and complex. Vehicle servicing on the pad includes, as required, transfer of $GN_2$, GHe, and propellants into the launch vehicle. Propellant vapor abatement systems and a hydrogen vent stack would be provided at the launch pad. The hydrogen flare stack pilot would use propane at Cape Canaveral AS and natural gas at Vandenberg AFB.

**Launch Control Support.** The launch control support facilities include one launch control center at each range. The EELV launch control centers would interface with the Range Operations Control Center (ROCC).

**Propellant and Gas Holding Areas.** Propellant holding areas would be used to store RP-1, $LO_2$, liquid hydrogen ($LH_2$), monomethyl hydrazine (MMH), and nitrogen tetroxide ($N_2O_4$). The gas storage area would include storage and handling facilities for GHe and $GN_2$; the propellant and gas holding areas

would be located at the SLC. Secondary containment for propellants would be sized to contain a minimum of 110 percent of the stored commodity tank volume.

An RP-1 tank, pump, and piping system would be used for the common booster. This would include a 90,000-gallon RP-1 tank, an unloading area, pumps, a piping system, secondary containment, and a leak detection system. Piping to the launch pad would be installed. In addition, $LO_2$ tanks and a piping system would be required for the common booster. Facilities would include two 300,000-gallon tanks, an unloading area, pumps, and a piping system.

An $LH_2$ fuel tank and piping system would be required for the CUS. Facilities would include a 55,000-gallon tank farm, an unloading area, pumps, a piping system, secondary containment, a leak detection system, a flare stack to burn excess vapor, a fire suppression/deluge system, power, and instrumentation. Piping to the launch pad would be installed. In addition, an $LO_2$ storage (28,000 gallons) and servicing area would be required for the CUS.

Requirements for the SUS propellant systems include mobile MMH and $N_2O_4$ storage tanks, propellant conditioning units, and scrubbers. The double-walled storage tanks (2,500 gallons each) are truck-mounted and DOT-certified. The propellant conditioning units maintain the required temperature during SUS loading. Existing scrubbers would be used for vapor abatement at both sites. The systems would also include tanks for temporary storage of waste fuels, piping, secondary containment, and leak detection systems.

Mobile packed-tower $N_2O_4$ and hydrazine fuel scrubbers currently being used by both the Air Force and NASA for payload loading and other hypergolic propellant transfer operations would be used for SUS loading at Cape Canaveral AS. The packed-tower $N_2O_4$ scrubber and bubble-cap hydrazine fuel scrubber currently available at SLC-3E would be used for SUS loading at Vandenberg AFB.

**2.1.1.3 Launch Site Operations.** The launch vehicle components would be shipped separately to each launch site (i.e., Cape Canaveral AS or Vandenberg AFB). Upon arrival, the components would undergo a variety of receiving inspections and off-line processing in the facilities noted above before final integration on the launch platform associated with the assembly facility. Figure 2.1-3 provides an overview of the Concept A launch operation concept.

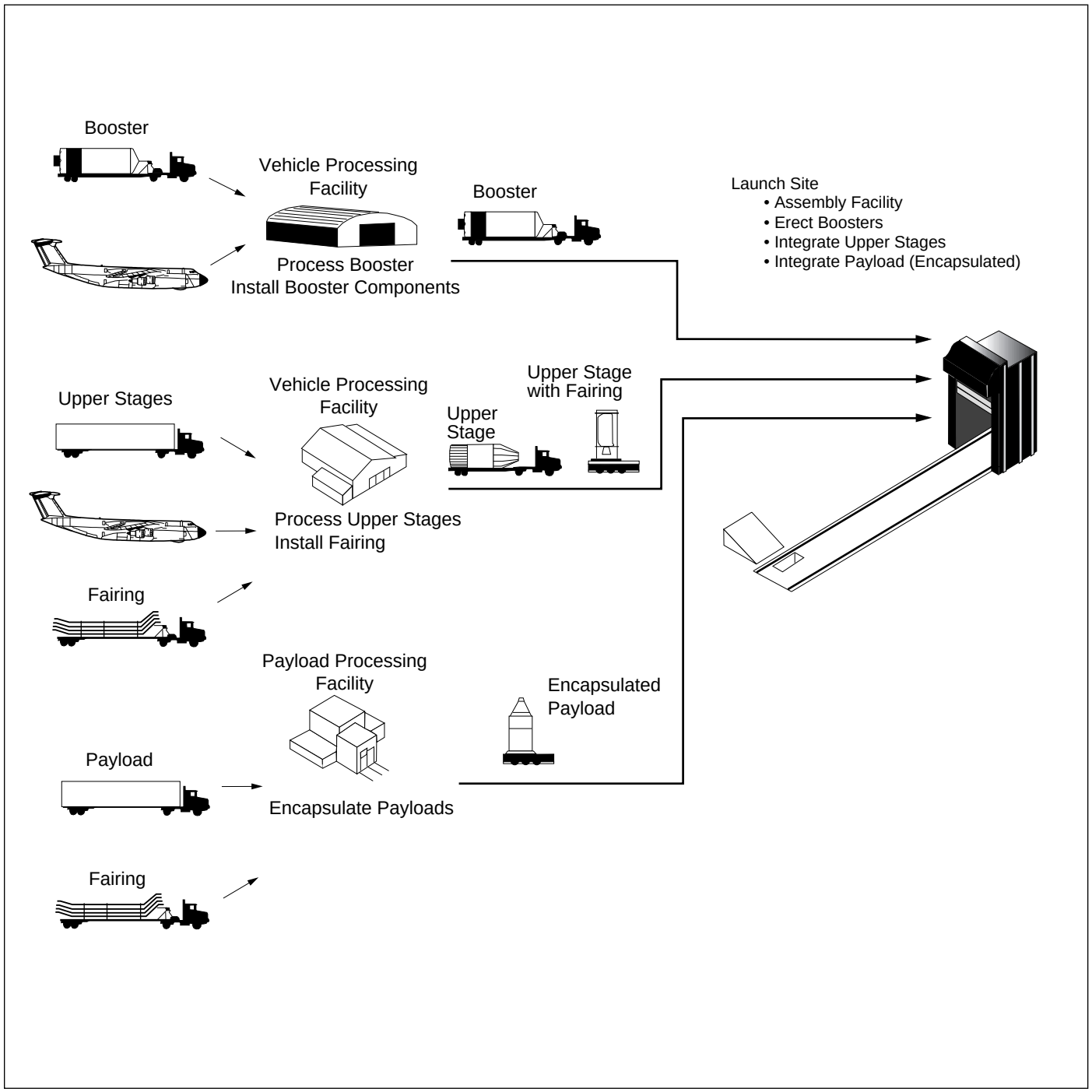
Launch process operations to be conducted at the launch site would include launch preparation, launch operations, and post-launch refurbishment. The operations process would be standard for both launch sites, as described below. Launch process operations for the MLV vehicle configurations, using the processes described below, would take approximately 30 days; launch process operations for the HLV vehicle configurations would take approximately 60 days.

Table 2.1-2 lists the types and total estimated amounts of hazardous materials used per launch for these processes under Concept A. All hazardous materials used would be handled in accordance with applicable

federal, state, and local regulations. Any spill of these materials would be collected and disposed of by a certified subcontractor in accordance with the Spill Prevention, Control, and Countermeasures (SPCC) plan.

**Receive and Check-Out Vehicle Components.** The SUS, fairings, and associated hardware (i.e., batteries, interstage skirts, and destruct ordnance) would be shipped via truck to both launch sites. The CUS would be transported by cargo aircraft, and the boosters would be transported via truck or by cargo aircraft. The boosters would be delivered in near- flightworthy condition and either placed in storage at the launch site or in the processing flow. Once flightworthy vehicle components (e.g., boosters, ordnance, batteries) have been delivered to the launch sites, a receiving inspection would be performed, which would include downloading transportation data to verify that no out-of-specification conditions existed as a result of transportation to the site. Payload fairings would arrive cleaned, double-bagged, and ready for storage. No additional cleaning would be required at the launch site.

Propellants for the launch vehicle would be shipped directly from the manufacturing location. All propellants would be shipped in accordance with DOT regulations, found in Title 49 Code of Federal Regulations (CFR) Parts 100-199. $LO_2$, $LH_2$, and RP-1 would be transported by truck and would be shipped from the manufacturing locations to the launch site. After the Directorate of Aerospace Fuels Management, located at Kelly AFB, Texas, approves the shipment of $N_2O_4$, it would be shipped by rail or truck from the manufacturing location to the launch site. MMH would be transported via truck by one of the authorized shippers (Directorate of Aerospace Fuels Management or NASA) to the launch site.




**Concept A Launch Operation Concept**

**Figure 2.1-3**

Note: Storage facilities not shown on figure.

**Table 2.1-2. Estimated Hazardous Materials Utilized Per Launch (all processes), Concept A[(a)]**

| Material | Quantity (lbs) MLV | Quantity (lbs) HLV |
|---|---|---|
| POL | 4,790 | 9,580 |
| VOC-Based Primers, Topcoats, and Coatings | 320 | 640 |
| Non-VOC-Based Primers, Topcoats, and Coatings | 190 | 320 |
| VOC-Based Solvents and Cleaners | 1,380 | 2,750 |
| Non-VOC-Based Solvents and Cleaners | 950 | 1,900 |
| Corrosives | 5,500 | 5,500 |
| Refrigerants | 0 | 0 |
| Adhesives, Sealants, and Epoxies | 2,280 | 4,570 |
| Other | 440 | 870 |
| Total | 15,850 | 26,130 |

Note: (a) Propellants are shown in Table 2.1-1.
HLV = heavy lift variant
lbs = pounds
MLV = medium lift variant
POL = petroleum, oil, and lubricants
VOC = volatile organic compound

**Store Vehicle Components.** Flightworthy vehicle components would be stored until needed for launch. The function begins when the component is placed in storage, and ends when the component is removed from storage for service.

**Process Components.** Final processing required to make vehicle components ready for integration into the launch vehicle in the assembly facility would occur under this function. This includes transport of the vehicle elements from the check-out/storage facility to the processing facility, as required. Processing includes installation of any loose items shipped (including destruct ordnance and batteries) and installation of the interstage adapters to the upper-stage elements. The function begins with completion of element inspection or element removal from storage, and ends when the launch vehicle components are ready for integration in the assembly facility.

**Encapsulate Payload.** This function begins when payload processing has been completed, and ends when the encapsulated payload is ready for transport to the assembly facility. This function also includes receipt of payload fairing sectors, establishment of a clean environment, encapsulation of the payload within the fairing, and positioning and securing the encapsulated payload on the transporter.

**Integrate Launch Vehicle.** Transporting, erecting, assembling, and integrating vehicle elements, including the encapsulated payload, into the completed launch vehicle would occur under this function. The function begins with transportation of processed vehicle elements to the assembly facility, and ends with the mating of the payload to the launch vehicle.
**Conduct Integrated Systems Test.** This function would be the final integrated test conducted within the assembly facility prior to launch countdown and would verify the functionality of all interfaces and services between the launch vehicle and the payload. Upon successful completion of this function, the vehicle would be configured for transport to the pad. This

function begins with completion of all payload mating operations, and ends with the launch vehicle ready for transport to the pad.

**Perform Launch Countdown.** Under this function, the launch system would be moved from the assembly facility to the pad. Activities performed for this function include moving equipment to safe positions, performing an interface test, loading propellants, performing initial FTS closed-loop checks, final range verification, countdown, engine firing, thrust verification, and final countdown.

For a launch, the launch platform would be rolled into position at the launch pad. Launch platform/pad connections include $GN_2$ and GHe, conditioned air, propellants, power, and data. Following a successful validation test, the booster would be fueled with RP-1 and $LO_2$ at the launch pad. No nonessential on-pad personnel access would be allowed during propellant transfer. The $LH_2$ and $LO_2$ for the CUS and the MMH and $N_2O_4$ for the SUS would also be loaded at the launch pad. Vapor emissions from these propellants would be controlled by vapor abatement devices (scrubbers or incinerators) at propulsion system vents to minimize air quality impacts. Once the pad is cleared of all nonessential personnel, final communication and vehicle checks would be performed. After range safety has verified safe operations, final countdown would be completed and the vehicle would be launched.

At launch, water would be sprayed at the launch vehicle exhaust, cooling the exhaust to minimize damage to the launch pad and providing acoustic damping. Approximately 50,000 gallons of water would be required for pad deluge for each launch. It is estimated that approximately 10,000 gallons of water would be lost as mist or vapor and 40,000 gallons would collect in the launch duct. Remaining deluge and wash water within the flame duct would be tested in the duct after launch in accordance with applicable regulations. At Cape Canaveral AS, deluge water remaining in the launch duct after launch would be pumped out to a percolation area or to the wastewater treatment plant (WWTP) if treatment is required. Deluge water dispersed as mist would not be collected. At Vandenberg AFB, deluge water would remain in the launch duct until it is pumped out into tankers, and delivered to the WWTP at SLC-6. Wastewater would be disposed of in accordance with applicable federal, state, and local regulations.

**Flight Support Operations.** During the flight, data would be transmitted to either ground-based telemetry or through the Tracking and Data Relay Satellite System (TDRSS) to recording ground stations. Data would be available real-time at the launch control centers at Cape Canaveral AS and Vandenberg AFB. Data collected would include final trajectory and orbital information, orbital insertion parameters, anomaly data (if an anomaly occurs), significant event descriptions, and spacecraft flight environment during flight.

**Perform Post-Launch Countdown.** This function would follow vehicle lift-off after the pad has been declared safe for access. It would include inspection of the launch pad facilities, launch platform, and equipment for damage, as well as general clean-up and performance of maintenance and repairs necessary to accommodate the next launch cycle. System design (e.g., aft umbilicals, auto couplers, rise-off disconnects, protective covers, and water deluge), combined with the use of liquid propulsion systems, would minimize

refurbishment required after each launch. This function ends when the launch platform and the launch pad are certified as ready for the next launch.

Although launch vehicle and payload fueling would be completed in a closed system, there may be small leaks and spills during fueling, as well as other hazardous material spills. These materials would be cleaned up, if necessary, by dilution with water, absorption or adsorption by the appropriate materials, and collection of the waste materials into DOT-approved waste containers for disposal. Disposal of waste materials would be conducted in accordance with applicable federal, state, and local regulations.

**2.1.1.4 Safety Systems.** Specific safety plans would be developed to ensure that each launch operation is in compliance with applicable regulations, as specified in numerous compliance documents, and by various organizations, including the following:

- Eastern and Western Range (EWR) 127-1, Range Safety Requirements
- Air Force Manual (AFM) 91-201, Explosive Safety Standards
- DoD Standard 6055.9, Ammunition and Explosives Safety Standards
- AFI 32-1023, Design and Construction Standards and Execution of Facility Construction Projects
- Air Force Occupational Safety and Health Standards
- National Fire Protection Association, National Fire Codes
- American National Standards Institute
- Occupational Safety and Health Administration (OSHA).

EWR 127-1 provides overall safety regulations for both Cape Canaveral AS and Vandenberg AFB. The objective of the range safety program is to ensure that the general public, launch area personnel, foreign land masses, and launch area resources are provided an acceptable level of safety, and that all aspects of prelaunch and launch operations adhere to public law. EWR 127-1 provides a framework for review and approval of all hazards associated with construction, prelaunch, and launch operations and incorporates all Air Force, DoD, and other applicable health and safety standards.

**Fire Protection System.** Fire protection, alarm, and fire suppression systems would be provided for all fuel holding areas and support facilities. Flame detectors in the fuel holding area would activate both the area deluge system and alarms to the Air Force Fire Department. A fire detection and alarm system would be provided in oxidizer holding areas. However, a deluge system would not be included because $N_2O_4$ and water are highly reactive.

**Security.** Security requirements, an integral component of project safety, would be incorporated within the project design and operational procedures.

Site security measures would include a perimeter security fence, a clear zone, an entrapment area road, security lighting, security standby power, an intrusion detection system, and security patrol roads. Procedures for security would include the use of entry controllers, alarm monitors, alarm/security response teams, radios, and vehicles in accordance with Air Force regulations.

**Launch Hazard Area Safety.** Both Cape Canaveral AS and Vandenberg AFB have established safety procedures for the areas affected by launch operations. Launches are not allowed to proceed if they present an undue hazard to persons and property due to potential dispersion of hazardous materials, propagation of blast, or other effects. At both launch locations, a standard dispersion computer model, run by installation meteorological/ environmental personnel, would be used for both normal and aborted launch scenarios prior to launch. If the model predicted that populated areas lay within the toxic hazard corridor (THC), the launch would be delayed until more favorable meteorological conditions existed.

At Cape Canaveral AS, Range Safety would monitor launch surveillance areas to ensure that the risks to people, aircraft, and surface vessels were within acceptable limits. Control areas and airspace would be closed to the public as required. A Notice to Mariners and Notice to Airmen would be provided in accordance with established procedures to provide warning to personnel.

At Vandenberg AFB, the coastal waters and surrounding areas would be patrolled prior to launch, and train movement through the base would be monitored. Both Jalama Beach and Ocean Beach county parks would be closed to public access prior to launches from SLC-3W. A Notice to Mariners and Notice to Airmen would be provided in accordance with established procedures to provide warnings to marine craft and aircraft. In accordance with 30 SW Instruction 91-105, Evacuating or Sheltering of Personnel on Offshore Oil Rigs, the Air Force would notify oil rig companies of an upcoming launch event approximately 10 to 15 days in advance. The Air Force's notification, provided through the Department of the Interior's Minerals Management Service, would request that operations on the oil rigs in the path of the launch vehicle overflight be temporarily suspended and that personnel be evacuated or sheltered.

Detanking or other procedures to be followed in the event of a launch delay or cancellation would be established and would generally be in accordance with procedures used for current vehicle systems.

**Mission/Vehicle Reliability.** Mission and launch vehicle reliability would meet the requirements set forth in the SPD prepared for the EELV program (see Appendix E). Mission reliability is measured from launch commit and is defined as the probability of successfully placing the payload into its delivery orbit with the required accuracy, and then executing a collision avoidance maneuver.

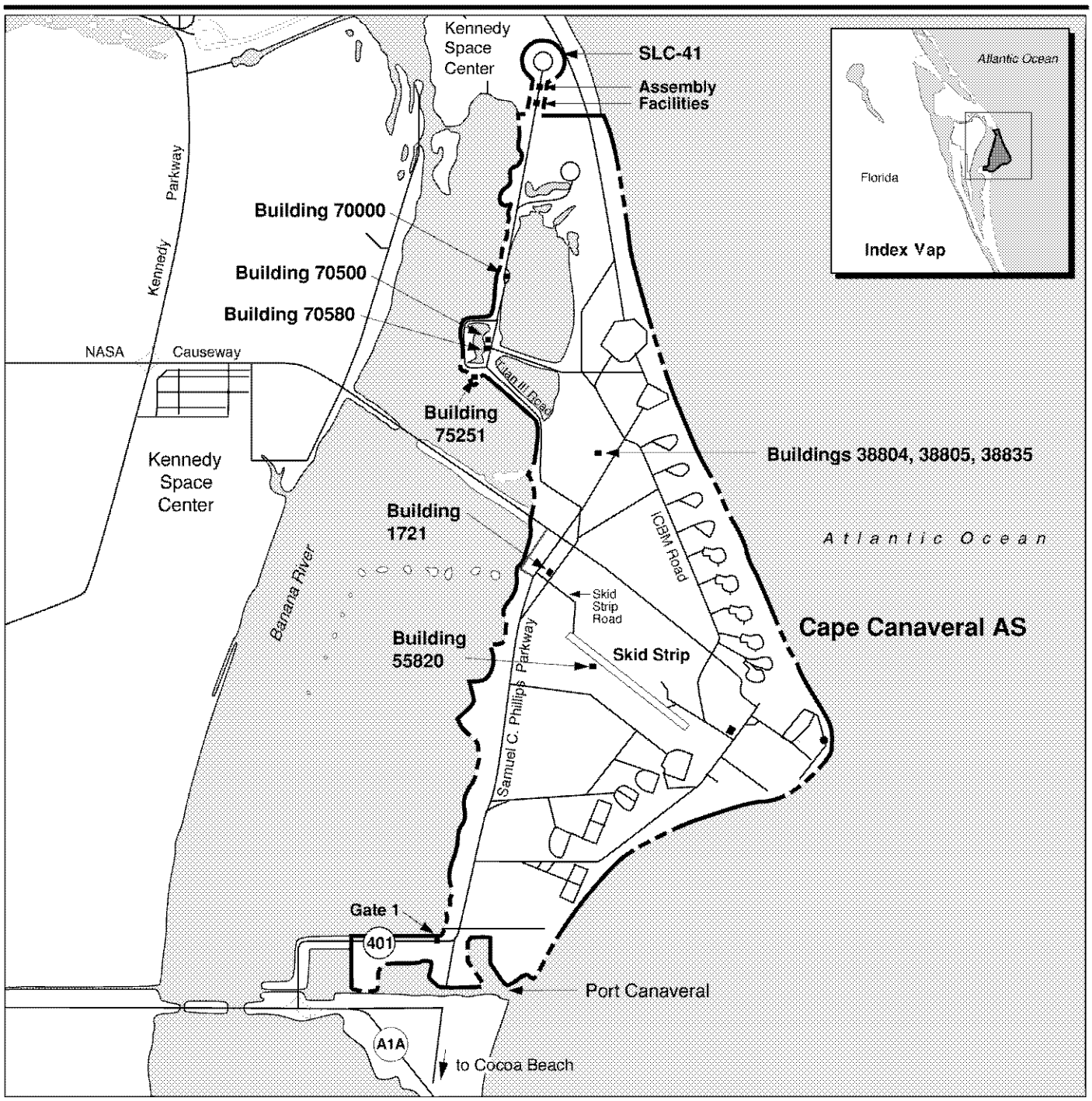
**Quantity-Distance Criteria.** Explosive Safety Quantity-Distance (ESQD) criteria are used to establish safe distances from launch complexes and associated support facilities to nonrelated facilities and roadways. These

regulations are established by DoD and Air Force Explosive Safety Standards. The criteria utilize the trinitrotoluene, also called TNT, explosive equivalent of propellant onboard a fueled launch vehicle, or stored components or propellant, to determine safe distances from space launch operations or processing and holding areas. The facilities associated with this concept would be sited to meet these criteria.

**2.1.1.5 Project Location and Access - Cape Canaveral AS.** EELV launch operations would be conducted at the 47-acre SLC-41 at Cape Canaveral AS, in the northwestern portion of the station. SLC-41 was used by the Air Force from 1964 to 1977 for Titan III launches. Renovated in 1986, it has been used for Titan IV launches since 1989. The last Titan IVB launch at SLC-41 has been tentatively scheduled for 1998.

Access to Cape Canaveral AS is provided through Gate 1 from State Route (SR) 401 (Figure 2.1-4). Once on Cape Canaveral AS, access to the site is along Samuel C. Phillips Parkway to Titan III Road, which connects to SLC-41.

**2.1.1.6 Support Structures/Operations - Cape Canaveral AS.** The launch rates associated with Concept A are provided in Table 2.1-3. Approximately 240 personnel are expected to be required to support EELV launch operations by 2003. Launch site operations for Cape Canaveral AS would be as described in Section 2.1.1.3 and would be conducted in the structures listed in Table 2.1-4. Figures 2.1-4 and 2.1-5 provide the general location of




**EXPLANATION**

- Station Boundary
- SLC Space Launch Complex
- A1A State Route

# Concept A Proposed Facility Map, Cape Canaveral AS, Florida

0 3000 6000 12000 Feet

**Figure 2.1-4**

EELV/001

## Table 2.1-3. Concept A Launch Rates

| | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East Coast[a] | | | | | | | | | | | | | | | | | | | | | |
| Government[b] | | | | | | | | | | | | | | | | | | | | | |
| MLV-D | 1 | 2 | 3 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 5 | 3 | 5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 59 |
| MLV-A | | 2 | 2 | 4 | 7 | 6 | 4 | 4 | 1 | 3 | 3 | 5 | 4 | 5 | 7 | 5 | 3 | 4 | 5 | 4 | 78 |
| HLV-L | | | | | | | | | | | | | | | | | | | | | |
| HLV-G | | | 1 | | | 1 | | 1 | | | 1 | | 1 | | 1 | | | 1 | | 1 | 8 |
| Commercial | | | | | | | | | | | | | | | | | | | | | |
| MLV-D | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 120 |
| MLV-A | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 120 |
| HLV-L | | | | | | | | | | | | | | | | | | | | | |
| HLV-G | | | | | | | | | | | | | | | | | | | | | |
| West Coast[c] | | | | | | | | | | | | | | | | | | | | | |
| Government[b] | | | | | | | | | | | | | | | | | | | | | |
| MLV-D | | 1 | 1 | | 1 | 1 | 3 | 2 | 1 | 2 | | 2 | 1 | 2 | | 1 | 1 | 1 | | 1 | 21 |
| MLV-A | | 1 | 1 | 3 | 2 | 3 | 3 | 1 | 3 | 2 | 4 | 2 | 2 | 4 | 1 | 2 | 3 | 4 | 1 | 3 | 45 |
| HLV-L | | | | | | | | 1 | | | | | | | | | | | | | 1 |
| HLV-G | | | | | | | | | | | | | | | | | | | | | |
| Commercial | | | | | | | | | | | | | | | | | | | | | |
| MLV-D | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 80 |
| MLV-A | | | | | | | | | | | | | | | | | | | | | |
| HLV-L | | | | | | | | | | | | | | | | | | | | | |
| HLV-G | | | | | | | | | | | | | | | | | | | | | |
| Total | 17 | 22 | 24 | 25 | 28 | 30 | 29 | 28 | 24 | 26 | 29 | 28 | 29 | 30 | 28 | 27 | 26 | 29 | 25 | 28 | 532 |

Notes: (a) Cape Canaveral Air Station, Florida.
(b) Based on the National Executable Mission Model.
(c) Vandenberg Air Force Base, California.
HLV = heavy lift variant
MLV = medium lift variant

**Table 2.1-4. Support Structures, Cape Canaveral AS, Concept A**

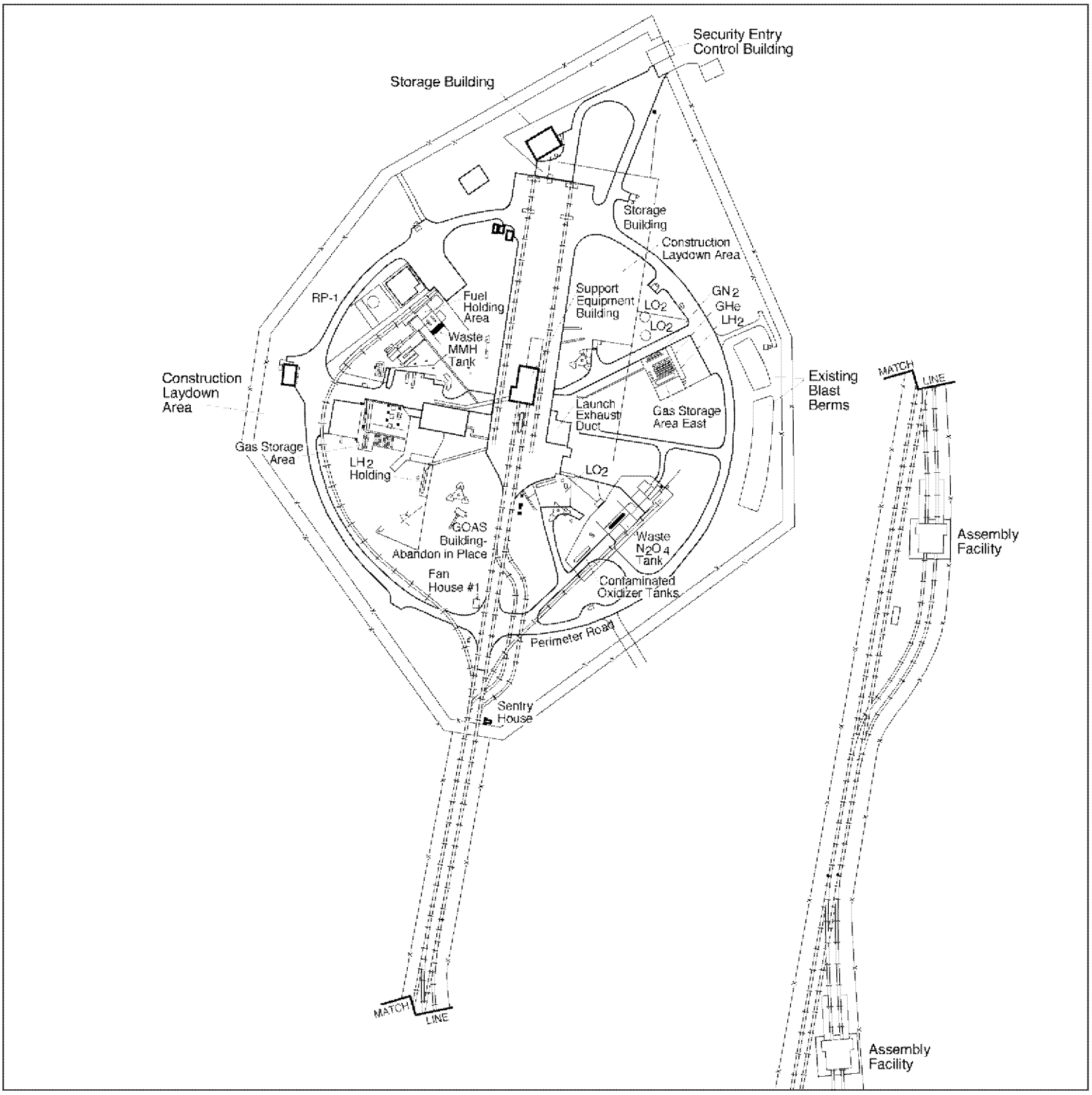
| Common Support Structure | Building | Operation | EELV Modifications |
|---|---|---|---|
| Aircraft Unloading | Cape Canaveral AS Skid Strip | Receive CUS/Booster | None |
| Storage | Building 1721 (Hangar J),<br>Facilities 38804 (Centaur Processing Building)<br>Building 70500 (Vehicle Integration Building [VIB])<br>Building 70580 (Receiving, Inspection, and Storage)<br>Building 75251 (Missile Inert Storage) | Store Launch Vehicle Elements | Modification (Facilities 1721 and 38804) |
| Vehicle Processing Facilities[(a)] | Building 1721 (Hangar J),<br>Building 38804 (Centaur Processing Facility) | Receive and Check Out Vehicle Elements, Process Elements | Modification |
| Payload Processing Facilities[(a)] | Building 70000 (Solid Motor Assembly Building [SMAB])<br>Building 70000 Annex (Spacecraft Processing Integration Facility [SPIF])<br>Building 55820 (DSCS Processing Facility [DPF]) | Encapsulate Payload | None |
| Assembly Facilities | New construction (south of SLC-41) | Integrate Launch Vehicle, Conduct Integrated System Test | New Construction |
| Launch Complex | SLC-41 | Launch Countdown, Post-Launch Countdown | Modification |
| Launch Control Support | Building 38835 (Centaur Processing Building Launch Control Center) | Launch Countdown, Launch | Modification |
| Propellant and Gas Holding Areas | SLC-41 | Launch Vehicle Fueling, Pressure Testing | Modification |

Note: (a) These are the currently identified facilities; other facilities may be utilized by the payload contractor.
AS = Air Station
CUS = Cryogenic Upper Stage
DSCS = Defense Satellite Communications System
EELV = Evolved Expendable Launch Vehicle
SLC = Space Launch Complex

facilities at Cape Canaveral AS and the site layout plan for SLC-41, respectively. The entire SLC-41 area would be utilized for launch operations.

Under Concept A, the activities associated with EELV would generate the following average utility demands at Cape Canaveral AS during the projected peak launch year (2015):

- Water - 13,950 gallons per day (gpd)
- Wastewater - 10,800 gpd
- Solid waste - 0.5 ton per day
- Electricity - 467 kilowatt hours (kWH) per day.




## EXPLANATION

| | |
|---|---|
| GHe | Gaseous Helium |
| $GN_2$ | Gaseous Nitrogen |
| $LH_2$ | Liquid Hydrogen |
| $LO_2$ | Liquid Oxygen |
| MMH | Monomethyl Hydrazine |
| $N_2O_4$ | Nitrogen Tetroxide |
| RP-1 | Rocket Propellant-1 (Kerosene Fuel) |
| —x— | Security fence |

0 150 300 Feet

# Concept A SLC-41 Site Plan, Cape Canaveral AS, Florida

**Figure 2.1-5**

EEL/047

Based upon employment projections and project activities, Concept A would generate 770 average daily vehicle trips. The evening peak-hour volume (PHV) is projected to be 160 vehicles.

**2.1.1.7 Project Construction Activities - Cape Canaveral AS.** At Cape Canaveral AS, construction activities would begin in July 1998 and continue through June 2000. Most of the ground-disturbing activities would occur between August 1998 and June 1999. Construction of the second assembly facility would occur between the first quarter of 2002 and the first quarter of 2004. Additional ground-disturbing activities would occur at the Hangar J driveway between April and May 2000. Construction personnel requirements would average 260, with a maximum of 382 during peak construction activities. Proposed construction activities at Cape Canaveral AS are described below.

Existing Facility Modification

**SLC-41.** Most of SLC-41 would be modified for this concept. Major modifications would include changing the existing site topography, as required, to support rail system work and facility modification/new construction. Modifications at the SLC would be as follows:

- The Mobile Service Tower (MST) and the umbilical tower would be demolished.
- Exterior modifications to the Support Equipment Building (SEB) would include extending the building to house the payload equipment van; interior modifications would consist of removing and/or abandoning existing cables and piping and reconfiguring the building interior to support communications equipment.
- The catch basins, gas storage area ($GN_2$ and GHe), and propellant systems ($LH_2$ and $LO_2$) would be modified. Mobile systems for $N_2O_4$ and MMH, and any necessary scrubbers, would be utilized.
- New facilities for the kerosene fuel (RP-1) system and piping would include a 90,000-gallon tank, an unloading area, pumps, a piping system, secondary containment, and a leak detection system.
- Piping to the launch pad would be installed.
- An aerial sound suppression water deluge system and fuel and oxidizer piping would be installed.
- New facilities for the $LO_2$ storage system would include a 600,000-gallon tank farm (two 300,000-gallon tanks), an unloading area, pumps, a piping system, secondary containment, and a leak detection system.

**Building 1721, Hangar J, Booster Storage and Check Out.** The existing driveway would be modified to provide an increased turning radius. Interior utilities would be modified to meet program requirements.

**Building 38804, Centaur Processing Facility (CPF) Upper Stage Storage and Check Out.** The existing facility would be modified to accommodate new support equipment.

**Facility 38835, Centaur Processing Building (CPB) Launch Control Center.** The interior of this facility would be renovated to meet program requirements.

**Road Modifications.** The road turning radius at the northeastern corner of Skid Strip Road and Samuel C. Phillips Parkway would be modified to allow transport of the launch vehicle.

**Infrastructure.** Utility lines required for the EELV program would be modified within SLC-41 in previously disturbed areas. In addition, a new fiber optic line may be required from the CPB to SLC-41 along the previously disturbed road corridor.

New Facilities

**Assembly Facilities.** Two identical assembly facilities, located in separate complexes of identical design, would be constructed south of SLC-41 along the current Titan IVB transporter rail line. Construction of the two assembly facilities would disturb approximately 15 acres. A single fence, utility shed, and guardhouse would be constructed within each complex, and an asphalt parking area would be constructed adjacent to each complex.

The transporter track systems would be modified to allow movement of the launch systems to the launch pad, assembly facilities, and refurbishment areas in the Integrate Transfer Launch (ITL) area.

Utilities for each assembly facility would include an electrical substation, a diesel generator, and two water chillers. Electrical power, potable water, $GN_2$, and GHe lines would need to be extended from SLC-41 to each assembly facility along the previously disturbed road corridor.

Construction Phase

Most of the construction activities would take place along existing road corridors. At the assembly facilities site, vegetation would be removed to create a cleared area approximately 300 feet wide. Construction equipment laydown areas, personal vehicle parking, temporary mobile offices (trailers), maintenance facilities, and other ancillary construction areas would be sited in previously disturbed areas (see Figure 2.1-5).
Earthwork for construction would be performed in accordance with the construction Storm Water Pollution Prevention Plan and project SPCC Plan that would be developed for this project.

A temporary truck washdown area would be provided within the boundaries of the construction laydown areas. In order to contain collected wastewater, the washdown area would be provided with an impoundment containing a sump that would allow water to percolate into the ground.

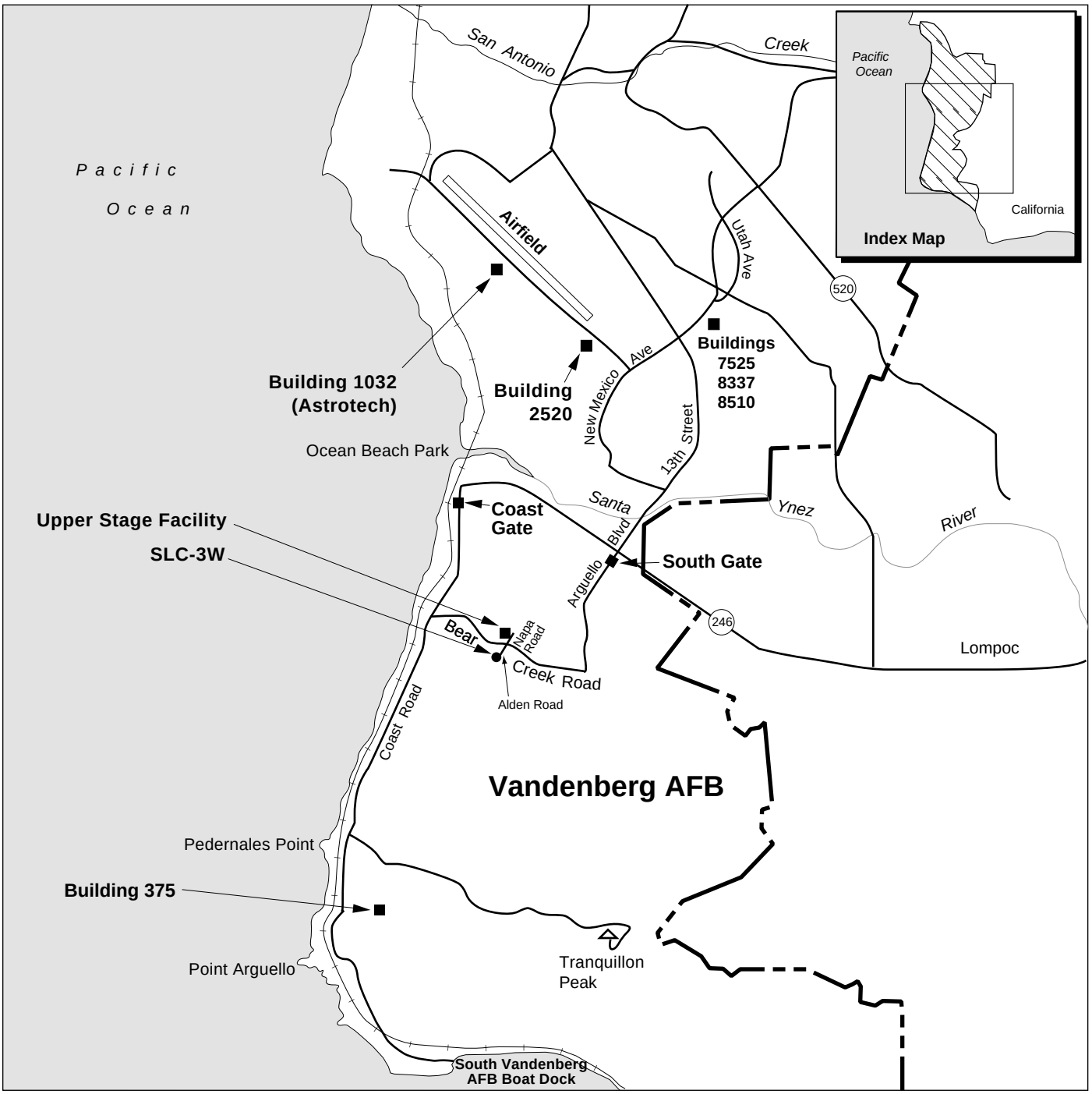
Approximately 15 acres of land would be disturbed for construction of the assembly facilities. Depending upon the final design and grading plans, earth movement would involve a minimum of about 24,000 cubic yards of cut and fill material. Unsuitable cut material would be removed from the project area to a spoil site located off station or at other approved locations. Appropriate erosion control would be implemented at the stockpile. Construction materials would generally be transported by truck through Gate 1 over Samuel C. Phillips Parkway to Titan III Road to SLC-41.

During the construction period, water use would average approximately 4,000 gpd for general activities (e.g., site washdown, cement mixing, personnel requirements). Some water would also be used for dust control. Wastewater generation would average approximately 3,760 gpd. In addition, approximately 3,580 tons of solid waste would be generated, of which the contractor expects to recycle 3,100 tons. The construction contractor would remove construction debris; any hazardous materials identified during construction (e.g., asbestos, lead-based paint) would be abated in accordance with applicable regulations.

From 1998 through 2000, construction traffic entering and exiting project construction sties on Cape Canaveral AS under Concept A is estimated to generate an average of 1,640 daily vehicle trips, with 170 trips expected during the peak hour. Construction traffic entering and exiting project construction sites during the peak construction period is expected to be 2,400 trips, with 250 trips occurring during the peak hour.

**2.1.1.8 Project Location and Access - Vandenberg AFB**. EELV launch operations would be conducted at the 33-acre SLC-3W at South Vandenberg AFB. SLC-3W was used for Atlas D/Agena launches from 1960 to 1963, for Thor Agena launches from 1963 to 1972, and for Atlas E/F launches from 1972 to 1995. SLC-3W is currently inactive and requires minimal maintenance.

Access to the SLC would be primarily through the Vandenberg AFB South Gate entrance via SR 246, then over Air Force-controlled secondary roadways, including Arguello Boulevard and Bear Creek and Coast roads (Figure 2.1-6).




**EXPLANATION**

- Base Boundary
- SLC Space Launch Complex
- (246) State Route

# Concept A Proposed Facility Map, Vandenberg AFB, California

0 .5 1 2 Miles

**Figure 2.1-6**

EELV/002

**2.1.1.9 Support Structures/Operations - Vandenberg AFB.** Launch rates associated with Concept A are provided in Table 2.1-3. Approximately 135 personnel are expected to be required to support EELV launch operations by 2006. Launch site operations for Vandenberg AFB would be as described in Section 2.1.1.3 and would occur in the structures listed in Table 2.1-5. Figures 2.1-6 and 2.1-7 provide the general location of facilities at Vandenberg AFB and the site layout plan for SLC-3W, respectively. The entire SLC-3W area would be utilized for launch operations.

Under Concept A, the activities associated with EELV would generate the following average utility demands at Vandenberg AFB during the projected peak launch year (2007):

- Water - 7,400 gpd
- Wastewater - 6,100 gpd
- Solid waste - 0.3 ton per day
- Electricity - 233 kWH per day.

Based upon employment projections and project activities, Concept A would generate 430 average daily vehicle trips, with 90 trips anticipated during the peak hour.

**2.1.1.10 Project Construction Activities - Vandenberg AFB.** At Vandenberg AFB, construction would begin in February 2000 and continue through February 2002. Most of the ground-disturbing activities would occur between March and September 2000. Construction personnel requirements would average 252, with a maximum of 324 during peak construction activities. Proposed construction activities at Vandenberg AFB are described below.

Existing Facility Modification

**SLC-3W.** Most of SLC-3W (within the fence line) would be modified for this concept. Major modifications would include:

- The kerosene fuel (RP-1) tank and piping system, fueling skid, skid foundation, and secondary containment would be removed.

- A 150-kilowatt generator and associated electrical and fuel systems would be removed.

- The roadway would be modified.

- The existing utility systems and the perimeter security fence, including new lighting, would be renovated.

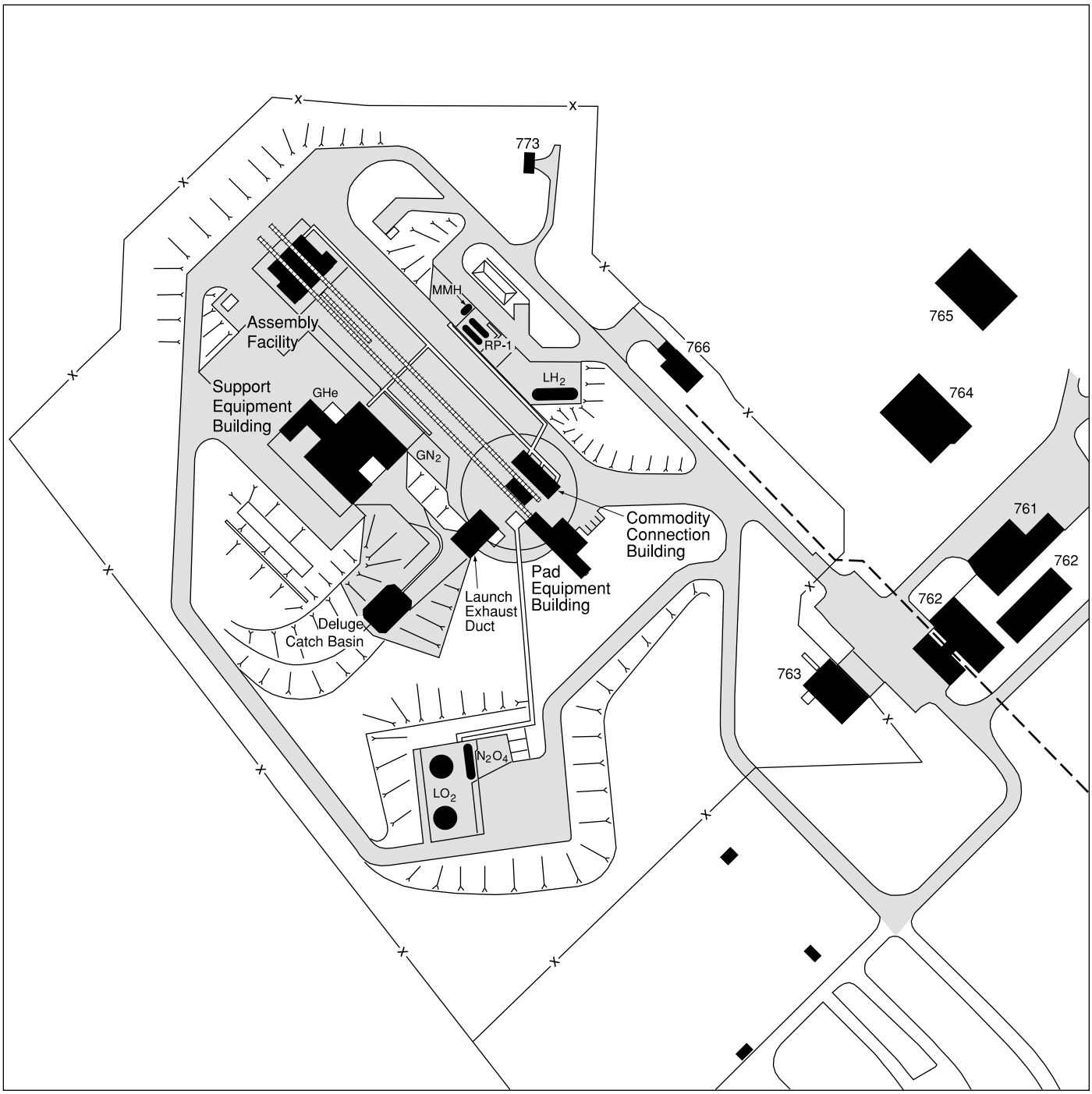
- A new rail system would be added from the assembly facility to the launch pad.

**Table 2.1-5. Support Structures, Vandenberg AFB, Concept A**

| Common Support Structure | Building | Operation | EELV Modifications |
|---|---|---|---|
| Aircraft Unloading | Vandenberg AFB Airfield | Receive Upper Stage/Booster | None |
| Storage | Building 7525 (Booster Assembly Building [BAB])<br>Upper Stage Facility (new construction)<br>Building 8337 (Payload Fairing Processing Facility) | Store Launch Vehicle Elements | Modification (Building 7525)<br>New Construction (Upper Stage Facility) |
| Vehicle Processing Facility | Building 7525 (BAB)<br>New construction (Upper Stage Facility) | Receive and Check Out Vehicle Elements, Process Elements | Modification (Building 7525)<br>New Construction (Upper Stage Facility) |
| Payload Processing Facilities | Building 375 (Integrated Processing Facility [IPF]),<br>Building 1032 (Astrotech)<br>Building 2520 (Payload Processing Facility [PPF]) | Encapsulate Payload | None |
| Assembly Facility | New construction (SLC-3W) | Integrate Launch Vehicle, Conduct Integrated Systems Test | New Construction |
| Launch Complex | SLC-3W | Launch Countdown, Post-Launch Countdown | Modification |
| Launch Control Support | Building 8510 (Remote Launch Control Center [RLCC]) | Launch Countdown, Launch | None |
| Propellant and Gas Holding Areas | SLC-3W | Launch Vehicle Fueling, Pressure Testing | Modification |

AFB = Air Force Base
EELV = Evolved Expendable Launch Vehicle
SLC = Space Launch Complex

- The existing MST, MST rail system, and the umbilical tower would be removed.
- The launch mounts, existing deluge systems, and pressurization and purge systems would be removed.
- A launch exhaust duct would be constructed.
- The area around the existing retention basin would be utilized as a secondary catch basin for storm water.
- Renovations to the SEB would include removal of the interior of the existing facility and installation of a new power substation.




## EXPLANATION

| | | | |
|---|---|---|---|
| GHe | Gaseous Helium | — — | Electrical Line |
| $GN_2$ | Gaseous Nitrogen | ⊢— | Embankment |
| $LH_2$ | Liquid Hydrogen | ▭ | New Pavement |
| $LO_2$ | Liquid Oxygen | | |
| MMH | Monomethyl Hydrazine | | |
| $N_2O_4$ | Nitrogen Tetroxide | | |
| RP-1 | Rocket Propellant-1 (Kerosene Fuel) | | |

0 60 120 240 Feet

# Concept A SLC-3W Site Plan, Vandenberg AFB, California

**Figure 2.1-7**

EEL/096

- The existing $LO_2$ tank and piping would be removed.

- Modifications to the gas storage area would include the addition of He storage bottles and piping connections to the existing $GN_2$ line that serves SLC-3E.

- A new launch pad deluge water and acoustic suppression system would be installed.

- Kerosene fuel (RP-1), $LH_2$, and $LO_2$ systems would be installed. Mobile systems for $N_2O_4$ and MMH, and any necessary scrubbers, would be utilized.

**Building 7525, Booster Assembly Building (BAB).** New entrance/exit driveways would be constructed in the front and rear of the facility. Construction would occur on the previously disturbed roadway shoulder.

**Road/Pavement Improvements.** Intersections at the following locations along the booster tow route would be widened to accommodate the turning radii of booster transporters: Coast and Bear Creek roads (south of intersection), Bear Creek and Napa roads (west of intersection), and Napa and Alden roads (intersection area) (see Figure 2.1-6). The route widening would occur in previously disturbed areas. Existing power poles at the northeastern side of Coast and Bear Creek roads would have to be relocated, and the traffic signal at Utah and New Mexico avenues would need to be modified (see Figure 2.1-6).

**Infrastructure.** New utility lines and connections would be located in previously disturbed areas or within construction areas or other proposed facilities. These would include water, wastewater, electrical, and gas lines.

New Facilities

**Assembly Facility.** An assembly facility containing a new power substation would be constructed approximately 500 feet northeast of the launch pad.

**Upper-Stage Processing Facility (USF).** A 3,200-square-foot USF would be constructed across Bear Creek Road from SLC-3. A concrete apron would be constructed on one side of the facility, and an asphalt surface would be constructed for transporter laydown. This site is currently the SLC-3 fallback parking area that has been previously disturbed. The facility would require a security fence, water lines, and a septic tank. Construction would occur in the northern corner of the SLC-3 fallback area.

Construction Phase

Initial construction would consist primarily of clearing and grading, and demolition of existing structures at the project site. Most construction activities would take place within the previously disturbed SLC-3W area or along existing road corridors. Construction equipment laydown, personal vehicle parking, temporary mobile offices (trailers), maintenance facilities, and other ancillary construction areas would be sited in previously disturbed areas at the SLC-3 fallback parking area.

Earthwork for construction would be performed in accordance with the construction Storm Water Pollution Prevention Plan and project SPCC Plan that would be developed for this concept.

To contain collected wastewater, a temporary truck washdown area with an impoundment would be provided within the boundaries of the construction laydown areas.

Approximately 33 acres of land within the SLC-3W fenceline would be disturbed during construction. Depending upon the final design and grading plans, earth work would involve a minimum of about 142,000 cubic yards of cut material. An equal amount of fill material would come from borrow areas on Vandenberg AFB (Manzanita Borrow Area). Unsuitable cut material would be returned to the embankment cut at the SLC that would be regraded prior to site revegetation. Some spoil material may be disposed of on the base landfill. A site restoration plan would be developed to replace non-native plant species disturbed during construction with native vegetation. Construction materials would generally be trucked through the Coast Gate entrance (see Figure 2.1-6), then to SLC-3W.

During the construction period, water use would average approximately 8,240 gpd for general activities (e.g., site washdown, cement mixing, personnel requirements). Some water would also be utilized for dust control. Wastewater generation would average approximately 3,760 gpd. In addition, approximately 4,920 tons of solid waste would be generated; the contractor estimates that 4,600 tons would be recycled. The construction contractor would remove construction debris; hazardous materials found during construction (e.g., asbestos, lead-based paint) would be abated in accordance with applicable regulations.

From 2000 to 2002, construction traffic entering and exiting project construction sites on Vandenberg AFB under Concept A is estimated to generate an average of 1,600 daily vehicle trips, with 170 trips expected during the peak hour. Construction traffic entering and exiting project construction sites during the peak construction period is expected to be 2,000 trips, with 210 trips occurring during the peak hour.

### 2.1.2 Concept B

Under Concept B, the contractor would use SLC-37 at Cape Canaveral AS and SLC-6 at Vandenberg AFB for EELV system activities, as well as other facilities at both locations.

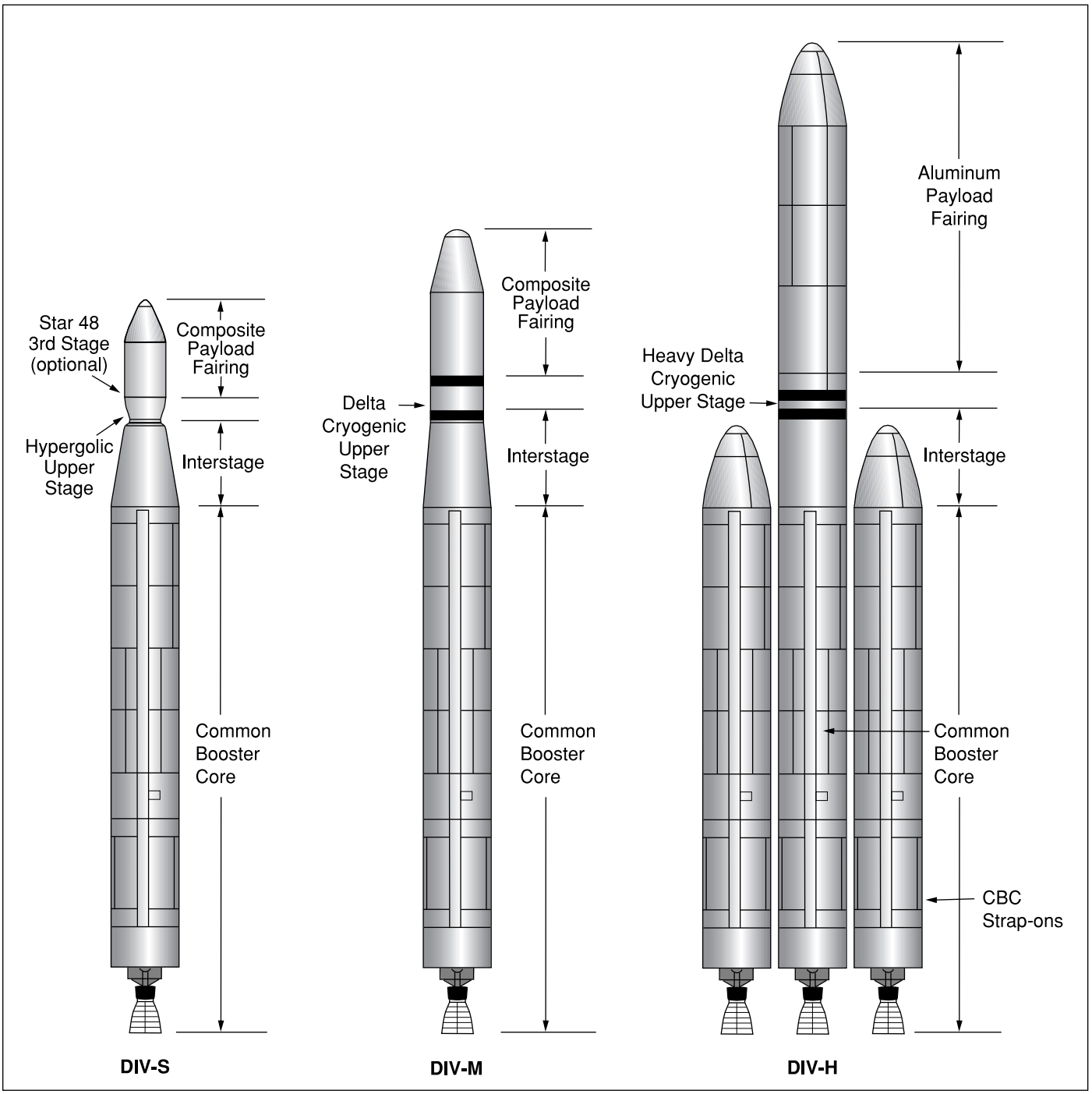
The following is a general description of the launch vehicle and facility requirements for Concept B. Specific descriptions for implementation of this alternative at Cape Canaveral AS and Vandenberg AFB follow the general description. Construction would include modifications to existing facilities and construction of new facilities. Most of the components (boosters, upper stages, and avionics modules) would be assembled and tested prior to shipment to the launch site (i.e., Cape Canaveral AS or Vandenberg AFB) in near flightworthy condition.

**2.1.2.1 Launch Vehicle Concept.** The EELV would consist of several variations of a Delta IVB (DIV) launch vehicle, including small (DIV-S), medium (DIV-M), and large (heavy) (DIV-H) launch vehicles, shown in Figure 2.1-8. This system would use a common booster core (CBC), with a Hypergolic Upper Stage (HUS), Delta Cryogenic Upper Stage (DCUS), or Heavy Delta Cryogenic Upper Stage (HDCUS) as second stages, depending upon the payload requirements. The small and medium vehicles would use one CBC first-stage core booster; the heavy vehicle would use one first-stage CBC and two CBC strap-ons. The strap-ons are the standard version of the CBC with Titan IV nose cones and appropriate separation hardware added. They have shorter burn times than the center core and would be jettisoned prior to burnout of the center core vehicle. A Delta IVB Medium Plus (DIV-M+) vehicle, consisting of a DIV-M with solid rocket motors (SRMs), would be utilized for some commercial missions (not shown in Figure 2.1-8). The SRM booster casing would be composed of graphite epoxy. Table 2.1-6 provides data for the launch vehicle components.

The medium and heavy upper stages would be fueled by $LH_2$ and $LO_2$, and the small vehicle upper stages would utilize Aerozine-50 (A-50) and $N_2O_4$. All propellant transfer would occur on the launch pad.

The CBC is a new design for the EELV program using a Rocketdyne RS-68 engine and would be a common element for all Concept B launch vehicles. The CBC casing would be composed of aluminum alloy and composite structures. The CBC propellants are $LH_2$ and $LO_2$.

The HUS would be designed to satisfy the low end of the NMM in terms of payload delivery to orbit and would be used on the DIV-S only. The DCUS would be used for the DIV-M, and the HDCUS would be used for the DIV-H. The DIV-S and the DIV-M both satisfy the medium lift requirement of the NMM.




**EXPLANATION**

| | |
|---|---|
| CBC | Common Booster Core |
| DIV | Delta IV |
| DIV-H | Heavy Launch Vehicle |
| DIV-M | Medium Launch Vehicle |
| DIV-S | Small Launch Vehicle |

NOT TO SCALE

**Concept B Launch Vehicle Concept**

**Figure 2.1-8**

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**Table 2.1-6. Launch Vehicle Components, Concept B**

| Launch Vehicle Component | Launch Vehicle | Propellant (lbs) | Fueling Location | Reaction Control System (lbs) | RCS Loading Location |
|---|---|---|---|---|---|
| CBC | DIV-S, DIV-M, and DIV-H | $LH_2$ (<63,000)<br>$LO_2$ (<450,000) | Launch Pad | NA | NA |
| HUS | DIV-S | $N_2O_4$ (<700)<br>A-50 (<400) | Launch Pad | Cold gas $N_2$ (24) | PPF |
| DCUS | DIV-M | $LH_2$ (<6,000)<br>$LO_2$ (<31,000) | Launch Pad | $N_2H_4$ (160)<br>He(1) | PPF |
| HDCUS | DIV-H | $LH_2$ (<8,700)<br>$LO_2$ (<49,000) | Launch Pad | $N_2H_4$ (320)<br>He (2) | PPF |
| Strap-on SRM | DIV-M+ | $NH_4ClO_4$ (25,000)<br>Al (7,000)<br>HTPB (5,000) | Launch Pad | NA | NA |
| Star 48B | DIV-S | $NH_4ClO_4$ (3,200)<br>Al (800)<br>HTPB (500) | Launch Pad | NA | NA |

A-50 = Aerozine-50 (50 percent by weight unsymmetrical dimethylhydrazine and anhydrous hydrazine)
Al = aluminum
CBC = common booster core
DCUS = Delta Cryogenic Upper Stage
DIV = Delta IVB
DIV-H = heavy launch vehicle
DIV-M = medium launch vehicle
DIV-M+ = medium launch vehicle with solid rocket motor strap-ons
DIV-S = small launch vehicle
HDCUS = Heavy Delta Cryogenic Upper Stage
He = helium
HTPB = hydroxyl-terminated polybutadiene (binder material)
HUS = Hypergolic Upper Stage
lbs = pounds
$LH_2$ = liquid hydrogen
$LO_2$ = liquid oxygen
NA = not applicable
$N_2$ = nitrogen
$N_2H_4$ = anhydrous hydrazine
$N_2O_4$ = nitrogen tetroxide
$NH_4ClO_4$ = ammonium perchlorate
PPF = Payload Processing Facility
RCS = reaction control system
SRM = solid rocket motor

For some small vehicle missions, a third stage (Star 48B) containing solid propellant would be utilized. The propellant would be composed of ammonium perchlorate ($NH_4ClO_4$), aluminum (Al), and hydroxyl-terminated polybutadiene (HTPB) (binder material). The third stage would be encapsulated with the payload and transported to the launch pad.

For the medium and heavy vehicles, fueling of the reaction control system (RCS) would occur in the payload processing facility. The RCS propellant would be anhydrous hydrazine ($N_2H_4$) and helium (He).

The payload fairings would be developed from existing Delta and Titan IV designs. The fairing structures for the DIV-H would be made of aluminum; small and medium vehicle payload fairings would be a graphite-epoxy composite.

The CBC avionics' basic architecture and all elements would be developed from Delta II/III avionics that provide single-fault tolerant control that monitors electrical power for all critical functions. The upper-stage avionics provide the inertial sensing and data processing for the navigation, guidance, control, and sequencing; radio frequency (RF) communication electronics; flight termination; and the telemetry, power, and distribution network.

The FTS would be a redundant system that would provide the capability to terminate a vehicle undergoing erratic flight before it could endanger people and property. The system for Concept B would rely upon existing

technologies that have been used for the Titan, Delta, and space shuttle programs.

Figure 2.1-2 depicts a representative launch vehicle ascent sequence. After completing its mission, the CBC would fall into the ocean and would not be recovered. Less than 25 gallons of hydraulic fluid would remain in the booster when it falls into the ocean and sinks. The payload fairings would separate from the vehicle prior to orbit, fall into the ocean, and would not be recovered. The upper-stage engine would cut off when the payload reached the desired orbit. The upper stages (HUS, DCUS, and HDCUS) of the launch vehicle would boost the payload into orbit, where the upper stage would separate from the payload. Residual propellant within the upper stages would be vented to minimize orbital debris due to breakup.

**2.1.2.2 Primary Support Structures.** Various support structures and equipment would be necessary to process and launch the vehicle. These would consist of structures at the proposed SLC (i.e., SLC-37 or SLC-6), as well as facilities and utilities located elsewhere on the launch site. The primary support structures and equipment that would be required at both Cape Canaveral AS and Vandenberg AFB are described in the following paragraphs. Exact facility locations at each launch site are described for Cape Canaveral AS in Section 2.1.2.6 and for Vandenberg AFB in Section 2.1.2.9.

**Unloading Facilities.** Barge/boat unloading facilities at each location would be used to unload CBCs transported by barge or boat. Airstrips at each location would be utilized to unload flight hardware transported by cargo aircraft. Hardware transported by truck would be received at appropriate processing facilities or interim storage facilities.

**Storage Facilities.** CBCs, upper stages, fairings, and other flight hardware may be stored in these facilities, if necessary, prior to processing. These facilities would also be utilized to store ground support equipment (GSE).

**Horizontal Integration Facility (HIF).** An HIF would be utilized for vehicle processing. Functions performed in the HIF would include the receiving, integration of CBCs and strap-ons for the DIV-H, and check-out of the CBC and upper stages. In addition, this facility would house many support functions required for integration of the launch vehicle.

**Payload Processing Facility.** Preprocessed and fueled payloads would be encapsulated within this facility. The Star 48B would be integrated with the payload and encapsulated. The payload would be inspected, any final assembly and checkout conducted, and if required, storable propellant ($N_2H_4$) loaded. Encapsulation of the payload within the fairing would be the final operation prior to transport to the launch pad.

**Launch Complex.** The launch complex would include the launch table and installation/interface points for various support services. It would also contain launch exhaust ducts that direct the exhaust flame from the launch vehicle away from the launch deck and complex for safe dispersal. The launch pad would include an MST, a Fixed Umbilical Tower (FUT), and an SEB that would

provide miscellaneous support systems that need to be close to the launch pad, as well as propellant and gas storage areas.

**Launch Control Center.** Launches would be controlled at the launch control center once SLC operations/procedures had been completed.

**Propellant and Gas Holding Areas.** Propellant and gas holding areas would include a gas storage area and $LH_2$ and $LO_2$ holding areas at the SLC. An $LH_2$ system, consisting of a double-walled tank; a leak detection system; and a piping system would be used for CBC, DCUS, and HDCUS fueling. This would include an 850,000-gallon tank at Cape Canaveral AS and an 850,000-gallon tank at Vandenberg AFB. This area would also include an unloading area, a piping system, a sloped spill runoff area, a propane flare stack, a hydrogen burn stack to burn excess vapor, a fire suppression system, power, and instrumentation. Piping to the launch pad would be installed. In addition, an $LO_2$ system consisting of a double-walled tank, pumps, and a piping system would be required for CBC, DCUS, and HDCUS loading. Facilities would include a 250,000-gallon tank at Cape Canaveral AS and a 300,000-gallon tank at Vandenberg AFB. An unloading area, an $LH_2$ leak detection system, and a piping system would also be required. At Vandenberg AFB, an existing berm that slopes to an existing containment area would be utilized for secondary containment. At Cape Canaveral AS, a containment system would be designed in accordance with Range Safety and OSHA requirements. The earthen berm containment areas would accommodate 100 percent of the liquid volume because of the rapid volatilization of any potential spills.

The gas storage area would include storage and handling facilities for GHe and liquid nitrogen ($LN_2$). At both Cape Canaveral AS and Vandenberg AFB, one 20,000-gallon tank of $LN_2$ and four 300-cubic-foot vessels of GHe would be required. $GN_2$ would also be provided to the launch facilities via existing pipelines. Additional piping would be installed, as required. Two additional $GN_2$ truck connections would be required at Cape Canaveral AS.

A-50 and $N_2O_4$ for the HUS would be transported to the site by DOT-approved supply tankers following procedures similar to those used currently for the Delta II program. These chemicals would not be stored on site. The loading area would include secondary containment and a leak detection system. Mobile scrubbers and a bubble overflow scrubber on the FUT would require air permits similar to those required for current Delta II operations.

Small quantities of MMH required for the DCUS would be provided in DoD-approved drums. It has not yet been determined whether air permits for scrubbers would be required; because of the small amounts of MMH used, permits may not be required. Hypergolic rinseate would be managed and disposed of in accordance with applicable federal, state, and installation requirements.

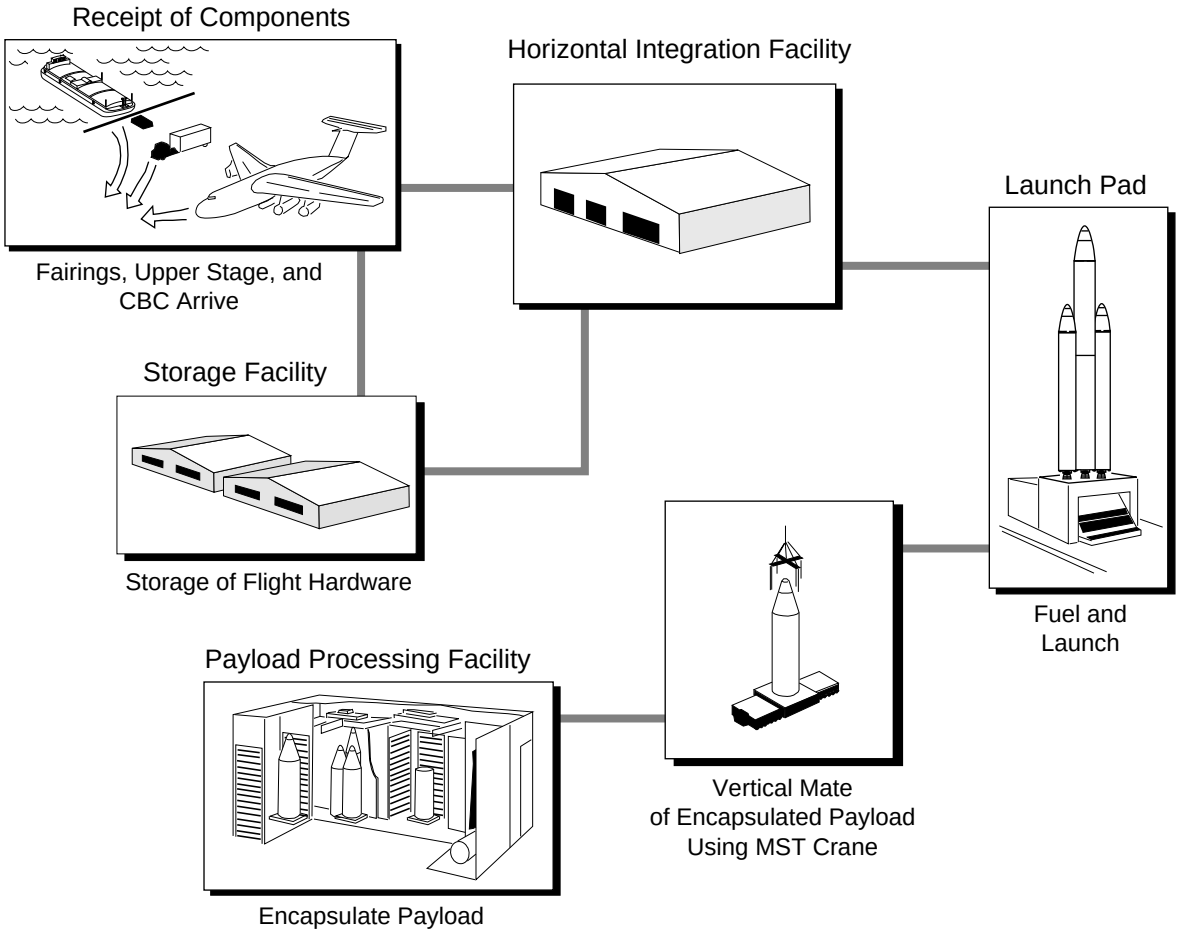
Solid propellant would not be stored in the launch pad area. Existing solid propellant storage facilities would be utilized at each launch location. At Cape Canaveral AS, solid propellant would be stored in a new Delta III building within Area 57E to be constructed in 1998, and within portions of

Buildings 50801 and 50803. At Vandenberg AFB, solid propellant would be stored in Building 1670.

**2.1.2.3 Launch Site Operations.** The launch vehicle components would be shipped separately to each launch site (i.e., Cape Canaveral AS or Vandenberg AFB). Upon arrival, the components would undergo a variety of receiving inspections and off-line processing in the facilities noted above before final integration on the launch pad. Figure 2.1-9 provides an overview of the Concept B launch operation concept.

Launch process operations that would occur at the launch site include launch preparation, launch operations, and post-launch refurbishment of the launch pad. Table 2.1-7 lists the types and total estimated quantities of hazardous materials used for these processes for each Concept B launch. All hazardous materials used would be handled in accordance with applicable federal, state, and local regulations. Any spill of these materials would be collected and disposed of by a certified subcontractor in accordance with the SPCC plan.

**Vehicle Receiving/Inspection.** The major transportation methods for this concept would include barge/boat, air, and truck. The CBCs, CBC/interstage, and CBC strap-ons would be shipped to the launch site by barge/boat and received at the barge unloading facilities. Upon arrival, the CBCs would be moved to the HIF or an interim storage facility. Some of the payload fairings would be transported to the launch site via aircraft and received at the airstrip; the upper stage and the remainder of the payload fairings would be transported by truck.




**EXPLANATION**

| | |
|---|---|
| CBC | Common Booster Core |
| MST | Mobile Service Tower |

**Concept B Launch Operation Concept**

**Figure 2.1-9**

Note: Solid rocket motors would be shipped by rail.

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**Table 2.1-7. Estimated Hazardous Materials Utilized Per Launch (all processes), Concept B[a]**

| Material | Quantity (lbs)[b] |
|---|---|
| POL | 80 |
| VOC-Based Primers, Topcoats, and Coatings | 580 |
| Non-VOC-Based Primers, Topcoats, and Coatings | 460 |
| VOC-Based Solvents and Cleaners | 530 |
| Non-VOC-Based Solvents and Cleaners | 1,070 |
| Corrosives | 5,500 |
| Refrigerants | 0 |
| Adhesives, Sealants, and Epoxies | 690 |
| Other | 20 |
| Total | 8,930 |

Notes: (a) Propellants are shown in Table 2.1-6.
(b) Estimated quantities are rounded to the nearest pound and are the same for Cape Canaveral AS and Vandenberg AFB. Estimates are not dependent on vehicle type.
lbs = pounds
POL = petroleum, oil, and lubricants
VOC = volatile organic compound

Once at the launch site, the payload fairings would be transported to the payload encapsulation facility. The HUS, CUS, and HDCUS would be transported to the HIF or an interim storage facility. Items received would be inspected and prepared for integration/encapsulation at designated facilities.

Liquid propellant for the launch vehicle would be shipped directly from the manufacturing location. All propellant would be shipped in accordance with DOT regulations in Title 49 CFR Parts 100-199. $LO_2$ and $LH_2$ would be transported by truck and would be shipped from the manufacturing locations to the launch site. After the Directorate of Aerospace Fuels Management, located at Kelly AFB, Texas, approves the shipment of $N_2O_4$, it would be shipped by rail or truck from the manufacturing location to the launch site. MMH and A-50 would be transported via truck by one of the authorized shippers (Directorate of Aerospace Fuels Management or NASA) to the launch site. Solid rocket motors could be shipped by truck, rail, barge, or aircraft.

**Horizontal Integration Facility Processing.** Receiving, integration, and check-out of the CBC and upper stages would be performed in the HIF. When the launch vehicle is ready, it would be transported to the launch pad.

**Payload Encapsulation.** This process would involve encapsulating the payload within the payload fairing, which would entail mating the payload-attach fittings, payload, and fairing, and conducting automated tests to ensure that all interfaces are verified. The third stage would be encapsulated with the

payload, if required, for some small vehicle missions. Fueling of the payload would be conducted prior to encapsulation in payload processing.

**Launch Vehicle Transfer and Erection.** During this process, the unfueled launch vehicle would be moved to the launch pad from the HIF and erected.

The assembled launch vehicle and umbilicals would then be raised and connected to the launch table.

**Launch Pad Processing.** The launch pad processing for all three vehicles would be similar, with the exception of the propellant servicing of the upper stages and attitude control systems. The vehicle would be erected and the launch mount unit secured to the launch table. The MST/mobile assembly shelter (MAS) (at Vandenberg AFB only) would be moved over the pad, and access platforms would be lowered or rotated in place to gain access to critical vehicle points. Interfaces at the pad include electrical, engine purge lines, GHe purge lines, ground equipment purge lines, $LO_2$ and $LH_2$ fill and drain lines, and vent lines, as applicable. The encapsulated payload would be hoisted by the MST crane and positioned over the upper stage.

Upon completion of final vehicle preparations for launch, the MST/MAS would be moved into the launch position, and final countdown would commence. The vehicle would undergo a final "hold fire" test to ensure range safe operation, followed by fueling of the vehicle stages. The final countdown would then be completed and the vehicle launched.

If deluge water were required, approximately 200,000 to 300,000 gallons of water per launch would be sprayed into the flame deflector to cool the rocket exhaust and minimize damage to the launch pad. At Cape Canaveral AS, deluge water remaining in the launch duct after launch would be released to grade in accordance with permit requirements. Pretreated deluge water that could not be released to grade would be released to the WWTP. At Vandenberg AFB, water would be transported to the SLC-6 deluge treatment plant for treatment and disposal into evaporation ponds. Wastewater would be disposed of in accordance with applicable federal, state, and local regulations.

Approximately 30,000 gallons of water would be required for pad wash- down after DIV-M+ vehicle launches. This water would be neutralized and disposed of according to installation requirements.

**Flight Support Operations.** Flight operations after launch include the downlinking of composite vehicle performance and system payload telemetry data to the NASA TDRSS. These data would be routed to recording stations, as required for processing, data archiving, analysis, and monitoring by launch team personnel. Pre- and post-launch telemetry data would be used to perform event reconstruction, trend analysis, and vehicle performance evaluation. Flight support operations also include range safety control throughout all phases of the mission.

**Post Launch Operations.** This process would include pad refurbishment in preparation for the next launch. Following launch, some of the components would require sandblasting and repainting; ablative material would be applied on some areas.

Small leaks and spills could occur during fueling, as could other hazardous material spills. These materials would be cleaned up, if necessary, by dilution with water, absorption or adsorption by the appropriate materials, and collection of the waste materials into DOT-approved waste containers for

disposal. Collected wastewater would be disposed of in accordance with applicable federal, state, and local regulations.

If a launch were to be canceled or delayed beyond the launch window, it would be necessary to defuel the launch vehicle in accordance with EWR 127-1 requirements. Defueling is accomplished through pneumatic-activated valves that allow propellant to drain to ground/mobile storage containers. Electrically activated valves would allow high-pressure helium to vent to the atmosphere.

**2.1.2.4 Safety Systems.** Concept B would be subject to the same rules and policies described in Section 2.1.1.4 for Concept A. Systems with aspects unique to Concept B are described below.

**Fire Protection System.** Fire protection, alarm, and fire suppression systems would be provided for all fuel (A-50, $LH_2$, $N_2H_4$) holding areas and support facilities. Gas ($H_2$) detectors, detecting the lower explosive limit in the $LH_2$ storage area, would activate the alarms to the Air Force Fire Department. Flame detection alarms would also automatically activate deluge systems and notify the Fire Department. At Cape Canaveral AS, fire suppression water would be obtained through an existing 10-inch potable water line; a fire suppression water tank (144,000-gallon minimum) and pumps would likely be required. At Vandenberg AFB, an existing tank above the launch complex would be utilized for fire suppression water. All launch pads at both locations would require installation of an underground fire suppression water loop encircling the site. This loop would contain approximately 15 hydrants; the total anticipated fire suppression water flow would be 1,500 to 2,000 gallons per minute (gpm). For oxidizer fueling performed by truck, a deluge system would not be included because $N_2O_4$ and water are highly reactive. Flushdown hoses, however, would be available.

**Security.** Security requirements, an integral component of project safety, would be incorporated within the project design and through operational procedures. Elements of site security would include a perimeter security fence, a clear zone, security lighting, security standby power, an intrusion detection system, and security patrol roads. Security procedures include the use of entry controllers, alarm monitors, closed circuit television (CCTV), alarm/security response teams, radios, and vehicles in accordance with Air Force regulations.

**Launch Hazard Area Safety.** The procedures for launch safety would be the same for Concept B as described for Concept A, except for the number of beach closures at Vandenberg AFB. Jalama Beach County Park would be closed to the public during some SLC-6 launches, depending on the launch azimuth. Ocean Beach County Park would not be closed during launches from SLC-6.

**Quantity-Distance Criteria.** The facilities associated with Concept B would be sited to meet ESQD criteria.

**2.1.2.5 Project Location and Access - Cape Canaveral AS.** EELV launch operations would be conducted at the 120-acre SLC-37 (Pads 37A and 37B) at Cape Canaveral AS, in the north-central portion of the station. SLC-37

was originally used for the Apollo Program. The only remaining structures at SLC-37 are concrete support equipment buildings that served as bases for the two launch pad umbilical towers, the former launch control center, miscellaneous retaining walls, and the concrete pad/refractory brick pad areas.

Cape Canaveral AS is accessible through Gate 1 from SR 401 (Figure 2.1-10). Once on Cape Canaveral AS, access to the site is along Samuel C. Phillips Parkway to Beach Road, which connects to SLC-37.

**2.1.2.6 Support Structures/Operations - Cape Canaveral AS.** Launch rates associated with Concept B are provided in Table 2.1-8. Approximately 540 personnel are expected to be required to support EELV program operations by 2007. Launch operations for Cape Canaveral AS would be as described in Section 2.1.2.3 and would be conducted in the structures listed in Table 2.1-9. Figures 2.1-10 and 2.1-11 provide the general location of facilities at Cape Canaveral AS and the site layout plan for SLC-37, respectively. Most of the area would be utilized for launch operations.

Under Concept B, the projected activities associated with EELV would generate the following average utility demands at Cape Canaveral AS during the projected peak launch year (2015):

- Water - 24,400 gpd
- Wastewater - 24,300 gpd
- Solid waste - 1.1 tons per day
- Electricity - 96,200 kWH per day.

Figure 2.1-10 Concept B Proposed Facility Map, Cape Canaveral AS, Florida

## Table 2.1-8. Concept B Launch Rates

| | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East Coast[a] | | | | | | | | | | | | | | | | | | | | | |
| Government[b] | | | | | | | | | | | | | | | | | | | | | |
| DIV-S | 1 | 2 | 3 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 5 | 3 | 5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 59 |
| DIV-M | | 2 | 2 | 4 | 7 | 6 | 4 | 4 | 1 | 3 | 3 | 5 | 4 | 5 | 7 | 5 | 3 | 4 | 5 | 4 | 78 |
| DIV-H | | | 1 | | | 1 | | 1 | | | 1 | | 1 | | 1 | | | 1 | | 1 | 8 |
| Commercial | | | | | | | | | | | | | | | | | | | | | |
| DIV-S | 4 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 118 |
| DIV-M | | | | | | | | | | | | | | | | | | | | | |
| DIV-M+ | 8 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 122 |
| DIV-H | | | | | | | | | | | | | | | | | | | | | |
| West Coast[c] | | | | | | | | | | | | | | | | | | | | | |
| Government[b] | | | | | | | | | | | | | | | | | | | | | |
| DIV-S | | 1 | 1 | | 1 | 1 | 3 | 2 | 1 | 2 | | 2 | 1 | 2 | | 1 | 1 | 1 | | 1 | 21 |
| DIV-M | | 1 | 1 | 3 | 2 | 3 | 3 | 1 | 3 | 2 | 4 | 2 | 2 | 4 | 1 | 2 | 3 | 4 | 1 | 3 | 45 |
| DIV-H | | | | | | | | 1 | | | | | | | | | | | | | 1 |
| Commercial | | | | | | | | | | | | | | | | | | | | | |
| DIV-S | | 4 | | | | | | | | | | | | | | | | | | | 4 |
| DIV-M | | | | | | | | | | | | | | | | | | | | | |
| DIV-M+ | 2 | | | 4 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 38 |
| DIV-H | 2 | | 4 | | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 38 |
| Total | 17 | 22 | 24 | 25 | 28 | 30 | 29 | 28 | 24 | 26 | 29 | 28 | 29 | 30 | 28 | 27 | 26 | 29 | 25 | 28 | 532 |

Notes: The DIV-S and DIV-M vehicles fulfill the medium lift requirement of the National Mission Model. The DIV-H vehicle fulfills the heavy lift requirement of the National Mission Model.

(a) Cape Canaveral Air Station, Florida.
(b) Based on the National Executable Mission Model.
(c) Vandenberg Air Force Base, California.

DIV-H = heavy launch vehicle
DIV-M = medium launch vehicle
DIV-M+ = medium launch vehicle with solid rocket motor strap-ons
DIV-S = small launch vehicle

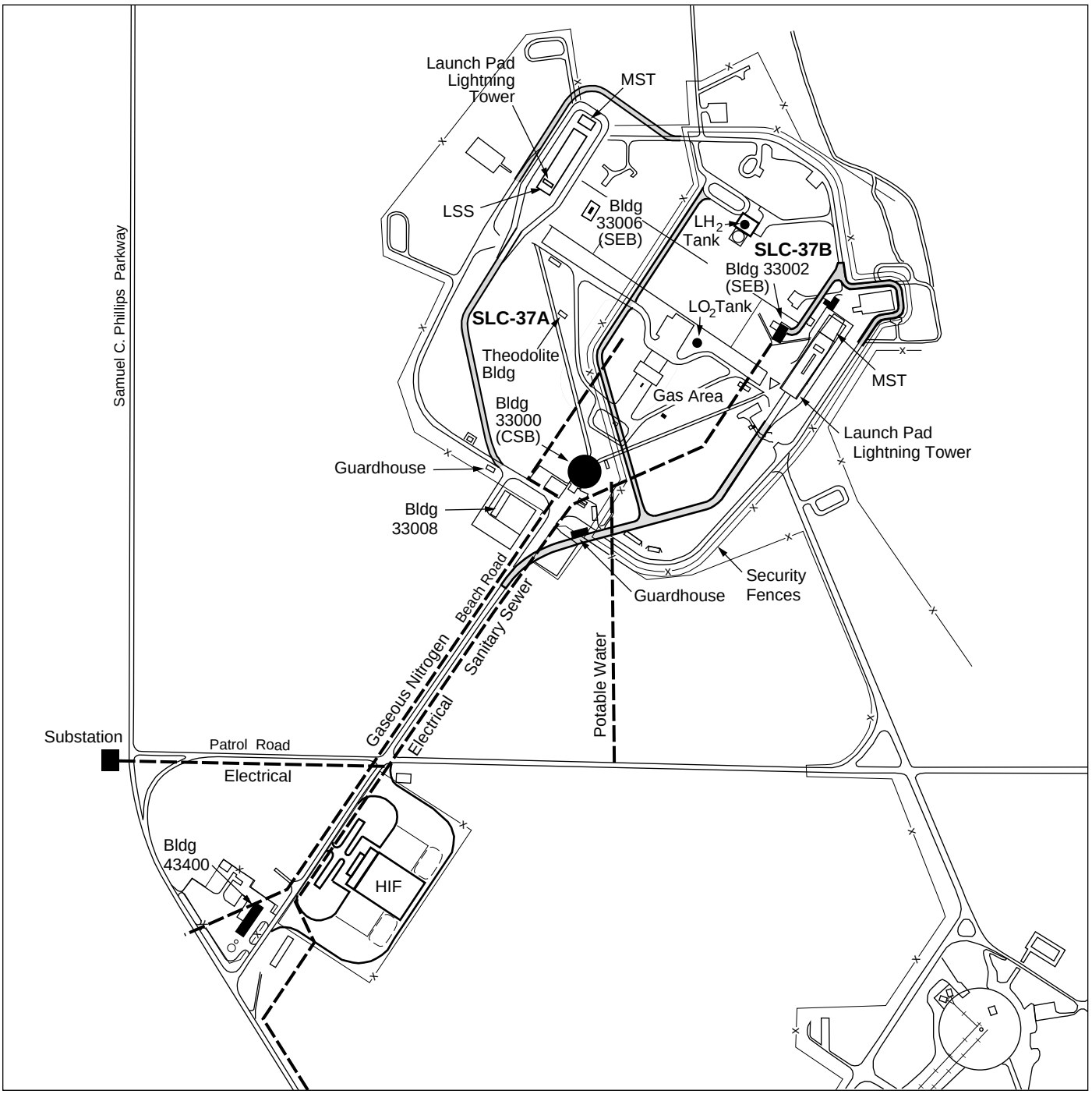
**Table 2.1-9. Support Structures, Cape Canaveral AS, Concept B**

| Common Support Structure | Building | EELV Modifications |
|---|---|---|
| Barge/Boat Unloading | Port of Canaveral Dock | None |
| Aircraft Unloading | Cape Canaveral AS Skid Strip | None |
| Storage Facility | Building 1348 (Hangar C) | Modification |
| Hardware Storage Facility | Building 75251 (Missile Inert Storage [MIS]) | Modification |
| Equipment Storage Facility | Buildings 33008/43400 | Modification |
| Electric Substation | New Construction | New Construction |
| Machine Shop | Building 43400 | Modification |
| Storage/Office Space | Buildings 38800/38804/38835 (Centaur Processing Facility [CPF] Complex) | Modification |
| Storage/Processing | Buildings 50801/50803 (Area 57E) | None |
| Horizontal Integration Facility | New Construction | New Construction |
| DSCS Processing Facility | Building 55820 (DSCS Processing Facility [DPF]) | None |
| Payload Processing Facility | Building 70000 (Spacecraft Processing Integration Facility [SPIF]) | None |
| Launch Complex | SLC-37 (Pads 37A and 37B) | New Construction/ Modification |
| Launch Control Center | Building 38835 (Centaur Processing Building [CPB]) | Modification |

AS = Air Station
DSCS = Defense Satellite Communications Systems
EELV = Evolved Expendable Launch Vehicle
SLC = Space Launch Complex

Based upon employment projections and project activities, Concept B would generate an average of 1,730 vehicle trips daily, with 360 trips expected to occur during the peak hour.

**2.1.2.7 Project Construction Activities - Cape Canaveral AS.** Construction at Cape Canaveral AS would begin after Engineering and Manufacturing Development (EMD) award (June 1998) and would be completed by July 2000. Construction personnel requirements would average 220, with a maximum of 405 personnel required during peak construction activities in June 1999. Proposed construction activities at Cape Canaveral AS are described below.




**EXPLANATION**

| | |
|---|---|
| CSB | Common Support Building |
| HIF | Horizontal Integration Facility |
| $LH_2$ | Liquid Hydrogen |
| $LO_2$ | Liquid Oxygen |
| MST | Mobile Service Tower |
| SEB | Support Equipment Building |
| | New Pavement |
| | New Utility System Corridor |

0 400 800 Feet

# Concept B SLC-37 Site Plan, Cape Canaveral AS, Florida

**Figure 2.1-11**

EEL/015

Existing Facility Modification

At SLC-37, launches are planned from both Pads 37A and 37B. Modifications required to support EELV activities would include the following (see Figure 2.1-11):

**Pad 37A**

- The existing roads would be modified.
- A launch pad would be constructed at the previous location of the existing Pad 37A. An FUT and MST would be constructed on the pad, which would be raised above the location of the previous pad to accommodate the exhaust duct and provide a level area for the MST. Support and tie-downs for the MST and the FUT would be provided on the pad.
- Facility 33006 (former Utility Building) would be modified for use as the SEB. A fire detection and suppression system would be installed.
- A modular security building with parking spaces would be constructed.
- Lightning protection towers would be constructed.
- A launch table containing the interfaces to the vehicle from the ground support systems would be constructed to support the vehicle prior to launch.
- A launch support structure connected to the SEB by a service tunnel would be constructed to support the launch table and MST. A fire detection and suppression system would be installed.
- A flame detector and exhaust duct would be installed.
- A Theodolite Building and an MST would be constructed.
- Buildings 33001, 33003, 33007, 33009, 38320, 43401, 43403, and 43405 are inactive, and would be abandoned in place.

**Pad 37B**

- The existing roads would be modified.
- The launch pad area would be modified, including removal of approximately 32,000 square feet of refractory brick that may contain asbestos and silica. Portions of the roads within SLC-37 would be new.
- A 250,000-gallon $LO_2$ tank would be installed within a gas storage area.
- An 850,000-gallon $LH_2$ tank would be installed.

- The existing SEB (Facility 33002) would be renovated, and a Theodolite Building, lightning protection towers, a guardhouse, a security fence between the Pad 37A and 37B areas, an MST, a launch table, and exhaust and launch ducts would be constructed.

- A launch support structure deck would be installed to provide rooms and passageways under the launch deck for umbilicals and services.

- The Common Support Building (CSB) (Facility 33000) would be modified.

- The existing Sentry House (Facility 33005) would be removed.

- A guardhouse would be installed at the entrance of the SLC.

- Chain-link security fence would be installed around the SLC between SLC-37A and SLC-37B.

- A pipeline and lift station would be installed to transfer wastewater to the Cape Canaveral AS WWTP.

- A GHe vaporization system and pipeline tie-in would be installed at SLC-37.

- A compressed $GN_2$ pipeline would be installed to connect the new gas storage area to the Cape Canaveral AS commercial line at Samuel C. Phillips Parkway. The underground portion of the line that ties into the existing line northeast of Building 43400 and runs along Beach Road to the SLC-37 gas storage area would be carbon steel; the aboveground piping at the gas storage area would be stainless steel. The carbon steel underground line would have cathodic protection.

**Port of Canaveral Dock.** A dock at the Port of Canaveral would be used for EELV program activities. Any additional required road or facility improvements would be the responsibility of the Port of Canaveral.

**Building 1348 (Hangar C).** This building would be used for GSE storage. Upgrades to Hangar C would include interior asbestos and lead-based paint abatement, minor interior modifications, and construction of new entrances. Additional storage space (approximately 20,000 square feet) would be required on Cape Canaveral AS; available facility space has not yet been identified.

**Building 75251, Missile Inert Storage (MIS).** This building would be used for hardware storage. Upgrades to Building 75251 would include interior and exterior modifications and installation of new doors.

**Buildings 33008 and 43400.** These buildings would be used for storage. Modifications to Buildings 33008 and 43400 would be required to support EELV program activities. The extent of modifications required has not yet been determined.

**Buildings 38800, 38804, 38835, Centaur Processing Facility.** These facilities would be used for storage of fairings and upper stages, as well as other support activities. Interior modifications to these buildings would be required. The launch control area within Building 38835 would be modified.

**Building 43400.** A portion of this building would be utilized as a machine shop. Interior modifications would be required.

**Area 57E.** Portions of existing Buildings 50801 and 50803, and a new building scheduled for construction for the Delta III program, all within Area 57E, would be utilized for storage and processing.

**Infrastructure.** New wastewater, electrical, and water lines would be installed (see Figure 2.1-11). Some improvements would be made along existing road corridors; new wastewater and electrical lines may be installed through undisturbed areas between SLC-37 and Samuel C. Phillips Parkway.

New Facilities

**Horizontal Integration Facility.** An HIF would be constructed near SLC-37 on the south side of Beach Road (see Figure 2.1-11). The facility would be of a hangar-like configuration, with a parking lot in front. A fire detection system and sprinkler system would be installed. An estimated 14 acres would be disturbed for construction of the HIF.

**Electric Substation.** An electrical substation and associated connections would be constructed in the vicinity of Patrol Road and Samuel C. Phillips Parkway, at the area of Building 43302 (which would be removed). All electrical lines would be run underground.

Alternative Facilities

Two alternative facilities have been identified at Cape Canaveral AS for Concept B activities, in the event that the preferred locations are not available in the time period required to support the EELV program. These facilities are described below.

**Horizontal Integration Facility.** An alternate location for construction of the HIF is adjacent to the CPF Complex (Buildings 38800/38804/38805).

**U.S. Air Force Roll-On/Roll-Off Dock.** If the Port of Canaveral Dock is not available to support EELV, the existing Air Force Roll-On/Roll-Off Dock would be modified. Limited dredging activities may be required in previously dredged areas. The dock would be modified to accommodate the turning radius of the transport vehicle/dolly in the egress area.

Construction Phase

The majority of new construction, except for construction of the HIF, would occur within the previously disturbed SLC-37 area or along existing road corridors. The entire area of SLC-37 inside the new security fence would be cleared of vegetation (approximately 25 to 30 acres for Pad 37A and 55

acres for Pad 37B). Construction equipment laydown areas, personal vehicle parking, temporary mobile offices (trailers), maintenance facilities, and other ancillary construction areas would be sited in previously disturbed areas (see Figure 2.1-11). The construction laydown areas would be located between Pads 37A and 37B.

Earthwork for construction would be performed in accordance with the construction Storm Water Pollution Prevention Plan and the SPCC plan.

To contain collected wastewater, a temporary truck washdown area with an impoundment would be provided within the boundaries of the construction laydown areas.

Approximately 80 acres of land, including the area for construction of the HIF and electric substation, would be disturbed during construction. Depending upon the final design and grading plans, 5,000 to 9,000 cubic yards of material would be excavated and 110,000 to 180,000 cubic yards of fill would be required. Fill material would come from borrow areas located off station. Unsuitable cut material would be removed from the project area to a spoil site on Cape Canaveral AS, or to other approved locations. Appropriate erosion control would be implemented at the stockpile. Construction materials generally would be trucked through Gate 1 over Samuel C. Phillips Parkway to SLC-37.

During the construction period, approximately 3,300 gpd of water would be required for general activities (e.g., site washdown, cement mixing, personnel requirements). Wastewater generation would average approximately 2,000 gpd. In addition, approximately 5,000 to 8,000 tons of solid waste would be generated, of which an estimated 3 to 5 percent would be recycled. Removal of construction debris would be the responsibility of the construction contractor; any hazardous materials found during construction (e.g., asbestos, lead-based paint) would be abated in accordance with applicable regulations.

From 1998 through 2000, construction traffic entering and exiting project construction sites on Cape Canaveral AS under Concept B is estimated to generate an average of 1,400 daily vehicle trips, with 150 trips expected during the peak hour. Construction traffic entering and exiting project construction sites during the peak construction period in June 1999 is expected to be 2,550 trips, with 270 trips occurring during the peak hour.

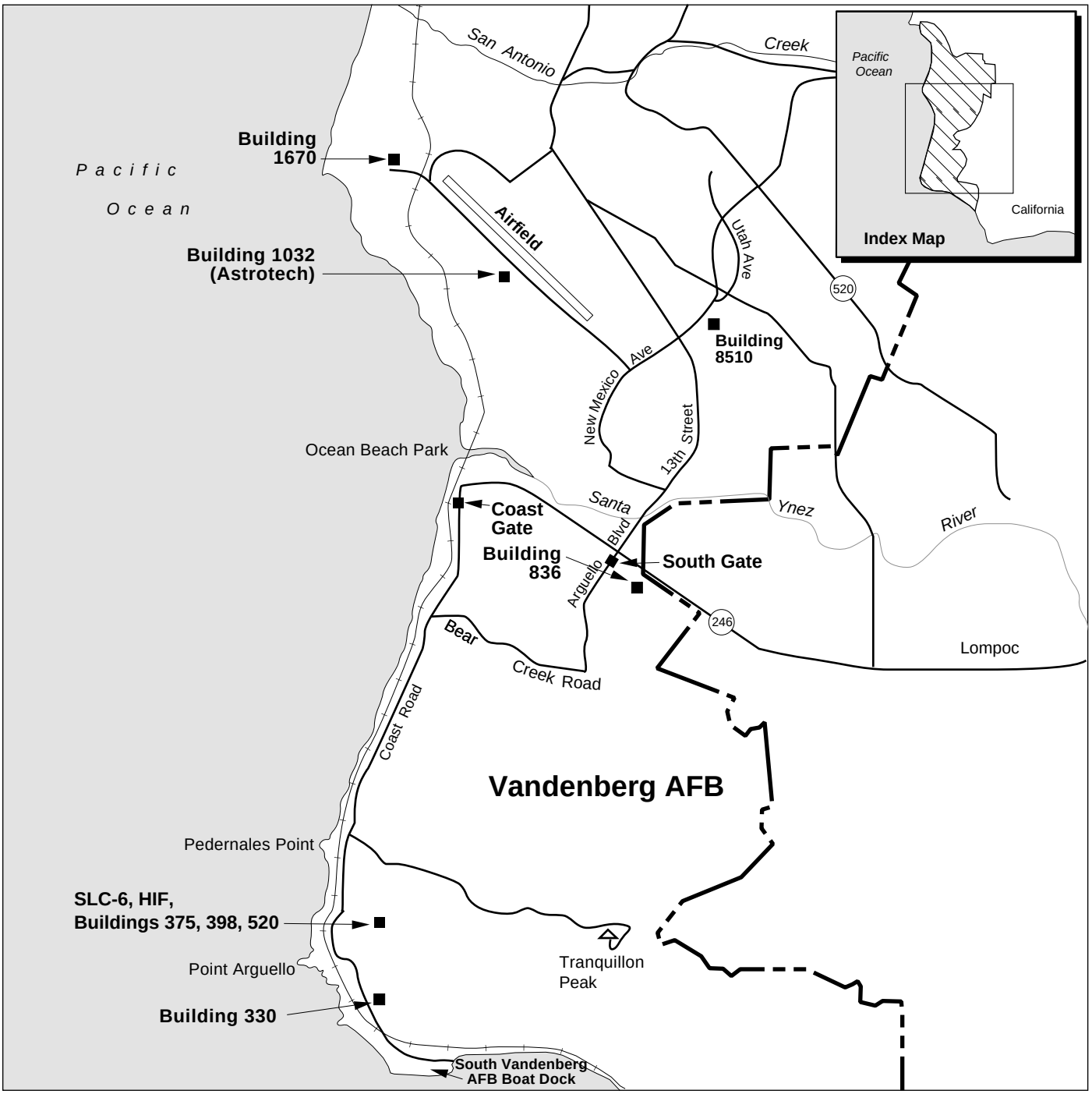
**2.1.2.8 Project Location and Access - Vandenberg AFB.** EELV launch operations would be conducted at the 100-acre SLC-6 at South Vandenberg AFB. The SLC-6 site was originally constructed in 1970 for the Titan IIIM manned launch vehicle that was to be used for the Manned Orbital Laboratory (MOL) program. After the MOL program was cancelled, SLC-6 was modified for the space shuttle program, but was never used for this program. Most of the facilities are currently in mothball status.
Some of the other facilities are currently being used by the California Commercial Spaceport and a launch contractor.

Access to the SLC would be primarily through the Vandenberg AFB South Gate entrance via SR 246, then over Air Force-controlled secondary roadways, including Arguello Boulevard, and Bear Creek and Coast roads (Figure 2.1-12).

**2.1.2.9 Support Structures/Operations - Vandenberg AFB.** Launch rates associated with Concept B are provided in Table 2.1-8. Approximately 400 personnel are expected to be required to support EELV launch operations by 2007. Launch site operations would be as described in Section 2.1.2.3 and would occur in the structures listed in Table 2.1-10. Figures 2.1-12 and 2.1-13 provide the general location of facilities at Vandenberg AFB and the site layout plan for SLC-6, respectively. Most of the SLC-6 area would be utilized for launch operations.

Under Concept B, the projected activities associated with EELV would generate the following average utility demands at Vandenberg AFB during the projected peak launch year (2007):

- Water - 18,100 gpd
- Wastewater - 18,000 gpd
- Solid waste - 0.8 ton per day
- Electricity - 89,500 kWH per day.




**EXPLANATION**

- Base Boundary
- HIF Horizontal Integration Facility
- SLC Space Launch Complex
- (246) State Route

# Concept B Proposed Facility Map, Vandenberg AFB, California

0 .5 1 2 Miles

**Figure 2.1-12**

EELV/002

**Table 2.1-10. Support Structures, Vandenberg AFB, Concept B**

| Common Support Structure | Building | EELV Modifications |
|---|---|---|
| Barge/Boat Unloading | South Vandenberg AFB Boat Dock | Modification |
| Aircraft Unloading | Vandenberg AFB Airfield | None |
| Hardware Storage | Building 836 | Modification |
| Storage and Refurbishment | Buildings 330, 398, 520 | Modification |
| Horizontal Integration Facility | New Construction (SLC-6) | New Construction |
| Payload Processing Facilities | Building 375 (Integrated Processing Facility [IPF])<br>Building 1032 (Astrotech) | Modification |
| SRM Storage and Processing | Building 1670 | Modification |
| Launch Complex | SLC-6 | Modification |
| Launch Control Center | Building 8510 (Range Launch Control Center [RLCC]) | None |

AFB = Air Force Base
EELV = Evolved Expendable Launch Vehicle
SLC = Space Launch Complex
SRM = solid rocket motor

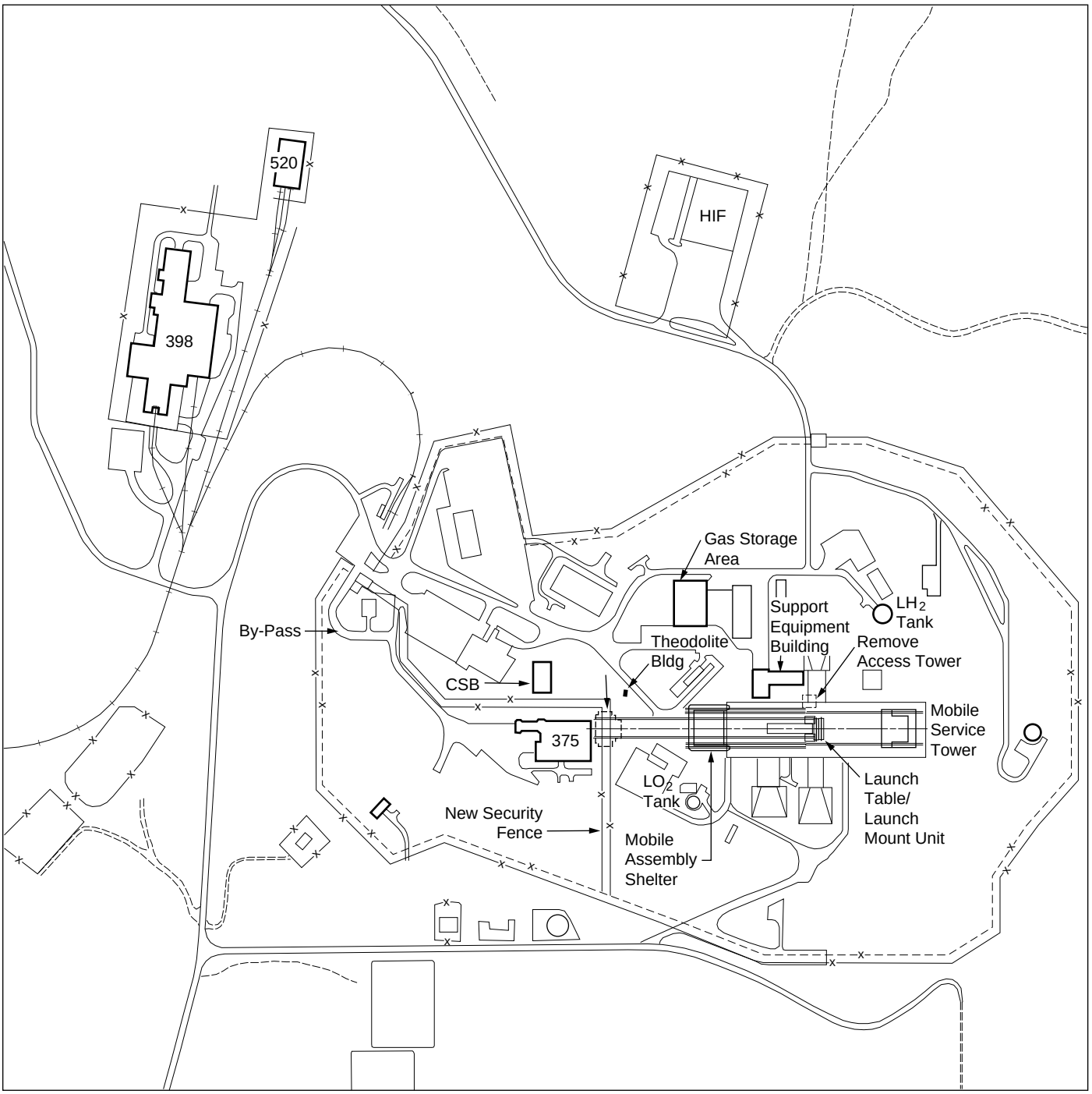
Based upon employment projections and project activities, Concept B would generate an average of 1,280 vehicle trips daily, with 270 trips occurring during the peak hour.

**2.1.2.10 Project Construction Activities - Vandenberg AFB.** At Vandenberg AFB, construction would begin after EMD award (June 1998) and would be completed by February 2001. Construction personnel requirements would average 173, with a maximum of 350 personnel required during peak construction activities between January and March 2000. Proposed construction activities at Vandenberg AFB are described below.

Existing Facility Modification

**SLC-6.** The MST, bridge cranes, launch mount and exhaust ducts, and $LO_2$ and $LH_2$ storage areas would be modified. Other modifications would include:

- A launch table and FUT would be constructed on the launch pad.
- The fuel holding area, oxidizer storage area, and payload changeout room would be demolished.
- A Theodolite Building would be constructed east of the launch pad.




**EXPLANATION**

| | |
|---|---|
| CSB | Common Support Building |
| HIF | Horizontal Integration Facility |
| $LH_2$ | Liquid Hydrogen |
| $LO_2$ | Liquid Oxygen |
| ——x—— | Security Fence |
| – – -x– – - | Double fence (if required) |

# Concept B SLC-6 Site Plan, Vandenberg AFB, California

0 200 400 800 Feet

Note: Construction laydown areas would be located immediately adjacent to the SLC-6 launch pad.

**Figure 2.1-13**

EEL/014

- Chain-link fencing would be installed around the Integrated Processing Facility (IPF) to form a security boundary. This would require clearance of vegetation for 30 feet on both sides of the fence.

**South Vandenberg AFB Boat Dock.** Modifications would consist of dredging approximately 20,000 cubic yards of sediment from the existing harbor channel. Dredging would be accomplished to the previously dredged depth. Disposal of material would be conducted in accordance with U.S. Army Corps of Engineers (USACE) permit requirements.

**Building 836.** Building 836 would be utilized for receiving, inspection, and storage of CBCs and upper stages. Minor interior modifications would be required.

**Building 375, Integrated Processing Facility and Building 1032 (Astrotech).** The IPF would require minor exterior and interior modifications. The Astrotech facility would likely require construction of a new high bay for encapsulation of heavy payloads.

**Buildings 330, 398, and 520.** These facilities would be utilized for storage and refurbishment of GSE. Minor interior modifications would be required at all three facilities.

**Building 1670.** Building 1670 would be utilized for SRM storage and processing. Minor interior modifications would be required.

**Infrastructure.** Utility modifications would occur within previously disturbed areas of SLC-6.

New Facilities

**New Horizontal Integration Facility.** A new HIF would be constructed in the northern portion of SLC-6. This area was the laydown area used during the initial construction of SLC-6 and is now a parking lot. Approximately 14 acres would be disturbed during construction.

Alternative Facilities

Two alternative facilities have been identified for Concept B activities at Vandenberg AFB, in the event that the preferred facilities are not available in the time period required to support the EELV program. These facilities are described below.

**Building 2520.** If Building 375 is not available for payload encapsulation activities, Building 2520 would be utilized for unbagging of payload fairings and encapsulation of small and medium payloads.
**Building 7525.** If Building 330 is not available to support EELV, Building 7525 would be utilized for GSE storage and refurbishment, and sandblasting and painting activities. If Building 836 is not available for storage of flight hardware, Building 7525 would be utilized for this purpose. The extent of modifications required has not yet been determined.

Construction Phase

Most of the construction activities would take place within the previously disturbed SLC-6 area or along existing road corridors. SLC-6 consists of 100 acres of semi-improved grounds within a perimeter fence. Construction equipment laydown areas, personal vehicle parking, temporary mobile offices (trailers), maintenance facilities, and other ancillary construction areas would be sited in previously disturbed areas, to the north of the construction site.

Earthwork for construction would be performed in accordance with the construction Storm Water Pollution Prevention Plan and the SPCC plan.

To contain collected wastewater, a truck washdown area and impoundment within the boundaries of the construction laydown areas would be provided.

Depending upon the final design and grading plans, 4,500 to 7,500 cubic yards of material would be excavated, and 80,000 to 135,000 cubic yards of fill would be required. Fill material would come from the Vandenberg AFB Manzanita Borrow Area. Unsuitable cut material would be removed from the project area to the Manzanita spoil site, or to other approved locations. Top-soil would be removed and stockpiled on site for re-spreading on disturbed areas for revegetation and erosion control after completion of construction. Appropriate erosion control would be implemented at the stockpile. Construction materials generally would be trucked through the Coast Gate, then over Coast Road to SLC-6.

During the construction period, approximately 2,100 gpd of water would be required for general activities (e.g., site washdown, cement mixing, personnel requirements). Wastewater generation would average approximately 1,400 gpd. In addition, approximately 2,200 to 3,800 tons of solid waste would be generated, of which it is estimated that 3 to 5 percent would be recycled. Removal of construction debris would be the responsibility of the construction contractor; any hazardous materials found during construction (e.g., asbestos, lead-based paint) would be abated in accordance with applicable regulations.

From 1998 to 2001, construction traffic entering and exiting project construction sites on Vandenberg AFB under Concept B is estimated to generate an average of 1,100 daily vehicle trips, with 115 trips expected during the peak hour. Construction traffic entering and exiting project construction sites during the peak construction period between January and March 2000 is expected to be 2,200 trips, with 230 trips occurring during the peak hour.

### 2.1.3 Concept A/B

Under Concept A/B, the contractors would use SLC-41 and SLC-37 at Cape Canaveral AS and SLC-3W and SLC-6 at Vandenberg AFB for the EELV system activities, as well as other facilities at both locations.

**2.1.3.1 Launch Vehicle Concept.** Under Concept A/B, the launch vehicle system described in Section 2.1.1.1 for Concept A and that described in Section 2.1.2.1 for Concept B would both be utilized.

**2.1.3.2 Primary Support Structures.** Structures described in Sections 2.1.1.2 and 2.1.2.2 for Concept A and B, respectively, would be utilized to support Concept A/B activities. If this concept were to proceed, any conflicts in facility usage between the two contractors would be addressed as the EELV program is further defined.

**2.1.3.3 Launch Site Operations.** Launch vehicle components would be delivered to the site, and all operations would be conducted as described in Sections 2.1.1.3 and 2.1.2.3 for Concepts A and B, respectively. Quantities of hazardous materials to be utilized would be the same per launch as shown in Tables 2.1-2 and 2.1-6, respectively, for both Concepts A and B.

**2.1.3.4 Safety Systems.** Concept A/B would be subject to the same rules and policies described in Sections 2.1.1.4 and 2.1.2.4, respectively, for Concepts A and B.

**2.1.3.5 Project Location and Access - Cape Canaveral AS.** As described in Section 2.1.1.5 for Concept A and in Section 2.1.2.5 for Concept B, EELV launch operations would be conducted at SLC-41 and SLC-37 at Cape Canaveral AS.

**2.1.3.6 Support Structures/Operations - Cape Canaveral AS.** Launch rates associated with Concept A/B are provided in Table 2.1-11. As described in Section 2.1, each contractor is assumed to launch approximately 50 percent of the combined total of EELV flights. No distinction has been made between government and commercial flights. Full staffing to support EELV program operations would be reached in 2003 for Concept A at 150 personnel and in 2007 for Concept B at 440 personnel.

Under Concept A/B, the projected activities associated with EELV would generate the following average utility demands at Cape Canaveral AS during the projected peak launch year (2015):

## Table 2.1-11. Concept A/B Launch Rates

| | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East Coast[a] | | | | | | | | | | | | | | | | | | | | | |
| Concept A | | | | | | | | | | | | | | | | | | | | | |
| MLV-D | 4 | 4 | 5 | 3 | 3 | 3 | 3 | 5 | 4 | 5 | 5 | 4 | 5 | 4 | 5 | 4 | 3 | 3 | 5 | 3 | 80 |
| MLV-A | 3 | 4 | 4 | 5 | 7 | 6 | 5 | 4 | 3 | 4 | 3 | 6 | 4 | 5 | 7 | 6 | 5 | 4 | 6 | 6 | 97 |
| HLV-L | | | | | | | | | | | | | | | | | | | | | |
| HLV-G | | | 1 | | | 1 | | 1 | | | 1 | | 1 | | 1 | | | 1 | | 1 | 8 |
| Concept B | | | | | | | | | | | | | | | | | | | | | |
| DIV-S | 3 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 1 | 1 | 3 | 3 | 2 | 2 | 3 | 3 | 2 | 3 | 3 | 3 | 47 |
| DIV-M | 2 | 2 | 3 | 3 | 3 | 4 | 3 | 4 | 2 | 2 | 3 | 4 | 4 | 3 | 4 | 2 | 3 | 2 | 3 | 2 | 58 |
| DIV-M+ | 2 | 3 | 4 | 2 | 4 | 3 | 2 | 4 | 4 | 4 | 2 | 2 | 2 | 3 | 4 | 4 | 2 | 2 | 4 | 4 | 61 |
| DIV-H | | 1 | 1 | | 1 | 1 | 1 | | | 2 | 1 | 1 | 2 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 19 |
| | | | | | | | | | | | | | | | | | | | | | 370 |
| West Coast[b] | | | | | | | | | | | | | | | | | | | | | |
| Concept A | | | | | | | | | | | | | | | | | | | | | |
| MLV-D | 2 | 2 | 2 | 1 | 2 | 2 | 4 | 2 | 2 | 3 | 1 | 2 | 2 | 2 | | 2 | 2 | 2 | | 1 | 36 |
| MLV-A | | 1 | 1 | 3 | 2 | 3 | 3 | 1 | 3 | 2 | 4 | 2 | 2 | 4 | 1 | 2 | 3 | 4 | 1 | 3 | 45 |
| HLV-L | | | | | | | | 1 | | | | | | | | | | | | | 1 |
| HLV-G | | | | | | | | | | | | | | | | | | | | | |
| Concept B | | | | | | | | | | | | | | | | | | | | | |
| DIV-S | | | | | 1 | | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | 1 | 2 | 2 | | 1 | 14 |
| DIV-M | 1 | 1 | 1 | 2 | 1 | 3 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | | 1 | 1 | 2 | 1 | 1 | 24 |
| DIV-M+ | | 2 | 2 | 2 | 2 | 2 | 4 | | 2 | 2 | 2 | 1 | 1 | 4 | 1 | 2 | 2 | 1 | | 1 | 33 |
| DIV-H | 1 | | | | | | 2 | 2 | 1 | 1 | | 1 | 1 | | | | | 1 | | 1 | 11 |
| | | | | | | | | | | | | | | | | | | | | | 164 |
| Total | 18 | 22 | 24 | 24 | 28 | 30 | 30 | 28 | 24 | 28 | 28 | 28 | 28 | 30 | 28 | 28 | 26 | 28 | 24 | 28 | 534 |

Notes: To ensure that an HLV system was analyzed for each contractor, the full AFSPC government HLV NMM has been included under Concept A/B.
(a) Cape Canaveral Air Station, Florida.
(b) Vandenberg Air Force Base, California.
AFSPC = Air Force Space Command
DIV-H = heavy launch vehicle
DIV-M = medium launch vehicle
DIV-M+ = medium launch vehicle with solid rocket motor strap-ons (commercial missions only)
DIV-S = small launch vehicle
HLV = heavy lift variant
MLV = medium lift variant
NMM = National Executable Mission Model

- Water - 27,700 gpd
- Wastewater - 26,600 gpd
- Solid waste - 1.2 tons per day
- Electricity - 72,817 kWH per day.

Based upon employment projections and project activities, Concept A/B would generate an average of 1,900 vehicle trips daily, with 390 trips expected to occur during the peak hour.

**2.1.3.7 Project Construction Activities - Cape Canaveral AS.** Construction activities described in Sections 2.1.1.7 and 2.1.2.7 for Concept A and B, respectively, would occur under Concept A/B. No additional construction would be required under this concept.

**2.1.3.8 Project Location and Access - Vandenberg AFB.** As described in Section 2.1.1.8 for Concept A and in Section 2.1.2.8 for Concept B, EELV launch operations would be conducted at SLC-3W and SLC-6 at Vandenberg AFB.

**2.1.3.9 Support Structures/Operations - Vandenberg AFB.** Launch rates associated with Concept A/B are provided in Table 2.1-11. Full staffing to support EELV operations would be reached in 2006 for Concept A at 135 personnel and in 2007 for Concept B at 300 personnel.

Under Concept A/B, the projected activities associated with EELV would generate the following average utility demands at Vandenberg AFB during the projected peak launch year (2007):

- Water - 19,700 gpd
- Wastewater - 18,700 gpd
- Solid waste - 0.83 ton per day
- Electricity - 66,551 kWH per day

Based upon employment projections and project activities, Concept A/B would generate an average of 1,300 vehicle trips daily, with 280 trips expected to occur during the peak hour.

**2.1.3.10 Project Construction Activities - Vandenberg AFB.** Construction activities described in Sections 2.1.1.10 and 2.1.2.10 for Concept A and B, respectively, would occur under Concept A/B. No additional construction would be required under this concept.

## 2.2 ALTERNATIVES TO THE PROPOSED ACTION

### 2.2.1 No-Action Alternative

Under the No-Action Alternative, Atlas IIA, Delta II, and Titan IVB launch vehicles would continue to support space launches to meet the requirements of the government portion of the NMM, both medium and heavy lift. These launch vehicles would provide DoD's source of expendable medium and heavy spacelift transportation to orbit through 2020. The No-Action Alternative does not include analysis of commercial launches. Table 2.2-1 presents the peak launch rates of these vehicles to meet the government

portion of the NMM. These launches would continue at existing launch complexes at both Cape Canaveral AS and Vandenberg AFB (Figures 2.2-1 and 2.2-2), utilizing existing manning levels. The infrastructure, operational procedures, and safety systems are in place for these launch vehicles at both Cape Canaveral AS and Vandenberg AFB. Chapter 3.0, Affected Environment, provides a description of the baseline conditions associated with these launch programs.

**Table 2.2-1. Launch Program, No-Action Alternative**

| | Cape Canaveral AS | | | Vandenberg AFB | | |
|---|---|---|---|---|---|---|
| Launch Vehicle | Launch Complex | Peak Year Launches (2015) | Operational Personnel Requirements | Launch Complex | Peak Year Launches (2007) | Operational Personnel Requirements |
| Atlas IIA | 36 | 7 | 250 | 3E | 3 | 175 |
| Delta II | 17 | 3 | 260 | 2W | 3 | 141 |
| Titan II | NA | NA | NA | 4W | 0 | 200 [(a)] |
| Titan IVB | 40/41 | 1 | 700 | 4E | 0 | 330 |

Note: (a) Launch requirements; caretaker of facilities only requires 25 personnel.
AFB = Air Force Base
AS = Air Station
NA = not applicable

Under the No-Action Alternative, the Air Force would continue to utilize the Atlas IIA, Delta II, and Titan IVB. Table 2.2-2 and Figure 2.2-3 present the general characteristics of these launch vehicles. The heavier lift version of each vehicle has been selected for analysis purposes.

**Atlas IIA.** The Atlas IIA has the ability to lift payloads of up to 14,000 pounds to low Earth orbit (LEO). The Atlas IIA consists of two $LO_2$/kerosene fuel (RP-1) booster engines, a sustainer section, and a CUS (see Table 2.2-2). The Atlas IIA is launched from SLC-36 at Cape Canaveral AS and SLC-3E from Vandenberg AFB. Deluge water requirements for the Atlas IIA are approximately 100,000 to 200,000 gallons per launch. The types and amounts of hazardous materials utilized for, and hazardous waste generated from, Atlas IIA launch operations are presented in Section 3.6, Hazardous Materials and Hazardous Waste Management (Tables 3.6-1 and 3.6-4, respectively).

**Delta II.** The Delta II has the ability to lift payloads of up to 7,500 pounds to LEO. The Delta II is a three-stage launch vehicle with a first stage that uses kerosene fuel (RP-1) and $LO_2$ (see Table 2.2-2). The second stage utilizes a mixture of 50 percent unsymmetrical dimethylhydrazine (UDMH) and

Figure 2.2-1 No-Action Alternative Launch Complexes, Cape Canaveral AS, Florida

Figure 2.2-2 No-Action Alternative Launch Complexes, Vandenberg AFB, California

**Table 2.2-2. Launch Vehicle Components, No-Action Alternative**

| Launch Vehicle | Maximum Vehicle Height (ft) | Approximate Vehicle Weight (lbs) | Approximate Propellant Weight (lbs) |
|---|---|---|---|
| **Atlas IIA** | 156 | 413,500 | |
| Stage I | | | $LO_2$ (240,320) |
| | | | RP-1 (108,050) |
| | | | $N_2H_4$ (40) |
| Centaur II Upper Stage | | | $LO_2$ (31,370) |
| | | | $LH_2$ (5,990) |
| | | | $N_2H_4$ (170) |
| Castor IVA SRM (4 per Atlas IIAS only) | | | $NH_4ClO_4$ (15,160) |
| | | | Al (4,240) |
| | | | HTPB (2,900) |
| **Delta II** | 125 | 510,000 | |
| Stage 1 | | | $LO_2$ (146,070) |
| | | | RP-1 (66,500) |
| Stage 2 | | | A-50 (4,610) |
| | | | $N_2O_4$ (8,630) |
| Star 48B (Stage 3) | | | $NH_4ClO_4$ (3,200) |
| | | | Al (800) |
| | | | HTPB (500) |
| SRM (9 per vehicle) | | | $NH_4ClO_4$ (18,380) |
| | | | Al (2,850) |
| | | | HTPB (4,660) |
| **Titan IVB SRMU** | 204 | 1,900,000 | |
| Stage 1 | | | $N_2O_4$ (220,770) |
| | | | A-50 (117,580) |
| Stage 2 | | | $N_2O_4$ (48,430) |
| | | | A-50 (27,580) |
| SRMU (2 per vehicle) | | | $NH_4ClO_4$ (479,840) |
| | | | Al (132,130) |
| | | | HTPB (83,450) |
| Centaur Upper Stage | | | $LO_2$ (38,220) |
| | | | $LH_2$ (7,900) |
| | | | $N_2H_4$ (340) |
| **Titan IVA** | 204 | 1,900,000 | |
| Stage 1 | | | $N_2O_4$ (218,110) |
| | | | A-50 (117,380) |
| Stage 2 | | | $N_2O_4$ (47,940) |
| | | | A-50 (27,470) |
| SRM (2 per vehicle) | | | $NH_4ClO_4$ (403,060) |
| | | | Al (94,840) |
| | | | PBAN (94,840) |
| TVC motors (2 per vehicle) | | | $N_2O_4$ (8,420) |

A-50 = Aerozine-50 (50 percent by weight symmetrical dimethylhydrazine and percent anhydrous hydrazine)
Al = aluminum
ft = feet
HTPB = hydroxyl-terminated polybutadiene (binder material)
lbs = pounds
$LH_2$ = liquid hydrogen
$N_2H_4$ = anhydrous hydrazine
$LO_2$ = liquid oxygen
$N_2O_4$ = nitrogen tetroxide
$NH_4ClO$ = ammonium perchlorate
PBAN = polybutadiene-acrylic acid-acrylonitrile terpolymer (binder material)
RP-1 = rocket propellant (kerosene fuel)
SRM = solid rocket motor
SRMU = solid rocket motor upgrade
TVC = Thrust Vector Control

Sources: Isakowitz, 1991; U.S. Air Force, 1994f, 1996e.

Figure 2.2-3 No-Action Alternative Launch Vehicles

50 percent anhydrous hydrazine (A-50) and $N_2O_4$, and the third stage utilizes solid propellant. Nine SRMs are attached to the first-stage motor to provide additional thrust. The Delta II is launched from SLC-17 at Cape Canaveral AS and from SLC-2W at Vandenberg AFB. Deluge water requirements for the Delta II are approximately 35,000 to 60,000 gallons per launch. The types and amounts of hazardous materials utilized for, and hazardous waste generated from, Delta II launch operations are presented in Section 3.6, Hazardous Materials and Hazardous Waste Management (Tables 3.6-2 and 3.6-5, respectively).

**Titan IVB.** The Titan IVB/solid rocket motor upgrade (SRMU) has the ability to lift payloads of up to 40,000 pounds to LEO. The typical Titan IVB launch vehicle consists of a two-stage core vehicle that uses $N_2O_4$ and a mixture of 50 percent UDMH and 50 percent anhydrous hydrazine (A-50), two SRMUs consisting of three segments each and a Centaur Upper Stage (see Table 2.2-2). The Titan IVB is launched from SLC-40 and SLC-41 at Cape Canaveral AS and from SLC-4E at Vandenberg AFB. Deluge water requirements for the Titan IVB are approximately 100,000 to 150,000 gallons per launch. The types and amounts of hazardous materials utilized for, and hazardous waste generated from, Titan IVB launch operations are presented in Section 3.6, Hazardous Materials and Hazardous Waste Management (Tables 3.6-3 and 3.6-6, respectively).

**Titan II.** The Titan II has the capability of carrying payloads of up to 5,600 pounds and is not currently launched from Cape Canaveral AS; SLC-4W has been utilized for Titan II launches from Vandenberg AFB. No Titan II launches are currently scheduled, and no future launches are planned to occur during the peak years considered in this EIS. The Titan II program is a relatively small program, with infrequent launches in the past; therefore, the Titan II launch vehicle will not be discussed further or analyzed in this EIS.

## 2.3 ALTERNATIVES ELIMINATED FROM FURTHER CONSIDERATION

Other launch concepts besides an expendable launch system were addressed in 1994, when a multi-agency SLMP was developed to evaluate national space launch systems and to improve the United States' launch capability. The SLMP contained four alternatives for the modernization of the United States' space launch capabilities: sustaining the existing launch systems (No-Action Alternative); evolving the current expendable launch systems (EELV); developing a new, expendable launch system; and developing a new, reusable launch system.

On August 5, 1994, the President signed the National Space Transportation Policy, tasking the Secretary of Defense to provide an implementation plan for improvement and evolution of the current Expendable Launch Vehicle fleet. On October 25, 1994, the Deputy Secretary of Defense signed the National Space Implementation Plan for National Space Transportation Policy, which identified the EELV program as DoD's solution to reduce the government launch cost baseline by 25 to 50 percent and lead implementation of DoD acquisition reform policies.

## 2.4 OTHER FUTURE ACTIONS AND POTENTIAL FOR CUMULATIVE IMPACTS

No other reasonably foreseeable actions have been identified that could be considered as contributing to a potential cumulative impact on the environment along with impacts associated with implementation of the EELV program.

## 2.5 COMPARISON OF ENVIRONMENTAL IMPACTS

A summary of the potential environmental impacts associated with implementation of the Proposed Action and the No-Action Alternative at Cape Canaveral AS and Vandenberg AFB is provided in Tables 2.5-1 and 2.5-2, respectively. Each resource potentially affected by implementation of the Proposed Action and No-Action Alternative is listed, and proposed mitigation measures, if applicable, are presented. Local community, land use and aesthetics, transportation, and utilities are considered factors that could influence environmental impacts; these factors are not included within the tables. Impacts to the environment are described briefly in the Summary and in detail in Chapter 4.0.

**Table 2.5-1. Cape Canaveral AS - Summary of Environmental Impacts and Suggested Mitigations [(a)] from the Proposed Action and No-Action Alternative**
**Page 1 of 6**

| Resource Category | Proposed Action | | | No-Action Alternative |
|---|---|---|---|---|
| | Concept A | Concept B | Concept A/B | |
| **Hazardous Materials and Hazardous Waste Management** | | | | |
| · **Hazardous Materials Management** | · **Impacts:**<br>Total hazardous materials and propellant usage would increase; per launch usage would decrease. | · **Impacts:**<br>Total hazardous materials usage would decrease and propellant use would increase; per launch usage would decrease. | · **Impacts:**<br>Similar to that described for Concept A. | · **Impacts:**<br>Similar to that associated with current launch vehicle programs. |
| · **Hazardous Waste Management** | · **Impact**<br>Hazardous waste generation would increase due to an increased number of launches. | · **Impacts:**<br>Similar to that described for Concept A. | · **Impacts:**<br>Similar to the combined effects of Concepts A and B. | · **Impacts:**<br>Similar to that associated with current launch vehicle programs. |
| · **Pollution Prevention** | · **Impacts:**<br>No Class I ODSs would be utilized. | · **Impacts:**<br>Same as Concept A. | · **Impacts:**<br>Same as Concept A. | · **Impacts**<br>Class I ODSs to be phased out. |
| · **Installation Restoration Program** | · **Impacts:**<br>Construction activities would be coordinated with IRP personnel to minimize impacts to remediation activities and the EELV program schedule. | · **Impacts:**<br>Same as Concept A. | · **Impacts:**<br>Same as Concept A. | · **Impacts:**<br>None. |

Note: (a) Mitigation measures are presented only where impacts are identified.
EELV = Evolved Expendable Launch Vehicle
IRP = Installation Restoration Program
ODS = ozone-depleting substance

**Table 2.5-1. Cape Canaveral AS - Summary of Environmental Impacts and Suggested Mitigations [(a)] from the Proposed Action and No-Action Alternative**
**Page 2 of 6**

| Resource Category | Proposed Action | | | No-Action Alternative |
|---|---|---|---|---|
| | Concept A | Concept B | Concept A/B | |
| · **Health and Safety** | · **Impacts:**<br>Safety procedures are in place to protect the public. Installation personnel and the general public not predicted to be at risk from normal and aborted launches. | · **Impacts:**<br>Same as Concept A. | · **Impacts:**<br>Same as Concept A. | · **Impacts:**<br>Safety procedures are in place to protect the public. Installation personnel and the general public not predicted to be at risk from normal and aborted launches. |
| · **Geology and Soils** | · **Impacts:**<br>Construction would occur on previously disturbed areas at SLC-41. Compliance with standard construction practices and adherence to permit requirements would reduce the potential for erosion during construction. | · **Impacts:**<br>Construction would occur on previously disturbed areas at SLC-37. Compliance with standard construction practices would be the same as that described for Concept A. | · **Impacts:**<br>Similar to combined effects of Concepts A and B. | · **Impacts:**<br>None. |
| · **Water Resources** | · **Impacts**:<br>Adequate water supply to meet demand; no impacts to groundwater are expected. An SWPPP would be required. Deluge water would be retained after launch and managed or treated in accordance with permit requirements. | · **Impacts**:<br>Similar to Concept A.<br>Brief acidification of surface water from deposition of HCl. No long-term impacts are expected.<br>Dredging activities would require a permit. | · **Impacts**:<br>Similar to combined effects for Concepts A and B. | · **Impacts**:<br>Adequate water supply to meet demand.<br>Brief acidification of surface water from deposition of HCl. No long-term impacts are expected. |

Note: (a) Mitigation measures are presented only where impacts are identified.
HCl = hydrochloric acid
SLC = Space Launch Complex
SWPPP = Storm Water Pollution Prevention Plan

**Table 2.5-1. Cape Canaveral AS - Summary of Environmental Impacts and Suggested Mitigations [(a)] from the Proposed Action and No-Action Alternative**
**Page 3 of 6**

| Resource Category | Proposed Action | | | No-Action Alternative |
|---|---|---|---|---|
| | Concept A | Concept B | Concept A/B | |
| · **Water Resources (Continued)** | A FONPA will be prepared to address construction in a floodplain. | | | |
| · **Air Quality (Lower Atmosphere)** | · **Impacts**:<br>Temporary and short-term increase of local concentrations of criteria pollutants during construction. Attainment status for these pollutants would not be jeopardized.<br>Peak-year launch operations would not jeopardize attainment status of criteria pollutants. | · **Impacts**:<br>Similar to that described for Concept A. | · **Impacts**:<br>Similar to combined effects for Concepts A and B. | · **Impacts**:<br>$NO_x$ emissions would be less than those projected for the Proposed Action, possibly due to the smaller number of launches. |
| | · **Mitigation**:<br>Application of water during ground-disturbing activities, scheduling of equipment use, and implementation of a phased construction schedule would mitigate impacts during construction. | · **Mitigation**:<br>Similar to that described for Concept A. | · **Mitigation**:<br>Similar to that described for Concept A. | · **Mitigation**:<br>None required. |

Note: (a) Mitigation measures are presented only where impacts are identified.
FONPA = Finding of No Practicable Alternatives
$NO_x$ = nitrogen oxides

**Table 2.5-1. Cape Canaveral AS - Summary of Environmental Impacts and Suggested Mitigations [(a)] from the Proposed Action and No-Action Alternative**
**Page 4 of 6**

| Resource Category | Proposed Action | | | No-Action Alternative |
|---|---|---|---|---|
| | Concept A | Concept B | Concept A/B | |
| · **Air Quality (Upper Atmosphere)** | · **Impacts**: No estimated emissions to the stratosphere of any ODSs. | · **Impacts**: Some commercial launches would produce emissions of alumina particulates and chlorine compounds into the stratosphere; minimal compared to worldwide contributions. | · **Impacts**: Similar to combined effects for Concepts A and B. | · **Impacts**: Continued emissions of alumina particulates and chlorine from solid rocket motors; minimal compared to worldwide contributions. |
| · **Orbital Debris** | · **Impacts**: Intact upper stages would contribute to orbital debris population through fragmentation. Stages would be designed to minimize breakup and reduce orbital debris. | · **Impacts**: Same as Concept A. | · **Impacts**: Same as Concept A. | · **Impacts**: Would continue to contribute to the orbital debris population through fragmentation of upper stages. |
| · **Noise** | · **Impacts**: Launch noise and sonic booms would be short-term and temporary; no human or structural impacts are expected. Sonic booms would occur over the Atlantic Ocean. | · **Impacts**: Similar to that described for Concept A. | · **Impacts**: Similar to that described for Concept A. | · **Impacts**: Noise and sonic boom exposure would be similar to current levels, which are comparable to those for the Proposed Action. |

Note: (a) Mitigation measures are presented only where impacts are identified.
ODS = ozone-depleting substance

**Table 2.5-1. Cape Canaveral AS - Summary of Environmental Impacts and Suggested Mitigations [(a)] from the Proposed Action and No-Action Alternative**
**Page 5 of 6**

| Resource Category | Proposed Action | | | No-Action Alternative |
|---|---|---|---|---|
| | Concept A | Concept B | Concept A/B | |
| · **Biological Resources** | · **Impacts:**<br>Potential loss of up to 8.2 acres of jurisdictional wetlands at SLC-41.<br>No impact to sea turtles because artificial light sources would be designed to minimize impacts.<br>No impacts to wildlife are anticipated from launch noise and sonic booms. | · **Impacts:**<br>Up to 2 acres of jurisdictional wetlands may be impacted at SLC-37.<br>Southern beach mouse may be impacted by fire and heat from the flame duct.<br>Gopher tortoises at SLC-37 would be identified and relocated prior to construction.<br>Use of solid rocket motors for some commercial launches would result in temporary deposition of HCl. | · **Impacts:**<br>Similar to combined effects of Concepts A and B. | · **Impacts:**<br>Solid rocket motors for some launches would result in temporary deposition of HCl. Noise and sonic boom effects would be similar to those discussed for Concept A.<br>No wetlands impacts because no construction planned. |
| | · **Mitigation:**<br>Proposed 6 to 1 enhancement of the existing wetlands. | · **Mitigation:**<br>Mitigation for wetlands impacts are similar to those described for Concept A. Clearing of scrub jay habitat could serve as a wetland restoration.<br>Impacts to the Southern beach mouse could be mitigated by trapping and relocation and habitat restoration. | · **Mitigation:**<br>Wetlands mitigations would be the same as those described for Concepts A and B combined. | · **Mitigation:**<br>None required. |

Note: (a) Mitigation measures are presented only where impacts are identified.
HCl = hydrochloric acid
SLC = Space Launch Complex

**Table 2.5-1. Cape Canaveral AS - Summary of Environmental Impacts and Suggested Mitigations [(a)] from the Proposed Action and No-Action Alternative**
**Page 6 of 6**

| Resource Category | Proposed Action | | | No-Action Alternative |
|---|---|---|---|---|
| | Concept A | Concept B | Concept A/B | |
| · **Cultural Resources** | · **Impacts:**<br>None identified.<br>· **Mitigation**:<br>None required. | · **Impacts:**<br>Proposed alterations to one potentially eligible facility.<br>· **Mitigation**:<br>Recordation if facility is eligible. | · **Impacts:**<br>Similar to effects described for Concepts A and B combined.<br>· **Mitigation**:<br>Similar to that described for Concept B. | · **Impacts:**<br>None.<br>· **Mitigation**:<br>None required. |
| · **Environmental Justice** | · **Impacts:**<br>None. | · **Impacts:**<br>None. | · **Impacts:**<br>None. | · **Impacts:**<br>None. |

Note: (a) Mitigation measures are presented only where impacts are identified.

**Table 2.5-2. Vandenberg AFB - Summary of Environmental Impacts and Suggested Mitigations [(a)] from the Proposed Action and No-Action Alternative**
**Page 1 of 5**

| Resource Category | Proposed Action | | | No-Action Alternative |
|---|---|---|---|---|
| | Concept A | Concept B | Concept A/B | |
| **Hazardous Materials and Hazardous Waste Management** | | | | |
| · **Hazardous Materials Management** | · **Impacts:**<br>Total hazardous materials and propellant usage would increase; per launch usage would decrease. | · **Impacts:**<br>Total hazardous materials usage would decrease and propellant use would increase; per launch usage would decrease. | · **Impacts:**<br>Similar to that described for Concept A. | · **Impacts:**<br>Similar to that associated with current launch vehicle programs. |
| · **Hazardous Waste Management** | · **Impact**<br>Hazardous waste generation would increase due to an increased number of launches. | · **Impacts:**<br>Similar to that described for Concept A. | · **Impacts:**<br>Similar to combined effects of Concepts A and B. | · **Impacts:**<br>Similar to that associated with current launch vehicle programs. |
| · **Pollution Prevention** | · **Impacts:**<br>No Class I ODSs would be utilized. | · **Impacts:**<br>Same as Concept A. | · **Impacts:**<br>Same as Concept A. | · **Impacts**<br>Class I ODSs to be phased out. |
| · **Installation Restoration Program** | · **Impacts:**<br>Construction activities would be coordinated with base personnel to minimize impacts to remediation activities and the EELV program schedule. | · **Impacts:**<br>Same as Concept A. | · **Impacts:**<br>Same as Concept A. | · **Impacts:**<br>None. |

Note: (a) Mitigation measures are presented only where impacts are identified.
EELV = Evolved Expendable Launch Vehicle
ODS = ozone-depleting substance

**Table 2.5-2. Vandenberg AFB - Summary of Environmental Impacts and Suggested Mitigations [(a)] from the Proposed Action and No-Action Alternative**
**Page 2 of 5**

| Resource Category | Proposed Action | | | No-Action Alternative |
|---|---|---|---|---|
| | Concept A | Concept B | Concept A/B | |
| · **Health and Safety** | · **Impacts:**<br>Safety procedures are in place to protect the public. Installation personnel and the general public not predicted to be at risk from normal and aborted launches. | · **Impacts:**<br>Same as Concept A. | · **Impacts:**<br>Same as Concept A. | · **Impacts:**<br>Safety procedures are in place to protect the public. Installation personnel and the general public not predicted to be at risk from normal and aborted launches. |
| · **Geology and Soils** | · **Impacts:**<br>Construction would occur on previously disturbed areas at SLC-3W. Compliance with standard construction practices and adherence to permit requirements would reduce the potential for erosion during construction. | · **Impacts:**<br>Construction would occur on previously disturbed areas at SLC-6. Compliance with standard construction practices would be the same as described for Concept A. | · **Impacts:**<br>Similar to combined effects for Concepts A and B. | · **Impacts:**<br>None. |
| · **Water Resources** | · **Impacts**:<br>Adequate water supply to meet demand; no impacts to groundwater are expected. An SWPPP would be required. Deluge water would be retained after launch and managed or treated in accordance with base requirements. | · **Impacts**:<br>Similar to that described for Concept A.<br>Dredging activities would require a permit.<br>Brief acidification of surface water from deposition of HCl. No long-term impacts are expected. | · **Impacts**:<br>Similar to combined effects for Concepts A and B. | · **Impacts**:<br>Adequate water supply to meet demand.<br>Brief acidification of surface water from deposition of HCl. No long-term impacts are expected. |

Note: (a) Mitigation measures are presented only where impacts are identified.
HCl = hydrochloric acid
SLC = Space Launch Complex
SWPPP = Storm Water Pollution Prevention Plan

**Table 2.5-2. Vandenberg AFB - Summary of Environmental Impacts and Suggested Mitigations [(a)] from the Proposed Action and No-Action Alternative**
**Page 3 of 5**

| Resource Category | Proposed Action | | | No-Action Alternative |
|---|---|---|---|---|
| | Concept A | Concept B | Concept A/B | |
| · **Water Resources (Continued)** | A FONPA will be prepared to address construction in a floodplain. | | | |
| · **Air Quality (Lower Atmosphere)** | · **Impacts**:<br>Temporary and short-term increase of local concentrations of criteria pollutants during construction. Attainment status for these pollutants would not be jeopardized.<br>Peak-year launch operations would not jeopardize attainment status of criteria pollutants. | · **Impacts**:<br>Similar to that described for Concept A.<br>Additionally, an air conformity determination would be completed to ensure compliance with the applicable SIP. | · **Impacts**:<br>Similar to combined effects for Concepts A and B. | · **Impacts**:<br>$NO_x$ emissions would be less than those projected for the Proposed Action, possible due to the smaller number of launches. |
| | · **Mitigation**:<br>Application of water during ground-disturbing activities, scheduling of equipment use, and implementation of a phased construction schedule would mitigate impacts during construction. | · **Mitigation**:<br>Similar to that described for Concept A. | · **Mitigation**:<br>Similar to that described for Concept A. | · **Mitigation**:<br>None required. |

Note: (a) Mitigation measures are presented only where impacts are identified.
FONPA = Finding of No Practicable Alternatives
$NO_x$ = nitrogen oxides
SIP = State Implementation Plan

**Table 2.5-2. Vandenberg AFB - Summary of Environmental Impacts and Suggested Mitigations [(a)] from the Proposed Action and No-Action Alternative**
**Page 4 of 5**

| Resource Category | Proposed Action | | | No-Action Alternative |
|---|---|---|---|---|
| | Concept A | Concept B | Concept A/B | |
| · **Air Quality (Upper Atmosphere)** | · **Impacts**: No estimated emissions to the stratosphere of any ODSs. | · **Impacts**: Some commercial launches would produce emissions of alumina particulates and chlorine compounds into the stratosphere; minimal compared to worldwide contributions. | · **Impacts**: Similar to combined effects for Concepts A and B. | · **Impacts**: Continued emissions of alumina particulates and chlorine from solid rocket motors; minimal compared to worldwide contributions. |
| · **Orbital Debris** | · **Impacts**: Intact upper stages would contribute to orbital debris population through fragmentation. Stages would be designed to minimize breakup and reduce orbital debris. | · **Impacts**: Same as Concept A. | · **Impacts**: Same as Concept A. | · **Impacts**: Would continue to contribute to the orbital debris population through fragmentation of upper stages. |
| · **Noise** | · **Impacts**: Launch noise and sonic booms would be short-term and temporary; no human or structural impacts are expected. Sonic booms would occur over the Pacific Ocean. | · **Impacts**: Similar to that described for Concept A. | · **Impacts**: Similar to that described for Concept A. | · **Impacts**: Noise and sonic boom exposure would be similar to current launch operation levels, which are comparable to those for the Proposed Action. |

Note: (a) Mitigation measures are presented only where impacts are identified.
ODS = ozone-depleting substance

**Table 2.5-2. Vandenberg AFB - Summary of Environmental Impacts and Suggested Mitigations [(a)] from the Proposed Action and No-Action Alternative**
**Page 5 of 5**

| Resource Category | Proposed Action | | | No-Action Alternative |
|---|---|---|---|---|
| | Concept A | Concept B | Concept A/B | |
| · **Biological Resources** | · **Impacts:**<br>Construction activities at SLC-3W may impact a wetland.<br>Temporary, minor impacts to sensitive species may occur from launch noise and sonic booms. A marine mammal take permit would be required, and monitoring may be required during launches. | · **Impacts:**<br>An arroyo wetland may be impacted at SLC-6.<br>Impacts from launches to sensitive species similar to Concept A.<br>Dredging activities at the Boat Dock area would require a permit.<br>Use of solid rocket motors (commercial launches only) would result in temporary deposition of HCl. | · **Impacts:**<br>Similar to combined effects for Concepts A and B. | · **Impacts:**<br>Solid rocket motors would continue to be used for some launches, and temporary deposition of HCl would occur. Other launch operation effects would be similar to those described for Concepts A and B.<br>No wetlands impacts because no construction planned. |
| | · **Mitigation:**<br>Replacement, protection, restoration, or avoidance of wetlands. | · **Mitigation:**<br>Replacement, protection, restoration, or avoidance of wetlands. | · **Mitigation:**<br>Mitigations for wetland impacts would be the same as those described for Concept B. | · **Mitigation:**<br>None required. |
| · **Cultural Resources** | · **Impacts:**<br>None identified. | · **Impacts:**<br>Proposed construction in an archaeologically sensitive area at SLC-6. Archaeological or Native American monitoring would be required during ground-disturbing activities. | · **Impacts:**<br>Similar to effects described for Concept B. | · **Impacts:**<br>None. |
| · **Environmental Justice** | · **Impacts:**<br>None. | · **Impacts:**<br>None. | · **Impacts:**<br>None. | · **Impacts:**<br>None. |

Note: (a) Mitigation measures are presented only where impacts are identified.
HCl = hydrochloric acid
SLC = Space Launch Complex

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# 3.0 AFFECTED ENVIRONMENT

## 3.1 INTRODUCTION

This chapter describes the existing environment of Cape Canaveral AS, Florida, and Vandenberg AFB, California, and their regions of influence (ROIs). This information serves as a baseline from which to identify and evaluate environmental changes resulting from the implementation of the EELV program. The baseline conditions assumed for the purposes of analysis are the existing conditions at Cape Canaveral AS and Vandenberg AFB. These conditions include activities conducted for the Atlas IIA, Delta II, and Titan IVB launch vehicle programs, which currently support space launches that meet the requirement of the government portion of the NMM.

Although this EIS focuses on the biophysical environment, the following nonbiophysical elements (influencing factors) are addressed: local community, land use and aesthetics, transportation networks, and public utility systems in the regions and local communities. In addition, this chapter describes the storage, usage, disposal, and management of hazardous materials/wastes as well as pollution prevention and Installation Restoration Program (IRP) status. The chapter contains a description of health and safety practices at each installation, and the pertinent natural resources of geology and soils, water resources, air quality, noise, orbital debris, biological resources, and cultural resources. Information on low-income and minority populations in the area used for the environmental justice analysis, concludes the chapter.

The ROI to be evaluated for the two installations is defined for each resource area potentially affected by the Proposed Action and No-Action Alternative. The ROI determines the geographical area to be addressed as the affected environment. Although the installation boundary may constitute the ROI limit for many resources, potential impacts associated with certain issues (e.g., air quality, utility systems, and water resources) transcend these limits. Within each resource discussion, separate ROIs for Concepts A and B are provided, where applicable. The Concept A/B ROI is considered to encompass the ROIs for both Concepts A and B and is therefore not provided separately.

## 3.2 COMMUNITY SETTING

### 3.2.1 Cape Canaveral AS

Cape Canaveral AS is situated on the Canaveral Peninsula along the east-central Atlantic Coast in Brevard County, Florida. The Canaveral Peninsula is a barrier island bordered on the east by the Atlantic Ocean, on the west by the Banana River, on the north by the Kennedy Space Center (KSC), and on the south by Port Canaveral. Patrick AFB is also situated south of Cape Canaveral AS. Incorporated cities within Brevard County include Cape Canaveral, Titusville, Cocoa, Melbourne (including Melbourne Beach and Melbourne Village), West Melbourne, Palm Bay, Cocoa Beach, Indialantic, Indian Harbor Beach, Malabar, Satellite Beach, and Rockledge.

**3.2.1.1 Employment.** In 1997, there were 231,553 total jobs within Brevard County, Florida (Table 3.2-1). The number of jobs in the county grew at an average annual rate of 4.1 percent between 1975 and 1990. During the same period, job growth at the national level was 1.9 percent annually. Between 1994 and 1997, the rate of annual county job growth averaged 2.9 percent.

**Table 3.2-1. Summary of Economic Indicators, Brevard County, Florida, Estimates for 1975, 1990, 1994, 1997 and Forecasts for 1998, 2000, 2007, 2015**

| | 1975 | 1990 | 1994 | 1997 | 1998 | 2000 | 2007 | 2015 |
|---|---|---|---|---|---|---|---|---|
| Total Jobs[a] | 97,084 | 205,128 | 212,706 | 231,553 | 237,835 | 250,400 | 285,540 | 315,600 |
| Average Annual Change[b] | 224 | 7,433 | 1,895 | 6,282 | 6,282 | 6,283 | 5,020 | 3,360 |
| Average Annual Change (percent) | 0.2 | 4.1 | 0.9 | 2.9 | 2.6 | 2.6 | 1.8 | 1.1 |

Notes: (a) Total jobs are average annual full- and part-time jobs within Brevard County.
(b) Average Annual Change in each column is calculated over the period of years from the preceding column; for the 1975 column, the change is calculated for the 1975-1990 period.

Sources: U.S. Bureau of Economic Analysis, 1996a, 1996b.

The services and retail trade sectors supported the greatest number of jobs in Brevard County in 1994 with 34.1 percent and 19.2 percent of total jobs, respectively. There were 5,922 jobs, or 2.8 percent of total jobs, in the transportation-communication-public utilities sector in 1994. Manufacturing, with 13.7 percent of total jobs in 1994, and construction, with 6.1 percent, provided the bulk of jobs within the goods-producing sectors (agriculture, mining, manufacturing, and construction). In 1994, state and local government supported about 8.7 percent of all county jobs, and the federal government provided about 5.2 percent of total jobs within Brevard County.

An employment forecast prepared by the U.S. Bureau of Economic Analysis (1996) projected that the number of jobs in Brevard County would increase at an average annual rate of 2.6 percent between 1994 and 2000. By 2000, the forecast projected that there would be more than 250,000 jobs in the county.

The unemployment rate averaged 7.4 percent in 1994, 6.5 percent in 1995, and 5.4 percent in 1996. By comparison, the state unemployment rate was 6.6, 5.5, and 5.1 percent, respectively, for the same 3 years (U.S. Bureau of Labor Statistics, 1997).

**3.2.1.2 Population.** The total population of Brevard County increased from 398,978 in 1990 to 460,824 in 1997 (Table 3.2-2). A 1997 forecast by the University of Florida Bureau of Economic and Business Research (BEBR) anticipates county population growth of 2.3 percent annually between 1997 and 2000, which would increase total population in Brevard County to 492,803 in 2000. A population forecast prepared by the U.S. Bureau of the Census projects the number of persons in Brevard County to increase at an average annual rate of 2.2 percent between 1994 and 2000 (U.S. Bureau of Economic Analysis, 1996a).

**Table 3.2-2. Population, Brevard County, Florida, Estimates for 1990, 1996, and 1997 and Forecasts for 2000, 2007, 2015**

| | 1990 | 1996 | 1997 | 2000 | 2007 | 2015 |
|---|---|---|---|---|---|---|
| Brevard County | 398,978 | 450,164 | 460,824 | 492,803 | 557,856 | 629,314 |
| Cape Canaveral | 8,014 | 8,375 | 8,457 | 8,701 | 8,963 | 9,047 |
| Cocoa | 17,722 | 17,874 | 17,939 | 18,134 | 18,206 | 18,227 |
| Cocoa Beach | 12,123 | 12,794 | 12,940 | 13,379 | 13,941 | 14,156 |
| Indialantic | 2,844 | 2,938 | 2,961 | 3,029 | 3,079 | 3,081 |
| Indian Harbour Beach | 6,933 | 7,579 | 7,713 | 8,114 | 8,809 | 9,342 |
| Malabar | 1,977 | 2,364 | 2,445 | 2,687 | 3,239 | 3,929 |
| Melbourne | 60,034 | 66,970 | 68,395 | 72,668 | 80,785 | 88,313 |
| Melbourne Beach | 3,078 | 3,198 | 3,226 | 3,309 | 3,386 | 3,403 |
| Melbourne Village | 591 | 612 | 617 | 632 | 644 | 648 |
| Palm Bay | 62,543 | 74,395 | 76,860 | 84,254 | 100,951 | 121,515 |
| Palm Shores | 210 | 578 | 641 | 829 | 1,098 | 1,300 |
| Rockledge | 16,023 | 18,434 | 18,930 | 20,418 | 23,530 | 26,941 |
| Satellite Beach | 9,889 | 10,106 | 10,166 | 10,344 | 10,382 | 10,463 |
| Titusville | 39,394 | 41,321 | 41,749 | 43,033 | 44,524 | 45,167 |
| West Melbourne | 8,399 | 9,171 | 9,331 | 9,810 | 10,637 | 11,261 |
| Unincorporated | 149,204 | 173,455 | 178,457 | 193,462 | 225,682 | 262,469 |

Source: University of Florida, 1997.

With an estimated population of 76,860 persons in 1997, Palm Bay is the largest city in Brevard County. Between 1990 and 1997, Palm Bay's population increased by 14,317, an average of 3.3 percent annually. The population of Melbourne, the second largest city in the county, increased by 8,361, an average of 1.9 percent per year, to 68,395 in 1997. The third largest city, Titusville, increased in population by 2,355, an average of 0.9 percent per year, to 41,749 in 1997. The cities of Rockledge, Cocoa, and Cocoa Beach are the next three largest cities in the county, with populations of 18,930, 17,939, and 12,940, respectively, in 1997.

Almost half of the population growth between 1990 and 1997 occurred in the unincorporated portion of Brevard County. In 1997, the population of unincorporated Brevard County was 178,457.

### 3.2.2 Vandenberg AFB

Vandenberg AFB is in the western part of unincorporated Santa Barbara County, California. The Santa Ynez River and SR 246 divide the base into North and South Vandenberg AFB. North Vandenberg AFB generally includes the developed portions of the base, whereas South Vandenberg AFB includes primarily open space. The city of Lompoc lies to the east, the city of Santa Maria to the northeast, and the city of Guadalupe to the north. Two unincorporated communities, Vandenberg Village and Mission Hills, are north of the city of Lompoc, and the unincorporated community of Orcutt is north of the base.

**3.2.2.1 Employment.** In 1997, there were 229,107 total jobs within Santa Barbara County (Table 3.2-3). The number of jobs in the county grew at an average annual rate of 2.3 percent between 1975 and 1990. By comparison,

the number of jobs in the state of California grew at an average annual rate of 2.5 percent during the same period. Between 1990 and 1997, the rate of county job growth averaged 2.4 percent annually.

**Table 3.2-3. Summary of Economic Indicators, Santa Barbara County, California, Estimates for 1975, 1990, 1994, 1997 and Forecasts for 1998, 2000, 2001, 2007, 2015**

| | 1975 | 1990 | 1994 | 1997 | 1998 | 2000 | 2007 | 2015 |
|---|---|---|---|---|---|---|---|---|
| Total Jobs[(a)] | 137,224 | 217,428 | 213,313 | 229,107 | 234,371 | 244,900 | 271,380 | 292,600 |
| Average Annual Change[(b)] | 4,232 | 4,686 | (1,029) | 5,265 | 2,118 | 5,265 | 3,782 | 2,300 |
| Average Annual Change (percent) | 3.4 | 2.3 | -0.5 | 2.4 | .9 | 2.2 | 1.4 | 0.8 |

Notes: (a) Total Jobs are average annual full- and part-time jobs within Santa Barbara County.
(b) Average Annual Change in each column is calculated over the period of years from the preceding column; for the 1975 column, the change is calculated for the 1970-75 period.

Sources: U.S. Bureau of Economic Analysis, 1996a, 1996b, 1997.

The services and retail trade sectors supported the greatest number of jobs in Santa Barbara County in 1994 with 32.2 percent and 17.6 percent, respectively. There were 6,027 jobs, or 2.8 percent of total jobs, in the transportation-communication-public utilities sector in 1994. Manufacturing, with 8.8 percent of total jobs in 1994, and agriculture (including agricultural services, forestry, and fishing) with 8.2 percent, provided the bulk of jobs within the goods-producing sectors. In 1994, state and local government agencies supported about 11.6 percent of all county jobs, and the federal government provided about 3.7 percent of total jobs in Santa Barbara County.

An employment forecast prepared by the U.S. Bureau of Economic Analysis projects the number of jobs in Santa Barbara County to increase at an average rate of 2.3 percent annually between 1994 and 2000 to almost 245,000 total jobs by 2000. The Santa Barbara County Association of Governments is anticipating employment growth to average 1.7 percent annually between 1995 and 2000 (Damkowitch, 1997). The University of California at Santa Barbara (UCSB) Economic Forecast Project projects the number of county jobs to increase at an average annual rate of 1.6 percent between 1996 and 2000.

The county unemployment rate averaged 7.2 percent in 1994, 6.7 percent in 1995, and 5.7 percent in 1996. By comparison, the state unemployment rate averaged 8.6 percent, 7.8 percent, and 7.2 percent, respectively, for those 3 years.

**3.2.2.2 Population.** The total population of Santa Barbara County increased from 369,608 persons in 1990 to 399,988 in 1997 (Table 3.2-4). A forecast by the Santa Barbara Association of Governments anticipates county population growth of 1.3 percent annually between 1996 and 2000, which would increase total population in the county to 416,213 in 2000 (Damkowitch, 1997). A population forecast prepared by the UCSB Economic Forecast Project projects the number of persons in Santa Barbara County to increase at an average annual rate of 0.9 percent between 1996 and 2000.

A forecast prepared by the U.S. Bureau of the Census projects an average annual growth rate of 1.6 percent between 1994 and 2000.

**Table 3.2-4. Population, Santa Barbara County, California, Estimates for 1990, 1996, 1997 and Forecasts for 2000, 2007, 2015**

| | 1990 | 1996 | 1997 | 2000 | 2007 | 2015 |
|---|---|---|---|---|---|---|
| Santa Barbara County | 369,608 | 394,580 | 399,988 | 416,213 | 445,415 | 439,320 |
| Buellton[(a)] | NA | 3,509 | 3,623 | 3,966 | 4,234 | 4,528 |
| Carpinteria | 13,747 | 14,490 | 14,790 | 15,689 | 17,320 | 17,804 |
| Guadalupe | 5,479 | 6,262 | 6,431 | 6,936 | 7,811 | 8,916 |
| Lompoc | 37,649 | 41,002 | 41,804 | 44,208 | 47,083 | 48,026 |
| Santa Barbara | 85,571 | 89,370 | 90,338 | 93,241 | 98,217 | 103,650 |
| Santa Maria | 61,552 | 68,888 | 70,454 | 75,152 | 83,688 | 96,573 |
| Solvang | 4,741 | 5,109 | 5,191 | 5,437 | 5,890 | 6,369 |
| Unincorporated | 160,869 | 165,950 | 167,359 | 171,584 | 181,172 | 193,454 |

Note: (a) Buellton became an incorporated city in 1993.
NA = not applicable

Sources: California Department of Finance, 1997; Santa Barbara County Association of Governments, 1994.

Santa Barbara, with an estimated population of 90,338 persons in 1997, is the largest city in the county. Between 1990 and 1997, Santa Barbara's population increased by 4,767, an average of 0.8 percent annually. Santa Maria, the second largest city in the county, increased in population by 8,902, an average of 2.0 percent per year, to 70,454 in 1997. The third largest city, Lompoc, increased in population by 4,155, an average of 1.6 percent per year, to 41,804 in 1997.

About 20 percent of the population growth between 1990 and 1997 occurred in the unincorporated portion of Santa Barbara County. In 1997, the population of the unincorporated portion of the county was 167,359.

Incorporated in 1993, the city of Buellton, with 3,623 persons in 1997, is anticipated to experience the greatest rate of growth in the county between 1997 and 2000, at 3.1 percent per year. Lompoc and Santa Maria are forecast to experience average annual growth rates of 2.6 percent and 2.2 percent, respectively, during the same period.

## 3.3 LAND USE AND AESTHETICS

This section describes the existing environment in terms of land use and aesthetics for the areas on and surrounding Cape Canaveral AS and Vandenberg AFB. Topics addressed are regional land use, on-station/base land use, coastal zone management, recreation, and aesthetics.

Land use can be defined as the human use of land resources for various purposes including economic production, natural resources protection, or institutional uses. Land uses are frequently regulated by management plans, policies, ordinances, and regulations that determine the types of uses that

are allowable or protect specially designated or environmentally sensitive uses.

Potential issues typically stem from encroachment of one land use or activity on another, or an incompatibility between adjacent land uses that leads to encroachment. Cape Canaveral AS and Vandenberg AFB coordinate with surrounding local and state jurisdictions to ensure that off-station/base development does not encroach on installation activities, and that installation activities do not encroach on, or create land use incompatibilities with, off-station/base uses.

Visual resources include natural and man-made features that give a particular environment its aesthetic qualities. The analysis considers visual sensitivity, which is the degree of public interest in a visual resource and concern over adverse changes in the quality of the resource.

### 3.3.1 Cape Canaveral AS

The ROI for land use at Cape Canaveral AS encompasses the station boundaries and potentially affected adjacent lands, including off-station lands within launch safety clear zones or land uses that may be affected by activities on the station.

**3.3.1.1 Regional Land Use**. Brevard County and the city of Cape Canaveral are the local planning authorities for incorporated and unincorporated areas near Cape Canaveral AS. Land uses designated by Brevard County for Merritt Island (a barrier island located between the Indian River and the Atlantic Ocean) include residential, industrial, public facilities, agricultural, recreation, and conservation (Figure 3.3-1). The City of Cape Canaveral Comprehensive Plan (Briley, Wild and Associates, 1990) designates residential, commercial, industrial, public facilities and recreation, and open space land use areas, with continued commercial and industrial uses planned for Port Canaveral. Port Canaveral is also used by NASA, the Navy, and the Air Force to support launch and shipping activities. Neither the county nor the city of Cape Canaveral has land use authority over Cape Canaveral AS land because it is federally owned. Cape Canaveral AS designates its own land use and zoning regulations. The general plans of the county and City of Cape Canaveral designate compatible land uses around Cape Canaveral AS.

KSC, which is north and west of Cape Canaveral AS, includes predominantly industrial uses associated with NASA launch programs and open space associated with the Merritt Island National Wildlife Refuge. Uses of the river and ocean water areas surrounding Cape Canaveral AS include commercial fishing, marine recreation, and marine transportation.

**3.3.1.2 Cape Canaveral AS Land Use.** Cape Canaveral AS encompasses an area of 15,800 acres, representing approximately 2 percent of the total land area of Brevard County. Land uses at Cape Canaveral AS include launch operations, launch and range support, airfield, port operations, station support area, and open space (Figure 3.3-2).

The launch operations land use category is present along the Atlantic Ocean shoreline and includes the active (SLCs 17A and B, SLCs 36A and B,

SLC-40, and SLC-41) and inactive (all other SLCs) launch sites and support facilities. The launch and range support area is west of the launch operations land use area and is divided into two sections by the airfield (Skid Strip). The airfield includes a single runway, taxiways, and apron, and is in the central part of the station. The port operations area is in the southern part of the station and includes facilities for commercial and industrial activities. The major industrial area is located in the center of the western portion of the station, near the Banana River, and is shown on Figure 3.3-2 under the station support area category. Although many of the activities are industrial in nature, this land use area includes administrative, recreational, and range support functions. Open space is dispersed throughout the station. The areas around SLC-37 and SLC-41 are within the launch operations land use area. There are no public beaches located on Cape Canaveral AS.

**3.3.1.3 Coastal Zone Management.** Federal activity in, or affecting, a coastal zone requires preparation of a Coastal Zone Consistency Determination, in accordance with the federal Coastal Zone Management Act (CZMA) of 1972, as amended (P.L. 92-583), and implemented by the National Oceanic and Atmospheric Administration (NOAA). This act was passed to preserve, protect, develop and, where possible, restore or enhance the nation's natural coastal zone resources, which include wetlands,

Figure 3.3-1 Off-Station Land Use, Cape Canaveral AS, Florida

Figure 3.3-2  On-Station Land Use, Cape Canaveral AS, Florida

floodplains, estuaries, beaches, dunes, barrier islands, coral reefs, and fish and wildlife and their habitat. The act also requires the management of coastal development to minimize the loss of life and property caused by improper development in a coastal zone. Responsibility for administering the Coastal Zone Management Program (CZMP) has been delegated to states that have developed state-specific guidelines and requirements. A federal agency must ensure that activities within the coastal zone are consistent with that state's coastal zone management program.

In Brevard County, the Florida Coastal Management Program, formed by the Florida Coastal Management Act (FCMA), applies to activities occurring in or affecting the coastal zone. The entire state of Florida is defined as being within the coastal zone. For planning purposes, a "no development" zone has been established. In Brevard County, the no development zone extends from the mean high water level inland 75 feet. Cape Canaveral AS has additional siting and facility design standards for construction near the coast, which require that facilities be set back at least 150 feet from the coast. The Florida Department of Community Affairs (FDCA) is the state's lead coastal management agency. The Air Force is responsible for making the final coastal zone consistency determinations for its activities within the state, and the FDCA will review the coastal zone consistency determination.

**3.3.1.4 Recreation.** Recreational activities near Cape Canaveral AS center mainly around the coastal beaches and large expanses of inland waters in the Indian and Banana rivers, the St. John's River, and large freshwater lakes. Boating, surfing, water skiing, and fishing are common activities. Brevard County provides several parks within the area surrounding the station. Jetty Park is situated immediately south of Port Canaveral on the beach and is the only park in the area that allows overnight camping. Public parks in the region are not affected by launch activities from Cape Canaveral AS. The beaches along Cape Canaveral AS are used for launch operations and are therefore restricted from public use. Recreational fishing is allowed at SLCs 34 and 16, and Camera Road A and B for KSC and Cape Canaveral AS personnel and their guests.

**3.3.1.5 Aesthetics.** The ROI for aesthetics at Cape Canaveral AS includes the general visual environment surrounding the station and areas of the station visible from off-station areas.

The visual environment in the vicinity of Cape Canaveral AS is characterized by the barrier island on which it is located. The Indian and Banana rivers separate the barrier island from the mainland. Topography of the island is generally flat, with elevations ranging from sea level to approximately 20 feet above sea level. The landscape is dominated by Florida coastal strand, coastal scrub, and coastal dune vegetation. The most visually significant aspect of the natural environment is the gentle coastline and flat island terrain. The area has a low visual sensitivity because the flatness of the area limits any prominent vistas.

Cape Canaveral AS is fairly undeveloped. The most significant man-made features are the launch complexes and various support facilities. These developed areas are surrounded by disturbed grasses, oak hammocks, and

scrub vegetation. Most of Cape Canaveral AS outside of the developed areas is covered with native vegetation.

Since public access to the station is prohibited, viewpoints are primarily limited to marine traffic on the east and west and distant off-site beach areas and small communities to the south. The station is bordered by approximately 15 miles of the Atlantic coastline on the east and approximately 12 miles of shoreline on the west. However, marine traffic is limited and public observation of the coastline is infrequent. Marine traffic consists mainly of transportation and fishing vessels, pleasure boats, and cruise ships. From the south, launch complexes can be viewed from various beach areas and small communities including Port Canaveral and the cities of Cape Canaveral and Cocoa Beach. Additionally, from KSC (north and west of the station), views of the launch complexes are available to a limited population.

### 3.3.2 Vandenberg AFB

The ROI for land use at Vandenberg AFB encompasses the base boundaries and potentially affected adjacent lands including off-base lands within launch safety clear zones or land uses that may be affected by increased on-base activities.

**3.3.2.1 Regional Land Use.** Santa Barbara County and the cities of Lompoc and Santa Maria are the local planning authorities for both incorporated and unincorporated areas adjoining the base. Of these planning authorities, only the county adjoins areas of South Vandenberg AFB near the proposed launch complexes. Neither the county nor the cities of Lompoc and Santa Maria have land use authority over Vandenberg AFB land because it is federally owned. Vandenberg AFB designates its own land use and zoning regulations. The general plans of the county and cities of Lompoc and Santa Maria designate compatible land uses around Vandenberg AFB. Figure 3.3-3 shows land uses adjacent to South Vandenberg AFB.

Santa Barbara County land use plans designate much of the area adjoining the base as agricultural. This designation is applied to the productive agricultural soils of the Lompoc and Santa Maria valleys. Other nonurban land east of the base is designated for rural residential use. Two large ranches, the Bixby Ranch and the Hollister Ranch, are located more than 10 miles southeast of SLC-6. Although some residential development has occurred, these ranches have been traditionally used for cattle grazing. Both

Figure 3.3-3 Off-Base Land Use, South Vandenberg AFB, California

of these properties are within the coastal zone of Santa Barbara County and are therefore governed by the county Coastal Plan, which regulates land use authority within the coastal zone, rather than the General Plan and zoning regulations. The Coastal Plan is intended to maintain non-prime agricultural operations (e.g., grazing) in the coastal areas of northern Santa Barbara County through large-lot zoning. Both ranch properties are currently used for agricultural purposes.

Urban land use dominates within the cities of Lompoc and Santa Maria, and the unincorporated communities of Vandenberg Village and Mission Hills. Outside of these areas, other land uses adjacent to the base are primarily agriculture and grazing, with some scattered oil production activities and other undeveloped uses (primarily recreation). To the west, offshore uses of the Pacific Ocean and beaches include primarily oil production, commercial fishing, and recreation. Three public beaches are near the base: Point Sal Beach State Park to the north, Ocean Beach County Park at the terminus of SR 246 near the north/south division of Vandenberg AFB, and Jalama Beach County Park, which is south of the base.

**3.3.2.2 Vandenberg AFB Land Use.** Vandenberg AFB encompasses approximately 98,400 acres, representing approximately 6 percent of the total land area of Santa Barbara County. According to the Base Comprehensive Plan (U.S. Air Force, 1989d), the base is generally divided into three functional areas: the base support area, the technical support area, and launch areas (Figure 3.3-4). The base support area includes the urban portion of the base, including family housing, industrial, and administrative areas, and is centrally located, north of SR 246. The technical support area encompasses the largest area on base and includes the airfield and munitions, fuel, and hazardous materials storage areas and associated safety zones. The launch areas are generally within a coastal corridor north and south of SR 246 and include launch pads and facilities and surrounding open space for safety zones.

The greatest use of land on Vandenberg AFB (60 percent) is for open space and recreation, followed by agriculture (37 percent), primarily grazing. These two areas are generally found within the launch and technical support areas.

Development has occurred mainly on North Vandenberg AFB, primarily within the base support area. The remaining north base development includes an airfield and test/launch facilities, which are within the launch and technical support areas.

The majority of South Vandenberg AFB is undeveloped; the developed portion includes launch complexes, test/launch facilities, technical support areas, several mountaintop tracking stations, and a 150-acre administrative/ industrial area. Some of the undeveloped areas on South Vandenberg AFB are leased for grazing.

Figure 3.3-4. On-Base Land Use, Vandenberg AFB, California

**3.3.2.3 Coastal Zone Management.** Federal activity in, or affecting, a coastal zone requires preparation of a Coastal Zone Consistency Determination, in accordance with the federal CZMA Management Act of 1972, as amended P.L. 92-583), and implemented by the NOAA (see Section 3.3.1.3).

The California Coastal Zone Management Program was formed through the California Coastal Zone Conservation Act of 1972. The Air Force is responsible for making final coastal zone consistency determinations for its activities within the state, and the California Coastal Commission reviews federally authorized projects for consistency with the California Coastal Zone Management Program.

Under the Coastal Plan for Santa Barbara County, the Santa Barbara County coastline is divided into seven subareas. The subarea along the western boundary of Vandenberg AFB is the North Coast Planning Area. On Vandenberg AFB, the coastal zone extends inland from approximately 3/4 mile at the northern boundary to 4-1/2 miles at the southern end of the base. It varies in width between the northern and southern boundaries, with the widest portion occurring at San Antonio Creek and south of Cañada Honda Creek to the southern boundary (Santa Barbara County, 1982).

**3.3.2.4 Recreation.** The recreational opportunities in the vicinity of Vandenberg AFB provide limited public access to the base's shoreline up to the mean high tide line. Ocean Beach and Jalama Beach county parks may be closed during launch activities on Vandenberg AFB.

Jalama Beach County Park is situated at the southern end of the base and is reached via Jalama Road from SR 1 (see Figure 3.3-4). Amenities are provided for day-use picnicking, and there are approximately 100 sites available for overnight camping. Approximately 122,400 people visited the park from June 1995 to June 1996, 60 percent of whom camped overnight. The park is closed to the public during low-azimuth Titan launches, in accordance with EWR 127-1, Range Safety Requirements. The Santa Barbara County Parks Department, County Sheriff, and California Highway Patrol are notified of scheduled launch events. Park rangers post a notice indicating the time and date of park closure. The County Sheriff usually initiates procedures for barricading about 6 hours prior to launch, and the park ranger clears the area. Following the launch or launch cancellation, the Air Force informs the park ranger and sheriff, and the park is reopened. Between 1990 and 1995, the park averaged one closure per year. The park is closed for approximately 8 hours per launch event.

Ocean Beach County Park is located between North and South Vandenberg AFB and is reached via SR 246 (see Figure 3.3-4). The park provides amenities for day-use picnicking and sightseeing and was visited by approximately 63,000 people in 1993. Ocean Beach County Park is closed for Atlas, Delta, and Titan launches. Closure procedures for this park are similar to those used for Jalama Beach County Park. Between 1990 and 1995, the park was closed an average of three times per year for an average of 8 hours per launch event.

The Boathouse Flats area on South Vandenberg AFB, the former location of the U.S. Coast Guard Rescue Station, provides Air Force personnel and their guests picnicking, diving, swimming, and fishing recreation opportunities. Approximately 1,800 persons use this area annually. Boathouse Flats lies on the coast south of SLC-6. This area would experience the same closures as Jalama Beach County Park during low-azimuth Titan launches.

**3.3.2.5 Aesthetics.** The ROI for aesthetics at Vandenberg AFB includes the general visual environment surrounding the base and areas of the base visible from off-base areas.

The visual environment in the vicinity of Vandenberg AFB is varied and characterized by rolling hills covered with chaparral and oak trees, valleys utilized for grazing or more intensive agriculture, and urbanized areas of the Lompoc Valley. Topography is largely dominated by the east-west-trending Santa Ynez Mountains that narrow toward the coast and terminate at Point Arguello. Views of the coastline are generally not available from inland locations due to access limitations and intervening topography.

South Vandenberg AFB is characterized by the somewhat rugged terrain of the western Santa Ynez Mountains, which rise to more than 2,000 feet at Tranquillon Peak. From this elevation, the mountains drop toward the coast, terminating at a narrow marine terrace at about 50 to 100 feet above the ocean. Slopes and terraces are covered with grasses and chaparral or coastal sage vegetation. With the exception of scattered launch facilities, South Vandenberg AFB is generally undeveloped. The most visually significant aspects of the natural environment are the rugged coastline and adjacent mountain slopes, and the most significant man-made features are the launch complexes.

Vandenberg AFB has a low visual sensitivity because views of South Vandenberg AFB from the east, and from the approximately 40 miles of coastline, are generally restricted by distance from public/private land, limited roadways, and the topography of the Santa Ynez Mountains that extend to Point Arguello at Cypress Ridge. Since public access to South Vandenberg AFB is generally not permitted, viewpoints are primarily limited to marine traffic, passengers on the Southern Pacific Railroad that traverses through the area parallel to the coastline, and views from Ocean Beach and Jalama Beach county parks.

The marine traffic consists primarily of fishing vessels and occasional pleasure boats. Visibility from the ocean is limited. Passenger railroad traffic provides the closest views of the area; about four passenger and eight freight trains pass through Vandenberg AFB daily. From the west, views for marine and railroad traffic include both SLC-3 and SLC-6. Views of the South Vandenberg AFB coastline north of Point Arguello are available from Ocean Beach County Park. Views from this location include SLC-3 and SLC-4; SLC-6 is not visible from the park.

From the south, views of the South Vandenberg AFB coastline are available from Jalama Beach County Park, which offers views north to Point Arguello. This area offers expansive views reflecting the predominantly undeveloped nature of the coastline. Existing launch facilities, such as SLC-3 and SLC-6,

cannot be seen from this location due to the intervening topography of the Santa Ynez Mountains.

## 3.4 TRANSPORTATION

This section addresses roadways and railways. The ROI for the roadways analysis includes the key road networks that provide access to Cape Canaveral AS and Vandenberg AFB. The analysis will focus on the immediate areas and local roadways surrounding the two installations. The rail networks in the vicinities of the two installations are described.

**Roadways.** The evaluation of the existing roadway conditions focuses on capacity, which reflects the ability of the network to serve the traffic demand and volume, usually expressed in number of vehicles per hour. The capacity of a roadway depends on the street width, number of lanes, intersection control, and other physical factors. Depending on the project and data available, traffic volumes are typically reported as the number of vehicular movements averaged over a daily period (ADT) or an annual period (AADT). Peak-hour volume (PHV) is defined as the highest volume of traffic in a 24-hour period that is recorded on a segment of roadway or intersection during a 1-hour period. The ADT and PHV values are useful indicators in determining the extent to which the roadway segment is used, and in assessing the potential for congestion or other traffic problems.

The performance of a roadway segment is generally expressed in terms of level of service (LOS). The LOS scale ranges from A to F, with each level defined by a range of volume-to-capacity (V/C) ratios. LOS A, B, and C are considered good operating conditions under which minor to tolerable delays are experienced by motorists. LOS D represents below-average conditions. LOS E reflects a roadway at maximum capacity, and LOS F represents traffic congestion. Table 3.4-1 presents the LOS designations and their associated V/C ratios used in this analysis.

Existing roads and highways within the ROI are described at two levels: (1) regional roads, representing key regional access, and (2) local roads, representing roads connecting the project site to regional roads within

**Table 3.4-1. Road Transportation Levels of Service**

| LOS | Description | Criteria (V/C) Multi-Lane Arterial | Criteria (V/C) 2-Lane Highway |
|---|---|---|---|
| A | Free flow with users unaffected by presence of other roadway users | 0-0.3 | 0-0.15 |
| B | Stable flow, but presence of the users in traffic stream becomes noticeable | 0.31-0.5 | 0.16-0.27 |
| C | Stable flow, but operation of single users becomes affected by interactions with others in traffic stream | 0.51-0.7 | 0.28-0.43 |
| D | High density, but stable flow; speed and freedom of movement are severely restricted; poor level of comfort and convenience | 0.71-0.84 | 0.44-0.64 |
| E | Unstable flow; operating conditions at capacity with reduced speeds, maneuvering difficulty, and extremely poor levels of comfort and convenience | 0.85-1.00 | 0.65-1.00 |
| F | Forced breakdown flow with traffic demand exceeding capacity; unstable stop-and-go traffic | >1.00 | >1.00 |

LOS = level of service
V/C = volume to capacity
Source: Compiled from Transportation Research Board, 1994.

the ROI. The local road network selected for analysis was determined based on the residential distribution of current employees. Traffic data and physical roadway characteristics were obtained primarily from data provided by the state and local highway departments.

The capacity of each roadway segment surrounding Cape Canaveral AS and Vandenberg AFB was determined using existing roadway geometric characteristics.

### 3.4.1 Cape Canaveral AS

**3.4.1.1 Regional.** The Cape Canaveral AS area can be accessed from Daytona Beach and other locations via U.S. Highway (U.S.) 1 or Interstate 95 (Figure 3.4-1). Orlando lies approximately 50 miles to the west on SR 528, and Miami is approximately 187 miles to the south on U.S. 1 or Interstate 95.

**Local.** The majority of the employees and other related support services providers for Cape Canaveral AS reside within the unincorporated areas of Brevard County and in the cities of Cape Canaveral, Cocoa, Cocoa Beach, and Rockledge, which are all within 14 miles of the station. The key local roads providing access to Cape Canaveral AS from KSC and the local

Figure 3.4-1 Regional and Local Road Systems, Cape Canaveral AS, Florida

communities include SR A1A, SR 520, SR 528, SR 401, SR 3, and SR 405. The NASA Causeway and Beach Road connect KSC and Cape Canaveral AS (see Figure 3.4-1).

Southern access into Cape Canaveral AS through Gate 1 is provided by SR 401, SR A1A, SR 520, and SR 528. SR 401 is a 5-lane road that narrows to a 4-lane divided road as it approaches Gate 1 where it becomes Samuel C. Phillips Parkway. SR A1A is a north-south, 4-lane divided highway to the south of Cape Canaveral AS that is used as a transportation corridor connecting SR 401 with the cities of Cape Canaveral and Cocoa Beach, and Patrick AFB. SR 520 is a 4-lane, east-west urban roadway that connects the cities of Cocoa and Rockledge to Merritt Island. By 2010, the road is expected to be resurfaced to a 6-lane roadway. As it continues east, SR 520 connects with SR A1A. SR 528 is a 4-lane, limited-access toll road that approaches the southern portion of Cape Canaveral AS from the west, connecting the mainland to Merritt Island and the barrier islands. The road is used extensively by KSC personnel. SR 528 and SR A1A merge into SR 401 just south of Cape Canaveral AS.

Western access onto Cape Canaveral AS is provided by SR 3 and SR 405. SR 3 is a north-south highway that bisects KSC. It becomes Kennedy Parkway on KSC and provides access to Gate 2. SR 405 is a 4-lane road providing access to Cape Canaveral AS from the west. It turns into the NASA Causeway after entering KSC at Gate 3.

From the north, Cape Canaveral AS can be accessed through Gate 4 and Gate 6 at KSC. SR 3 provides access to Gate 4 from the north, and Beach Road provides access to Gate 4 and Gate 6 from the west. Beach Road becomes SR 401 as it approaches Cape Canaveral AS and subsequently turns into Samuel C. Phillips Parkway. PHVs and existing LOS for key roads on Cape Canaveral AS are presented in Table 3.4-2.

**Table 3.4-2. Peak-Hour Traffic Volumes and LOS on Key Roads - Cape Canaveral AS**

| Roadway | Segment/No. of Lanes | Capacity VPH | 1996 PHV | LOS |
|---|---|---|---|---|
| SR A1A | South from Samuel C. Phillips Parkway; 4-lane | 8,000 | 3,950 | C |
| SR A1A | East from Samuel C. Phillips Parkway; 4-lane | 8,000 | 3,750 | B |
| NASA Causeway | Between U.S. 1 and Samuel C. Phillips Parkway; 4-lane | 8,000 | 1,750 | A |
| Samuel C. Phillips Pkwy/Hangar Road | Between Gate 1 and SR 401 (Gate 6); 4-lane | 8,000 | 1,900 | A |

LOS = level of service
NASA = National Aeronautics and Space Administration
PHV = peak-hour volume
SR = State Route
U.S. = U.S. Highway
VPH = vehicles per hour

**On-Site.** The major on-site roadway on Cape Canaveral AS is Samuel C. Phillips Parkway, a 4-lane divided highway that accommodates most of the north-south traffic. At its intersection with Skid Strip Road, Samuel C. Phillips Parkway becomes a one-way northbound arterial, with Hangar Road serving as the southbound arterial. Samuel C. Phillips Parkway provides access to

the launch site locations (SLC-41 and SLC-37). To the north and south of Cape Canaveral AS, Samuel C. Phillips Parkway becomes SR 401.

**3.4.1.2 Railways.** The ROI for railways includes the Florida East Coast Railway, which provides rail service to Brevard County through the cities of Titusville, Cocoa, and Melbourne. An additional railway in the ITL area on Cape Canaveral AS is accessible by the Florida East Coast Railway through KSC and Titusville.

### 3.4.2 Vandenberg AFB

**3.4.2.1 Regional.** Vandenberg AFB is accessible by U.S. 101, which connects the base with San Francisco on the north and Santa Barbara on the south. SR 1, SR 135, and SR 246 provide access to the base from U.S. 101.

**Local.** The majority of the workers and other related support services providers for Vandenberg AFB reside within the unincorporated areas of Santa Barbara County and in the cities of Lompoc, Santa Maria, Guadalupe, Buellton, Solvang, and Santa Barbara. The key local roads providing access to Vandenberg AFB include SR 1, SR 135, Santa Lucia Canyon Road, SR 246, U.S. 101, and Central Avenue (Figure 3.4-2).

Vandenberg AFB is accessible through the northeast at the Santa Maria Gate by SR 1, a 4-lane rural expressway extending primarily along the coastal region of California. SR 1 connects with SR 135 south of the city of Santa Maria.

SR 246, Central Avenue, and Santa Lucia Canyon Road provide eastern access to Vandenberg AFB. SR 246 leads to two base gates, the South Vandenberg AFB Gate and Solvang Gate. SR 246 is a 2-lane rural highway connecting Lompoc to U.S. 101, a divided, 4-lane, major arterial. SR 246 becomes Ocean Avenue within the city of Lompoc and is one of the main transportation routes connecting Lompoc with Vandenberg AFB. Ocean Avenue is a major east-west, 4-lane divided road running through southern Lompoc. Central Avenue connects SR 1 with Ocean Avenue, and subsequently, SR 246. Central Avenue is a 2-lane undivided street running east-west through the northern part of Lompoc. The other western gate is Lompoc Gate, north of the city of Lompoc, and accessible through Santa Lucia Canyon Road, a 2-lane undivided highway. Santa Lucia Canyon Road runs north-south, connecting Ocean Avenue with Lompoc Gate. PHVs and existing LOS for key roads on Vandenberg AFB are presented in Table 3.4-3.

Figure 3.4-2 Regional and Local Road Systems, Vandenberg AFB, California

**Table 3.4-3. Peak-Hour Volumes and LOS on Key Roads - Vandenberg AFB**

| Roadway | Segment/No. of Lanes | Capacity VPH | 1996 PHV | LOS |
|---|---|---|---|---|
| Coast Road | Between SLC-6 and Bear Creek Road; 2-lane | 2,800 | 350 | A |
| Bear Creek Road | Between Coast Road and Ocean Avenue; 2-lane | 2,800 | 350 | A |
| 13th Street | Between Ocean Avenue and Santa Maria Gate; 2-lane | 2,800 | 1,550 | D |
| Ocean Avenue | Between Bear Creek Road and SR 1; 4-lane | 8,000 | 250 | A |
| SR 1 | Between Santa Maria Gate and SR 135; 4-lane | 8,000 | 1,550 | B |

LOS = level of service
PHV = peak-hour volume
SR = State Route
VPH = vehicles per hour

Source: Santa Barbara County Planning Department Traffic Count, 1996

**On-Site.** The major roads on Vandenberg AFB that provide access to the project sites are Coast Road, Bear Creek Road, 13th Street, and Ocean Avenue. Coast Road is a 2-lane undivided roadway providing access to SLC-6. Coast Road connects to Bear Creek Road, north of SLC-6. Bear Creek Road is a 2-lane arterial that provides access to the launch site location SLC-3W. Bear Creek Road is accessible through 13th Street from the north or Ocean Avenue from the east. The Solvang Gate, Santa Maria Gate, and El Rancho Gate are connected to 13th Street, a 2-lane arterial that runs north-south on the base. Ocean Avenue is an east-west road that bisects Vandenberg AFB and connects with Bear Creek and Coast roads. The Solvang and South Vandenberg AFB gates are located just north and south, respectively, of Ocean Avenue.

**3.4.2.2 Railways.** The ROI for railways includes the Southern Pacific, Santa Maria Valley, and the Ventura County Railroad companies, which provide services to the cities of Santa Maria, Lompoc, Santa Barbara, San Luis Obispo, and Ventura. Three branch lines connect Vandenberg AFB to the Southern Pacific Railroad main line. Approximately four passenger and eight freight trains pass through Vandenberg AFB daily. The railroad tracks pass between the Pacific Ocean and the launch facilities and must be overflown during launches; however, trains are never overflown during launches due to the potential risk to people and property. An electronic surveillance system, posted railroad schedules, and close coordination, including radio communication, between train engineers and Vandenberg AFB launch personnel, are used to minimize the possibility of an overflight.

## 3.5 UTILITIES

The utility systems addressed in this EIS include the facilities and infrastructure used for potable water supply, wastewater collection and treatment, solid waste disposal, and electricity.

The ROI for utilities consists of all or portions of the service areas of each utility provider that serves the project site, other installation facilities, and

incorporated and unincorporated areas of the applicable county. The major attributes of utility systems in the ROI are processing, distribution, and storage capacities, and related factors, such as average daily consumption and daily peak demand. These factors are used in determining whether the existing utility systems are capable and adequate to provide services to the project sites in the future.

ROI utility use was determined from records of purveyors, historic consumption patterns, and system-wide average annual growth rates.

### 3.5.1 Cape Canaveral AS

Potable water, wastewater, solid waste, and electrical systems for Cape Canaveral AS and the surrounding area are discussed in this section.

**3.5.1.1 Water.** The ROI for water supply and distribution consists of Patrick AFB, Cape Canaveral AS, KSC, the cities of Cocoa, Cocoa Beach, Rockledge, Cape Canaveral, unincorporated areas of Merritt Island, and unincorporated areas north, west, and south of the city of Cocoa. The water delivered to the ROI comes from the Florida aquifer and is delivered by the city of Cocoa's water distribution system, with a capacity of 37 million gallons per day (MGD). In 1995, the water consumption in the ROI averaged 25 MGD. Cape Canaveral AS used an average of 0.75 MGD including deluge water in 1995 and has a system capacity of 3 MGD.

Water is supplied to the launch complexes through the domestic water distribution system. Ten ground-level tanks with a total capacity of 5,900,000 gallons are used to store deluge water, which is supplied to the launch pads. Because these tanks are used infrequently, the stored water can become stagnant and chlorine levels can dissipate below acceptable human consumption levels. This condition also occurs in the large-volume pipes for the deluge system because average daily water use is small compared to the quantity in large-volume pipes. To prevent this stagnant water from contaminating drinking water, Cape Canaveral AS plans to install a separate piping system. In 1995, there were 16 launches from Cape Canaveral AS, resulting in use of approximately 3,200,000 gallons of deluge water.

**3.5.1.2 Wastewater.** Cape Canaveral AS treats both domestic and industrial wastewater on site. The wastewater treatment plant has a permitted capacity of 0.8 MGD and a peak daily flow of approximately 0.6 MGD. Cape Canaveral AS has an industrial wastewater permit to discharge deluge water to grade or to pump to the WWTP for treatment. Maximum total flow of wastewater from domestic use allows a residual wastewater capability of approximately 200,000 gpd for treatment of contaminated deluge water, if required.

**3.5.1.3 Solid Waste.** The ROI for solid waste management consists of the cities located within central Brevard County. General solid refuse at Cape Canaveral AS is collected by a private contractor and disposed of off-site at the Brevard County Landfill, a 192-acre Class I landfill located near the city of Cocoa. In 1995, the landfill received between 2,200 and 2,400 tons of waste per day, of which 8.5 tons per day came from Cape Canaveral AS. The Brevard County Landfill has a 10- to 12-year life expectancy. Cape

Canaveral AS also operates an on-site landfill that accepts construction and demolition debris and asbestos-containing material. The landfill has a capacity of 182 acres but currently uses only 55 acres. Of the remaining 127 acres, there are 7 acres of permitted capacity for construction and demolition debris disposal. In 1995, Cape Canaveral AS disposed of approximately 2,085 tons of construction and demolition debris, 25,546 tons of concrete, and 748 tons of asbestos-containing material.

**3.5.1.4 Electricity.** In 1995, approximately 220,000 megawatt-hours per day (MWH/day) were delivered to Brevard County, of which 864 MWH/day were consumed by Cape Canaveral AS. Transmission lines enter the station at three locations: the southwestern boundary; across the NASA Causeway; and from Merritt Island. The capacity of the three substations is 55 megawatts (MW); the substations are capable of providing 1,320 MWH/day. There are also 170 substations on Cape Canaveral AS that convert the voltage to user voltages.

### 3.5.2 Vandenberg AFB

Potable water, wastewater, solid waste, and electrical systems for Vandenberg AFB and the surrounding area are discussed in this section.

**3.5.2.1 Water.** The ROI for water supply and distribution consists of the Lompoc and Santa Maria valleys. Water supplies in these areas are provided by wells located in the Santa Ynez, San Antonio Creek Valley, and Santa Maria watersheds. In 1997, Vandenberg AFB was connected to the State Water Project for supplemental water supply. A maximum of 5,000 acre-feet per year may be obtained through the base's entitlement rights. The total potable water consumption in the ROI was approximately 33.9 MGD in 1995.

Water on Vandenberg AFB is supplied from the San Antonio Aquifer and the Lompoc Terrace Groundwater Basin. The main portion of the water supply delivered to North Vandenberg AFB comes from the western portion of the San Antonio aquifer. The total potable water supplied from this aquifer in 1995 was approximately 3.22 MGD. South Vandenberg AFB obtains water from the Lompoc Terrace Groundwater Basin. The water supplied from this aquifer in 1995 was approximately 0.20 MGD. In 1995, the combined potable water use for Vandenberg AFB was approximately 3.42 MGD.

**3.5.2.2 Wastewater.** The Lompoc Regional WWTP services the city of Lompoc, Vandenberg AFB, and portions of the surrounding areas. In 1996, Vandenberg AFB contributed approximately 1.29 MGD of wastewater to the Lompoc Regional WWTP. The capacity of the Lompoc Regional WWTP is 5 MGD.

Industrial wastewater generated during launch processing operations on Vandenberg AFB is treated at the Industrial Wastewater Treatment Plant (IWTP) on South Vandenberg AFB. The IWTP was constructed in the mid-1980s to treat wastewater generated as a result of space shuttle launch activities from SLC-6 but now handles all industrial wastewater from launch processes. The operable units of the IWTP include the ultraviolet (UV)/ozone system, the storage/distribution system, and the evaporation ponds. Currently, only one pond is utilized, pending completion of the engineering

analysis for integrity. Depending on the contents of the wastewater, the water is either taken to the UV/ozone system or to the evaporation ponds. Hydrazine-contaminated wastewater must first be processed in the UV/ozone system. Prior to transfer to the evaporation ponds, the water is sampled, characterized, and reviewed to ensure that it meets industrial wastewater criteria. The wastewater is transported via truck from the origination point to the IWTP.

Two tanker trucks, each with a maximum capacity of 5,000 gallons, operate over steep grades and travel up to 25 miles from the source of origin. The horsepower-to-weight ratio of the trucks limits the amount of wastewater per load to 2,000 to 4,000 gallons.

In 1996, the IWTP processed over 675,000 gallons of industrial wastewater, of which approximately 125,000 gallons required treatment for hydrazine at the UV/ozone system. Approximately 90 percent of the industrial wastewater originated at SLC-2, SLC-3, and SLC-4, and the hypergolic storage facility. Launches projected for 1997 are expected to produce over 1 million gallons of wastewater to be treated.

The IWTP capacity is limited to evaporation from the two lined surface impoundments. Each pond has a capacity of approximately 477,000 gallons at the 12-inch level and approximately 973,000 gallons at the 24-inch level. The evaporation rate for each pond varies from approximately 910 gpd during the winter to over 11,240 gpd during the summer. The standard operating depth is 12 inches; however, the ponds are frequently filled to 20 inches due to limited storage capacity. At this depth, spillage can occur from wind blowing across the ponds. Several instances of spills occurred during the 1994-1995 operating year, resulting in non-compliance issues. Currently, the IWTP operates at or above capacity during the rainy season. Wastewater is anticipated to increase as much as 100 percent over the next 3 years, exceeding plant capacity, as the ponds were not designed to handle the entire installation's industrial wastewater.

Vandenberg AFB is currently developing plans for construction of a closed-loop on-site water reclamation unit for each of the SLCs. The recycled industrial launch water could be reused for future launches instead of drawing from the potable water supply. A pilot project, identified under a joint DoD and U.S. EPA water quality initiative, is currently awaiting approval and funding. In the interim, Vandenberg AFB is researching measures that can be used to manage the treatment of industrial wastewater at the IWTP.

**3.5.2.3 Solid Waste.** Solid waste generated by Vandenberg AFB is disposed of in the on-base Class III landfill. Vandenberg AFB owns and operates the 187-acre landfill, about 4 miles north of Lompoc. In 1995, 60.3 tons per day were disposed of in the landfill, which has a life expectancy of 75 years.

**3.5.2.4 Electricity.** Electricity is provided by Pacific Gas and Electric Company's Morro Bay plant to Vandenberg AFB's main substation, then distributed through the base distribution system. The base also maintains diesel-powered generators to support technical facilities. In 1995, approximately 452 MWH/day were consumed by Vandenberg AFB.

## 3.6 HAZARDOUS MATERIALS AND HAZARDOUS WASTE MANAGEMENT

The relevant aspects of hazardous materials/waste management include the applicable regulations and procedures for hazardous materials usage and hazardous waste generation, and management programs for existing hazardous waste-contaminated sites within the ROIs.

### 3.6.1 Regulatory Framework

**3.6.1.1 Hazardous Materials Management.** Hazardous materials are those substances defined as hazardous by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (42 U.S.C. Sections 9601-9675), the Toxic Substances Control Act (TSCA) (15 U.S.C. Sections 2601-2671), and the Hazardous Materials Transportation Act (HMTA) (49 U.S.C. Section 1801, Parts 172-173). In general, this includes substances that, because of their quantity, concentration, or physical, chemical, or infectious characteristics, may present substantial danger to public health or welfare, or to the environment, when released. Air Force Instruction (AFI) 32-7086, *Hazardous Materials Management*, establishes procedures and standards that govern management of hazardous materials on Air Force installations.

**3.6.1.2 Hazardous Waste Management.** Management of hazardous waste must comply with the Resource Conservation and Recovery Act (RCRA), as amended by the Hazardous and Solid Waste Amendments of 1984 (HSWA) (42 U.S.C. Sections 6901-6992), which is administered by the U.S. EPA, unless otherwise exempted through CERCLA actions. Title C Part 261 identifies which solid wastes are classified as hazardous waste. RCRA requires that hazardous wastes be treated, stored, and disposed of to minimize the present and future threat to human health and the environment. Air Force guidance in AFI 32-7042, *Solid and Hazardous Waste Compliance*, provides a framework for complying with environmental standards applicable to hazardous waste.

**3.6.1.3 Pollution Prevention.** The federal Pollution Prevention Act (PPA) of 1990 established pollution prevention as a national objective. Air Force Policy Directive (AFPD) 32-70, Environmental Quality, outlines the Air Force policy for pollution prevention and references AFI 32-7080, *Pollution Prevention Program*, which defines the Air Force's Pollution Prevention Program requirements. AFI 32-7080 instructs all Air Force installations to implement a hierarchy of actions into daily operations to reduce the use of hazardous materials and the release of pollutants into the environment. The hierarchy of actions to prevent pollution is as follows: source reduction, waste reuse, waste recycling and, as a final option, waste disposal.

**3.6.1.4 Installation Restoration Program.** The IRP is an Air Force program that identifies, characterizes, and remediates past environmental contamination on Air Force installations. The program has established a process to evaluate past disposal sites, control the migration of contaminants, and control potential hazards to human health and the environment. In response to CERCLA and Section 211 of Superfund Amendments and Reauthorization Act (SARA) requirements, DoD established the Defense

Environmental Restoration Program (DERP) to facilitate clean up of past hazardous waste disposal and spill sites nationwide. Section 105 of SARA mandates that response actions follow the National Oil and Hazardous Substances Pollution Contingency Plan, as promulgated by the U.S. EPA. AFI 32-7020, The Environmental Restoration Program, implements the DERP as outlined in DoD Manual 5000.52-M, Environmental Restoration Program Manual.

The following subsections discuss specific programs for management of hazardous materials, hazardous waste, pollution prevention, and IRP sites at Cape Canaveral AS and Vandenberg AFB. The ROI for hazardous materials and hazardous waste management at both installations encompasses all geographic areas that are exposed to the possibility of a release of hazardous materials or hazardous wastes.

### 3.6.2 Cape Canaveral AS

The ROI for Cape Canaveral AS includes the areas around SLC-41 and SLC-37 and areas adjacent to proposed EELV facility locations.

**3.6.2.1 Hazardous Materials Management.** Numerous types of hazardous materials are used to support the various missions and general maintenance operations at Cape Canaveral AS. These materials range from common building paints to industrial solvents and hazardous fuels. Hazardous materials used to support current launch vehicle system activities (Atlas IIA, Delta II, Titan IVB) are presented in Tables 3.6-1, 3.6-2, and 3.6-3.

**Table 3.6-1. Hazardous Materials Utilized Per Launch, Atlas IIA**

| Hazardous Material | Quantity (lbs) |
|---|---|
| POL | 4,160 |
| VOC-Based Primers, Topcoats, and Coatings | 480 |
| Non-VOC-Based Primers, Topcoats, and Coatings | 2,800 |
| VOC-Based Solvents and Cleaners | 1,130 |
| Non-VOC-Based Solvents and Cleaners | 600 |
| Corrosives | 5,500 |
| Refrigerants | 0 |
| Adhesives, Sealants, and Epoxies | 2,540 |
| Extremely Hazardous Substances (not otherwise included) | 0 |
| Other | 460 |
| Total | 17,670 |

Note: Propellant quantities are listed in Table 2.2-2.
lbs = pounds
POL = petroleum, oil, and lubricants
VOC = volatile organic compound

Source: Lockheed Martin, 1997

A separate hazardous materials pharmacy distribution system (HazMart) has not yet been established or enforced at Cape Canaveral AS. Individual contractors at Cape Canaveral AS may obtain hazardous materials through their own organizations, local purchases, or other outside channels, although contractors are encouraged to obtain hazardous materials through the Patrick

AFB pharmacy whenever possible. Cape Canaveral AS is scheduled to implement a pharmacy system in 1998.

Management of hazardous materials, excluding hazardous fuels, is the responsibility of each individual or organization. The primary source for hazardous materials purchase and acquisition is through the Patrick AFB supply system. Patrick AFB implemented a HazMart for procurement,

**Table 3.6-2. Hazardous Materials Utilized Per Launch, Delta II**

| Hazardous Material | Quantity (lbs) |
|---|---|
| POL | 40 |
| VOC-Based Primers, Topcoats, and Coatings | 290 |
| Non-VOC-Based Primers, Topcoats, and Coatings | 230 |
| VOC-Based Solvents and Cleaners | 270 |
| Non-VOC-Based Solvents and Cleaners | 530 |
| Corrosives | 5,500 |
| Refrigerants | 0 |
| Adhesives, Sealants, and Epoxies | 340 |
| Extremely Hazardous Substances (not otherwise included) | 0 |
| Other | 10 |
| Total | 7,210 |

Note: Propellant quantities are listed in Table 2.2-2.
lbs = pounds
POL = petroleum, oil, and lubricants
VOC = volatile organic compound

Source: Boeing Company Response to Data Needs, 1997

**Table 3.6-3 Hazardous Materials Utilized Per Launch, Titan IVB**

| Hazardous Material | Quantity (lbs) |
|---|---|
| POL | 830 |
| VOC-Based Primers, Topcoats, and Coatings | 220 |
| Non-VOC-Based Primers, Topcoats, and Coatings | 40 |
| VOC-Based Solvents and Cleaners | 6,900 |
| Non-VOC-Based Solvents and Cleaners | 25,200 |
| Corrosives | 5,500 |
| Refrigerants | 60 |
| Adhesives, Sealants, and Epoxies | 290 |
| Extremely Hazardous Substances (not otherwise included) | 0 |
| Other | 160 |
| Total | 39,200 |

Note: Propellant quantities are listed in Table 2.2-2.
lbs = pounds
POL = petroleum, oil, and lubricants
VOC = volatile organic compound

Source: Lockheed Martin Environmental Analysis Report, 1997

storage, and distribution of hazardous materials. The purpose of the HazMart is to improve hazardous materials tracking and minimize hazardous waste generation by minimizing the use of hazardous materials. Under the HazMart concept, all hazardous materials are screened prior to being procured to

determine if less toxic alternative materials could be utilized during an industrial process. Under this system, only specific individuals within an organization can order and sign for hazardous materials.

Hazardous propellants are controlled by the Joint Propellants Contractor (JPC) for the 45 SW. The JPC handles the purchase, transport, temporary storage, and loading of hypergolic propellants and oxidizers.

Spills of hazardous materials are covered under 45 SW Operations Plan (OPlan) 32-3, Hazardous Materials Response Plan, which ensures that adequate and appropriate guidance, policies, and protocols regarding hazardous material incidents and associated emergency response are available to all installation personnel (45 Space Wing, 1996d).

**3.6.2.2 Hazardous Waste Management.** Hazardous waste management, including explosive ordnance disposal (EOD) at Cape Canaveral AS is regulated under the RCRA (Title 40 CFR 260-280) and the Florida Administrative Code (FAC) 62-730. These regulations are implemented through 45 SW OPlan 19-14, Petroleum Products and Hazardous Waste Management Plan, which addresses the proper identification, management, and disposition of hazardous waste on Cape Canaveral AS, and compliance with applicable federal, state, and Air Force requirements (45 Space Wing, 1996d).

All DoD-generated hazardous waste is labeled with the U.S. EPA identification number for Cape Canaveral AS, under which it is transported, treated, and disposed of. All individuals or organizations generating hazardous waste at Cape Canaveral AS are responsible for administering all applicable regulations and plans regarding hazardous waste. Generators must also comply with applicable regulations regarding the temporary accumulation of waste at the process site.

Cape Canaveral AS reported 513,507 pounds of DoD-generated hazardous waste in 1996. Typical hazardous wastes include various solvents, paints and primers, sealants, photo-developing solutions, adhesives, alcohol, oils, fuels, and various process chemicals. Hazardous wastes associated with current launch vehicle system activities are presented in Tables 3.6-4, 3.6-5, and 3.6-6. They are grouped by general description and the EPA-designated hazardous waste number.

Individual contractors and organizations maintain hazardous waste satellite accumulation points (SAPs) and 90-day hazardous waste accumulation areas in accordance with 45 SW OPlan 19-14. Cape Canaveral AS operates 40 SAPs. A maximum of 55 gallons per waste stream of hazardous waste can be accumulated at an SAP. There are currently 14 90-day accumulation areas on the station. There is no limit to the volume of waste that can be stored, but wastes must be taken to the permitted storage facility or disposed of off site within 90 days.

**Table 3.6-4. Hazardous Waste Generated Per Launch, Atlas IIA**

| RCRA Hazardous Waste | Quantity (lbs) |
|---|---|
| Ignitable (D001) RCRA Wastes | 3,270 |
| Halogenated Solvents (F001/F002) RCRA Wastes | 0 |
| Non-Halogenated Solvents (F003/F004/F005) RCRA Wastes | 0 |
| Toxic (D004) EPA Wastes | 40 |
| Commercial Chemical Products (U) RCRA Wastes | 380 |
| Corrosive (D002) RCRA Wastes | 5,500 |
| Acutely Hazardous (P) RCRA Wastes | 0 |
| Reactive (D003) RCRA Wastes | 0 |
| State-Regulated Wastes | 0 |
| Miscellaneous Wastes | 50 |
| Total | 9,240 |

EPA = Environmental Protection Agency
lbs = pounds
RCRA = Resource Conservation and Recovery Act

Source: Lockheed Martin Response to Data Needs, 1997

**Table 3.6-5. Hazardous Waste Generated Per Launch, Delta II**

| RCRA Hazardous Waste | Quantity (lbs) |
|---|---|
| Ignitable (D001) RCRA Wastes | 2,380 |
| Halogenated Solvents (F001/F002) RCRA Wastes | 0 |
| Non-Halogenated Solvents (F003/F004/F005) RCRA Wastes | 440 |
| Toxic (D004) EPA Wastes | 850 |
| Commercial Chemical Products (U) RCRA Wastes | 220 |
| Corrosive (D002) RCRA Wastes | 5,500 |
| Acutely Hazardous (P) RCRA Wastes | 0 |
| Reactive (D003) RCRA Wastes | 10 |
| State-Regulated Wastes | 5,240 |
| Miscellaneous (Remediation) Wastes | 2,170 |
| Total | 16,810 |

EPA = Environmental Protection Agency
lbs = pounds
RCRA = Resource Conservation and Recovery Act

Source: U.S. Air Force, 1994b

**Table 3.6-6. Hazardous Waste Generated Per Launch, Titan IVB**

| RCRA Hazardous Waste | Quantity (lbs) |
|---|---|
| Ignitable (D001) RCRA Wastes | 5,990 |
| Halogenated Solvents (F001/F002) RCRA Wastes | 430 |
| Non-Halogenated Solvents (F003) RCRA Wastes | 70 |
| Toxic (D004) EPA Wastes | 2,200 |
| Commercial Chemical Products (U) RCRA Wastes | 0 |
| Corrosive (D002) RCRA Wastes | 5,500 |
| Acutely Hazardous (P) RCRA Wastes | 0 |
| Reactive (D003) RCRA Wastes | 20,000 |
| State-Regulated Wastes | 2,000 |
| Miscellaneous Wastes | 0 |
| Total | 36,190 |

EPA = Environmental Protection Agency
lbs = pounds
RCRA = Resource Conservation and Recovery Act

Source: U.S. Air Force, 1988e

The permitted storage facility (RCRA Part B Permit, Number HO01-255040) is operated within Buildings 44200/44205. The facility is permitted to store hazardous wastes for up to 1 year under the current Florida Department of Environmental Protection (FDEP) permit and is operated by the Launch Base

Support (LBS) contractor. The waste storage site facility is not permitted to store waste hydrazine, MMH, or $N_2O_4$.

The JPC is responsible for the collection and transportation of hazardous waste (including propellant waste) from accumulation sites to a 90-day hazardous waste accumulation area, to the permitted hazardous waste storage facility, or to a licensed, permitted disposal facility off station. The Defense Reutilization and Marketing Office (DRMO) is responsible for managing and marketing excess and recoverable products and waste materials in accordance with applicable regulations. Hazardous items that cannot be managed by the DRMO are disposed of as hazardous wastes.

Waste deluge water that has been used for fire and sound suppression is discharged into percolation ponds adjacent to the launch pads or pumped to the WWTP for treatment (see Section 3.5.1.2). Groundwater monitoring wells are sampled quarterly in accordance with permit requirements.

**3.6.2.3 Pollution Prevention.** The 1996 45 SW Pollution Prevention Program Guide (PPPG) and Pollution Prevention Management Action Plan (PPMP) satisfy requirements of the Pollution Prevention Act of 1990. The PPPG also complies with requirements in DoD Directive 4210.15, AFI 32-7080, and the Air Force Installation PPPG. The PPPG establishes the overall strategy, delineates responsibilities, and sets forth specific objectives for reducing pollution of the ground, air, surface water, and groundwater. The purpose of the PPPG is to provide sufficient guidance for pollution prevention management on Patrick AFB and Cape Canaveral AS. Specific goals include implementation of management practices that eliminate or reduce the use of hazardous materials, increase efficiency in the use of raw materials, protect natural resources, and encourage source reduction through recycling, treatment, and disposal practices.

**3.6.2.4 Installation Restoration Program.** The IRP efforts at Cape Canaveral AS have been conducted parallel with the program at Patrick AFB and in close coordination with the U.S. EPA and the FDEP. Cape Canaveral AS is not a National Priorities List (NPL) site. The IRP sites are remediated under RCRA regulations in lieu of CERCLA.

Contamination has been confirmed at 63 IRP sites. Of the 63 IRP sites, 22 have regulatory concurrence for closure (No Further Response Action Planned [NFRAP]) or require monitoring only, 24 remain under investigation, and 17 are petroleum-contaminated sites. The identification of areas contaminated by petroleum is separate from that performed for IRP sites. This is a specific requirement under the FDEP's Petroleum Contamination Assessment (FAC 62-770 protocols). Of the 17 petroleum-contaminated sites, 7 are in remedial action phases and 10 are proposed for closure or have already been closed with regulatory approval. Cape Canaveral AS also has identified 46 areas of concern (AOCs). Of the 46 AOCs identified, 4 are currently proposed for NFRAP and 22 have been closed with regulatory approval.

The following discussion focuses on EELV activities at Cape Canaveral AS that have the potential to affect the ongoing investigations of IRP and AOC sites.

**Concept A ROI**

**SLC-41.** IRP Site DP-24 (Solid Waste Management Unit [SWMU] C047) is present at SLC-41. Hydrazine, diesel fuel, halogenated solvents, paints, thinners, trace metals, and waste oils may have been disposed of at the site. A RCRA Facility Investigation (RFI) has been conducted at this site.

In October 1996, an estimated 150,000 tons of polychlorinated biphenyl (PCB)-contaminated soil were identified at SLC-41. Approximately 25 percent of the contaminated soil was identified as containing PCB concentrations exceeding the regulated level of 50 ppm PCBs. The state of Florida regulates cleanup for industrial sites with contamination levels greater than 3 ppm.

**Other EELV Facilities**. IRP Site DP-60 (SWMU C095) is associated with Building 70500. Groundwater contamination may be present from past operations that required the use of solvents, oils, acids, and metals. Remedial investigation is in progress.

**Concept B ROI**

**SLC-37.** IRP Site C-L37 (SWMU 56) is present at SLC-37. This site consists of several areas where hydrazine, diesel fuel, RP-1, hydrocarbons, PCBs, solvents, and waste oils may have been disposed of. The site is currently undergoing a preliminary assessment/site investigation (PA/SI) under the IRP. As the sole user of SLC-37, NASA is currently investigating this site. Investigations will be conducted to determine whether a groundwater contamination plume underlies SLC-37. The AFSPC and NASA will determine what agency is ultimately responsible for site remediation.

### 3.6.3 Vandenberg AFB

The ROI for Vandenberg AFB includes the areas around SLC-3W and SLC-6, and areas adjacent to proposed EELV facility locations.

**3.6.3.1 Hazardous Materials Management.** Numerous types of hazardous materials are used to support the various missions and general maintenance operations at Vandenberg AFB. Hazardous materials utilized during current launch vehicle system activities are presented in Tables 3.6-1, 3.6-2, and 3.6-3. Vandenberg AFB requires all contractors using hazardous materials to submit a hazardous materials contingency plan prior to working on base.

In 1994, Vandenberg AFB implemented a HazMart (see Section 3.6.2.1). Distribution of hazardous materials is coordinated from a single issue point (Building 8317). Any unused materials are returned to the HazMart for reissue to another organization. Presently, all Air Force organizations participate in the HazMart, but contractor involvement is limited. Management of hazardous materials obtained directly from off-base suppliers by contractors is the responsibility of the individual contractor. The HazMart may be available to all base contractors.

Hazardous propellants for the 30 SW are controlled by United Paradyne, which handles the purchase, transport, temporary storage, and loading of hypergolic fuels and oxidizers. They are stored at the Hypergolic Storage Facility (Buildings 974 and 975) on South Vandenberg AFB.

Spills of hazardous materials are covered under the Hazardous Materials Emergency Response Plan, 30 SW Plan 32-4002, which ensures that adequate and appropriate guidance, policies, and protocols regarding hazardous material incidents and associated emergency response are available to all installation personnel.

**3.6.3.2 Hazardous Waste Management.** Hazardous wastes at Vandenberg AFB are regulated by RCRA (Title 40 CFR 260-280) and the California Environmental Protection Agency, Department of Toxic Substances Control, under the California Health and Safety Code, Title 22 Division 20, Chapter 6.5, Sections 25100 through 25159, and the California Administrative Code, Sections 25100 through 67188. These regulations require that hazardous waste be handled, stored, transported, disposed of, or recycled according to defined procedures.

The Vandenberg AFB Draft Hazardous Waste Management Plan (HWMP), 30 SW Plan 32-7043-A, implements the above regulations and outlines the procedures for disposing of hazardous waste. Implementing the procedures outlined in this plan ensures the proper identification, management, and disposition of hazardous waste on Vandenberg AFB, and compliance with applicable federal, state, and Air Force requirements.

All hazardous waste generated is labeled with the U.S. EPA identification number for Vandenberg AFB, under which it is transported, treated, and disposed of. All individuals or organizations at Vandenberg AFB are responsible for administering all applicable regulations and plans regarding hazardous waste, and for complying with applicable regulations regarding the temporary accumulation of waste at the process site.

Vandenberg AFB generated 2,008,174 pounds of hazardous waste in 1996. Typical hazardous wastes include various solvents, paints and primers, sealants, photo-developing solutions, adhesives, alcohol, oils, fuels, and various process chemicals. Hazardous wastes associated with current launch vehicle system activities are presented in Tables 3.6-4, 3.6-5, and 3.6-6. Hazardous waste is stored at its point of origin until the waste container is full, or until 60 days following the day the container first received waste (whichever is first). The waste is then transported to the permitted consolidated Collection Accumulation Point (CAP) for temporary storage for no longer than 30 days. Waste hypergolic fuel is stored at a separate consolidated Hypergolic Storage Facility CAP managed by United Paradyne. Consolidation of CAP functions helps to ensure that all legal requirements are met before transporting hazardous waste to the permitted storage facility.

Hazardous waste can be stored at the permitted storage facility (Building 3300) for up to 1 year from the date of accumulation. The permitted storage facility, operated by the DRMO, was issued a final RCRA Part B permit in 1996. DRMO serves as the agent to receive and store specified hazardous wastes and make arrangements for removal to off-base treatment, storage, or

disposal facilities (TSDFs) in compliance with “cradle to grave” RCRA management requirements. Wastes not listed in the Part B permit must be shipped to an off-base TSDF prior to the 90-day storage limit.

Waste deluge water that has been used for fire and sound suppression is collected and tested by the Vandenberg AFB Aerospace Fuels Lab. If the water is not found to be hazardous, it is sent to the base IWTP. Hazardous wastewater is characterized in accordance with California Title 22, Section 66261 requirements and sent to the CAP.

The base has been working with the regulators to implement a Water Quality Initiative. The system would implement a closed-loop recycling process at the major launch complexes (see Section 3.5.2.2.)

**3.6.3.3 Pollution Prevention.** The 1996 Vandenberg AFB PPMP, 30 SW Plan 32-7080, satisfies requirements of the Pollution Prevention Act of 1990 (U.S. Air Force, 1996b). The PPMP also complies with requirements in DoD Directive 4210.15, AFI 32-7080, and the Air Force Installation PPPG. The PPMP establishes the overall strategy, delineates responsibilities, and sets forth specific objectives for reducing pollution of the ground, air, surface water, and groundwater. The purpose of the PPMP is to provide sufficient guidance for pollution prevention management on Vandenberg AFB. Specific goals include implementation of management practices that eliminate or reduce the use of hazardous materials, increase efficiency in the use of raw materials, protect natural resources, and encourage source reduction through recycling, treatment, and disposal practices.

**3.6.3.4 Installation Restoration Program.** Vandenberg AFB is not listed on the NPL. IRP sites at Vandenberg AFB are being addressed in a manner generally consistent with the CERCLA process.

As of the end of 1996, 36 IRP sites were in the remedial investigation/ feasibility study (RI/FS) stage including those undergoing Interim Remedial Actions (IRAs). In addition, 40 sites are in the Remedial Action (RA) phase. Sixty sites have been recommended for NFRAP, with state concurrence.

Additionally, 166 AOCs at Vandenberg AFB were identified in the Supplemental Preliminary Assessment Report (U.S. Air Force Space Command, 1995c). Of the 166 AOCs, 2 were identified as areas of special handling. The AOCs are currently in the site investigation (SI) phase to determine whether contamination is present. Additional assessment efforts will be undertaken by Vandenberg AFB to ascertain the potential environmental concerns associated with these areas. The AOCs will be further investigated and remediated, if required.

The following discussion focuses on proposed EELV activities at Vandenberg AFB that have the potential to affect IRP and AOC sites.

**Concept A ROI**

**SLC-3W.** IRP Site 6 (SLC-3W) is at the northwestern end of Alden Road at SLC-3W. Hazardous substances that may have been released include RP-1, UDMH, component flushing solvents (trichloroethylene [TCE], methylene

chloride, and isopropyl alcohol), diesel fuel, waste oil, trace metals in deluge water, and paint residue in sandblast grit. In 1990, initial soil sampling was conducted at the site, and follow-up sampling was conducted in 1992. Based on the sampling results, IRP Site 6 was recommended for NFRAP, as all residual contaminants were found to be below levels that would pose an unacceptable risk to human health and the environment. A Preliminary Endangerment Assessment (PEA) report prepared for IRP Site 6 recommended that a NFRAP decision document be prepared and submitted for regulatory approval (Jacobs Engineering Group, Inc., 1995). The appropriate state agencies have concurred with the NFRAP finding. Any future environmental response actions will be conducted under the environmental compliance programs.

IRP Site 7 (Bear Creek Pond) is located west of Old Surf Road, just south of Bear Creek Pond. The pond area is the farthest downgradient portion of Bear Creek prior to Coast Road. At SLC-3E and SLC-3W, deluge water was released to Bear Creek Canyon. Contaminants of concern include hydrazine, solvents, lubricating oil, metals, and TCE. A Phase II RI Work Plan was completed for the site in 1996 to fill gaps identified in the Phase I data. Phase II RI field sampling and analyses are expected to be completed by the end of 1997.

Two AOCs associated with the SLC-3 area were identified during the PA/SI. AOC-66 is located at Building 765, a missile/space research facility with a substation and a transformer with detectable levels of PCBs. AOC-91, a 55-gallon waste oil drum, was associated with Building 780, the Water Pump House. The drum has been removed under a compliance removal action.

**Other EELV Facilities.** Building 7525, the Rocket Processing Building, is associated with AOC-143. In the past, a mixture of TCE and water was disposed of to grade. Currently, the building includes a paint spray booth, a hydraulic pumping station, and facilities for the use of solvents, photo-processing chemicals, and Freon.

**Concept B ROI**

**SLC-6.** There are no IRP sites located at SLC-6. However, AOC-89 is associated with Buildings 390A, 390M, 390T, and 391 within the SLC-6 area. Building 390 is actually composed of several structures labeled 390A-390T. Building 390A was constructed as an MST for the Manned Orbital program in 1969. Both past and present hydraulic leaks have been noted at this facility. Building 390M, a blast deflector made of concrete, is located west of Building 390A. Both photochemical waste and industrial wastewater releases have occurred within this facility. Building 390T was constructed in 1968 as a contaminated fuel holding area. Although no spills have been documented at this facility, it fits the definition of a potential SWMU under RCRA. Currently, this AOC is being investigated further to determine whether remediation is required.

**Other EELV Facilities.** Building 836, the NASA Building, is associated with IRP Site 19. Waste oils and solvents generated from operations at Building 836 were reportedly disposed of in a drainage ditch south of the building. A

PEA report will be prepared for IRP Site 19. A TCE plume is present beneath the northeastern side of the building. Remediation of the plume should be completed by 2000.

## 3.7 HEALTH AND SAFETY

### 3.7.1 Regulatory Framework

The regulatory environment for health and safety issues consists of those regional and local elements that have been established to minimize or eliminate potential risk to the general public and on-site personnel as a result of operations. The ROI for health and safety includes the areas surrounding Cape Canaveral AS and Vandenberg AFB that could be affected by launch operations or a credible accident, and areas associated with the transportation of hazardous materials. Both Cape Canaveral AS and Vandenberg AFB have extensive experience in the operations associated with launch vehicles.

Range safety regulations at both Cape Canaveral AS and Vandenberg AFB are contained in EWR 127-1, Range Safety Requirements (U.S. Air Force, 1995a). The objective of the range safety program is to ensure that the general public, launch area personnel, foreign land masses, and launch area resources are provided an acceptable level of safety, and that all aspects of prelaunch and launch operations adhere to public laws. Range Safety reviews, approves, and through operation safety, monitors and imposes safety holds, when necessary, on all prelaunch and launch operations conducted on the ranges. This is to ensure that hazards associated with propellant, ordnance, and other hazards do not expose the general public to risks greater than those considered acceptable by public law or state documents.

EWR 127-1 is divided into seven chapters that address all aspects of range safety. Range safety is the responsibility of all 45 and 30 SW organizations, tenants, contractors, subcontractors, range users, and visitors to the ranges. Active range safety involvement in a program from the earliest concept phases through launch enhances the chances for a safe program. To implement this, the Air Force has developed the "Concept to Launch" process, which identifies key safety milestones to ensure that all aspects of safety are addressed. This process for new launch programs includes an introduction to range safety, tailoring of EWR 127-1 for specific program requirements, noncompliance resolution, flight analysis review, launch vehicle elements and ground support equipment design review, airborne range safety system review, facility design review, operation test review, final range safety approval for launch operations, safety critical launch operations, and final range safety clear to launch. These safety reviews are applicable to the launch vehicle, payload, support equipment, and facilities. The safety review procedure provides a means of substantiating compliance with program safety requirements and encompasses all systems analyses and testing as required by the DoD. Major safety documents must be prepared to meet the requirements of EWR 127-1. Among these documents are the following:

**Toxic Release Contingency Plan (TRCP).** The TRCP may have to be updated to include program-specific launch vehicle, payload, ground-support equipment, and facility toxic material (propellants) at the ER, and Toxic Hazard Assessments (THA) at the WR. THAs are conducted to develop and control Toxic Hazard Zones (THZ) for each launch. THAs provide the appropriate safety clear areas for the storage, handling, and transfer of propellants; they also provide for protection of workers and the general public during vehicle processing and launch operations. The TRCP and THA must be updated prior to loading or storing the program toxic materials.

**Explosive Quantity-Distance Site Plan.** This site plan must be generated or updated for facilities used to store, handle, or process ordnance items or propellants. AFM 91-201, Explosive Safety Standards, and DOD-STD-6055.9, Ammunition and Explosives Safety Standards, are the governing documents for explosive siting. DoD Explosive Safety Board approval of this plan is required prior to construction of new facilities, and prior to the arrival of ordnance and propellants.

Hazardous materials such as propellant, ordnance, chemicals, and booster/payload components are transported to both ranges in accordance with DOT regulations for interstate shipment of hazardous substances (Title 49 CFR 100-199). Hazardous materials such as liquid rocket propellant are transported in specially designed containers to reduce the potential of a mishap should an accident occur. For some hazardous materials, each state may have its own required transportation routes, time of shipments, and permits. To date, no major accidents involving the shipment of hazardous materials associated with launch vehicles have occurred.

### 3.7.2 Cape Canaveral AS

**3.7.2.1 Regional Safety.** The range contractor at Cape Canaveral AS, the city of Cape Canaveral, Brevard County, and the KSC have a mutual-aid agreement in the event of an on- or off-station emergency. Each organization may request equipment and manpower in the event of a fire or other emergency. Current procedures mandate that a representative of the Brevard County Emergency Management Staff sit in the ROCC during all launches (Wadzinski, 1997). Consequently, Brevard County Emergency Management can better respond to a launch emergency through improved communications with Cape Canaveral AS staff.

Prior to a launch, the 45 SW uses an air dispersion computer model to predict toxic plume concentrations and locations for normal and failure launch modes. A detailed description of the computer model is discussed in Section 3.7.2.2, On-Station Safety. During launch activities, communication is maintained with Brevard County Emergency Management, KSC, the Florida Marine Patrol, the U.S. Coast Guard, and the State Warning Point, Division of Emergency Management, in Tallahassee, Florida. Additionally, real-time video and audio of all launches are provided to all off-station agencies. Currently, in addition to the facsimiles discussed above, the 45 SW transmits facsimiles of general messages that describe plume effects and general emergency response procedures.

At the ER, Range Safety monitors launch surveillance areas to ensure that risks to people, aircraft, and surface vessels are within acceptable limits. Control areas and airspace are closed to the public as required. 45 SW Flight Analysis notifies the 45 Range Squadron prior to launch of the areas that are hazardous to aircraft (i.e., impact debris corridor). The 45 Range Squadron is responsible for disseminating a Notice to Airmen through the FAA, Miami Air Route Traffic Control Center. 45 SW also ensures that a Notice to Mariners within the impact debris corridor is disseminated beginning 10 working days prior to launch. The United States Coast Guard (USCG) transmits Marine radio broadcast warnings to inform vessels of the effective closure time for the sea impact debris corridor. In addition, warning signs are posted in various Port Canaveral areas for vessels leaving the port. Figures 3.7-1 and 3.7-2 present impact debris corridors for a typical launch from SLC-41 and SLC-37, respectively.

**Impact Debris Corridors.** Flight termination boundaries ("destruct lines"), which protect impact limit lines, are established for each flight. These boundaries are computed to minimize potential debris impact on populated areas resulting from destruct action. Debris impacts are contained within the impact limit lines because the flight would be terminated to protect the public if the launch vehicle violates the flight boundaries. Vehicle trajectory deviations, obvious erratic flight, or other flight termination criteria which are unique for a particular mission would trigger the flight termination action. A debris hazard exists for normal launches, which results primarily from jettisoned payload fairings, stages, and other launch vehicle components. These hazards are all contained within the impact limit lines and the nominal impact areas are identified through Notices to Airmen and Mariners.

**3.7.2.2 On-Station Safety.** Launches are not allowed if an undue hazard exists for persons and property due to potential dispersion of hazardous materials or propagation of blast. The 45 SW has prepared a Toxic Hazard Control Plan that details the procedures to be used to control heated toxic gas hazards.

An air dispersion computer model, the Rocket Exhaust Effluent Diffusion Model (REEDM) (Bjorklund, 1990), is run to predict THCs associated with launches. It can also predict toxic plume concentrations and locations resulting from an actual abort during launch. Inputs to this model include predicted meteorological conditions, including rawinsonde balloon (a meteorological balloon used to provide wind speed and other data in the upper atmosphere) data, probable failure modes, and solid/liquid propellant emission estimates from the launch vehicle and/or facility. REEDM produces outputs in terms of peak concentration, time-averaged concentration of user-inputted time interval, and dosage estimates as required for the exposure criteria for each chemical species being analyzed. Three types of THCs are supported using REEDM: the Potential Hazard Corridor for a planned credible failure mode, the Emission Hazard Corridor for nominal emissions, and the Operational Hazard Corridor resulting from a failure mode that has actually occurred.

Figure 3.7-1  Typical Impact Debris Corridors, SLC-41

Figure 3.7-2  Typical Impact Debris Corridors, SLC-37

THCs are predicted for launches to ensure that Cape Canaveral AS/KSC personnel and the general public will not be exposed to toxic gases that may adversely affect their health.

Headquarters AFSPC Surgeon General's Office (HQ AFSPC/SG) has made recommendations regarding exposure criteria for contaminant concentrations that are modeled by REEDM. These recommendations are currently under review by the National Academy of Science, National Research Council, Committee on Toxicology (NAS/NRC/COT). When the NAS/NRC/COT completes its review, the Air Force Surgeon General (AF/SG) will consider the NAS/NRC/COT recommendations for adoption as Air Force standards. The Air Force currently follows the HQ AFSPC/SG recommendations.

The HQ AFSPC/SG has recommended exposure criteria for HCl, nitrogen dioxide ($NO_2$), nitric acid ($HNO_3$), and various hydrazines. HCl criteria apply to chlorine ($Cl_2$), because $Cl_2$ is formed from HCl in the presence of water. HCl is the byproduct of combustion of solid fuel and is the primary hazard during normal launches with solid rocket motors (e.g., Titan IVB). During an abort, the primary health hazards are $NO_2$, $HNO_3$, and hydrazines (if hydrazines are used as liquid propellants), although HCl is present. $NO_2$ and $HNO_3$ are formed from nitrogen tetroxide $N_2O_4$ during fireball-type chemical reactions during a launch abort. $N_2O_4$ is carried in upper stages of a launch vehicle and only produces $NO_2$ and $HNO_3$ during an explosion caused by an abort.

Table 3.7-1 presents Tier 1, Tier 2, and Tier 3 recommended exposure criteria for HCl, $NO_2$, $HNO_3$, and various hydrazines. Through a comparison of predicted exposure concentrations to Tier 1, Tier 2, or Tier 3 exposure criteria, Systems Safety will arrive at specific risk management decisions to protect installation personnel and the public.

Prior to a launch, the air dispersion model Ocean Breeze Dry Gulf (OBDG), a model contained in the Meteorological and Range Safety Support (MARSS) System, is run to plot downwind concentrations of toxic gases during cold spills (i.e., spills or releases of toxic materials from storage tanks or that occur during loading or unloading of tanks).

The 45 Weather Squadron alerts Cape Canaveral AS as soon as possible concerning a potential hurricane strike. Cape Canaveral AS personnel are evacuated as appropriate according to updated weather information. All buildings, facilities, fuel handling systems, mobile launch support towers, and other above-ground structures have been constructed to withstand a wind velocity up to 105 miles per hour. Prior to a hurricane strike, launch vehicles are detanked and either transferred to an aboveground structure for protection or protected on the launch pad by enclosure within a mobile support tower.

**Table 3.7-1. Exposure Criteria for Constituents in Rocket Motor Exhaust Plumes**

| | Tier 1[a] | Tier 2[b] | Tier 3[c] |
|---|---|---|---|
| HCl | 2 ppm[d] (60 min)<br>10 ppm[e] | 10 ppm[e] | 50 ppm[e] |
| $N_2H_4$ | NA | 2 ppm (60 min) | 50 ppm[d] (30 min) |
| UDMH | NA | 5 ppm (60 min) | 15 ppm[d](30 min) |
| A-50 | NA | 4 ppm[d] (60 min) | 15 ppm[d](30 min) |
| MMH | NA | 2 ppm (60 min) | 20 ppm[d](30 min) |
| $NO_2$ | 0.2 ppm[d] (60 min)<br>2 ppm[e] | 2 ppm[d] (60 min)<br>4 ppm[e] | 20 ppm[d] (30 min) |
| $HNO_3$ | 0.3 ppm[e] | 2.5 ppm[d] (60 min)<br>4 ppm[e] | 25 ppm[d] (30 min) |

Notes: (a) Tier 1—An airborne exposure level (maximum concentration) which poses no hazard to the general population but which may affect certain sensitive individuals (e.g., asthmatics, individuals with emphysema, and certain other lung-diseased people). An area where exposure levels equal or exceed Tier 1 exposure criteria, but do not exceed Tier 2 criteria, requires no controls.

(b) Tier 2—An airborne exposure level (maximum concentration) which may cause short-term symptoms but which most individuals could endure without experiencing or developing irreversible or other serious health effects or symptoms that could impair their ability to take protective action.

(c) Tier 3—An airborne exposure level (maximum concentration) that could cause irreversible health effects or impair one's ability to take protective action. Concentrations are immediately dangerous to life and health and pose significant risk to exposed individuals.

(d) Time-weighted average (TWA) exposure concentration. The time period indicated is the time over which the concentration measurements will be measured and averaged.

(e) Ceiling limit. A peak concentration that should not be exceeded during the exposure period.

A-50 = Aerozine-50 (50 percent by weight unsymmetrical dimethylhydrazine and anhydrous hydrazine)
HCl = hydrochloric acid
$HNO_3$ = nitric acid
min = minutes
MMH = monomethyl hydrazine
NA = not applicable
$N_2H_4$ = anhydrous hydrazine
$NO_2$ = nitrogen dioxide
ppm = parts per million
UDMH = unsymmetrical dimethylhydrazine

Emergency responses to major peacetime accidents and natural disasters are covered by 45 Space Wing Oplan 32-1, Volume II. Emergency responses involving hazardous materials are covered by 45 Space Wing Oplan 32-3, Volume I. The Launch Disaster Control Group (LDCG) is an emergency response team formed prior to each launch and situated at a fallback location

respond to launch accidents in order to save lives, protect property, control fires, limit the extent of damage, prevent adverse public relations, and return to normal launch operations as soon as possible after an accident. The Disaster Control Group (DCG) is an emergency response team that is activated for nonlaunch-related disasters at Cape Canaveral AS. The mission of the DCG is to minimize the loss of personnel and operational capability caused by wartime contingencies, peacetime disasters, and major accidents including those involving hazardous materials.

### 3.7.3 Vandenberg AFB

**3.7.3.1 Regional Safety.** Regionally, Santa Barbara County prepared a Hazardous Material Response Plan that is used for countywide disaster response. Cities and communities in the county are required to have their own emergency response plans that were incorporated by the county into a comprehensive Multihazard Functional Plan, which specifies actions to be taken in case of a local disaster. The city of Lompoc adopted its Multihazard Functional Plan in 1989 and amended it in 1994. Because of the potential for Vandenberg AFB operations to affect off-base areas, Vandenberg AFB plays a prime role in regional emergency planning (Environmental Science Associates, 1996; U.S. Air Force, 1989a).

The city of Lompoc and Vandenberg AFB have entered into a mutual aid agreement, which allows emergency units from either Lompoc or Vandenberg AFB to provide each other with assistance in the event of an emergency. A "hotline" exists between the city of Lompoc and Vandenberg AFB in order to immediately notify the city in case of a major accident on the base. In the event of an emergency involving a launch mishap in Lompoc, Vandenberg AFB would assume control and could set up a national defense area if protected material were involved in the accident.

In the event of a launch vehicle impacting other areas outside Vandenberg AFB, the On-Scene DCG from Vandenberg AFB would respond to the accident upon request of the county. County agencies would be used to help in the evacuation and possible fire control for such an incident. Military personnel would assume responsibility for disaster control in the immediate impact area.

Impact debris corridors have been established off the Santa Barbara County coast between Point Sal and Point Conception. These corridors were established to meet security requirements and reduce the hazard to persons and property during a launch-related activity. Impact debris corridors are established through the designation of debris impact areas for each specific launch. These corridors are plotted for all launches. Figures 3.7-3 and 3.7-4 present example impact debris corridors for a typical launch from SLC-3W and SLC-6, respectively.

Figure 3.7-3  Typical Impact Debris Corridors, SLC-3W

Figure 3.7-4  Typical Impact Debris Corridors, SLC-6

Zone closures are announced daily over various radio frequencies and posted in harbors along the coast. 30 SW Flight Analysis notifies the 30 Range Squadron of areas that are hazardous to aircraft (i.e., impact debris corridors) for all normally jettisoned and impacting stages by 30 working days prior to launch. The 30 Range Squadron notifies the FAA, Los Angeles Center or Oakland Center, so that the information can be disseminated through a Notice to Airmen. 30 SW also ensures that a Notice to Mariners within the impact debris corridor is disseminated beginning 30 working days prior to launch. Information regarding impact debris corridors is distributed to surface vessels when the 30 SW sends written notification of impact debris corridors to be published weekly in the USCG Long Beach Broadcast to Mariners. Broadcasts by USCG Long Beach provide the latest available hazard information to offshore surface vessels.

30 SW has developed procedures related to evacuating or sheltering personnel on offshore oil rigs during launch operations. These procedures pertain to offshore platforms located west of 120 degrees 15 minutes longitude. The 30 SW Chief of Safety notifies 30 Range Squadron of future launches, and 30 Range Squadron notifies the Minerals Management Service (MMS), Department of the Interior, to notify oil rig personnel of a future launch. The MMS will first notify the oil rig operator 10 to 15 days before a launch to prepare for possible sheltering or evacuation. The second notice is given 24 to 36 hours before the launch confirming the requirement to shelter or evacuate. The third notice is given by Frontier Control to provide final notice before, during, and after securing the operation. Additional notices are sent as required. Oil rig operators are notified to shelter or evacuate personnel according to REEDM models of toxic vapor plumes and potential impact of launch debris.

Jalama Beach and Ocean Beach county parks are closed on the day of a launch from South Vandenberg AFB. The beaches are within the range safety zone that has been calculated for South Vandenberg AFB launches. Although direct overflight of the beaches does not normally occur, there is the possibility of debris from a launch anomaly impacting the beaches. In order to protect park visitors, Vandenberg AFB, the County Parks Department, the County Sheriff, and the California Highway Patrol have agreed to close the parks upon request during launches affecting the beaches.

**3.7.3.2 On-Base Safety.** As discussed in Section 3.7.2.2, launches are not allowed if an undue hazard exists to persons and property due to potential dispersion of hazardous materials or propagation of blast. The 30 SW runs REEDM before a launch to estimate THCs. A description of REEDM is provided in Section 3.7.1.2. The procedure to estimate risk to Vandenberg AFB personnel and the general public through comparison of THC exposure concentrations to exposure criteria is the same as described in Section 3.7.1.2. Other safety procedures are similar to those described in Section 3.7.1.2, with the exception of those safety procedures described below. The air dispersion models Mountain Iron and AFTOX are run to plot downwind concentrations of toxic gases during cold spills.

Launch vehicle mishaps (i.e., accidents involving any launch vehicle operation) are handled by various emergency support teams on base. Some of these procedures include authorization to enter an accident area, control

procedures for monitoring trains, and salvage procedures. Several distinct teams of qualified individuals are available to respond to emergencies that might occur during a launch. These teams include the Specialized Operation Support Team, the On-Scene Disaster Group, the Missile Potential Hazard Team, and the Launch Support Team.

The Southern Pacific Transportation Company (SPTC) railroad crosses Vandenberg AFB; SPTC owns the railroad property. Most launches fly over the railroad. 30 SW has procedures for train protection and subsequent "hold" or "proceed" decisions during launch operations.

Vandenberg AFB is located in Seismic Hazard Zone 4, which is the most severe seismic region. Consequently, the seismic design of all new or modified facilities, structures, and equipment shall be in accordance with all applicable Air Force standards (see Appendix E, Section 3.4.3.1). Equipment that has the potential to cause the following hazards must be designed to withstand an earthquake:

- Severe personal injury
- A catastrophic event
- Significant impact on space vehicle or missile processing and launch capability.

## 3.8 GEOLOGY AND SOILS

This section provides an overview of the physiography, geology, soils, and geologic hazards in the vicinity of Cape Canaveral AS and Vandenberg AFB. In general, the ROI is the regional geologic setting and the areas in the immediate vicinity of the launch complexes that could be affected by construction and launch operation activities.

### 3.8.1 Cape Canaveral AS

**3.8.1.1 Geologic Setting.** Cape Canaveral AS lies on a barrier island composed of relict beach ridges formed by wind and wave action. The island is 4.5 miles wide at its widest point. Its land surface ranges from sea level to 20 feet above mean sea level (MSL) at the harbor dredge disposal site near Port Canaveral. The average land surface elevation is approximately 10 feet above MSL. The higher naturally occurring elevations occur along the eastern portion of Cape Canaveral AS, with a gentle slope to lower elevations toward the marshlands along the Banana River.

The geology underlying Cape Canaveral AS can be generally defined by four stratigraphic units: the surficial sands, the Caloosahatchee Marl, the Hawthorn Formation, and the limestone formations of the Floridan aquifer (U.S. Air Force, 1991c). The surficial sands immediately underlying the surface are marine deposits that typically extend to depths of approximately 10 to 30 feet below the surface. The Caloosahatchee Marl underlies the surficial sands and consists of sandy shell marl that extends to a depth of 70 feet below the surface. The Hawthorn Formation, which consists of sandy limestone and clays, underlies the Caloosahatchee Marl and is the regional

confining unit for the Floridan aquifer. This formation is generally 80 to 120 feet thick, typically extending to a depth of approximately 180 feet below the surface (U.S. Air Force, 1991c). Beneath the Hawthorn Formation lie the limestone formations of the Floridan aquifer, which extend several thousand feet below the surface at Cape Canaveral AS (U.S. Air Force, 1991c).

The principal geologic hazard in central Florida is sinkholes that develop when overlying soils collapse into existing cavities. Cape Canaveral AS is not located in an active sinkhole area, and the review of topographic maps did not reveal the presence of any sinkholes. The Canaveral Peninsula is not prone to sinkholes, since the limestone formations are over 100 feet below the ground surface, and confining units minimize recharge to the limestone (45 Space Wing, 1996b).

A seismological investigation conducted by the U.S. Department of Commerce shows that the underground structure in the heavy launch area is free of anomalies, voids, and faults (45 Space Wing, 1995c). Cape Canaveral AS is located in Seismic Hazard Zone 0 as defined by the Uniform Building Code (International Conference of Building Officials, 1991). Seismic Zone 0 represents a very low potential risk for large seismic events.

**3.8.1.2 Soils.** The three most prominent soil types at Cape Canaveral AS comprise the Canaveral-Palm Beach-Welaka Association. This association is made up of nearly level and gently sloping ridges interspersed with narrow wet sloughs that generally parallel the ridges. The soils have rapid permeability and low available water capacity due to the near-surface water table. This permeability rate allows water to rapidly dissipate into the ground. According to the General Plan, limitations to development are slight to moderate for light industrial uses. No problems associated with previous construction activities at the SLCs have been identified. Soils in the areas of SLC-41 and SLC-37 are not considered highly suitable for commercial agricultural uses. There are no prime or unique farmland soils on Cape Canaveral AS (Pan Am World Services, Inc., 1989).

### 3.8.2 Vandenberg AFB

**3.8.2.1 Geologic Setting.** The region encompassing South Vandenberg AFB lies within the Transverse Ranges Physiographic Province of California and is dominated by the Santa Ynez Mountains. The Pacific Ocean and Santa Barbara Channel lie west and southeast, respectively, of the mountains, and the Lompoc-Santa Ynez River Valley lies to the north. Topography within Vandenberg AFB is varied, ranging from sea level to about 2,000 feet MSL in the Santa Ynez Mountains.

Locally, within the area incorporating South Vandenberg AFB, bedrock at the surface consists of diatomaceous shale that has an approximate thickness of 1,600 feet, known as the Upper Monterey Formation. Marine terrace deposits varying in thickness from a few to several tens of feet unconformably overlie the Monterey Formation. Weathered material 1 to 5 feet thick covers most of the slope areas that have low to moderate gradients.

Numerous onshore and offshore faults have been mapped within the vicinity of Vandenberg AFB; most are inactive and not capable of surface fault rupture or of generating earthquakes (U.S. Air Force, 1989a). Four faults have been mapped on Vandenberg AFB: the Lion's Head, Hosgri, Santa Ynez River, and Honda (U.S. Air Force, 1989d). The Lion's Head Fault runs through North Vandenberg AFB, and the Hosgri, Santa Ynez, and Honda faults run through South Vandenberg AFB. Of the three faults on South Vandenberg AFB, only the Hosgri Fault is considered to be active (ruptured in the last 10,000 years). The Santa Ynez River Fault is approximately one-half mile south of SLC-3W. The Hosgri Fault is located approximately 7.5 miles northwest of SLC-3W and 2.5 miles northwest of SLC-6. The Honda fault is the closest fault to SLC-6, which is approximately 1.5 miles north.

The secondary effects of fault rupture are earthquake ground motions, or seismicity. The Western Transverse Ranges, inclusive of the continental borderlands, have historically been in a moderately high seismic region. Since 1900, within a 20-mile radius of the project area, there have been over 90 earthquakes with magnitudes ranging from 3.0 to 7.3 (U.S. Air Force, 1989a). Two earthquakes were notable, one in 1812 (M7.1), most likely epicentered in the Santa Barbara Channel, and the other in 1927 (M7.3), offshore near Point Arguello. The 1927 event may have occurred less than 20 miles west of South Vandenberg AFB. Vandenberg AFB is located in a Seismic Zone IV, as defined by the Uniform Building Code (International Conference of Building Officials, 1991), characterized by areas likely to sustain major damage from earthquakes, and corresponds to intensities of VIII or higher on the Modified Mercalli Scale.

Shallow failures (i.e., 5 to 10 feet deep) such as slumps, rock falls, debris or mud flows and deep-seated landslides have not been identified in the immediate EELV project area locations. From a geologic standpoint, natural slopes on or adjacent to the area have been stable for many hundreds of years, although modifications to slopes, such as those that have occurred at SLC-6, may change slope conditions. Geotechnical investigations are conducted during engineering design to determine potential unstable conditions, and recommendations are made for safe slope design (U.S. Air Force, 1989a).

**3.8.2.2 Soils.** Soil deposits occur on most slopes and surfaces where bedrock is not exposed. The deposits were developed by weathering of the underlying Monterey Formation and/or terrace deposits. Soil thickness varies throughout the area but is generally less than 3 feet. Because of the slope of the terrain on South Vandenberg AFB, drainage (surface run off) and erosion affect local soils. Soils in the areas of SLC-3W and SLC-6 are not considered highly suitable for commercial agricultural uses. There are no prime or unique farmlands within proposed EELV operation areas at Vandenberg AFB.

Erosion of soils and bedrock materials is a continuing process caused by running water and wind. Soils within the area vary greatly, and those that are very sandy are more susceptible to erosion than are fine-grained deposits. Excessive erosion problems have occurred at several locations in the South Vandenberg AFB area, primarily associated with developed (graded) slopes (U.S. Air Force, 1989a). No problems associated with previous construction

activities at the SLCs have been identified. Developed slopes are often stabilized to prevent erosion.

In the vicinity of SLC-3W, the Lompoc Terrace is cut by Spring Canyon (directly south of SLC-4), Bear Canyon (between SLC-3 and SLC-4), and Lompoc Canyon (east of SLC-3). The valley floors of these canyons are approximately 100 to 300 feet below the surrounding terrace surface. The ground surface elevation at SLC-3W ranges from 400 to 500 feet above MSL. Slopes within the SLC-3W security fence are mild (less than 10-percent slope), except for the area southeast of the SLC-3E retention basin, where there are 25-percent slopes. Soils in the vicinity of SLC-3W have moderate to rapid permeability. The site is well vegetated, reducing the potential for surface erosion (Jacobs Engineering Group, Inc., 1995).

The SLC-6 site is located on an elevated marine terrace adjacent to the lower slopes of the Santa Ynez Mountains. Developed portions of the site have been graded and do not reflect the original topography. Adjacent undeveloped areas slope gently to the west with an average gradient of about 5 percent. The site lies generally between 200 and 500 feet above MSL, with a total relief of about 300 feet from west to east. The SLC-6 area is bounded on the north and south by two drainages. The southerly drainage extends from a large canyon east of the site to a discharge point about 1 mile to the northwest. The northerly drainage, known as Red Roof Canyon, extends from developed slopes of SLC-6 northwest, to a discharge point over 1 mile from the site. Both drainages have steep side slopes. Some erosion of soils is evident at points along the drainages bounding the SLC-6 site. The erosion potential of most on-site soils is severe. Slope stabilization measures have been implemented, especially adjacent to Red Roof Canyon, where excessive erosion required cement gunnite to protect graded slopes (U.S. Air Force, 1989a).

## 3.9 WATER RESOURCES

Water resources include groundwater and surface water and their physical, chemical, and biological characteristics. Aquatic and wetland habitats and organisms are discussed under Section 3.14, Biological Resources. This section focuses on the potential effects of EELV development and operation on the physical and chemical factors that influence water quality and surface runoff. Effects from erosion are discussed in Section 3.8, Geology and Soils.

The federal Clean Water Act (CWA) is the primary law regulating water pollution. The CWA, as amended (P.L. 92-500), is administered by the U.S. EPA, which delegates authority to the appropriate state agency. The CWA defines the primary and secondary standards for water quality. Treated water discharged to surface water or to the ocean is subject to the requirements of a National Pollution Discharge Elimination System (NPDES) permit, which ensures that the water discharged meets water quality standards at the point of discharge. In addition, projects disturbing 5 acres or more are subject to NPDES permit requirements for storm water discharges during construction. This permit requires the preparation of a Storm Water Pollution Prevention Plan. Section 319 of the CWA requires states to assess nonpoint water pollution problems and to develop nonpoint source pollution management programs with controls to improve water quality. Section 404 of the CWA

requires a permit from the USACE in order to locate a structure, excavate, or discharge dredged or fill material into Waters of the United States.

Executive Order (EO) 11988, Floodplain Management, directs federal agencies to avoid to the extent possible the long- and short-term adverse impacts associated with occupancy and modification of floodplains. AFI 32-7064 (Chapter 4, Floodplain Management and Wetlands Protection) requires the Air Force to prepare a Finding of No Practicable Alternatives (FONPA) before construction within a floodplain. The Deputy Assistant Secretary (Environment, Safety, and Environmental Health) must approve the FONPA before initiation of construction activities.

### 3.9.1 Cape Canaveral AS

The ROI for groundwater includes the local aquifers that are directly or indirectly used by Cape Canaveral AS. The ROI for surface water is the drainage system/watershed in which the station is located. The St. John's River Water Management District (SJRWMD) issues the Environmental Resource Permit, which includes storm water and wetlands management, in coordination with the FDEP and the USACE. The FDEP is responsible for management of the NPDES permit process and wastewater discharges.

**3.9.1.1 Groundwater.** Two aquifer systems underlie Cape Canaveral AS: the surficial and the Floridan aquifer systems. The surficial aquifer system, which comprises generally sand and marl, is under unconfined conditions and is approximately 70 feet thick. The water table in the aquifer is generally a few feet below the ground surface. Recharge to the surficial aquifer is principally by percolation of rainfall and runoff. Groundwater in the surficial aquifer at Cape Canaveral AS generally flows to the west, except along the extreme eastern coast of the peninsula.

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 and 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.

Cape Canaveral AS receives its potable water from the city of Cocoa, which pumps water from the Floridan aquifer. According to the General Plan, this water supply is more than adequate to meet usage demands and water quality standards (45 Space Wing, 1995).

**3.9.1.2 Surface Water.** Cape Canaveral AS is situated on a barrier island that separates the Banana River from the Atlantic Ocean. The station is within the Florida Middle East Coast Basin. This basin contains three major bodies of water in proximity to the station: 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.

Surface drainage at Cape Canaveral AS generally flows to the west into the Banana River, even near the eastern side of the peninsula.

Several water bodies in the Middle East Coast Basin have been designated as Outstanding Florida Water (OFW) in FAC 62-3, 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. These water bodies are afforded the highest level of protection, and any compromise of ambient water quality is prohibited. The Indian River Lagoon System has also been designated an Estuary of National Significance by the U.S. EPA. Estuaries of National Significance are identified to balance conflicting uses of the nation's estuaries while restoring or maintaining their natural character. The Banana River has been designated a Class III surface water, as described by the CWA. Class III standards are intended to maintain a level of water quality suitable for recreation and the production of fish and wildlife communities. There are no wild and scenic rivers located on or near Cape Canaveral AS.

Floodplains are lowland and relatively flat areas adjoining inland and coastal waters that are subject to flooding. The 100-year floodplain is subject to a 1-percent or greater chance of flooding in any given year. On Cape Canaveral AS, the 100-year floodplain extends 7 feet above MSL on the Atlantic Ocean side, and 4 feet above MSL on the Banana River side.

**Concept A ROI.** A portion of the area for construction of the assembly facilities south of SLC-41 at Cape Canaveral AS is within a 100-year floodplain.

**Concept B ROI.** There are no 100-year floodplains within areas proposed for EELV activities under Concept B.

**3.9.1.3 Water Quality.** Surface water quality near Cape Canaveral AS and KSC is monitored at 11 long-term monitoring stations that are maintained by NASA. The FDEP has classified water quality in the Florida Middle East Coast Basin as "poor to good" based on the physical and chemical characteristics of the water, as well as whether they meet their designated use under FAC 62-3. 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 area. However, recent studies by NASA indicate that certain parameters (i.e., primarily phenols and silver) consistently exceed state water quality criteria, with hydrogen ion concentration (pH), iron, and aluminum occasionally exceeding criteria. Nutrients and metals, when detected, have generally been below Class II standards (National Aeronautics and Space Administration, 1995c). Areas of poor water quality exist along the western

portions of the Indian River, near the city of Titusville, and in Newfound Harbor in southern Merritt Island. Fair and poor water quality areas are influenced primarily by WWTP effluent discharges and urban runoff.

### 3.9.2 Vandenberg AFB

The ROI for groundwater includes the local aquifers that are directly or indirectly used by Vandenberg AFB. The ROI for surface water is the drainage system/watershed in which the base is located. In California, the state Water Resources Control Board and the Regional Water Quality Control Board (RWQCB) administer the CWA and state water regulations. The Central Coast Region RWQCB is the local agency responsible for the Vandenberg AFB area. The RWQCB is responsible for management of the NPDES permit process for California.

The California Porter-Cologne Water Quality Act provides a framework for establishing beneficial uses of water resources and the development of local water quality objectives to protect these beneficial uses. State regulations require a Waste Discharge Requirement (WDR) for permitting discharge. A Report of Waste Discharge (RWD) (similar to an NPDES permit application) is required for actions that will involve discharge of waste to surface and/or groundwater. The California Porter-Cologne Water Quality Act implements the NPDES program for the state.

**3.9.2.1 Groundwater.** The main sources of potable water in the region are from the San Antonio Creek Valley groundwater basin, the Lompoc Plain groundwater basin, the Lompoc Upland groundwater basin, and the Lompoc Terrace groundwater basin. These groundwater basins are pumped for potable water for Vandenberg AFB and the surrounding communities. Activities at Vandenberg AFB are concentrated in the Lompoc subarea (Lompoc Plain, Lompoc Upland, and Lompoc Terrace groundwater basins) and the western portion of the San Antonio Creek Valley basin.

Historically, the entire water supply on South Vandenberg AFB has been provided by two wells in the Lompoc Terrace Aquifer. These wells have been pumped at a rate that exceeds the natural recharge of the two wells. This sustained over-withdrawal has resulted in a 0.4-foot decrease in the aquifer each year over the last 10 years. Launch complex process water use represented nearly 17 percent of this overdraft condition.

**3.9.2.2 Surface Water.** Four major drainages occur on Vandenberg AFB: Cañada Tortuga Creek, Bear Creek, Cañada Honda Creek, and Jalama Creek. There are numerous unnamed minor drainage basins containing seasonal and ephemeral streams. Drainage from these basins is predominantly to the west, toward the Pacific Ocean.

The Santa Ynez River forms the geomorphic boundary between North and South Vandenberg AFB. The major drainage for South Vandenberg AFB is Cañada Honda Creek, with a watershed of about 12 square miles. Springs associated with Cañada Honda Fault usually issue a minimal flow of water to the watershed. There are no permanent lakes, impoundments, rivers, or floodplains on South Vandenberg AFB; however, there are several streams that drain directly into the ocean. Jalama Creek is near and outside the

southern boundary of the base. There are no 100-year floodplains within proposed EELV project locations.

**Concept A ROI.** In the vicinity of SLC-3W, the Lompoc Terrace is cut by Bear Canyon (southwest of SLC-3W) and Lompoc Canyon (east of SLC-3W). No perennial streams or springs exist on the SLC-3W site. Surface water from the site is directed toward Bear Creek Canyon.

**Concept B ROI.** No perennial streams or springs exist on the SLC-6 site. Erosion control ditches are used to direct surface water runoff created during storm events to a small arroyo on the north side of SLC-6. From this arroyo, the water flows toward the ocean and is either absorbed by the ocean or by soil before it reaches the ocean. Cañada Agua Viva is a south-flowing, perennial drainage located east of SLC-6 that is fed by two springs near Wild Horse Flats. Cañada Agua Viva has a watershed area of approximately 1 square mile.

**3.9.2.3 Water Quality.** Groundwater quality in the region meets all National Primary Drinking Water Regulation standards (U.S. Air Force, 1989a). Continued overdraft of the groundwater basins could lead to a degradation in the water table levels and a compaction of the basins. A slight decrease in water quality has been occurring in the region due to the use of water for irrigation. As this water flows through the soil back to the basin, it entrains salts and leads to a buildup of salts in the groundwater (U.S. Air Force, 1989a).

Groundwater monitoring is conducted for basins that are utilized for drinking water. Water in the San Antonio Valley Creek groundwater basin currently exceeds drinking water standards for total dissolved solids (TDS), manganese, and iron. The Lompoc Terrace groundwater contains constituents that exceed maximum contaminant levels (MCLs) for TDS. Groundwater is treated prior to its usage as potable water.

Watersheds are subject to on-base construction and agricultural runoff. San Antonio Creek, Santa Ynez River, and Shuman Canyon Creek also receive off-base agricultural runoff resulting in elevated dissolved solids, phosphates, and nitrates. Surface water is not directly used as a potable water supply at Vandenberg AFB. Ambient water quality sampling is performed by the Air Force.

## 3.10 AIR QUALITY (LOWER ATMOSPHERE)

This section describes air quality resources for the atmosphere at altitudes below 3,000 feet.

### 3.10.1 Federal Regulatory Framework

Air quality for both installations is regulated federally under Title 40 CFR 50 (National Ambient Air Quality Standards [NAAQS]), Title 40 CFR 51 (Implementation Plans), Title 40 CFR 61 and 63 (National Emission Standards for Hazardous Air Pollutants [NESHAPs]), and Title 40 CFR 70 (Operating Permits).

**Title 40 CFR 50 (NAAQS).** This regulation contains the NAAQS for primary and secondary criteria pollutants. The National Primary Ambient Air Quality Standards define the levels of air quality that the U.S. EPA judges as necessary to protect the public health with an adequate margin of safety. The National Secondary Ambient Air Quality Standards define levels of air quality that the U.S. EPA has determined to be necessary to protect the public welfare from any known anticipated adverse effects of a pollutant. There are standards for ozone ($O_3$), carbon monoxide (CO), $NO_2$, sulfur dioxide ($SO_2$), particulate matter equal to or less than 10 microns in diameter ($PM_{10}$), and lead (Pb).

Air quality in a given location is described as the concentration of various pollutants in the atmosphere, generally expressed in units of ppm or micrograms per cubic meter ($\mu g/m^3$), or in a pollution standard index. Air quality is determined by the type and amount of pollutants emitted into the atmosphere, the size and topography of the air basin, and the prevailing meteorological conditions. The significance of a pollutant concentration is determined by comparing it to federal and state ambient air quality standards.

According to U.S. EPA guidelines, an area with air quality better than the NAAQS is designated as being in attainment; areas with worse air quality are classified as nonattainment areas. A nonattainment designation is given to a region if the primary NAAQS for any criteria pollutant is exceeded at any point in the region for more than three days during a 3-year period. Pollutants in an area may be designated as unclassified when there is insufficient data for the U.S. EPA to determine attainment status.

The U.S. EPA is in the process of revising the NAAQS. New standards for ozone and particulate matter were published in the Federal Register on July 18, 1997. The new particulate standards are for particles less than 2.5 microns in diameter ($PM_{2.5}$). The standards are: an annual $PM_{2.5}$ standard of 15 micrograms per cubic meter ($\mu g/m^3$) based on a 3-year average of the arithmetic mean from community-oriented monitors (two monitors per urban area); a 24-hour standard set at 65 $\mu g/m^3$ based on the 3-year average of the $98^{th}$ percentile at each population-oriented monitor (one monitor per 1 million people) within an area; and a 24-hour $PM_{10}$ standard based on the $99^{th}$ percentile of the 24-hour $PM_{10}$ concentrations at each monitor within an area. The new ozone standard is 0.08 ppm, or 158 $\mu g/m^3$, based on the 3-year average of the fourth highest 8-hour average. Additionally, the 1-hour

standard (0.12 ppm, or 235 μg/$m^3$) remains in effect until the area is in attainment.

As the new standards are implemented, areas will be reclassified based on their attainment of the new criteria. The U.S. EPA plans to set up 1,500 new monitors to collect $PM_{2.5}$ data that will result in reclassifications between 2002 and 2004. There is already sufficient data to designate areas for the new ozone standard. However, the Presidential Memorandum publishing the new standards states that the Clean Air Act (CAA) provides up to 3 years for state governors to designate an area according to their most recent air quality and up to 3 additional years to develop and implement a State Implementation Plan (SIP) to provide attainment of the new standard.

The main criteria pollutants considered in this EIS are ozone, CO, $NO_2$, $SO_2$, and $PM_{10}$. Airborne emissions of lead are not addressed in this EIS because there are no known lead emission sources in the regions or proposed for use in any of the EELV alternatives.

Ozone is a secondary pollutant formed in the atmosphere by photochemical reactions of previously emitted pollutants, or precursors. Ozone precursors are mainly nitrogen oxides ($NO_x$) and VOCs. Volatile organic compounds (VOCs) are defined by the U.S. EPA as compounds containing carbon, excluding CO, carbon dioxide ($CO_2$), carbonic acid, metallic carbonates, ammonium carbonate, and organic compounds found not to contribute to ozone-generating reactions. $NO_x$ is the designation given to the group of all oxygenated nitrogen species, including $NO_2$, nitrous oxide ($N_2O$), nitric oxide (NO), nitrogen trioxide ($NO_3$), $N_2O_4$, nitric anhydride ($N_2O_5$), and nitrous anhydride ($N_2O_3$). Although all of these compounds can exist in the air, only $N_2O$, NO, and $NO_2$ are found in appreciable quantities.

Nitrogen dioxide is primarily formed by the conversion of NO to $NO_2$ in the presence of oxygen (either during combustion or in the atmosphere). NO is produced by fuel combustion in both stationary and mobile sources, such as automobiles and aircraft. The amount of production is dependent upon the combustion temperature conditions and the rate of exhaust gas cooling. Higher temperatures and rapid cooling rates produce greater quantities of NO.

Carbon monoxide is formed through several processes, including incomplete fuel combustion. Sulfur dioxide is primarily formed through the combustion of sulfur-containing fuels, such as coal or oil. Particulate emissions are formed from several sources including fuel combustion, material processing, and road dust.

The states will consider activities that produce emissions at Cape Canaveral AS and Vandenberg AFB in developing their emission budgets and SIPs for achievement and maintenance of the NAAQS. The process by which emissions of these attainment pollutants is prevented from creating a nonattainment condition is called Prevention of Significant Deterioration (PSD). This process limits the allowable ambient impact of emissions from new major stationary sources or major modifications to specific increments designed to prevent any substantial degradation of the area's acceptable air quality. However, the PSD process currently applies only to ozone precursors

(VOC and $NO_x$), $NO_2$, $SO_2$, and particulate emissions (not CO), and does not provide a mechanism for dealing with non-stationary sources such as motor vehicles and aircraft.

**Title 40 CFR 51 (Implementation Plans).** This regulation contains the requirements pertaining to implementation plans, which are prepared by state or federal authorities with the goal of meeting the NAAQS.

**Title 40 CFR 51 Part 93 (General Conformity).** This regulation requires federal actions to conform to any SIP approved or promulgated under Section 110 of the CAA. A conformity determination is required for each pollutant resulting from a federal action for which the total of direct and indirect emissions in a nonattainment or maintenance area would equal or exceed de minimis thresholds listed in Title 40 CFR 51.853. The requirements for conformity determinations are detailed in Subpart W. The Air Force has developed an Air Force Air Conformity Guide recommended for use when preparing a conformity applicability analysis and/or Conformity Determination.

**Title 40 CFR 61 and 63 (NESHAPs).** The NESHAPs regulate stationary sources that were constructed or modified after the date of the publication of the regulations. These regulations require a written application for determination by the U.S. EPA of whether the stationary sources meet the regulation requirements. There is a variety of stationary sources specifically identified in the NESHAPs regulations; the standards for these sources are referred to as Maximum Available Control Technology (MACT) standards.

The NESHAPs regulations apply to specific types and sizes of equipment. The only section of the NESHAPs regulations that could apply to this analysis is Title 40 CFR 63 Subpart GG, which applies to facilities that manufacture or rework commercial, civil, or military aerospace vehicles or components and that are major sources of hazardous air pollutants (HAPs). These include cleaning operations, primer and topcoat application operations, depainting operations, chemical milling maskant application operations, and waste storage and handling operations.

Exemptions to this subpart include hazardous wastes that are subject to requirements of RCRA including specialty coatings, adhesives, adhesive bonding primers, or sealants at aerospace facilities; HAP or VOC contents less than 0.1 percent for carcinogens or 1.0 percent for noncarcinogens; and low-volume coatings.

This subpart gives the standards for cleaning operations, primer and topcoat application operations, depainting operations, chemical milling maskant application operations, and waste storage and handling operations. Also listed are the compliance dates and determinations, test methods and procedures, and monitoring, recordkeeping, and reporting requirements.

The owner or operator of an affected source is also subject to sections of Subpart A, including prohibited activities and circumvention (Section 63.4); construction and reconstruction (Section 63.5); and compliance with standards and maintenance requirements (Section 63.6). A startup, shutdown, and malfunction plan for an air pollution control device or equipment to control HAP emissions must be prepared and operated in accordance with Title 40 CFR 63.743(b).

**Title 40 CFR 70 (Operating Permits).** Title V of the Clean Air Act Amendments (CAAA) of 1990 requires all major sources to file an operating permit application. The operating permit incorporates all applicable federal requirements under the CAA affecting the respective sources. A major source is defined as a source that has the potential to (1) emit 100 tons per year of any regulated air pollutant within an area that is in attainment for that pollutant; (2) emit 10 tons per year of any one of the 189 HAPs; or (3) emit 25 tons per year of total HAPs. If the source is in a nonattainment area for a pollutant, the major source thresholds can be lower. For example, if the source is in a zone designated as a "serious" nonattainment area for ozone, the major source threshold for ozone precursors ($NO_x$ and VOCs) is 50 tons per year rather than 100 tons per year.

On August 2, 1996, the U.S. EPA issued the memorandum *Major Source Determinations for Military Installations under the Air Toxics, New Source Review, and Title V Operating Permit Programs of the Clean Air Act.* This memorandum recommends procedures to divide military installations into sections when determining whether Title V and other air programs apply. For example, activities under the control of different military services can be considered to be in separate facilities.

Because potential emissions are above major source thresholds, Cape Canaveral AS is currently a major source with respect to Title 40 CFR 70 regulations. The Title V Operating Permit application has been submitted to the FDEP and is under review. This application treats Cape Canaveral AS as a single major facility. The station can continue operations until the review is complete.

Vandenberg AFB has entered into an agreement with the U.S. EPA as part of the Environmental Investment (ENVVEST) program. This program is designed to allow operational flexibility in reducing emissions and complying with environmental regulations. The program is the result of a November 1995 Memorandum of Agreement between DoD and the U.S. EPA on Regulatory Reinvention Pilot Projects (Project XL). On September 8, 1997, the proposed Project XL Final Project Agreement for Vandenberg AFB was published in the Federal Register.

As part of the ENVVEST program, Vandenberg AFB is being exempted from the requirements of Title 40 CFR 70. Instead, Vandenberg AFB has facility-specific operational and reporting requirements. Vandenberg AFB has committed to implementing "a phased program to reduce annual emissions of ozone precursors by at least 10 tons by November 30, 2002." This is expected to be accomplished through the reduction of emissions from boilers, furnaces, and process heaters.

Vandenberg AFB has prepared a final draft Major Source Determination, which reviewed the stationary source air emissions and used the EPA's Major Source Guidance for military installations to determine where the emissions were coming from and under whose control (Standard Industrial Classification [SIC] Code) the emissions fall. Following the inventory and assessment, the Santa Barbara County Air Pollution Control District (SBCAPCD) and Vandenberg AFB determined that the base would be divided into separate source designations and the SBCACPD would implement a new rule capturing this decision. This rule, Rule 1301, was issued September 18, 1997. Currently, the stationary source designations are: Air Force Primary Mission, Remediation, NASA, Flight Line, Navy, Range Group, Amenities Group, Hospital Services, and Commercial Space.

**Title 40 CFR 82 (Protection of Stratospheric Ozone).** This regulation seeks to prevent damage to the ozone layer by Class I and Class II Ozone-Depleting Substances (ODSs) and contains subparts addressing production and consumption controls, servicing of motor vehicle air conditioners, bans on nonessential products, federal procurement, recycling and emissions reduction, and alternative compounds. The regulations relating to federal procurement state that safe alternatives to Class I and Class II ODSs shall be substituted to the maximum extent practicable. The regulations additionally require contractors to ensure compliance with Title 40 CFR 82 regulations, proper labeling, and reporting of the use of ODSs.

### 3.10.2 Cape Canaveral AS

**3.10.2.1 Florida Regulatory Framework.** Air quality for the Cape Canaveral AS area is regulated under FAC 62-200 et seq. Specific regulations that may be applicable to EELV activities include FAC 62-204.240 (Ambient Air Quality Standards), FAC 62-210 (Stationary Source General Requirements), FAC 62-212 (Stationary Source Preconstruction Permitting), FAC 62-213 (Operating Permits), and FAC 62-242 (Mobile Sources).

**FAC 62-204.240 (Ambient Air Quality Standards).** This rule lists the ambient air quality standards for Florida (Table 3.10-1). The Florida Ambient Air Quality Standards (FAAQS) are not significantly different from the NAAQS.

**FAC 62-210 (Stationary Source General Requirements).** This rule establishes general requirements for stationary sources of air pollutant emissions and provides criteria for determining the need to obtain an air construction or air operation permit. It establishes public notice and reporting requirements and

**Table 3.10-1. National and Florida Ambient Air Quality Standards**

| Pollutant | Averaging Time | Florida Standards[a, b] ($\mu g/m^3$) | National Standards ($\mu g/m^3$) [c] | |
|---|---|---|---|---|
| | | | Primary [d] | Secondary [e] |
| Ozone | 1 Hour | 235 | 235 | 235 |
| Carbon Monoxide | 8 Hours | 10,000 | 10,000 | ---- |
| | 1 Hour | 40,000 | 40,000 | ---- |
| Nitrogen Dioxide | Annual | 100 | 100 [f] | Same as primary standard |
| Sulfur Dioxide | Annual | 60 | 80 | ---- |
| | 24 Hours | 260 | 365 | ---- |
| | 3 Hours | 1,300 | ---- | 1,300 |
| $PM_{10}$ | Annual | 50 | 50 [f] | Same as primary standard |
| | 24 Hours | 150 | 150 | Same as primary standard |
| Lead | Quarterly | 1.5 | 1.5 | Same as primary standard |

Notes:
(a) Florida standards for ozone, carbon monoxide, sulfur dioxide, nitrogen dioxide and $PM_{10}$ are values that are not to be exceeded. The lead value is not to be equaled or exceeded.
(b) Values for standards are based on a reference temperature of 25 degrees Celsius (°C) and a reference pressure of 760 millimeters (mm) of mercury. All measurements of air quality are to be corrected to a reference temperature of 25°C and a reference pressure of 760 mm of mercury (1,013.2 millibars).
(c) National standards other than ozone and those based on annual averages or annual arithmetic means are not to be exceeded more than once a year. The ozone standard is attained when the expected number of days per calendar year, with maximum hourly average concentrations above the standards, is equal to or less than one. The lead and annual sulfur dioxide standards are not to be exceeded in a calendar year.
(d) National Primary Standards: The levels of air quality necessary to provide an adequate margin of safety to ensure protection of the public health.
(e) National Secondary Standards: The levels of air quality necessary to provide that the public welfare is safe from any known or anticipated adverse effects of pollutant.
(f) Calculated as arithmetic mean.

$\mu g/m^3$ = micrograms per cubic meter
$PM_{10}$ = particulate matter equal to or less than 10 microns in diameter

Source: Title 40 Code of Federal Regulations 50 and Florida Administrative Code 62-204.240

requirements relating to estimating emission rates and using air quality models. This chapter also sets forth special provisions related to compliance monitoring, stack heights, circumvention of pollution control equipment, and excess emissions.

**FAC 62-212 (Stationary Source Preconstruction Permitting).** The preconstruction review requirements for proposed new emissions units or facilities and proposed modifications are established in this rule. The requirements of this chapter apply to those proposed activities for which an air construction permit is required. This chapter includes general preconstruction review requirements and specific requirements for emissions units subject to PSD and nonattainment area preconstruction review. It also includes preconstruction review requirements applicable to specific emissions unit types.

**FAC 62-213 (Operating Permits).** This rule implements federal rule Title 40 CFR 70, which provides a comprehensive operation permit system for permitting major sources of air pollution (Title V sources). The amount and schedule of payment of the annual emissions fee are provided. For facilities

operating under the terms of Title V air general permits, applicability, general procedures and conditions, and local air program requirements are explained. Also provided are permit requirements for all Title V sources, changes allowed at a source without necessitating a permit revision, allowable trading of emissions within a source, permit application compliance, permit issuance, renewal and revision, and permit review by the U.S. EPA and any affected states.

Because potential emissions are above major source thresholds, Cape Canaveral AS is currently a major source with respect to FAC 62-213 regulations. The Title V Operating Permit application has been submitted to the FDEP and is under review.

**3.10.2.2 Meteorology.** Cape Canaveral AS is on the northern portion of a barrier island on the Atlantic Ocean, situated midway up the Florida peninsula (28.5°N latitude). The climate at Cape Canaveral AS is best characterized as maritime-tropical with long, relatively humid summers and mild winters. This barrier island experiences moderate seasonal and daily temperature variations. Average annual temperature is 71°F with a minimum monthly average of 60°F in January and a maximum of 81°F in July. During the summer, the average daily humidity range is 70 to 90 percent. The winter is drier with humidity ranges of 55 to 65 percent; frosts are quite rare. Despite average drier conditions during the winter, most occurrences of fog (54 days of the year) occur during the winter and are associated with the passage of weather fronts.

The seasonal wind pattern is reflected in the speed and direction statistics presented in Table 3.10-2. During the winter, the prevailing winds steered by the jet stream aloft are frequently from the north and west, and the land-sea temperature diminishes, resulting in fewer easterly sea breezes that counter the prevailing westerly winds. As the jet stream retreats northward during the spring, the prevailing winds shift and come out of the south. During the summer and early fall, as the land-sea temperature difference increases and the Bermuda high-pressure region strengthens, the winds originate predominantly from the south and east.

Under normal midday weather conditions, surface mixing occurs over a layer with an average daily maximum value of 2,300 to 2,950 feet during the winter and 3,900 to 4,600 feet during the summer. The mixed layer is rarely capped by a strong temperature inversion. At the surface, easterly sea breezes with moderate speeds (5 to 10 miles per hour [mph]) and depths on the order of 500 to 1,000 feet occur nearly every day during the summer and early fall. Aloft, the prevailing winds are more westerly and northerly during the winter due to the southward migration of the jet stream.

**Table 3.10-2. Climatological Data, Kennedy Space Center**

| Month | Surface Winds: Prevailing Direction | Surface Winds: Mean Speed (mph) | Mean Number of Days Occurrence: Precipitation (inches) [a] $0.01 | Precipitation (inches) [a] $0.5 | Thunder-storms | Fog Visibility <2 miles |
|---|---|---|---|---|---|---|
| January | NNW | 8 | 7 | 2 | 1 | 9 |
| February | N | 8 | 7 | 2 | 2 | 7 |
| March | SSE | 8 | 8 | 2 | 3 | 7 |
| April | E | 9 | 5 | 1 | 3 | 4 |
| May | E | 8 | 8 | 2 | 8 | 3 |
| June | E | 7 | 12 | 3 | 13 | 2 |
| July | S | 6 | 11 | 4 | 16 | 2 |
| August | E | 6 | 11 | 3 | 14 | 2 |
| September | E | 6 | 13 | 4 | 10 | 2 |
| October | E | 8 | 11 | 3 | 4 | 3 |
| November | N | 7 | 7 | 2 | 1 | 6 |
| December | NW | 8 | 8 | 1 | 1 | 7 |
| Annual | E | 7 | 108 | 29 | 76 | 54 |
| Years of Record | 10 | 10 | 26 | 26 | 26 | 26 |

Note: (a) Snowfall has not occurred in 26 years.
E = east
mph = miles per hour
N = north
NNW = north northwest
NW = northwest
S = south
SSE = south southeast

Source: U.S. Air Force, 1991e

Most periods of high winds and heavy rainfall occur during thunderstorms, which develop mainly from May through September (see Table 3.10-2). The Cape Canaveral AS region has the highest number of thunderstorms in the world during the summer months. On the average, there are thunderstorms on 76 out of 180 days. Over 70 percent of the annual 48 inches of rain occurs during the summer. During thunderstorms, wind gusts of more than 60 mph and rainfall of over 1 inch often occur in a one-hour period. Numerous lightning strikes to the ground occur (1,400 strikes per month over the 135-square-mile region surrounding Cape Canaveral). During such weather, flight activities at Cape Canaveral AS are often suspended. Hurricanes can also occur, normally between August and October. Landfall for hurricanes is relatively infrequent. Flight activities are suspended during hurricanes.

**3.10.2.3 Regional Air Quality.** Existing air quality is defined by air quality data and emissions information. Air quality data are obtained by examining records from air quality monitoring stations maintained by the FDEP. Information on pollutant concentrations measured for short-term (24 hours or less) and long-term (annual) averaging periods is extracted from the monitoring station data in order to characterize the existing air quality background of the area.

The FDEP classifies areas of the state that are in attainment or nonattainment of the FAAQS. In Florida, regional air quality is assessed at the county level. Cape Canaveral AS is in Brevard County (Figure 3.10-1),

which has been designated by both the U.S. EPA and the FDEP to be in attainment for ozone $SO_2$, $NO_x$, CO, and $PM_{10}$. As discussed in Section 3.10.1, the NAAQS are being revised; these revisions may affect the attainment status of Brevard County.

The ROI for lower-atmosphere air quality resources may extend beyond the project boundaries (i.e., the launch complexes and other construction areas) to include those areas significantly affected by air dispersion and/or commuter traffic. This could include an area as large as the regional air quality basin (Brevard County) and may affect the maintenance of the NAAQS and the FAAQS for Brevard County.

Ambient air quality is measured at weather stations throughout Florida. The nearest weather station to Cape Canaveral AS, at the KSC, measures ozone $NO_2$, $SO_2$, $PM_{10}$, and CO. The nearest weather station that monitors lead level concentrations is the Orlando station in Orange County. Table 3.10-3 shows available 1995 hourly average ambient air concentrations for criteria pollutants.

**Table 3.10-3. 1995 Average Ambient Air Concentrations for Criteria Pollutants Near Cape Canaveral AS**

| Pollutant | Averaging Time | Concentration ($\mu g/m^3$) |
|---|---|---|
| $O_3$ | Hourly | 57.4 |
| $NO_x$ | Hourly | 11.4 |
| | Yearly | 1.4 |
| $SO_2$ | 3 Hours | 19.4 |
| | 24 Hours | 5.8 |
| $PM_{10}$ | Hourly | 15.0 |
| Pb | Hourly | 0.0 |
| CO | Hourly | 4,230 |
| | 8 Hours | 2,640 |

CO = carbon monoxide
$\mu g/m^3$ = micrograms per cubic meter (approximate, converted from parts per million)
$NO_x$ = nitrogen oxides
$O_3$ = ozone
Pb = lead
$PM_{10}$ = particulate matter equal to or less than 10 microns in diameter
$SO_2$ = sulfur dioxide

Figure 3.10-1 Air Quality Region of Influence, Cape Canaveral AS

In addition to regional impacts, emissions from specific sources can impact local air quality. If a specific source emits high levels of a pollutant, it can significantly increase the concentration of that pollutant in the vicinity of the source. Sources of criteria pollutants and sources of HAPs can have local air quality impacts.

**3.10.2.4 Air Emissions.** Emission inventory information for the affected environment was obtained from the FDEP and from Cape Canaveral AS. Inventory data for each pollutant are reported in tons per year in order to describe the baseline conditions of pollutant emissions in the area.

In July 1996, an Air Emissions Inventory report was completed for Cape Canaveral AS for calendar year 1994 (Radian International, 1996). This report lists emissions from all stationary sources at Cape Canaveral AS (Table 3.10-4), as well as from other activities, such as the generation of road dust.

**Table 3.10-4. Cape Canaveral AS Baseline Emissions[(a)]**

| | VOC | $NO_x$ | CO | $SO_2$ | $PM_{10}$ |
|---|---|---|---|---|---|
| Existing Launch Program | | | | | |
| Vehicle Launches | 0.0 | 13.3 | 0.0 | 0.0 | 144.1 |
| Vehicle Preparation, Assembly, and Fueling | 14.9 | 0.0 | 0.0 | 0.0 | 5.0 |
| Mobile Sources | 37.6 | 63.6 | 311.3 | 2.9 | 128.6 |
| Point Sources | 1.0 | 22.9 | 6.2 | 17.7 | 1.0 |
| Total | 53.6 | 99.8 | 317.5 | 20.6 | 278.6 |
| Cape Canaveral AS 1994 Air Emissions Inventory Report[(b)] | 104.4 | 382.9 | 274.5 | 102.6 | 75.5 |
| Brevard County Point Source | 107 | 11,514 | 991 | 26,492 | 340 |
| Brevard County Area Source | 24,876 | 14,608 | 13,3752 | 1,032 | 34,750 |
| Brevard County Total | 24,983 | 26,122 | 13,4743 | 27,524 | 35,090 |

Note: (a) All emissions in tons per year for 1995 unless otherwise indicated.
(b) Includes stationary source emissions only.
AS = Air Station
CO = carbon monoxide
$NO_x$ = nitrogen oxides
$PM_{10}$ = particulate matter equal to or less than 10 microns in diameter
$SO_2$ = sulfur dioxide
VOC = volatile organic compound

A baseline launch emissions inventory has been generated for the applicable launch activities in 1995. The baseline emissions included in this inventory are specifically for the current launch vehicle systems (Atlas II, Delta II, and Titan IV), and associated support activities. This inventory includes estimates of emissions from the following key sources:

- Vehicle launch
- Vehicle preparation, assembly, and fueling
- Mobile sources such as support equipment, commercial transport vehicles (including trucks and aircraft), and personal vehicles
- Point sources such as heating/power plants, generators, incinerators, and storage tanks.

Estimates are divided into two categories: emissions that are directly launch-related and infrastructure emissions. Launch-related emissions are estimated on a pounds-per-launch basis. Infrastructure emissions are estimated on a pounds-per-day basis and are assumed to take place regardless of the number of launches per year. Emission comparisons are summarized in Table 3.10-4 for criteria pollutants. Emissions from each of the key sources are calculated as described below.

**Vehicle Launch.** Table 3.10-5 lists expendable vehicle launches from Cape Canaveral AS in 1995. Actual launch emissions are estimated using kinetics and flowfield models as described below. Emissions predicted to be below 3,000 feet in altitude are included in the inventory totals. Emissions at altitudes above 3,000 feet are addressed in Section 3.11, Air Quality (Upper Atmosphere). Emissions are addressed only for those vehicles that would be replaced by EELV launches (Atlas II, Delta II, Titan IV).

**Table 3.10-5. 1995 Launches, Cape Canaveral AS**

| Date | Vehicle | Launch Complex |
|---|---|---|
| January 10 | Atlas IIAS | SLC-36B |
| January 28 | Atlas IIA | SLC-36A |
| March 22 | Atlas IIAS | SLC-36B |
| April 8 | Atlas IIA | SLC-36 |
| May 14 | Titan IV | SLC-40 |
| May 23 | Atlas I | SLC-36B |
| May 31 | Atlas IIA | SLC-36A |
| July 10 | Titan IV | SLC-41 |
| July 31 | Atlas II | SLC-36A |
| August 5 | Delta II | SLC-17 |
| August 28 | Atlas IIAS | SLC-36B |
| October 22 | Atlas II | SLC-36A |
| November 6 | Titan IV | SLC-40 |
| December 2 | Atlas IIAS | SLC-36B |
| December 15 | Atlas IIA | SLC-36A |
| December 30 | Delta II | SLC-17A |

SLC = Space Launch Complex

A standard Two-Dimensional Kinetics (TDK) Nozzle Performance Computer Model (version 1993) models the engine performance to provide information on the mass flux out of the engine. The Standardized Plume Flowfield Model (SPF-3) is used to model after-burning to provide mass fractions of chemical products such as $NO_x$, carbon, and chlorine compounds found in some fuels as a function of atmospheric density and temperature.

Emission estimates were made using the launch trajectory information for LEO and geosynchronous orbit missions. The fraction of each propellant emitted below 3,000 feet, along with the height-dependent mass fractions from SPF-3, are used to estimate the emissions. Information on mission trajectory for each launch in Table 3.10-5 was not available, so an equal split between the two trajectories was assumed for each launch vehicle.

The emissions shown in Table 3.10-4 are totals for emissions from the selected 1995 launch vehicles. These data are useful for estimating the effect of these launches on regional air quality. In addition, the launches can impact local air quality by causing a short-term increase in pollutant concentrations near the launch site. These impacts are best addressed on a per-launch basis for each vehicle type. The relevant comparisons are presented in the analysis within Section 4.10.

**Vehicle Preparation, Assembly, and Fueling.** For the 15 launches included in the 1995 baseline, most of the preparation and assembly operations took place at Cape Canaveral AS. However, the majority of these activities do not produce air emissions. Emissions are estimated for solvent cleaning and sanding activities, which produce VOC and particulate emissions, respectively. Payload processing is not included in the vehicle preparation emissions estimates, as it is considered separate from the vehicle preparation activities.

For years prior to the baseline emissions year (1995), the rocket engines for each vehicle were sometimes flushed with chlorinated solvent (notably TCE). By 1995, efforts to replace the use of chlorinated solvents had progressed to the point where little or no chlorinated solvent was used for rocket engine cleaning.

ODSs are used for refrigeration, fire suppression, and some degreasing operations. Some emissions can occur from leakage from refrigeration and fire suppression systems as well as from evaporation during cleaning and degreasing. Total ODS emissions associated with the Atlas, Delta, and Titan operations are estimated to be 192 pounds for 1995 Cape Canaveral AS operations.

Fueling of hydrogen involves some venting of hydrogen through a flare. Each flare uses propane as auxiliary fuel. Emissions of combustion products from the hydrogen control flares are estimated using EPA AP-42 standard factors for external combustion; these emissions are very minor.
Emissions from RP-1 storage and fueling are estimated using U.S. EPA AP-42 emission factors. Estimates are made for working emissions, caused by filling and emptying the storage tanks, and breathing emissions, caused by daily warming and cooling of the tanks in the sunlight. Because RP-1 is not a very volatile fuel, emissions from RP-1 storage tanks are very small.

Emissions from hydrazine and $N_2O_4$ loading are controlled by a combination of sealed transfer systems, wet scrubbing, and oxidation. Emissions of hydrazine are listed as HAP emissions, discussed below. Emissions of $N_2O_4$ (a form of $NO_x$) are insignificant compared to other sources of nitrogen oxides.

After vehicle launch, the SLC must be cleaned and repaired. Surfaces are cleaned using an abrasive blaster; ablative coatings are applied, and painted surfaces are touched up or repainted. Particulate emissions from sandblasting are estimated based on estimated use and a particulate emission factor. VOC emissions from coatings are obtained from coating use quantity estimates.

**Mobile Sources.** Mobile emission sources include:

- Vehicle Deliveries and Miscellaneous Supply Traffic
- Vehicle Assembly and On-Site Transport
- Personal Automobile Use.

Vehicle Deliveries and Miscellaneous Supply Traffic

The Atlas, Delta, and Titan vehicle components were delivered by truck and airplane. Truck emissions are calculated using pounds of emissions per Vehicle Miles Traveled (VMT) for both on- and off-site trips. Emission factors are taken from the MOBILE 5a and PART5 computer models. Emissions from required escort cars for oversize loads are calculated similarly.

Because the ROI for Cape Canaveral AS includes all of Brevard County, transportation emissions are calculated for all vehicular traffic directly related to EELV activities that take place in Brevard County.

Deliveries made by truck are assumed to involve round-trip traffic to and from the northern county line (50 percent) or the southern county line (50 percent). It is assumed that travel would occur along Interstate 95 occurs.

Portions of the Atlas, Delta, and Titan vehicles are delivered by airplane. The Delta deliveries are made using a C-141 aircraft. Emissions from the C-141 aircraft associated with landing and take-off are calculated using the factors available in the computer model Emissions and Dispersion Modeling System (EDMS), Version 3.0. The Titan deliveries are made using a C-5 Galaxy aircraft. Emissions from the C-5 aircraft associated with landing and take-off and emissions of particulate matter are calculated using the factors available in the Calculation Methods for Criteria Air Pollutant Emission Inventories (Jagielski and O'Brien, 1994).

Vehicle Assembly and On-Site Transport

Assembly of vehicle components and on-site transport of the vehicle create emissions from mobile sources, several of which are standard vehicles (trucks, etc.). Emissions from these sources are estimated using VMT and the emission factors available in the MOBILE 5a and PART5 computer models.

Other mobile sources (cranes, specialized transport vehicles) are not standard and therefore have no associated standard emission factors. Emissions from these vehicles are calculated using hours of operation, rated capacity (in horsepower), and the stationary source AP-42 emission factors for the appropriate engine types. Pollutant activities from these sources are relatively minor, and general estimates are used where specific data are not available.

Personal Automobile Use

Emissions from employee personal automobile use are calculated based on both on- and off-site emissions. Based on studies conducted for this EIS, employees' places of residence were identified and commuting distances calculated from the center of their resident cities to Cape Canaveral AS. Non-work trip VMT are also included in the total off-site VMT. The average vehicle ridership number is applied to VMT calculations. Emissions are calculated using VMT and the emission factors available in the MOBILE 5a and PART5 computer models. A surge in automobile traffic prior to launch, associated with pre-launch processing activities, is accounted for in the calculations.

**Point Sources.** Point sources include combustion sources, such as boilers and internal combustion engines. Emissions from other point sources such as spray booths and solvent cleaning equipment are included in the total emission calculations for vehicle preparation and assembly. Emissions from boilers and internal combustion engines are listed in the July 1996 Air Emissions Inventory report for Cape Canaveral AS (Radian International, 1996). The emissions from these sources are attributed to the Atlas, Delta, and Titan programs for use in this baseline emissions inventory.

**Hazardous Air Pollutants.** Emissions of HAPs have been quantified from emission sources addressed in the criteria pollutant section of this analysis. In quantifying emissions, HAP emissions can occur from three separate activities:

- Vehicle Launch (chlorine compounds)
- Fuel Loading (hydrazine)
- VOC solvent and coating usage (VOC HAPs such as toluene and methyl ethyl ketone).

Emissions of chemically active chlorine compounds ($Cl_x$) from vehicle launch are estimated using the TDK and SPF-3 models. These emissions include hydrochloric acid (HCl), chlorine (Cl), and other chemically active compounds; chemically inactive compounds such as aluminum chlorides are treated as particulate matter (PM). Hydrazine emissions from fuel loading are estimated based on an estimated percentage loss during fueling and an estimated control efficiency for the wet scrubber/oxidizer vapor control systems. Emissions of VOC HAPs from solvent and coating usage are conservatively assumed to be 100 percent of the VOC emissions from these sources. Baseline emissions of HAPs for Cape Canaveral AS are summarized in Table 3.10-6.

**Table 3.10-6. Cape Canaveral AS Baseline HAPs Emissions[(a)]**

| | $Cl_x$ | Hydrazine fuels | VOC HAP |
|---|---|---|---|
| Vehicle Launches | 72.3 | 0.0 | 0.0 |
| Vehicle Fueling | 0.0 | <0.01 | <0.01 |
| Vehicle Coating/Solvent Use | 0.0 | 0.0 | 14.9 |
| Project Total | 72.3 | <0.01 | 14.9 |

Note: (a) All emissions in tons per year for 1995
$Cl_x$ = chlorine compounds
HAP = hazardous air pollutant
VOC = volatile organic compound

### 3.10.3 Vandenberg AFB

**3.10.3.1 California Regulatory Framework.** Air quality for the Vandenberg AFB area is regulated under the California Code of Regulations (CCR), Title 17, Division 3, Chapter 1. Specific regulations of interest include CCR 17-Section 70200 (Ambient Air Quality Standards), and CCR 17-Section 93000 et seq. (Toxic Air Contaminants). Vandenberg AFB is also regulated by the SBCAPCD. Specific regulations of interest include Regulation II (Permits), Regulation X (NESHAPs), and Regulation XIII (Operating Permits).

**CCR 17-Section 70200. California Ambient Air Quality Standards (CAAQS).** The California Air Resources Board (CARB) has developed ambient air quality standards (Table 3.10-7), which represent the maximum allowable atmospheric concentrations that may occur and still ensure protection to public health and welfare with a reasonable margin of safety.

**Table 3.10-7. National and California Ambient Air Quality Standards**

| Pollutant | Averaging Time | California Standards[a,c] ($\mu g/m^3$) | National Standards ($\mu g/m^3$)[b] Primary[d] | Secondary[e] |
|---|---|---|---|---|
| Ozone | 1 Hour | 180 | 235 | Same as primary standard |
| Carbon Monoxide | 8 Hours | 10,000 | 10,000 | ---- |
| Nitrogen Dioxide | 1 Hour | 23,000 | 40,000 | Same as primary standard |
| | Annual | ---- | 100 [g] | |
| Sulfur Dioxide | 1 Hour | 470 | | ---- |
| | Annual | ---- | 80 | ---- |
| | 24 Hours | 1050 | 365 | ---- |
| | 3 Hours | ---- | ---- | 0.5 ppm (1,300 $\mu g/m^3$) |
| $PM_{10}$ | 1 Hour | 655 | ---- | ---- |
| | Annual | 30 [f] | 50 [g] | Same as primary standard |
| Sulfates | 24 Hours | 50 | 150 | Same as primary standard |
| Lead | 24 Hours | 25 | ---- | ---- |
| | 30 Days | 1.5 | ---- | ---- |
| | Quarterly | ---- | 1.5 | Same as primary standard |
| Hydrogen Sulfide | 1 Hour | 42 | ---- | ---- |
| Vinyl Chloride | 24 Hours | 26 | ---- | ---- |
| Visibility-Reducing Particles[h] | 8 Hours (10 a.m. to 6 p.m., Pacific Standard Time) | In a sufficient amount to produce an extinction coefficient of 0.23 per km due to particles when the relative humidity is less than 70 percent CARB Method V. | | |

Notes:
(a) California standards for ozone, carbon monoxide, sulfur dioxide (1 hour and 24 hours), nitrogen dioxide, particulate matter less than 10 microns in diameter ($PM_{10}$), and visibility-reducing particles are values that are not to be exceeded. The sulfates, lead, hydrogen sulfide, and vinyl chloride standards are not to be equaled or exceeded.
(b) National standards other than ozone and those based on annual averages or annual arithmetic means are not to be exceeded more than once a year. The ozone standard is attained when the expected number of days per calendar year, with maximum hourly average concentrations above the standards, is equal to or less than one.
(c) Values for standards are based on a reference temperature of 25 degrees Celsius (°C) and a reference pressure of 760 millimeters (mm) of mercury. All measurements of air quality are to be corrected to a reference temperature of 25°C and a reference pressure of 760 mm of mercury (1,013.2 millibars).
(d) National Primary Standards: the levels of air quality necessary to provide an adequate margin of safety to ensure protection of the public health.
(e) National Secondary Standards: the levels of air quality necessary to provide that the public welfare is safe from any known or anticipated adverse effects of pollutant.
(f) Calculated as geometric mean.
(g) Calculated as arithmetic mean.
(h) This standard is intended to limit the frequency and severity of visibility impairment due to regional haze and is equivalent to a 10-mile nominal visual range when relative humidity is less than 70 percent.

CARB = California Air Resources Board
km = kilometer
$\mu g/m^3$ = micrograms per cubic meter
$PM_{10}$ = particulate matter equal to or less than 10 microns in diameter
ppm = parts per million

Source: California Air Resources Board, 1992

**CCR 17-93000 et seq. (Toxic Air Contaminants).** Subchapter 7 of this regulation defines toxic air pollutants as well as HAPs (including hydrazine fuel). Subchapter 7.5 contains requirements for air toxics control measures; these requirements are industry-specific. Subchapter 7.6 (CCR 17-93300)

incorporates by reference Health and Safety Code sections 44300-44394 (Part 6), which codify the requirements of the Air Toxics "Hot Spots" Information and Assessment Act of 1987.

Changes to the use of toxic and hazardous air pollutants on site may require the submission of an Air Toxic "Hot Spots" Questionnaire. The SBCAPCD may require Vandenberg AFB to file or update its AB-2588 toxic plan. In addition, Part 6 Chapter 3 (Section 44340) of the Air Toxics "Hot Spots" Information and Assessment regulations requires preparation and submission of a comprehensive emissions inventory plan.

**SBCAPCD Regulations, Regulation II - Permits.** This regulation requires that any person building, erecting, altering, or replacing any article, machine, equipment, or other contrivance, the use of which may cause the issuance of air contaminants, or the use of which may eliminate or reduce or control the issuance of air contaminants, shall first obtain authorization for such construction from the Control Officer in the form of an Authority to Construct Permit. This permit shall remain in effect until the permit to operate the equipment for which a permit application was filed is granted or denied or the application is canceled. The facility must have a permit to operate before equipment may be operated or used; a written permit shall be obtained from the Control Officer. The application must include information or analysis that will disclose the nature, extent, quantity, or degree of air contaminants the source may discharge. An application may also be necessary for equipment that is modified.

In 1991, a Memorandum of Agreement (MOA) between the Air Force and the SBCAPCD designated Vandenberg AFB as a single stationary source. Under this MOA, new or modified sources would require Best Available Control Technology (BACT) and offsetting reduction of emissions elsewhere on base if emissions are increased at SLC-3W. Recent changes to the SBCAPCD regulations are affecting the regulatory framework for Vandenberg AFB, and the 1991 MOA may no longer be applicable.

**Santa Barbara County Air Pollution Control District Regulation VII.702 (General Conformity).** In October 1994, the SBCAPCD adopted Rule 702, taken verbatim from Subpart W, except for Section 51.860 (mitigation measures), in order to address General Conformity.

**Santa Barbara County Air Pollution Control District Regulations Regulation X (National Emission Standards for Hazardous Air Pollutants).** This regulation incorporates the federal regulation for NESHAPs (Title 40 CFR 61 and 63) and provisions recently promulgated by the U.S. EPA as published in the Federal Register.

SBCAPCD Regulation X incorporates the federal NESHAPs regulations, including 40 CFR 63 Subpart GG (National Emission Standards for Aerospace Manufacturing and Rework Facilities).

**Santa Barbara County Air Pollution Control District Regulations, Regulation XIII (Operating Permits).** This regulation incorporates the federal regulation for Operating Permits under Title 40 CFR Part 70, which states that federally enforceable requirements include, but are not limited to, New Source

Performance Standards (NSPS), PSD, New Source Review (NSR), NESHAPs, NAAQS, Maximum Available Control Technology (MACT) Standards, Title III Section 112, Title IV (Acid Deposition Control), and Title VI (Stratospheric Ozone Protection).

As discussed in Section 3.10.1, Vandenberg AFB has entered into an agreement with the U.S. EPA and SBCAPCD as part of the ENVVEST program. As part of this program, Vandenberg AFB has been exempted from the requirements of Title 40 CFR 70 and therefore from SBCAPCD Regulation XIII. Instead, Vandenberg AFB has facility-specific operational and reporting requirements.

**3.10.3.2 Meteorology.** Vandenberg AFB is situated on Point Arguello on the California coast in the western portion of Santa Barbara County. The climate is categorized as Mediterranean, or dry and subtropical. The coastal location of Vandenberg AFB experiences moderate seasonal and diurnal variation in temperature and humidity. Temperatures are mild, ranging from 45 degrees (°) Fahrenheit (F) to 85°F with an annual mean temperature of 55°F. Temperatures below freezing and above 100°F are rare. The rainy season extends from November to April. Annual precipitation is 13 inches with the most rain falling during February (2.6 inches) and the least during July (0.01 inch). The annual relative humidity is 77 percent. The driest periods occur during the fall, when Santa Ana winds can result in humidity as low as 10 percent.

The Point Arguello region consists of moderately complex terrain consisting of steep hills and valleys. Because of its terrain and the fact that it is bounded by the ocean on two sides, there is a geographically variable wind field at the surface. The mean annual wind speed in the area is 7 mph out of the northwest. The strongest winds occur during the winter and midday, and at ridge lines. Over half the time, the wind blows at speeds greater than 7 mph at the base. Calms are rare (less than 1 percent), and the lowest wind speeds occur during the evening and early morning hours. Easterly winds occur very infrequently and generally occur during the fall, when Santa Ana winds may invade the region for a day or two.

The diurnal weather pattern in the area is characterized by nighttime and early-morning low cloud cover and coastal fog. Cloud cover occurs almost half of the time. The fog burns off by mid-morning and is replaced by a sea breeze as the land begins to warm. Sea breezes are less frequent during the winter. The average visibility is the worst during July through September due to the occurrence of fog. During the winter, storms and fronts move through the area, resulting in gusty and rainy conditions. Thunderstorms are relatively infrequent, occurring two or three times each year.

The average annual ceiling height for the cloud cover is approximately 1,000 feet, but often depends on the height of the base of a capping inversion layer. The entire south-central coastal region experiences a persistent subsidence inversion due to a Pacific high-pressure region. The temperature inversion occurs below the 4,500-foot level and caps the planetary boundary layer, effectively disconnecting it from the free tropospheric air masses. The average maximum daily inversion height over

Point Arguello ranges from 1,600 feet during the summer to 2,800 feet during the winter (Holzworth, 1964).

**3.10.3.3 Regional Air Quality.** Information on how existing air quality is defined is provided in Section 3.10.2.2.

The CARB classifies areas of the state that are in attainment or nonattainment of the CAAQS. In California, air quality is assessed on a county and regional basis. Vandenberg AFB is in Santa Barbara County, which is part of the South Central Coast Air Basin (SCCAB) (Figure 3.10-2). The SCCAB includes the counties of San Luis Obispo, Santa Barbara, and Ventura and has been designated by both the U.S. EPA and CARB as being in attainment of the NAAQS and CAAQS for $SO_2$, $NO_x$, and CO, but as in nonattainment for ozone. Vandenberg AFB has been designated by the U.S. EPA to be unclassified for $PM_{10}$ but has been designated by CARB to be in nonattainment of CAAQS for $PM_{10}$.

The U.S. EPA uses two categories to designate areas with respect to $PM_{10}$. These designations are nonattainment (areas that do not meet national standards) and unclassified (areas that cannot be classified). The levels for state and national $PM_{10}$ standards may differ. For Santa Barbara County, the state $PM_{10}$ 24-hour standard is 50 $\mu g/m^3$. The national $PM_{10}$ 24-hour standard is 150 $\mu g/m^3$. Vandenberg AFB is designated as in non-attainment with the state $PM_{10}$ standard only.

According to the federal classification, the SCCAB is designated as being in the “moderate” ozone nonattainment category (ozone concentrations between 0.138 to 0.160 ppm). An area designated as “moderate” is subject to a number of requirements.

Figure 3.10-2. Air Quality Region of Influence, Vandenberg AFB

On September 2, 1997, the Federal Register published the EPA's proposed reclassification (Title 40 CFR 81) of Santa Barbara County from a moderate ozone nonattainment area to a serious ozone nonattainment area. This reclassification was proposed because Santa Barbara County had failed to attain the 1-hour ozone NAAQS by the statutory deadline of November 15, 1996. The reclassification will place more stringent requirements on the area. As discussed in Section 3.10.1, the NAAQS are being revised; these revisions may also affect the attainment status of Santa Barbara County.

The ROI for lower-atmosphere air quality resources may extend beyond the project boundaries to include those areas significantly affected by air dispersion and/or commuter traffic. This could include an area as large as the regional air quality basin (South Central Coast Air Basin) and may affect the maintenance of the NAAQS and the CAAQS for the Vandenberg AFB area.

Ambient air quality is measured at weather stations throughout California. The nearest air station for monitoring these data is on Vandenberg AFB. No data are available for 1995 lead concentrations. Table 3.10-8 shows 1995 average ambient air concentrations for criteria pollutants.

**Table 3.10-8. 1995 Average Ambient Air Concentrations for Criteria Pollutants at Vandenberg AFB**

| Pollutant | Averaging Time | Concentration, $\mu g/m^3$ |
|---|---|---|
| $O_3$ | Hourly | 150 |
| $NO_x$ | Hourly | 18 |
| $SO_2$ | Hourly | 18 |
| | 3 Hours | 10.5 |
| | 24 Hours | 5.3 |
| $PM_{10}$ | 24 Hours | 75.5 |
| CO | Hourly | 2,500 |
| | 8 Hours | 2,150 |

CO = carbon monoxide
$\mu g/m^3$ = micrograms per cubic meter (approximate, converted from parts per million)
$NO_x$ = nitrogen oxides
$O_3$ = ozone
$PM_{10}$ = particulate matter equal to or less than 10 microns in diameter
$SO_2$ = sulfur dioxide

Source: Santa Barbara County Air Pollution Control District, 1997.

**3.10.3.4 Air Emissions.** Emissions inventory information for the affected environment was obtained from the SBCAPCD, the CARB, and Vandenberg AFB. Inventory data for each pollutant are reported in tons per year in order to describe the baseline conditions of pollutant emissions in the area.

The existing SBCAPCD Emissions Questionnaire lists emissions from stationary sources. This information has been included in Table 3.10-9. These emissions are for all stationary sources at Vandenberg AFB.

**Table 3.10-9. Vandenberg AFB Baseline Emissions[(a)]**

| | VOC | $NO_x$ | CO | $SO_2$ | $PM_{10}$ |
|---|---|---|---|---|---|
| Existing Launch Programs | | | | | |
| Vehicle Launches | 0.0 | 1.7 | 0.0 | 0.0 | 30.8 |
| Vehicle Preparation, Assembly, and Fueling | 2.3 | 0.0 | 0.0 | 0.0 | 0.7 |
| Mobile Sources | 33.8 | 30.0 | 354.5 | 2.0 | 101.5 |
| Point Sources | 0.2 | 8.1 | 1.2 | 0.6 | 0.5 |
| Total | 36.3 | 39.8 | 355.7 | 2.6 | 133.4 |
| Vandenberg AFB Stationary Sources (Emissions Questionnaire)[(b)] | 4.2 | 21.3 | 1.2 | 7.7 | 2.1 |
| Santa Barbara County Point Source | 1,350 | 418 | 2,108 | 585 | 145 |
| Santa Barbara County Area Source | 43,314 | 13,576 | 100,401 | 705 | 29,229 |
| Santa Barbara County Total | 44,664 | 13,994 | 102,509 | 1,290 | 29,374 |

Note: (a) All emissions in tons per year for 1995.
(b) Includes stationary source emissions only.
CO = carbon monoxide
$NO_x$ = nitrogen oxides
$PM_{10}$ = particulate matter equal to or less than 10 microns in diameter
$SO_2$ = sulfur dioxide
VOC = volatile organic compound

A baseline launch emissions inventory has been generated for the applicable launch activities in 1995. The baseline emissions included in this inventory are specifically for current launch vehicle systems (Atlas II, Delta II, and Titan IV), and support activities for the launch of those vehicles. This inventory includes estimates of emissions from the following key sources:

- Vehicle launch
- Vehicle preparation, assembly, and fueling
- Mobile sources such as support equipment, commercial transport vehicles (including trucks and aircraft), and personal vehicles
- Point sources such as heating/power plants, generators, incinerators and storage tanks.

Estimates are divided into two categories: emissions that are directly launch-related and infrastructure emissions. Launch-related emissions are estimated on a pounds-per-launch basis. Infrastructure emissions are estimated on a pounds-per-day basis and are assumed to take place regardless of the number of launches per year. Emissions comparisons are summarized in Table 3.10-9 for criteria pollutants.

Emissions from each of the key sources are calculated as described below.

**Vehicle Launch.** Table 3.10-10 lists vehicle launches from Vandenberg AFB in 1995. Emissions are addressed only for those vehicles being replaced (Atlas II, Delta II, Titan IV). Actual launch emissions are estimated using kinetics and flowfield models as described below. Emissions predicted to be below 3,000 feet in altitude are included in the inventory totals; emissions at altitudes above 3,000 feet are addressed in Section 3.11, Upper Atmosphere.

**Table 3.10-10. 1995 Launches, Vandenberg AFB**

| Date | Vehicle | Launch Complex |
|---|---|---|
| March 24 | Atlas E | SLC-3W |
| November 3 | Delta II | SLC-2W |
| December 5 | Titan IV | SLC-4E |
| April 3 | Pegasus | L-1011 |
| June 22 | Pegasus XL | L-1011 |
| August 15 | Lockheed LLV | SLC-6 |

The standard TDK Nozzle Performance Computer Model is utilized to model the engine performance, as described in Section 3.10.2.2.

The emissions estimates presented in Table 3.10-9 are for normal launches and do not require any further modeling. Emission estimates were made using the launch trajectory information for LEO and GTO missions. The fraction of each propellant emitted below 3,000 feet, along with the height-dependent mass fractions from SPF-3, is used to estimate the emissions. Information on mission trajectory for each launch in Table 3.10-10 was not available, so for analysis purposes, it was assumed that 50 percent of launches would utilize a GTO trajectory, and 50 percent would utilize a LEO trajectory.

The emissions shown in Table 3.10-9 are totals for emissions from the selected 1995 launch vehicles and show the contribution of these launches to regional air quality. Local air quality impacts are addressed on a per-launch basis in the analysis within Section 4.10.

**Vehicle Preparation, Assembly, and Fueling.** For the two launches included in the 1995 baseline, much of the preparation and assembly operations took place at Vandenberg AFB. A discussion of emissions associated with these activities is provided in Section 3.10.2.2.

Total ODS emissions associated with the Atlas, Delta, and Titan operations are estimated to be 64 pounds for 1995 Vandenberg AFB operations.

**Mobile Sources.** Mobile emission sources are described in Section 3.10.2.2.

Vehicle Deliveries and Miscellaneous Supply Traffic

Methods and assumptions utilized to calculate emissions associated with these activities are described in Section 3.10.2.2.

Because the ROI for Vandenberg AFB includes all of the SCCAB, transportation emissions are calculated for all vehicular traffic that takes place in Santa Barbara, San Luis Obispo, and Ventura counties and is directly related to EELV activities.

Vehicle Assembly and On-Site Transport

Methods used to calculate emissions for these activities are described in Section 3.10.2.2.

Personal Automobile Use

Methods utilized to calculate emissions associated with these activities are described in Section 3.10.2.2.

**Point Sources.** Emissions from point sources such as spray booths and solvent cleaning equipment are included in the total emission calculations for vehicle preparation and assembly. Emissions from boilers and internal combustion engines are calculated based on the information provided in the 1995 Santa Barbara County Air Pollution Control District (APCD) Annual Emission Inventory Questionnaire. The emissions from these sources are attributed to the Atlas, Delta, and Titan programs for use in this baseline emissions inventory.

**Hazardous Air Pollutants.** Methods used to calculate HAPs emissions are described in Section 3.10.2.2. Baseline emissions of HAPs for Vandenberg AFB are summarized in Table 3.10-11.

**Table 3.10-11. Vandenberg AFB Baseline HAPs Emissions[(a)]**

| | $Cl_x$ | Hydrazine fuels | VOC HAP |
|---|---|---|---|
| Vehicle Launches | 15.4 | ~0.0 | 0.0 |
| Vehicle Fueling | 0.0 | >0.01 | >0.01 |
| Vehicle Coating/Solvent Use | 0.0 | 0.0 | 2.3 |
| Total | 15.4 | >0.01 | 2.3 |

Notes: (a) All emissions in tons per year.
$Cl_x$ = chlorine compounds
HAP = Hazardous Air Pollutant
VOC = volatile organic compound

## 3.11 AIR QUALITY (UPPER ATMOSPHERE)

The atmosphere above 3,000 feet in altitude has been divided into two tropospheric layers (lower troposphere and upper troposphere) and the stratosphere. Immediately above the well-mixed, surface cloud layer at the Earth's surface (below 3,000 feet) lies the lower troposphere (3,000 feet to 10,000 feet). Air quality dispersion modeling for ambient pollutant concentrations that directly impact ground-level monitoring sites was conducted over the first 10,000 feet above the ground. This modeling region includes the mixed layer and the lower troposphere. Near-source modeling was conducted over the first 10,000 feet and within several tens of kilometers from the launch pad using the REEDM air quality model (Brady et al., 1997). Near-source modeling was conducted to determine if there would be immediate significant contributions of pollutant concentrations to the ambient concentrations of criteria and toxic pollutants that affect U.S. EPA and state and county air quality management plans. The upper troposphere lies between altitudes of 10,000 and 49,000 feet, where regional global-scale transport and dispersion of the rocket plume occurs. The stratosphere occupies altitudes between 49,000 and 164,000 feet.

### 3.11.1 Troposphere

The atmosphere above the mixed layer is generally referred to as the free troposphere. This portion of the atmosphere is continually stirred by the turbulence generally referred to as "weather". Removal of most of the rocket emissions from the free troposphere takes place over a period of less than a week, even at the top of the troposphere. Material is removed by rain-out and by vertical motions that bring material to the ground. With such removal processes, global buildup does not occur, and any potential air impact from rocket launches is confined to a spatial extent of less than several hundred kilometers downrange and downwind from the launch site.

The ROI for free tropospheric effects is essentially the same, regardless of the launch vehicle used.

Estimates of annual troposphere baseline emissions into the troposphere from Cape Canaveral AS and Vandenberg AFB were developed for 1995 and 1996. During this period, the most recent configurations of the Atlas, Delta, and Titan vehicles were launched (Table 3.11-1). These configurations include the Atlas IIAS, the Delta II 6825, and the Titan IV SRM. Five Atlas IIAS launches were made with strap-on SRMs during the 2-year period.

Specific data describing the configurations of the vehicles launched from Cape Canaveral AS and Vandenberg AFB during 1995 and 1996 are provided in Table 3.11-2.

**Table 3.11-1. Launch Summary**

| Vehicle | 1995 Vandenberg AFB | 1995 Cape Canaveral AS | 1996 Vandenber gAFB | 1996 Cape Canaveral AS |
|---|---|---|---|---|
| Atlas II | 0 | 10 | 0 | 6 |
| Delta II | 1 | 2 | 2 | 7 |
| Titan IV | 1 | 3 | 2 | 2 |
| Total | 6 | 23 | 8 | 23 |

AFB = Air Force Base
AS = Air Station

The emissions for each region were estimated from the following information:

(1) Total flight-time fraction for each engine in each layer
(2) The total propellant mass of each engine
(3) Each ODS's far-field mass fraction of the nozzle exit mass flow.

The total propellant mass emitted into each layer is estimated from the first two items described above. The amount of a specific chemical was estimated using the far field mass fraction. After-burning occurs in the troposphere, so in the tropospheric layers, CO was entirely converted to $CO_2$, and significant amounts of $NO_x$ were generated. The HCl/Cl ratio is altered by after-burning; the emissions were estimated as $Cl_x$ for the sum of the two chemicals. Both compounds are toxic and are treated cumulatively in this analysis. All aluminum compounds emitted from SRMs were treated as $PM_{10}$.

The total flight-time fraction is a function of the flight trajectory, which varies with respect to the mission specifics such as payload, desired orbit (height, eccentricity), and engine configuration. Although there can be some initial flight trajectory variation, the range of trajectories is somewhat limited. As a result, two trajectories representing the envelope of vehicle trajectories were used to estimate the flight-time fractions for each vehicle given its elapsed design burn time. The elapsed times at the top of each atmospheric layer are summarized in Table 3.11-3. For analysis purposes, it was assumed that 50 percent of launches would utilize a GTO trajectory, and 50 percent would utilize a LEO trajectory.

The fraction of the propellant burned in the 3,000 to 10,000-foot layer is estimated using the engine burn duration and the trajectory residence time in the lower troposphere. The height-dependent mass fractions of the ODSs resulting from each pound of propellant burned are obtained from predictions made using the after-burning flow field model (SPF-3). These fractions are used with the amount of propellant burned in each atmospheric layer to estimate the emissions of the ODSs in the tropospheric layers. Table 3.11-4 summarizes the annual emissions of the ODSs for launches from Cape Canaveral AS and Vandenberg AFB for 1995 and 1996. During after-burning, the majority of $NO_x$ and $CO_2$ production occurs in the troposphere, whereas CO emissions are notable only in the stratosphere (see Section 3.11.2). Table 3.11-4 indicates that there are large differences in emission

**Table 3.11-2. Summary of Atlas II, Delta II, and Titan IV Configurations Launched during 1995 and 1996**

| | Atlas IIA | Atlas IIAS | Delta II 7925 | Titan IVA | Titan IVB |
|---|---|---|---|---|---|
| Core motor fuel type | $LO_2$/RP-1 | $LO_2$/RP-1 | $LO_2$/RP-1 | $N_2O$/A-50 | $N_2O_4$/A-50 |
| Core motor fuel mass | 348.4K lbs | 348.4K lbs | 212.6K lbs | 335.5K lbs | 338.4K lbs |
| Burn Duration | 172 s | 172 s | 265 s | 190 s | 190 s |
| SRM Strap-on type | NA | Castor IVA | GEM | SRM | SRMU |
| Number of Strap-ons | NA | 4 | 9 | 2 | 2 |
| Fuel mass/ engine | NA | 22.3K lbs | 25.8K lbs | 600K lbs | 680K lbs |
| Burn duration | NA | 56.2 s for each firing | 63.0 s for each firing | 122 s | 137 s |
| Stage 1 fuel type | Same as core motor | Same as core motor | $LO_2$/RP-1 | $N_2O_4$/A-50 | $N_2O_4$/A-50 |
| Stage 1 fuel mass | Included in core motor | Included in core motor | 13.3K lbs | 77.2K lbs | 77.2k lbs |
| Burn duration | 283 s | 283 s | 40 s | 223 s | 223 s |
| Stage 2 fuel type | $LO_2$/$LH_2$ (Centaur II) | $LO_2$/$LH_2$ (Centaur II) | A-50/$N_2O_4$ | $LO_2$/$LH_2$ (Centaur II) | $LO_2$/$LH_2$ (Centaur II) |
| Stage 2 fuel mass | 37.5K lbs | 37.5K lbs | 13.2K lbs | 75.4K lbs | 75.4K lbs |
| Burn duration | 600 s | 600 s | 85.1 s | 600 s | 600 s |

A-50 = Aerozine-50
Castor IVA = older solid rocket motor (Thiokol)
GEM = graphite-epoxy motor
HTPB = hydroxyl-terminated polybutadiene
K = 1,000
lbs = pounds
$LH_2$ = liquid hydrogen
$LO_2$ = liquid oxygen
NA = not applicable
$N_2O_4$ = nitrogen tetroxide
RP-1 = kerosene fuel (rocket propellant-1)
s = seconds
SRM = solid rocket motor
SRMU = solid rocket motor upgrade

**Table 3.11-3. Flight Trajectories Used to Estimate the Fraction of Engine Burn Time in each Layer**

| Layer Designation | Layer top elevation (feet) | Trajectory 1 (GTO) (seconds) | Trajectory 2 (LEO) (seconds) |
|---|---|---|---|
| Lower atmosphere | 3,000 | 29 | 19 |
| Lower troposphere | 10,000 | 50 | 33 |
| Upper troposphere | 49,000 | 95 | 72 |
| Stratosphere | 164,000 | 173 | 155 |

GTO = Geosynchronous Transfer Orbit
LEO = Low Earth Orbit

estimates at Vandenberg AFB between 1995 and 1996 (due to the different number of launches and vehicle type). Both years are presented for comparison; 1995 is used as the baseline year for consistency with the lower-atmosphere air quality discussion (see Section 3.10).

### 3.11.2 Stratosphere

Rocket launches can affect the atmosphere both in an immediate, episodic manner, and in a long-term, cumulative manner. The stratosphere is affected immediately after launch along the flight trajectory. Emissions from some types of launch vehicles significantly perturb the atmosphere along the launch trajectory at a range of a kilometer or less from the rocket passage. Ozone is temporarily reduced, an aerosol plume may be produced, and combustion products such as $NO_x$, chlorinated compounds, and reactive radicals can temporarily change the normal chemistry along the vehicle path.

The stratosphere exchanges mass with the troposphere beneath it at a relatively low rate. With no rain-out or other removal mechanisms, the rocket combustion products can build up in the stratosphere over time if there is a sufficient launch rate. When deposited into the stratosphere, ideally sized particulates (0.15 to 0.4 microns in size) such as alumina aerosols can persist for months and circle the globe. Aerosols that exist in the stratosphere can assist in catalyzing the destruction of ozone.

Gaseous chlorine compounds can also be sequestered in the stratosphere in a form that at some later date can be converted and contribute to ozone destruction anywhere over the globe.

The ROI for stratospheric effects is essentially the same, regardless of which launch vehicle is being used.

The lower boundary of the stratosphere lies between altitudes of 32,800 and 49,000 feet above the Earth's surface (with an atmospheric pressure in the range of 100 to 200 millibars [mb]) at a temperature inversion known as the tropopause, which extends up to nearly 164,000 feet (with an atmospheric pressure of about 1 mb). Although containing less than 20 percent of the atmosphere's mass, and despite having relatively little direct impact on

**Table 3.11-4. Troposphere Emissions from Launches at Cape Canaveral AS and Vandenberg AFB, 1995 and 1996 (tons/year)**

| Chemical of Concern | CCAS 1995 Emissions | | CCAS 1996 Emissions | | VAFB 1995 Emissions | | VAFB 1966 Emissions | |
|---|---|---|---|---|---|---|---|---|
| | Lower Troposphere | Upper Troposphere | Lower Troposphere | Upper Troposphere | Lower Troposphere | Upper Troposphere | Lower Troposphere | Upper Troposphere |
| PM | 103 | 388 | 100 | 385 | 26 | 107 | 64.1 | 245 |
| $NO_x$ | 5.6 | 13.8 | 4.5 | 12.4 | 1 | 2.9 | 2.5 | 6.7 |
| CO | 0.0 | 20.2 | 0.0 | 18.4 | 0.0 | 3.8 | 0.0 | 8.7 |
| $CL_x$ | 52 | 196 | 51 | 195 | 13 | 54 | 32.3 | 123 |
| VOC | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| $SO_2$ | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

CCAS = Cape Canaveral Air Station
CO = carbon monoxide
$CL_x$ = chloride compounds
$NO_x$ = nitrogen oxides
PM = particulate matter
$SO_2$ = sulfur dioxide
VAFB = Vandenberg Air Force Base
VOC = volatile organic compound

weather at the surface, the composition of the stratosphere can strongly influence the attenuation of solar radiation reaching the Earth's surface. Perturbations in the trace gas composition of the stratosphere by high-flying aircraft and rockets can potentially affect how the stratosphere absorbs and scatters the sun's radiation incident at its top. The environment at the Earth's surface can be affected by either changes in UV radiation or by changes in the balance of outgoing and incoming long- and short-wave solar radiation, which maintains the Earth's present climate. The stratospheric ozone burden is of key importance because it has a major influence on the surface UV flux and is a significant contributor to the global climatic heat budget. Nearly as important as ozone is the stratosphere's aerosol burden, which also determines the degree of solar attenuation. Because it contains halogens (chlorine, bromine), the aerosol can also perturb the stratosphere's ozone mass budget.

**The Chemistry of the Stratosphere.** The concentration profile of ozone varies with latitude. Most ozone is photochemically produced in the equatorial atmosphere and is transported polewards and downwards with time (Andrews et al., 1987). At 30° N latitude, which corresponds approximately to the latitude of the two launch facilities, the annual ozone peak concentrations occur at an altitude of approximately 70,000 feet. Ozone concentration varies seasonally, so that at 30° N latitude, the seasonal change in columnar ozone is on the order of 10-20 out of an average of 290 dobson units (World Meteorological Organization, 1989).

Considerable monitoring has found evidence of significant ozone decreases in both the Arctic and Antarctic polar regions (World Meteorological Organization, 1989). The most pronounced reductions, the so-called ozone "hole", occur during the spring near Antarctica. The cause is now known to be due chiefly to the appearance of at least one type of polar stratospheric cloud (PSC). PSCs form when the ambient air is sufficiently cold, sufficient water vapor is present, and when there is a sufficient lack of polewards mixing of warmer and drier air. A PSC acts to destroy ozone by freeing chlorine bound up in the chloro-nitrate pool via direct activation on frozen or super-cooled liquid surfaces within the cloud via a reaction such as: $ClONO_2 + HCl \rightarrow 2Cl + HNO_3$. The free chlorine and bromine rapidly destroy ozone in a catalytic cycle before being bound up again.

Injections of water and sulfur compounds can play a role in perturbing lower stratospheric ozone in the tropics and mid-latitudes without requiring extremely low temperatures for PSC formation. Water vapor, which can form PSCs, can also be injected into the lower stratosphere through the agency of intense cumulonimbus cloud systems. A single cloud can temporarily inject up to 100 metric tons of water or ice hydrometeors immediately above the tropopause (Cotton and Anthes, 1989). Much of the water and ice immediately precipitates out; however, some of the very smallest particles with very low fall velocities (e.g., submicron range) can persist for weeks.

Stratospheric aerosols can also originate from a number of terrestrial sources such as the sulfate produced by the oxidation of carbonyl sulfide diffusing up from the troposphere (Warneck, 1988). Volcanoes also directly inject aerosols and $SO_2$, which oxidizes to form a sulfate aerosol. Although the surface reactivity of such stratospheric aerosols may be relatively inefficient in

catalyzing ozone destruction, the large mass injections by volcanic eruptions, such as El Chicon, can produce substantial temporary reductions in columnar ozone over the entire northern hemisphere (World Meteorological Organization, 1989).

Nitrogen and $N_2O$ can also perturb stratospheric ozone through several processes. $N_2O$ is released naturally from bacterial processes in the soil. Overfertilization can greatly increase the emission rate. $N_2O$ is also released from the oceans, which may be its primary source (Warneck, 1988). $N_2O$ is relatively inert with a chemical lifetime in the troposphere measurable in years. As it is slowly mixed into the stratosphere, it is photolyzed to produce excited atomic oxygen which, in turn, produces nitric oxide. NO reacts rapidly with ozone and is a net catalytic destroyer of ozone in a pure oxygen atmosphere. $NO_x$ is also introduced directly into the stratosphere via direct injection by high-flying aircraft and rockets.

The impact of space shuttle launches on the stratosphere has been studied (Jackman et al., 1996). In the Jackman study, a total of nine space shuttle and three Titan IVB launches were assumed per year. Chlorine emissions were assumed to be in the form of HCl. Such a fleet of launches would result in emissions of 725 tons of chlorine per year. This amount is equal to only 0.25 percent of the 300,000 tons of chlorine per year released from the breakdown of industrial halocarbons.

The resulting peak launch impacts on ozone concentrations are on the order of 0.1 to 0.2 percent (roughly 1 part in a thousand) of the average concentrations and occur between 131,240 and 164,000 feet at nearly the same latitude as launch. This peak impact region is well above the region of maximum ozone concentration, so the impact of columnar ozone will be considerably smaller. The Jackman study indicates a worst-case impact of total (columnar integrated) ozone reductions of 0.014 percent.

The stratospheric chemistry of alumina surfaces under stratospheric conditions has also been studied (Meads et al., 1994). The results of this study indicated that the reaction probabilities for critical chlorine reactions are typically an order of magnitude less than those for ice and water-rich nitrate aerosols. However, the alumina surfaces are considerably more reactive than the sulfuric acid aerosols found in the lower stratosphere in mid-latitudes. As a result, for regions where PSCs and water or ice aerosols are rare, such as in the tropical and mid-latitudes, the alumina aerosol surfaces may play an important role in expediting ozone destruction by halogen species if a sufficient atmospheric loading occurs. However, compared with the sulfate aerosol loading, the alumina loading from rocket launches is less than 1 percent of the sulfate aerosol even when there have not been any recent volcanic eruptions. Significant depletion due to alumina aerosol would be expected to be relatively local and transient given the rapid horizontal rate of dispersion of the rocket plume after launch (Beiting, 1997).

Chlorine is only one of several chemicals that can destroy ozone in the stratosphere. Only 19 percent of all ozone destroyed has been estimated to be destroyed by chlorine (Warneck, 1988). Reaction of ozone with NO results in 34 percent of total ozone loss. The reaction of ozone with atomic oxygen accounts for the second largest loss rate, nearly 26 percent. The rocket

engine perturbation to the stratospheric Chapman ozone chemistry is rather small. Over 100,000 tons of ozone per year enter from sources other than launch vehicles. Each launch introduces on the order of 100 tons, so launches add up to one part in 1,000.

**Stratospheric Impacts by Rocket Emissions.** As discussed for the troposphere, annual stratosphere baseline emissions estimates from Cape Canaveral AS and Vandenberg AFB have been developed for 1995 and 1996, based on the data presented in Tables 3.11-1 and 3.11-2.

The emissions for each region were estimated using the same criteria as described for the troposphere emissions. After release, HCl in the stratosphere suffers two fates; it either precipitates out of the stratosphere as aerosol, or a small portion is repartitioned to free chlorine.

The estimated annual emissions of ODSs in the stratosphere are presented in Table 3.11-5. Chlorine is the primary chemical of concern for ozone depletion. Over the 2-year period, launches contributed 4.4 percent of the chlorine emissions. Atlas IIAS, Delta II (23.2 percent), and Titan IV SRM launches contributed 72.4 percent. Almost all after-burning conversion of rocket exhaust products occurs in the troposphere. As a result, very little NO production occurs in the stratosphere, and CO emitted by combustion is no longer converted to $CO_2$ in the stratosphere.

**Table 3.11-5. Stratosphere Emissions from Launch Operations at Vandenberg AFB and Cape Canaveral AS, 1995 and 1996 (tons/year)**

| | VAFB Emissions | | CCAS Emissions | |
|---|---|---|---|---|
| ODS | 1995 | 1996 | 1995 | 1996 |
| PM | 150 | 300 | 472 | 435 |
| $NO_x$ | 0.6 | 1.2 | 1.8 | 356 |
| CO | 152 | 304 | 900 | 698 |
| $Cl_x$ | 75 | 150 | 236 | 179 |

CCAS = Cape Canaveral Air Station
$Cl_x$ = chlorine compounds
CO = carbon monoxide
$NO_x$ = nitrogen oxides
ODS = ozone-depleting substance
PM = particulate matter
VAFB = Vandenberg Air Force Base

## 3.12 NOISE

Noise is usually defined as unwanted sound. It may be undesirable because it interferes with speech communication and hearing, is intense enough to damage hearing, or is simply annoying. High-amplitude noise can be unwanted because of potential structural damage. Noise is usually thought of as coming from man-made activities, but some natural sounds (e.g., insects, animals, wind, waves) are considered to be noise.

The characteristics of sound include parameters such as amplitude, frequency, and duration. Sound can vary over an extremely large range of amplitudes. The decibel (dB), a logarithmic unit that accounts for the large variations in amplitude, is the accepted standard unit for the measurement of sound.

Different sounds may have different frequency content. When measuring sound to determine its effects on a human population, it is common to adjust the frequency content to correspond to the frequency sensitivity of the human ear. This adjustment is called A-weighting (American National Standards Institute, 1988). Sound levels that have been so adjusted are referred to as A-weighted sound pressure level (AWSPL). The unit is still dB, but the unit is sometimes written dBA or dB(A) for emphasis. Figure 3.12-1 summarizes typical A-weighted sound levels.

If structural damage is a concern, then the overall sound pressure level (OSPL) is used. This quantity has no frequency weighting and therefore includes low frequencies that are not audible but can affect structures.

Noise levels usually change with time. A number of descriptors have been developed that account for this and provide a cumulative measure of noise exposure (Appendix F). The most widely used cumulative measure is the day-night average sound level ($L_{dn}$ or DNL), a day-long average of the AWSPL, with a 10-dB penalty applied at night, from 10 pm to 7 am. The state of California uses the Community Noise Equivalent Level (CNEL), which is similar to $L_{dn}$ except that a penalty of 5 dB is also applied to noise in the evening, from 7 pm to 10 pm.

A quantity falling between single-event measures like AWSPL and cumulative measures like $L_{dn}$ is the sound exposure level (SEL), a measure of the total sound from a single event combining the level of the sound with its duration. The formal definition of SEL is presented in Appendix F. For a sound with an effective duration of one second, SEL is equal to AWSPL. For sounds with longer effective duration, SEL is larger than AWSPL and thus reflects the greater intrusion of the longer sound.

Figure 3.12-1  A-Weighted Sound Levels of Common Sounds

The cumulative quantities $L_{dn}$ and CNEL are based on sounds that occur on a regular basis, at least every day, and usually many times per day. An important part of the noise environment at both Cape Canaveral AS and Vandenberg AFB includes launches of existing launch vehicles. These events are relatively infrequent, at rates well below those needed for $L_{dn}$ or CNEL to be meaningful. Emphasis in this EIS is therefore placed on single-event noise levels: AWSPL, OSPL, and SEL.

Three distinct noise events are associated with launch and ascent of a launch vehicle: on-pad rocket noise, in-flight rocket noise, and sonic boom. It is common to depict noise over an area by means of noise contours.

**On-Pad Rocket Noise.** On-pad rocket noise occurs when engines are firing but the vehicle is still on the pad. The rocket exhaust is usually turned horizontally by deflectors or an exhaust tunnel. Noise is highly directional, with maximum levels in lobes that are at about 45 degrees from the main direction of the deflected exhaust. Noise levels at the vehicle and within the launch complex are high. Because the sound source is at or near ground level, propagation from the rocket to off-site locations grazes along the ground and tends to experience significant attenuation over distance. On-pad noise levels are typically much lower than in-flight noise levels because sound propagates in close proximity to the ground and undergoes significant attenuation when the vehicle is on or near the pad.

**In-Flight Rocket Noise.** In-flight rocket noise occurs when the vehicle is in the air, clear of the launch pad, and the engine exhaust plume is in line with the vehicle. In the early part of the flight, when the vehicle's motion is primarily vertical, noise contours are circular. The sound source is also well above the ground and therefore experiences less attenuation as it propagates to large distances. The shapes of the contours for launch vehicle ascent are approximately circular, particularly for the higher levels near the center. The outer contours tend to be somewhat distorted. They can be stretched out in the launch direction or broadened across the launch direction, depending on specific details of the launch. Because the contours are approximately circular, it is often adequate to summarize noise by giving the sound levels at a few distances from the launch site. On-pad noise contours are much smaller than in-flight contours. Because in-flight noise is greater than on-pad noise, analysis in this study has concentrated on in-flight noise.

The major source of rocket noise is from mixing of the exhaust flow with the atmosphere, combustion noise in the combustion chamber, shock waves and turbulence in the exhaust flow, and occasional combustion noise from the post-burning of fuel-rich combustion products in the atmosphere. The emitted acoustic power from a rocket engine and the frequency spectrum of the noise can be calculated from the number of engines, their size and thrust, and their flow characteristics. Normally, the largest portion of the total acoustic energy is contained in the low-frequency end of the spectrum (1 hertz [Hz] to 100 Hz). Noise measurements conducted during a Titan IIID launch indicated that the maximum sound pressure levels occurred at around 20 to 50 Hz (U.S. Air Force, 1991).

To evaluate the potential noise impact associated with launch and ascent, it is necessary to consider not only the overall sound level but the frequency spectrum and the duration of exposure. High noise levels can cause annoyance and hearing damage. OSHA has established noise limits to protect workers at their work places. According to these standards, no worker shall be exposed to noise levels higher than 115 dBA. The exposure level of 115 dBA is limited to 15 minutes or less during an 8-hour work shift (U.S. Air Force, 1992). The OSHA standards are the maximum allowable noise levels for the personnel in the vicinity of the launch pad. Off the base, concerns for noise are community annoyance, damage to fragile structures, and adverse effects on animals.

**Sonic Boom.** Another noise characteristic of launch vehicles is that they reach supersonic (faster than the speed of sound) speeds and will generate sonic booms. A sonic boom, the shock wave resulting from the displacement of air in supersonic flight, differs from other sounds in that it is impulsive and very brief (less than 1 second). Sonic booms are generally described by their peak overpressure in pounds per square foot (psf).

Figure 3.12-2 shows nominal noise contours for the sonic boom from a launch vehicle. The contour values represent psf, the unit used for sonic boom overpressures. The launch site is noted on the figure, and the launch direction is to the right. Regions within each contour experience overpressures equal to or greater than that denoted for the contour. The contours denote the peak pressure that occurs at each point over the course of the launch and do not represent noise at any one time. The sonic boom event at each position is brief, as noted in the preceding paragraph.

Because a sonic boom is not generated until the vehicle reaches supersonic speeds, some time after launch, the launch site itself does not experience a sonic boom. The crescent shape of the contours reflects this “after launch” nature of sonic boom. The entire boom footprint is downtrack, and the portions of the footprint to the side of the trajectory (up and down in the figure) represent the overpressures caused as the shock wave expands radially from the line of travel of the launch vehicle. There is actually no boom to the left of the contours shown, and the boom diminishes rapidly farther downtrack, to the right of the contours.

The 0.5-psf contour shown in Figure 3.12-2, although not to scale, has a shape similar to an actual low-overpressure sonic boom contour. The two higher contours, 2.0 and 5.0 psf, have been considerably distorted from typical actual contours for illustrative purposes. The crescent shape is correct, and the width across the trajectory (i.e., vertical height on the figure)

Figure 3.12-2 Nominal Sonic Boom Contours for Ascent of a Launch Vehicle

relative to that of the 0.5-psf contour is approximately correct. However, their width and position in the direction along the trajectory are greatly exaggerated for illustrative purposes. Typically, the left edge of these higher overpressures would be very close to the left edge of the 0.5-psf contour and would not appear as a distinct line when plotted to any reasonable scale. The right edge of these contours would also be much closer to the left than shown and would often not appear as distinct lines. The concentration of these contours is due to focusing of the boom as the vehicle accelerates. The focal zone "super boom" region is within the 5.0-psf contour illustrated in Figure 3.12-2 and is very narrow (typically less than 100 yards).

It is common to calculate sonic boom footprints with the assumption that the ground is hard and does not significantly attenuate the boom. This is usually a good assumption for most of the footprint. However, near the edges of the footprint, the boom approaches the ground at a shallow angle and is attenuated by the same process discussed previously for on-pad rocket noise. This is typically important in the outermost 20 percent of the width of the outermost contour (the 0.5-psf contour in Figure 3.12-2). The attenuated sonic boom in this region sounds like rumbling or distant thunder, rather than the distinct double bang usually associated with sonic booms.

Appendix F contains more detailed descriptions of noise and sonic boom. Effects of sonic booms on wildlife are addressed in Section 4.14, Biological Resources. The following two subsections describe the environments around each EELV launch site that may be affected by noise.

### 3.12.1 Cape Canaveral AS

**Ambient Noise Levels Off Station.** Most of the region surrounding Cape Canaveral AS is open water, with the Atlantic Ocean to the east and the Banana River to the west. Immediately north of Cape Canaveral AS is KSC; Port Canaveral is to the south. This relative isolation of the station reduces the potential for noise to affect adjacent communities. The closest residential areas to Cape Canaveral AS are to the south, in the cities of Cape Canaveral and Cocoa Beach. Expected sound levels in these areas are normally low, with higher levels occurring in industrial areas (Port Canaveral) and along transportation corridors. Residential areas and resorts along the beach would be expected to have low overall noise levels, normally about 45 to 55 dBA. Infrequent aircraft flyovers from Patrick AFB and rocket launches from Cape Canaveral AS would be expected to increase noise levels for short periods of time. Noise levels at KSC probably approximate those of any urban industrial area, reaching levels of 60 to 80 dBA. The launch of space vehicles from KSC does generate intense, but relatively short-duration, noise levels of low frequencies. The highest recorded levels are those associated with the space shuttle, which in the launch vicinity (i.e., on the pad and its supporting facilities) can exceed 160 dBA. Noise levels at Port Canaveral would be expected to be typical of those at an industrial facility, reaching levels of 60 to 80 dBA.

Noise and sonic boom patterns are oriented according to the launch azimuth. Azimuth is defined as horizontal direction expressed as the angular distance between the direction of a fixed point and the direction of the object; inclination is the angle between the orbital plane of a space object and the plane of the Earth's equator. Figure 3.12-3 shows the range of potential launch azimuths from Cape Canaveral AS.

**Ambient Noise Levels On Station.** An additional source of noise in the area is the Cape Canaveral AS Skid Strip. Because of the infrequent use of the skid strip, noise generally does not affect public areas. Other less frequent but more intense sources of noise in the region are space launches from Cape Canaveral AS. Current launches include Atlas, Delta, Titan, and Trident.

Noise from a Delta II launched from SLC-17 was measured during a July 1992 launch at four locations (McInerny, 1993a). Measurements were taken downrange at nominal distances of 1,500, 2,000, and 3,000 feet from the launch pad. Table 3.12-1 shows the noise levels (OSPL, AWSPL, and A-weighted SEL) measured during the launch at each location, and pre-launch predicted OSPL. Because launches from Cape Canaveral AS would occur intermittently, the resulting noise would not cause an increase in the equivalent sound pressure level ($L_{eq}$) (the average sound level over a period of time) in nearby areas.

**Table 3.12-1. Measured Delta II Sound Levels, July 1992**

| | Noise Levels (dB) | | | |
|---|---|---|---|---|
| Distance from Pad (feet) | Predicted Maximum OSPL | Measured Maximum OSPL | Measured Maximum AWSPL | Measured A-weighted SEL |
| 1,500 | 135.4 | 130.6 | 120.2 | 127.5 |
| 2,000 | 132.9 | 130.4 | 117.7 | 125.5 |
| 3,000 | 129.4 | 125.8 | 115.1 | 123.0 |

AWSPL = A-weighted sound pressure level
dB = decibel
OSPL = overall sound pressure level
SEL = sound exposure level (A-weighted)

Source: McInerny, 1993a

Following lift-off, launch vehicles gain altitude, pitch over, and accelerate quickly. When flight speed exceeds the speed of sound, shock waves develop. When these shock waves intersect with the ground, they are of environmental concern as sonic booms. Sonic booms produced during vehicle ascent occur over the Atlantic Ocean and are directed in front of the vehicle.

Figure 3.12-3 Potential Launch Azimuths, Cape Canaveral AS, Florida

Peak overpressures from large vehicles such as the Titan IVB approach 10 psf in focal zones (Downing, 1996). Sonic booms generated from launches at Cape Canaveral AS do not impact developed areas (45 Space Wing, 1996b).

**Concept A ROI.** The ROI for Concept A includes on- and off-station areas described above. Noise levels at SLC-41 would be similar to those in an urbanized industrial area when operations are taking place, averaging about 50 to 60 dBA, due to ongoing activities. Nighttime noise levels occurring when the facility is not in use would be lower due to limited activity and would be similar to those expected to be found in rural areas. Noise levels at this site increase with the launch of the Titan IVB from this complex. Expected noise levels from the Titan IVB would be similar to those launched from Vandenberg AFB (see Section 3.12.2).

**Concept B ROI.** The ROI for Concept B includes the on- and off-station areas described above. Because SLC-37 is not in use, expected noise levels would be typical of those in a rural environment, averaging 40 to 45 dBA. Noise levels would be expected to increase due to periodic traffic, use of nearby buildings, and the infrequent event of a launch from another launch complex.

**Concept A/B ROI.** The ROI for Concept A/B includes the off- and on-station areas for Concepts A and B described previously.

### 3.12.2 Vandenberg AFB

**Ambient Noise Levels Off Base.** The area immediately surrounding Vandenberg AFB is mainly undeveloped and rural, as discussed in Section 3.3.2.1, Regional Land Use, with some unincorporated residential areas within the Lompoc and Santa Maria valleys. The two urban areas in the region are the cities of Lompoc and Santa Maria, which support a few localized industrial areas. Sound levels measured for most of the region are normally low, with higher levels appearing in industrial areas and along transportation corridors. Rural areas in the Lompoc and Santa Maria valleys would be expected to have low overall CNEL levels, normally about 40 to 45 dBA. Infrequent aircraft flyovers and rocket launches from Vandenberg AFB would be expected to increase noise levels for short periods of time (City of Lompoc, 1996).

Urban areas are primarily affected by noise from automobiles, trucks, trains, and aircraft. CNEL contours have been measured based on typical sound levels in the Lompoc area. These contours show the highest CNEL levels (greater than 65 dBA) appearing around the Southern Pacific Railroad and major roadways, with lower CNEL levels (50 to 65 dBA) farther from main transportation corridors. Sound levels in Santa Maria are expected to be similar to those in Lompoc (City of Lompoc, 1996). Areas of higher localized noise levels would occur around stationary industrial sources. Presently, few of these stationary sources exist in the Lompoc and Santa Maria areas; consequently, overall sound levels are relatively low (U.S. Air Force, 1989a).

**Ambient Noise Levels On Base.** An additional source of noise in the area is the Vandenberg AFB Airfield, which follows state regulations concerning noise and maintains a CNEL equivalent to 65 dBA or lower for off-base areas. Two types of operations take place at this airfield: regular takeoffs and landings and touch-and-go maneuvers. Touch-and-go maneuvers are used for training purposes and create noise levels similar to regular aircraft takeoffs and landings (City of Lompoc, 1996).

Other less frequent, but more intense, sources of noise in the region are rocket launches from Vandenberg AFB. Current Minuteman and Delta II launch activities are from North Vandenberg AFB, and Titan IV and Atlas II launches are from South Vandenberg AFB.

Noise and sonic boom patterns are oriented according to the launch azimuth. Figure 3.12-4 shows the range of potential launch azimuths from Vandenberg AFB.

Noise levels in Lompoc and Santa Maria from Minutemen rocket launches would be expected to be a maximum of 49 dBA and 74 dBA, respectively (U.S. Air Force, 1987c). Noise from a Titan IV launched from SLC-4 in August 1993 (Do, 1994) was measured at six locations. The Titan IV is the largest launch vehicle in the United States' military inventory and has the greatest potential for noise impacts. Measurement sites were located downrange at nominal distances of 2,700, 6,680, 11,200, 16,800, 19,000, and 43,129 feet from the launch pad. Data were tape recorded at all sites and processed into appropriate sound levels. Direct sound level meter measurements were made at 2,700, 11,200, and 19,000 feet. Table 3.12-2 shows the maximum noise levels during the launch measured at each location. Of interest is the measurement at the 43,129-foot site in the city of Lompoc: AWSPL was 88.0 dB, A-weighted SEL was 93.7 dB, and OSPL was 112.8 dB. Because launches from all of these facilities would occur intermittently, the resulting noise would not cause an increase in the average ($L_{eq}$, $L_{dn}$ or CNEL) noise levels in nearby areas.

The maximum sonic boom overpressure for the Titan IVB was calculated and measured to be about 10 psf (Downing, 1996). Because most launch azimuths at Vandenberg AFB are over the Pacific Ocean, sonic boom effects on human population centers have been minor.

As discussed in Section 3.3.2.2, Vandenberg AFB Land Use, North Vandenberg AFB contains most of the base facilities, and South Vandenberg AFB is largely undeveloped with some scattered facilities. Noise levels measured on North Vandenberg AFB are generally typical of levels in urban areas with little industrialization. Noise levels on South Vandenberg AFB

Figure 3.12-4 Potential Launch Azimuths, Vandenberg AFB, California

**Table 3.12-2. Measured Titan IV Sound Levels, August 1993**

| Distance from Pad (feet) | Noise Levels (dB) Measured Maximum OSPL | SLM Measured OSPL | Measured Maximum AWSPL | Measured A-weighted SEL |
|---|---|---|---|---|
| 2,700 | 141.7 | 141.0 | 124.4 | 133.0 |
| 6,680 | 131.4 | - | 112.4 | 121.9 |
| 11,200 | 129.0 | 129.9 | 110.6 | 116.2 |
| 19,000 | 122.1 | 127.6 | 99.0 | 109.0 |
| 43,129[(a)] | 112.8 | - | 88.0 | 93.7 |

Note: (a) In City of Lompoc
AWSPL = A-weighted sound pressure level
dB = decibel
OSPL = overall sound pressure level
SEL = sound exposure level (A-weighted)
SLM = sound level meter

Source: Do, 1994

would be expected to be similar to levels found in rural areas, except around active launch complexes, where noise levels during operations may be similar to those at an industrial site.

**Concept A ROI.** The ROI for Concept A includes the on- and off-base areas described above. Although the SLC-3W site is not currently in use, noise levels there would be similar to those in an urbanized industrial area because of activities at nearby SLC-3E, averaging about 50 to 60 dBA, due to ongoing activities. Nighttime noise levels would be lower due to limited activity and would be similar to those expected to be found in rural areas of South Vandenberg AFB, about 40 to 45 dBA. Noise levels would be expected to increase due to trains passing on the nearby Southern Pacific Railroad, aircraft flyover, or the infrequent event of a launch from another launch complex.

**Concept B ROI.** The ROI for Concept B includes the on- and off-base areas described above. Noise levels at the SLC-6 site would be similar to those in an urbanized industrial area when operations are taking place, averaging about 50 to 60 dBA due to ongoing activities. Nighttime noise levels would be lower due to limited activity and would be similar to those expected to be found in rural areas of South Vandenberg AFB, about 40 to 45 dBA. Noise levels would be expected to increase due to trains passing on the nearby Southern Pacific Railroad, aircraft flyover, the construction of the California Spaceport, or the infrequent event of a launch from another launch complex.

**Concept A/B ROI.** The ROI for Concept A/B includes the off- and on-base areas for Concepts A and B described above.

## 3.13 ORBITAL DEBRIS

Orbital debris is a concern as a potential collision hazard to spacecraft. De-orbiting debris (i.e., debris re-entering the atmosphere from orbit) is a potential concern as a source of deposition of small particles into the stratosphere, and a possible contributor to stratospheric ozone depletion. Large pieces of debris are of concern with respect to re-entry and eventual Earth impact. The term “orbital debris” or “space debris” is used to refer to all earth-orbiting objects except active satellites (spacecraft) (i.e., payloads performing some type of operation or mission). Earth-orbiting debris can be classified as either natural or man-made objects. Natural objects consist of meteoroid material that travels through space. The measured number of man-made debris particles exceeds that of the meteoroid material particles, except in the 0.0004- to 0.04-inch range. The following sections address man-made debris only.

Man-made debris consists of material left in Earth orbit from the launch, deployment, and deactivation of spacecraft. It exists at all inclinations and primarily at LEO altitudes of approximately 217 to 1,243 miles. Orbital debris moves in many different orbits and directions, at velocities ranging from 2.5 miles per second to over 4 miles per second (Office of Technology Assessment, 1990).

Although space debris is not explicitly mentioned in any U.S. legislation, an Executive Branch policy directive, *National Space Policy* (September 19, 1996), identifies the following guidance to support major U.S. space policy objectives:

> “The United States will seek to minimize the creation of space debris. NASA, the Intelligence Community, and the DoD, in cooperation with the private sector, will develop design guidelines for future government procurements of spacecraft, launch vehicles, and services. The design and operation of space tests, experiments and systems, will minimize or reduce accumulation of space debris consistent with mission requirements and cost effectiveness.” (Intersector Guidelines [2] Space Debris [a]).

To date, no design guidelines have been agreed to, issued, or published (Huang, 1997; Johnson, 1997).

### 3.13.1 Characteristics of Orbital Debris

Salient characteristics of orbital debris include the orbital regimes in which it is found; its sources; debris particle size; estimated population; altitude distribution; and orbital lifetime.

**Orbital Regimes.** The space around the Earth in which satellites operate is generally divided into four regimes: LEO, medium Earth orbit, geosynchronous Earth orbit, and "other." Most cataloged orbital debris occurs in LEO because most space activity, particularly commercial, has traditionally occurred at those altitudes. LEO occurs at altitudes less than 1,243 miles, with orbital periods of 127 minutes or less. The boundary between LEO and higher orbits is not well defined. Medium Earth orbit occurs

between low and geosynchronous Earth orbits and is a semi-synchronous orbit with a period of approximately 12 hours. Geosynchronous Earth orbit is occupied by objects orbiting at an altitude of 22,238 miles, with an orbital period of approximately 24 hours. Geostationary Earth orbit is a special case of geosynchronous Earth orbit in which the object orbits above Earth's equator at an angular rotation speed equal to the rotation of the Earth. It thus appears to remain stationary with respect to a point on the equator. The fourth regime, "other", is defined by highly eccentric and geosynchronous transfer orbits that transit between LEO and higher orbital altitudes (Office of Technology Assessment, 1990).

**Sources of Orbital Debris.** Historically, the largest uncontrolled addition to orbital debris has been the breakup of launch vehicle upper stages (Loftus, 1989), which appears to be caused by pressure-vessel failure due to either deflagration or detonation of propellants remaining in the tanks, stress failure of the vessels, or reduction of pressure-vessel integrity by collision with meteoroids or other space objects (Loftus, 1989). In January 1981, a Delta second stage exploded in orbit, resulting in a large amount of orbital debris. Since 1981, however, a depletion burn to eliminate excess fuel after placing the payload in orbit has been performed on all Delta stages. Although explosions have occurred in the lower atmosphere, no orbital Delta stages have exploded since this practice was implemented, and future explosions of Delta stages in orbit are highly improbable (Kessler, 1989).

**Debris Particle Size.** Orbital debris particles can be characterized by size as follows:

- Small - Debris particles smaller than 0.4 inch in diameter. They are too small to be detected by sensors and are considered essentially "invisible".

- Medium - Debris particles between 0.4 and 4 inches in diameter. These medium-sized particles are unlikely to be detected by the Space Surveillance Network.

- Large - Debris particles larger than 4 inches in diameter. This regime represents 5 percent of the total population of debris particles larger than 0.4 inch in size. Particles of this size can be tracked and cataloged by the Space Surveillance Network.

A worldwide array of sensors, the Space Surveillance Network, tracks large pieces of orbital debris through the use of radar and ground telescopes. The AFSPC currently maintains a catalog of almost 8,000 tracked objects in space that are 4 inches or larger in size. As of November 1, 1995, there were 5,747 objects in LEO, 134 in medium Earth orbit, 601 in geosynchronous Earth orbit, and 1,447 in the "other" orbital regime. Only objects that can be consistently tracked and whose source can be identified are entered into the catalog (Office of Science and Technology Policy, 1995).

**Debris Population.** What is known about the debris population is derived from the worldwide network of sensors (optical, electro-optical, conventional radar, phased-array radar, and interferometer sensors) that can detect objects in space of varying sizes. The National Research Council estimates that there

are more than 10,000 objects greater than 4 inches in size in orbit (including the almost 8,000 tracked by AFSPC), tens of millions between 0.039 and 4 inches in size, and trillions less than 0.039 inch in size (National Research Council, 1995). However, there is no universal agreement on these numbers, with most analysts agreeing that neither the number nor the distribution of objects is well known. An estimated 99.5 percent of the orbital debris is between 0.039 and 4 inches in size, but 99.95 percent of the mass of orbital debris is estimated to consist of objects greater than 4 inches in size (Office of Science and Technology Policy, 1995).

The quantity of orbital debris has been growing at a roughly linear rate, and growth is projected to continue into the future. Between 1981 and 1994, an average of 100 launches worldwide occurred annually (Office of Science and Technology Policy, 1995). A high-velocity collision between two objects could produce many objects, increasing the likelihood of additional collisions in that orbit. As additional collisions occur, the likelihood of additional collisions increases further, producing an exponential growth in the debris population (National Research Council, 1995). This mechanism is incorporated in NASA, European Space Agency, and Russian debris models, which predict an increasing probability of orbital collisions over time. However, it is not yet considered sufficiently validated by the DoD to incorporate into DoD models (Office of Science and Technology Policy, 1995).

**Altitude Distribution.** The altitude distribution of all orbiting debris is unknown due to tracking limitations. As the altitude increases, the minimum-sized detectable objects increase due to sensor limitations. With the exception of a slight concentration near the poles, objects are spread uniformly over the surface of the Earth (Kessler, 1988).

**Orbital Lifetime/De-orbiting Debris.** Orbiting objects lose energy through friction with the upper reaches of the atmosphere and various other orbit-perturbing forces. Over time, the object falls into progressively lower orbits and eventually falls to Earth. As the object's orbital trajectory draws closer to Earth, it speeds up and outpaces objects in higher orbits. Once the object enters the measurable atmosphere, atmospheric drag will slow it down rapidly and cause it either to burn up or deorbit and fall to Earth. For example, unless reboosted, satellites in circular orbits at altitudes of 124 to 248 miles re-enter the atmosphere within a few months. At 248- to 559-mile orbital altitudes, orbital lifetimes can exceed a year or more depending on the mass and area of the satellite. Above 559-mile altitudes, orbital lifetimes can be 500 years or more (Interagency Group [Space], 1989). Figure 3.13-1 shows the relationship between altitude and orbital lifetime.

Both satellite and orbital debris Earth orbit lifetimes are a function of drag and ballistic coefficients. The greater the mass per unit area of the object, the greater the ballistic coefficient and the less the object will react to atmospheric drag. For example, a fragment with a large area and low mass (e.g., aluminum foil) has a lower ballistic coefficient and will decay much faster (have a shorter orbital life) than a fragment with a small area and high mass (e.g., a ball bearing). The combination of a variable atmosphere and unknown ballistic coefficients of orbital debris make decay and re-entry prediction difficult and inexact (Interagency Group [Space], 1989).

Orbital lifetimes for objects in elliptical orbits can vary significantly from lifetimes of objects in circular orbits. For elliptical orbits, the lower the perigee altitude (the point in the orbit that is nearest to the center of the Earth), the greater the atmospheric drag effects. Therefore, considering a circular and an elliptical orbit with equal energies, an object in an elliptical orbit will have a higher apogee (the point in the orbit that is at the greatest distance from the center of the Earth) decay rate and a shorter on-orbit lifetime (Interagency Group [Space], 1989). Solar-lunar perturbations act on debris in a highly elliptical orbit to either raise or lower the perigee, and therefore affect de-orbiting rates (Johnson, 1987).

### 3.13.2 Uncertainty in the Orbital Debris Environment

A large degree of uncertainty exists in understanding the current orbital debris environment. The uncertainties in assessing the debris environment include the number, density, mass, and the size of orbital debris. For orbital debris larger than 4 inches, it is generally accepted that the LEO environment has been measured reasonably adequately by space surveillance sensors, and these data provide a basic estimate of the orbital debris population.

Mathematical models of spacecraft or rocket body breakups are used to predict the size and number of fragments smaller than 4 inches. These predictions are then compared with limited telescope and special radar observations. The difference between the expected number of objects to be detected and the number actually observed becomes an estimate of the uncertainty of the populations. Based upon these data, the population density of the measured debris is known to an uncertainty factor of two to

Figure 3.13-1. Estimated Orbital Lifetime

five, depending on the diameter of the debris. However, for debris 0.4 to 4 inches, there are no confirmed measurements, and the estimates are based on linear extrapolation, which has an uncertainty factor of 10 (Interagency Group [Space], 1989).

Uncertainties in the natural decay process add to the degree of overall uncertainty. Natural decay is usually the result of atmospheric drag, solar-lunar perturbations (for highly elliptical orbits), or solar radiation pressure (for very light objects). Solar flares affect the rate of debris decay and contribute to the uncertainty. A major parameter in orbital decay is atmospheric density at the altitude of the orbiting object, which is also a function of the level of solar activity at any given altitude. Therefore, the more accurate the solar activity and atmospheric density prediction, the more accurate the debris decay prediction. However, forecasting solar activity is not an exact science (Kessler, 1988).

Other factors that contribute substantially to the uncertainty in the orbital debris environment include lack of predictability in the level of future space activities, including the types of activities, and lack of understanding of the causes of explosion/collision-induced satellite breakups. As noted above, these breakup events are the major sources of orbital debris. As commercial and foreign agencies enter the space arena, there will be more opportunities for debris generation. Although the exact cause of most breakups is unknown, it is generally thought that they are most often the result of inadvertent mixing of hypergolic fuels, overheating of residual propellants, or deliberate fragmentation (Johnson, 1987).

### 3.13.3 Hazards to Space Operations from Orbital Debris

The effects of launch-vehicle-generated orbital debris impacts on other spacecraft would depend on the altitude, orbit, velocity, angle of impact, and mass of the debris. Debris less than about 0.004 inch in diameter can cause surface pitting and erosion. Over a long period of time, the cumulative effect of individual particles colliding with a satellite might become significant because the number of particles in this size range is very large in LEO. Long-term exposure of payloads to such particles is likely to cause erosion of exterior surfaces and chemical contamination, and may degrade operations of vulnerable components such as optical windows and solar panels. Debris between 0.004 and 0.4 inch in diameter would produce significant impact damage that can be serious, depending on system vulnerability and defensive design provisions. Objects larger than 0.4 inch in diameter can produce catastrophic damage. Although it is currently practical to shield against debris particles up to 0.4 inch in diameter (a mass of 0.05 ounce), for larger sizes of debris, current shielding concepts become impractical (Office of Science and Technology Policy, 1995).

Solid rocket motors eject aluminum oxide dust (typically less than 0.004 inch) into the orbital environment, and may release larger chunks of unburned solid propellant or slag. However, solid rocket motor particles typically either decay very rapidly, probably within a few perigee passages, or are dispersed by solar radiation pressure. Thus, the operational threat of solid rocket motor dust is probably limited to brief periods of time related to specific mission events (Office of Science and Technology Policy, 1995).

Orbital debris generated by launch vehicles contributes to the larger problem of pollution in space that includes radio-frequency interference and interference with scientific observations in all parts of the spectrum. For example, emissions at radio frequencies often interfere with radio astronomy observations (Office of Technology Assessment, 1990). Not only can orbital debris interfere with the performance of scientific experiments, but it can even accidentally destroy them (Scheraga, 1986).

## 3.14 BIOLOGICAL RESOURCES

The ROI for biological resources includes the native and introduced plants and animals within the area potentially affected by construction activities and launch operations. For discussion purposes, these are divided into vegetation, wildlife (including aquatic biota), threatened or endangered species, and sensitive habitats. Appendix G provides lists of plants and animals potentially occurring in the vicinities of Cape Canaveral AS (Table G-1) and Vandenberg AFB (Table G-2).

The vegetation and wildlife subsections focus on those species expected to be present in habitats adjacent to the project area sites, aquatic species that could be affected by water quality changes, and birds and mammals of the offshore waters, islands, estuaries, lagoons, and wildlife refuges that could be affected during launch operations. Sensitive species (i.e., former federal Category 2 species, state species of special concern, and regionally rare and declining species) are included in this discussion. Federally and state-listed threatened and endangered species are discussed under a separate subsection.

Sensitive habitats include wetlands, plant communities that are unusual or of limited distribution, and important seasonal use areas for wildlife (e.g., migration routes, breeding areas, crucial summer/winter habitats). They also include critical habitat as protected by the Endangered Species Act and sensitive ecological areas as designated by state or federal rulings.

Information used in developing this section includes current and historical aerial photographs, numerous survey reports including wetland delineation survey reports, interviews with local experts, site visits in February and March 1997, National Wetlands Inventory data, and natural resource data.

### 3.14.1 Cape Canaveral AS

Cape Canaveral AS occupies 15,800 acres of coastal habitat on a barrier island complex that parallels Florida's mid-Atlantic coast. The ROI for biological resources consists of Cape Canaveral AS and the surrounding land and adjacent Atlantic Ocean vicinities that could be affected by construction activities and effects from launch operations. Included in the ROI are three major water bodies, other than the Atlantic Ocean, that could be subjected to indirect launch effects, depending on the prevailing wind direction: the Banana and Indian rivers and the Mosquito Lagoon (Figure 3.14-1).

**3.14.1.1 Vegetation.** Cape Canaveral AS has a series of ridges and swales parallel to the coastline that support several ecologically significant natural communities, even though the communities are highly fragmented by mission-related construction and clearing. At least 10 high-quality natural communities exist on Cape Canaveral AS: oak scrub, rosemary scrub, maritime hammock, coastal strand, coastal dunes, grasslands, seagrasses, and three wetland communities (hydric hammock, interdunal swales, and estuarine tidal swamps and marshes).

Vegetation on the station consists mainly of the indigenous Florida coastal scrub (including oak and rosemary scrub), and xeric and maritime hammocks. These scrub habitats contain the non-native nuisance plant, the Brazilian pepper, which invades these communities along disturbed areas, and then becomes established as it outcompetes native species. Coastal strand, coastal dune, and grasslands can be found along the 13 miles of shoreline along the Atlantic Ocean. Seagrasses are found in the nearby rivers. Numerous wetlands and associated vegetation communities including hydric hammock, interdunal swales, and estuarine tidal swamps and marshes can be found on Cape Canaveral AS and its 12-mile shoreline along the Banana River. The remaining areas are associated with the cleared launch complexes and support facilities (National Aeronautics and Space Administration, 1996). Wetlands are discussed under Sensitive Habitats.

Oak scrub consists of densely growing shrubs that include myrtle oak, sand live oak, saw palmetto, and Chapman oak. Scrub is a fire-maintained community with hot, intense fires occurring every 20 to 80 years. Prior to modern development, these oak scrub communities would have burned frequently from lightning-strike fires. However, fire suppression has caused the scrub to become so densely vegetated that, if burned, it would result in a catastrophic fire that would completely remove the vegetation from the area. The Integrated Natural Resources Management Plan for Cape Canaveral AS includes a burn plan to manage scrub oak. Rare plants and animals can be found in such openings where fire or mechanical removal of trees has occurred (Florida Natural Areas Inventory, 1996b).

Figure 3.14-1. Biological Resource Features, Cape Canaveral AS, Florida

Maritime hammock is found on Cape Canaveral AS in two locations: on the east side, just landward of coastal strand, referred to as Atlantic maritime hammock, and on the west side of the peninsula, bordering the Banana River, referred to as Banana River maritime hammock. The largest stand of Atlantic maritime hammock occurs on the southern end of the station. Coastal strand
typically contains sea oats (a state species of special concern) and is often integrated with scrub species from the coastal scrub communities. It often contains thickets of cabbage palm, saw palmetto, sea grapes, and tough buckthorn (Florida Natural Areas Inventory, 1996b).

Coastal dunes are inhospitable to many plants because of the constantly shifting substrate, salt deposition, abrasion from wind-blown sand, and effects of storm waves. The beaches south of Cape Canaveral AS have been eroding, while beaches to the north are enlarging. Cape Canaveral AS beaches are also enlarging, and several parallel dune lines and conspicuous offshore sand bars are supported. Sea oats, beach elder, railroad vine, beach croton, bitter panic grass, saltgrass, camphorweed, and beach cordgrass can often be found in coastal dune communities (Florida Natural Areas Inventory, 1996b).

Natural grasslands are rare in the areas of the launch complexes. These areas are subject to frequent disturbance from mowing and other human activities, and grasslands there typically comprise primarily exotic species.

Seagrasses, including Cuban shoal, manatee, and turtle grasses, are present in the northern Indian River system (including the Banana River).

**Concept A ROI.** Florida coastal scrub is the prevalent vegetation type surrounding SLC-41, although maritime hammock is found adjacent to the southern side of the complex (Figure 3.14-2). Mowed grasses and forbs are the predominant vegetation on SLC-41. Brazilian pepper dominates the Titan II Transporter Road margins, excluding all but the hardiest live oak, red cedar, wax myrtle, and cabbage palm. Woody vines are found entwined in the tree cover and include wild grape, pepper vine, and Virginia creeper. Coastal plain willow and giant leather fern characterize the Brazilian pepper transition into a wetland community, which is described in Section 3.14.1.4. Maritime hammock comprises 1.5 acres on the site and represents the only high-quality natural community on the project site.

**Concept B ROI.** Florida coastal scrub is the prevalent vegetation type surrounding SLC-37, although maritime hammock is found adjacent to the northern side of the complex (Figure 3.14-3). Scrub habitat is also found along the entrance to SLC-37, although the Brazilian pepper is dominant along the roadways. Portions of SLC-37 within 200 feet of the beach area are within the influence of the coastal strand communities. The proposed HIF site location contains a coastal scrub community with dry grassy swales.

Figure 3.14-2  SLC-41 Vegetation and Sensitive Habitat, Cape Canaveral AS, Florida

Figure 3.14-3  SLC-37 Vegetation and Sensitive Habitat, Cape Canaveral AS, Florida

Myrtle oak, sand live oak, Chapman's oak, saw palmetto, sand cordgrass, prickly pear, and buckthorn dominate this vegetation type.

**3.14.1.2 Wildlife.** The coastal scrub and associated woodlands provide habitat for mammals including the white-tailed deer, armadillo, bobcat, feral hog, raccoon, long-tailed weasel, and round-tailed muskrat. The Florida mouse (a state species of special concern) requires open dry scrub habitat and could occur on Cape Canaveral AS.

Numerous land and shore birds are found at Cape Canaveral AS. In the maritime hammock, the little blue heron, the mourning dove, the gray catbird, the black-throated warbler, and the northern cardinal can be found. Burned hammock provides habitat for the rufous-sided towhee, the common yellow-throat, the northern mockingbird, the house wren, the downy woodpecker, and the osprey. Oak-hickory scrub is habitat for the blue and scrub jays, the mourning and common ground doves, and the red-bellied woodpecker, as well as many maritime hammock species. Shore birds include the black-necked stilt, the willet, the ruddy turnstone, the spotted sandpiper, gulls, the Caspian tern, the brown pelican, the roseate spoonbill, the wood stork, and the great blue heron. Turkey vultures, hawks including the red-tailed and the sharp-shinned hawks, the barn swallow, the fish crow, the common grackle, warblers, and sparrows are also found on Cape Canaveral AS.

Neotropical migrants observed on Cape Canaveral AS include eight species of warbler such as the blue-winged and black-and-white warblers, yellow-throated and red-eyed vireos, the eastern kingbird, the ovenbird, and the American redstart. Migrating raptors, including merlin, Cooper's hawk, and peregrine falcon, forage in the maritime hammock during fall and spring.

Numerous amphibians and reptiles have been observed at Cape Canaveral AS. Amphibians observed include the spade-foot and eastern narrow-mouth toads, squirrel and southern leopard frogs, and green treefrogs. Besides the common American alligator, reptiles observed include the Florida box turtle, the gopher tortoise, the Florida softshell, the green anole, the six-lined racerunner, the broadhead skink, the southern ringneck snake, the everglades racer, the eastern coachwhip, and the mangrove salt marsh snake.

The Cape Canaveral AS area is a transition zone between temperate and subtropical forms in terms of aquatic biota. Aquatic organisms found in the area are generally adapted to fluctuations in temperature and salinity. Numerous marine mammals can be found along the coast of Florida near Cape Canaveral AS and in the lagoons, including the bottlenose dolphin, the spotted dolphin, and the manatee. The seagrass beds in the northern Indian River system provide important nursery areas, shelter, and foraging habitat for a wide variety of fish and invertebrates, and for manatees. The Banana and Indian rivers and the Mosquito Lagoon provide habitat for marine worms, mollusks, and crustaceans. The Mosquito Lagoon, located approximately 6 miles northwest of Cape Canaveral AS, is considered an important shrimp nursery area. It also has the best oyster and clam harvesting in the area.

Within the Indian and Banana River systems, a number of saltwater fish species can be found. The bay anchovy is one of the dominant species inhabiting the lagoon system (U.S. Air Force,1987a). Other species known to occur include pipefish, goby, silver perch, lined sole, spotted seatrout, and oyster toadfish.

The small freshwater habitats found on Cape Canaveral AS contain bluegill, garfish, largemouth bass, killifishes, sailfin molly, and top minnow.

**Concept A ROI.** Wildlife on SLC-41 is mostly transient. The SLC is mostly developed (urban landscape).

**Concept B ROI.** Gopher tortoise burrows were found in many areas on SLC-37.

**3.14.1.3 Threatened and Endangered Species.** Cape Canaveral AS contains habitat utilized by a large number of federally and state-listed species. Listed species that are known to be present or near the station boundaries are presented in Table 3.14-1.

Six species of listed plants have been documented on Cape Canaveral AS (Florida Natural Areas Inventory, 1996b). Two of these species, Curtiss' milkweed (one occurrence) and the nodding pinweed (two occurrences), were identified in scrub habitat on the southern half of Cape Canaveral AS. These species are dependent on the clearings created by occasional fires and benefit from clearing for scrub jay habitat.

Two listed plant species were found in maritime and hydric hammocks: hand fern (one occurrence) and the satin-leaf (not recorded when found). These communities are not fire-maintained and are threatened by the encroachment of exotic species, such as the Brazilian pepper. The hand fern is an epiphyte that exists in cabbage palmetto old leaf bases, which are present in moist hammock communities. It is extremely sensitive to habitat disturbance. The hand fern was found on the southern half of Cape Canaveral AS.

The remaining two listed plant species were also found in coastal dune, coastal interdunal swale, and coastal strand habitats, as well as in openings and disturbances in other communities: beach-star (five occurrences) and coastal vervain (ten occurrences). These species are colonizers of open, sandy areas provided by wind, fire, or storm overwash. The beach-star was found along sandy beaches. The coastal vervain was found along some roads and other areas on the station. None of the populations occurs near the roads or facilities proposed for EELV activities.

**Table 3.14-1. Threatened, Endangered, and Candidate Species Occurring or Potentially Occurring at Cape Canaveral AS, Florida**

| Common Name | Scientific Name | Federal Status | State Status |
|---|---|---|---|
| **Plants** | | | |
| Giant leatherfern | *Acrostichum danaeifolium* | - | T |
| Curtiss' milkweed | *Asclepias curtissii* | - | E |
| Satin-leaf | *Chrysophyllum olivaeforme* | - | E |
| Coastal vervain | *Glandulareia maritima* | (C2) | E |
| Nodding pinweed | *Lechea cernua* | - | E |
| Hand fern | *Ophioglossum palmatum* | - | E |
| Golden polypody | *Phlebodium aurea* | - | T |
| Beach-star | *Remirea maritima* | - | E |
| **Reptiles and Amphibians** | | | |
| Gopher frog | *Rana capito* | C | SC |
| American alligator | *Alligator mississippiensis* | T(S/A) | SC |
| Eastern Indigo snake | *Drymarchon corais couperi* | T | T |
| Green sea turtle | *Chelonia mydas* | E | E |
| Loggerhead sea turtle | *Caretta caretta* | T | T |
| Leatherback sea turtle | *Dermochelys coriacea* | E | E |
| Atlantic (Kemp's) Ridley sea turtle | *Lepidochelys kempi* | E | E |
| Hawksbill sea turtle | *Eretmochelys imbricata imbricata* | E | E |
| **Birds** | | | |
| Wood stork | *Mycteria americana* | E | E |
| Bald eagle | *Haliaeetus leucocephalus* | T | T |
| Peregrine falcon | *Falco peregrinus* | E(S/A) | E |
| Florida scrub jay | *Aphelocoma coerulescens coerulescens* | T | T |
| Piping plover | *Charadrius melodus* | T | T |
| Least tern | *Sterna antillarum* | - | T |
| Southeastern American kestrel | *Falco sparverius paulus* | (C2) | T |
| **Mammals** | | | |
| Manatee | *Trichechus manatus* | E | E |
| Southeastern beach mouse | *Peromyscus polionotus niveiventris* | T | T |
| Finback whale | *Balaenoptera physalus* | E | E |
| Humpback whale | *Megaptera novaeangliae* | E | E |
| Northern right whale | *Eubalaena glacialis* | E | E |
| Sei whale | *Baeaenoptera borealis* | E | E |
| Sperm whale | *Physeter catodon* | E | E |

C = candidate (former Category C1)
C2 = former Category 2
E = endangered
SC = special concern (state designation)
(S/A) = listed by similarity of appearance to a listed species
T = threatened

Listed animals in the vicinity of the launch complexes include the bald eagle, the southeastern American kestrel, the American alligator, the Atlantic loggerhead and green sea turtles along the Atlantic coastline; the southeastern beach mouse along the vegetation zones paralleling the beach

and dune lines; the eastern indigo snake and the gopher frog in moist areas or in dry land gopher tortoise burrows; gopher tortoises in all habitats; the Florida scrub jay in Florida coastal scrub and slash pine stands; and the West Indian manatee along the Banana River (National Aeronautics and Space Administration, 1996).

The gopher tortoise is still common in some parts of its range although rare in others. Although this species is not formally listed by federal or state agencies, gopher tortoise habitat warrants special note because the burrows provide important habitat to numerous other protected species. The gopher tortoise was found in moderate densities on Cape Canaveral AS in areas of sandy, well-drained soils, primarily in coastal strand and dry clearings. The gopher tortoise prefers open habitats that have herbaceous plants for forage including disturbed areas such as recent burn areas, road shoulders, fence lines, and launch complexes. Gopher tortoises are tolerant of human presence.

The gopher frog is a candidate species found mainly in native xeric upland habitats, including xeric oak hammocks. It will often use gopher tortoise burrows as shelter. The egg masses are often laid within 4.5 centimeters of the water's surface on emergent vegetation or on the bottom of shallow pools.

Although commonly found throughout Cape Canaveral AS, the American alligator is federally listed as threatened because it is similar in appearance to the American crocodile, which is not present on the station. The American alligator lives in fresh to brackish waters found in marshes, ponds, lakes, rivers, swamps, bayous, and large spring runs. It basks on land next to the water and digs dens and builds nests in river banks, lake margins, or marshes. The American alligator uses the dens for protection from cold or drought.

The threatened eastern Indigo snake has been found on Cape Canaveral AS and likely occurs throughout the station. It is known to occur in most types of hammocks, flatwoods, scrub, and swale marshes, often near wetlands, and is often associated with gopher tortoise burrows. Home ranges for males range from 191 to 360 acres; female home ranges are from 14 to 139 acres.

Green sea turtle breeding populations along the Florida and Pacific coasts and the Gulf Coast of Mexico are federally listed as endangered; all other populations are listed as threatened throughout its range worldwide. Pollution and human development are degrading the beach nesting and ocean feeding habitats for the green sea turtle in portions of its range. Nighttime lighting near beaches generally makes nesting on beaches unsuitable for successful reproduction. Development on the beaches sometimes forces nesting to occur too close to the tidal zone, which causes many nests to be destroyed by tidal inundation and erosion. Green sea turtles are present on the Florida coast from May to October (Mercadante, 1997) and are known to nest on Cape Canaveral AS beaches. Cape Canaveral AS has a lighting management program in place to minimize light impacts on sea turtle nesting beaches.

The threatened (federal and state listing) loggerhead sea turtle is relatively abundant and occupies most of the Florida coastline. The turtles nest on the beaches of Florida from May to October. It is possible that only the females are migratory; males are known to occupy Florida waters year-round. Loggerhead sea turtles are known to nest on Cape Canaveral AS beaches.

The endangered (federal and state listing) leatherback sea turtle population in Florida is small and is threatened by disturbances to natural lighting conditions, erosion, nest predation, and pollution along the beaches. Leatherback sea turtles occur mainly in the open sea, but some females can be found on the Florida beaches and utilize coastal waters from April to July. The leatherback sea turtle has been reported to nest on Cape Canaveral AS beaches (three occasions).

Although the Atlantic (Kemp's) Ridley and the Hawksbill sea turtles are not known to nest on Cape Canaveral AS beaches, they have been known to occur in the waters off the Florida coast and near shore areas.

Wood storks forage in marshes, ponds, and lagoons and are year-round residents in the Cape Canaveral AS area, nesting in the treetops of mangrove swamps or by man-made impoundments.

As of 1995, the bald eagle has been down-listed to threatened throughout the continental United States, although the Florida population has been listed as threatened for years. They can be found year-round near the coast, rivers, and large lakes of Florida, but they do not breed on Cape Canaveral AS, although numerous active nests have been reported at the KSC. On rare occasions, bald eagles can be tolerant of human activity if it is not directed toward them. However, they typically need a one-quarter to one-half mile buffer between human activity and an active nest site to avoid disruption of breeding and nesting activities.

All free-flying peregrine falcons are federally listed as endangered (because of their similarity in appearance to the subspecies *Falco peregrinus anatum,* which is listed as endangered). The peregrine falcon migrates through the Florida area and can be found most of the year, except from mid-June to mid-August. The bird is basically tolerant of human presence.
The Florida scrub jay is a year-round resident that is very sedentary and territorial. Its habitat is in open oak scrub without a dense canopy, as well as palmetto, sand pine, and rosemary. Scrub jays nest in territories adjacent to several northern SLCs with successful nesting occurring March through June next to these launch facilities. As little as 5 to 10 acres of suitable habitat may support a mated pair (Fernald and Toland, 1991). Statewide average scrub jay territory size is 20 acres (U.S. Air Force, 1993b). The average on Cape Canaveral AS is approximately 13 acres. Without suitable habitat, scrub jays are susceptible to predation and have low nesting success. It is believed that 25 percent of the state's total scrub jay population inhabits Cape Canaveral AS. Drier, more sparsely vegetated habitats are better for scrub jay management activities than wetter areas. The species can become habituated to human presence over time. The scrub jays near SLC-40 and SLC-41 were monitored for three years during Titan IVB launches (Larson et al., 1993). Launches occurred every three months from March to September at SLC-40, and once during June at SLC-41. No scrub jay mortalities were

associated with these launches. The only distress shown by any birds within hours of a launch occurred when vegetation was burned or defoliated near a flame trench at SLC-40. The birds avoided this damaged area for one month. A study of the effects of construction on scrub jay territory size found that construction at SLC-41, resulting in a loss of 2.5 acres of scrub and 1.5 acres of mowed grass habitat, caused the average surrounding territories to decrease slightly in size (Larson, et al., 1993).

Least terns nest along sandy or gravelly beaches by SLC-46 and on gravel rooftops in an industrial area on Cape Canaveral AS, approximately 1 mile north of the jetty. They are very sensitive to disturbance when nesting. Inhabiting Cape Canaveral AS from April to mid-October, they typically nest between May and June.

Piping plover nest in or near least tern colonies along the Atlantic coast from approximately March to August. There are no confirmed nesting areas on Cape Canaveral AS; however, they may overwinter in the area.

The Florida populations of the southeastern American kestrel may be year-round residents and were observed in the winter on Cape Canaveral AS. Found in open or partly open habitat in scrub, open forests, cultivated lands, and wooded streams, they have not been observed to breed on Cape Canaveral AS.

The Florida manatee is endemic in this region of Florida, occupying shallow coastal waters, estuaries, bays, and enters coastal rivers and lakes. Sheltered bays, coves, and canals are important environments for its reproductive activities. Manatees are semipermanent residents in the area but may migrate southward for the winter. Manatee critical habitat is present in the Banana River on Cape Canaveral AS and in the surrounding area (see Figure 3.14-1). Manatees are sensitive to human disturbance, and their survival is complicated by their low population densities, low reproductive rates, limited range, and high mortalities. Die-offs associated with red tides and unusually cold weather have occurred in Florida. However, the primary threat to the manatee is boat-propeller-inflicted injury.

Southeastern beach mouse populations on Cape Canaveral AS have been found at the launch complexes where the area is artificially open grassland. The coastal grasslands and strand communities provide the highest population densities at Cape Canaveral AS. Other habitat is the primary dune, although the sea oat vegetation is not as suitable for the beach mouse as the grassland.

Finback, humpback, northern right, sei, and sperm whales, all federally and state-listed as endangered, are pelagic mammals that are generally found from the shelf edge seaward. The whales move to northern temperate waters in the spring and toward the equator in the fall, migrating past Cape Canaveral AS and around the tip of Florida north of Cuba. The National Marine Fisheries Service (NMFS) is proposing to designate the water adjacent to the coast of Florida as critical habitat for the northern right whale.

**Concept A ROI.** Scrub jay nesting territories are adjacent to the eastern side of SLC-41 and are approximately 500 feet east of the site of the two proposed assembly facilities (see Figure 4.13-2). Although no sensitive species are known to reside on SLC-41, many sensitive species such as the manatee occur in the adjacent aquatic habitat. At the site of the proposed assembly facilities, two plants listed as threatened by the Florida Department of Agriculture and Consumer Services occur: the giant leather fern and the golden polypody. These plants are locally abundant, however, and are not listed as rare on Cape Canaveral AS by the Florida Natural Areas Inventory (Smith Environmental Services, 1997). One American alligator was documented as using the cattail marshes and adjacent Brazilian pepper/willow wetland on the assembly facilities site, but this species is common on Cape Canaveral AS.

**Concept B ROI.** The gopher tortoise occurs on SLC-37 and could support numerous commensal species. The complex is also adjacent to Florida beach mouse habitat. Scrub jay nesting territories are adjacent to SLC-37, and scrub jays use the open habitat on the SLC for foraging. Scrub jay nesting territories are also present at the proposed HIF site.

**3.14.1.4 Sensitive Habitats.** Sensitive habitats on Cape Canaveral AS include wetlands, critical habitats for threatened and endangered species as defined by the Endangered Species Act, and the nearby Cape Canaveral National Seashore and Merritt Island National Wildlife Refuge.

**Wetlands.** Cape Canaveral AS contains many wetlands and associated vegetation communities including estuarine tidal (mangrove) swamps and marshes, hydric hammock, coastal interdunal swales, and man-made borrow pits and canals. A U.S. Fish and Wildlife Service (USFWS) National Wetlands Inventory conducted in 1994 identified a total of 2,235 acres of wetlands on Cape Canaveral AS. Specific wetland delineations for each concept have been conducted and are described in the site-specific discussions that follow.

Hydric hammocks occur along the Banana River on the western boundary of the station in lowland areas where the soils are generally saturated year-round but are inundated only for short periods after heavy rains. Hydric hammocks often transition into a sawgrass-willow or cattail marsh. Cabbage palm is present throughout the hammock, and live oak, American elm, and mulberry are present in the better-drained areas. Tropical species including the myrsine, twinberry, wild coffee, and white stopper can be found with strangler fig “strangling” cabbage palms. Ferns are abundant in many areas. The exotic Brazilian pepper has invaded even the most intact hydric hammock.

Coastal interdunal swales are found in the coastal dune areas and between areas of maritime hammock. These swales are saturated most of the year and support grasses and a few woody plants. Sedges, arrowhead, frog-fruit, sabatia, and fleabane can also be found. The drier swales support some woody plants including the wax myrtle, the live oak, the saw palmetto, and the groundsel tree. The listed coastal vervain can be found in the interdunal swales.

**Cape Canaveral National Seashore.** The Cape Canaveral National Seashore lies north of Cape Canaveral AS (see Figure 3.14-1). The least disturbed and undeveloped coastal segments remaining along Florida's eastern shoreline were set aside in 1975 as part of the National Seashore to ensure preservation of these segments.

**Merritt Island National Wildlife Refuge.** The Merritt Island National Wildlife Refuge lies west of Cape Canaveral AS (see Figure 3.14-1). A large manatee aggregation site, attracting up to 200 manatees in the spring, is within the boundaries of the refuge. Other threatened or endangered species that inhabit the scrubby flatwoods of Merritt Island include the Florida scrub jay, the eastern indigo snake, and the southern bald eagle.

**Critical Habitat.** Manatee critical habitat, located in the Banana River system, includes the entire inland sections of the Indian and Banana rivers, and all waterways between the two rivers, with the exception of some man-made structures or impoundments not necessary to the normal needs of the manatee. The NMFS is proposing to designate the water adjacent to the coast of Florida as critical habitat for the northern right whale.

**Indian River Lagoon.** The Indian River Lagoon is home to more than 4,300 kinds of plants and animals. This unique estuary is actually three lagoons, the Mosquito Lagoon, the Banana River, and the Indian River (Pacetti, 1996). These "rivers" have no mouth or flowing current but are headwaters where flow begins, fed by rivers, canals, and streams. The lagoon has a gradation of brackish water (salt and fresh water mixed) to salt water where it opens to the ocean. This lagoon, which is listed as an Estuary of National Significance, contains more species than any other estuary in North America (2,965 animals, 1,350 plants, 700 fish, and 310 birds) (St. John's River Water Management District, n.d.). Located along the Atlantic Flyway, it provides important migratory bird habitat. The lagoon contains one of the highest densities of nesting turtles in the western hemisphere (Pacetti, 1996), is a rich fishery, and is used by up to one third of the United States' manatee population. Development along the shoreline and mosquito control practices have destroyed large areas of mangroves and seagrasses. Mangroves provide essential shoreline protection and nesting areas for rare lagoon birds, such as the wood stork and the roseate spoonbill.

The upper reaches of the Banana River adjacent to Cape Canaveral AS and the lower reaches of the Mosquito Lagoon have generally good water quality due to the lack of urban and industrial development in the area. However, as summarized in the water quality discussion, phenols and aluminum (found in liquid rocket fuels) and pH (a result of solid rocket fuel combustion) occasionally exceed state water quality criteria in these areas. Localized fish kills have been noted after space shuttle launches as a direct result of a temporary (several hours) and localized increase in acidity in the waters adjacent to the launch sites. The long-term effects that these pollutants will have on the estuaries of the area is unknown.

**Concept A ROI.** Wetlands near SLC-41 consist mainly of mixed salt-tolerant grasses, black mangroves, and sea oxeye daisy vegetation (National Aeronautics and Space Administration, 1995c). The mangrove swamps occur in a mosaic fashion on the northwestern edge of Cape Canaveral AS as it

fringes the Banana River. A wetland delineation was conducted for the proposed assembly facilities site. Approximately 8.2 acres of the total 13.5-acre site are jurisdictional wetlands (Smith Environmental Services, 1997). These wetlands are isolated and extremely degraded. Exotic and nuisance plant species, primarily Brazilian pepper, coastal plain willows, and cattail, replaced the historical saltmarsh/mangrove plant communities after mosquito control and development in the area completely isolated the wetlands from the Banana River Lagoon. The disturbance created a wetland with extremely low natural community heterogeneity habitable by only a narrow range of fish and wildlife.

East of the access road to SLC-41, several areas have been impounded and flooded for mosquito abatement. These impounded areas are considered wetlands, although they are not of high quality.

A wood stork rookery was located approximately 1.4 miles north of SLC-41 (National Aeronautics and Space Administration, 1995c). This rookery was abandoned in 1991.

**Concept B ROI.** A wetland delineation was conducted from May to August 1997 (ENSR Corporation, 1997c). SLC-37 contains approximately 7 acres of drainage that are not protected as wetlands because they were constructed on dry land, but may be considered “other surface waters” by the SJRWMD and “Water of the United States” by the USACE (see Figure 3.14-3). The vegetation in these ditches consists of Brazilian pepper, wax myrtle, cattail, duckweed species, leather fern, and water primrose.

SLC-37 is also surrounded by an upland ditch that ultimately connects to the Banana River to the west. This wetland contains cattail and water primrose.

Wetlands were also delineated at the proposed HIF site. Two small, isolated swales of approximately 0.31 and 0.37 acre are on the site (see Figure 3.14-3). They contain sawgrass, sand cordgrass, climbing hempvine, marsh fleabane, wax myrtle, and saltbush. These wetlands have been impacted by changes in the natural hydrology and do not maintain a high functional value (ENSR Corporation, 1997c).

### 3.14.2 Vandenberg AFB

The ROI for biological resources consists of Vandenberg AFB, the adjacent Pacific Ocean, and the northern Channel Islands (Figure 3.14-4).

**3.14.2.1 Vegetation.** Vandenberg AFB occupies a transition zone between the cool, moist conditions of northern California and the semi-desert conditions of southern California. Many plant species and plant communities reach their southern or northern limits in this area. Natural vegetation types on Vandenberg AFB include southern foredunes; southern coastal, central dune, central coastal, and Venturan coastal sage scrub; chaparral including central maritime chaparral; coast live oak woodland and savanna; grassland; tanbark oak and southern bishop pine forest; and wetland communities including coastal salt marsh and freshwater marsh, riparian forests, scrub, and vernal pools (U.S. Air Force, 1989a).

Under the No-Action Alternative, Atlas IIA, Delta II, and Titan IVB launches would continue from SLC-3E, SLC-2W, and SLC-4E, respectively. Within this section, the descriptions of SLC-3E and SLC-4E are included within the Concept A and B ROI descriptions. Because SLC-2W is located on North Vandenberg AFB, the ROI for this site is described separately within each subsection. The undeveloped areas of SLC-2W contain sparse vegetation that can be described as coastal dune scrub. Central dune scrub has been defined by Holland (1986) as a "dense coastal scrub community of scattered shrubs, subshrubs, and herbs generally less than one meter tall and often

Figure 3.14-4. Biological Resource Features, Vandenberg AFB, California

developing considerable cover." This plant community is characterized by species suited to central California's coastal dune environments, such as mock heather, dune lupine, California sage brush, deerweed, and dune mint. Dune mint is a federally listed Category 2 species and is on California Native Plant Society List 1B (plants rare and endangered in California and elsewhere) (National Aeronautics and Space Administration, 1993).

**Concept A ROI.** Plant communities in the vicinity of SLC-3 include coastal sage scrub, grassland and disturbed areas, mixed grassland-coastal sage scrub, riparian woodland and associated emergent vegetation, Burton Mesa chaparral (central maritime chaparral), and non-native woodland (Figure 3.14-5) (U.S. Air Force, 1991f). The coastal sage scrub community is dominated by California sagebrush, coyote brush, mock heather, poison oak, Lompoc bush monkeyflower, and giant wild rye. Two former Category 2 species, black-flowered figwort and Kellogg's horkelia, occur in the coastal sage scrub community and are known to occur near SLC-3 (U.S. Air Force, 1991f).

The grassland community is dominated by non-native grasses including brome, veldtgrass, wild oats, and fescue. It may also include native perennial needle grasses and scattered small shrubs, such as cudweed aster and California sagebrush. Native and non-native forbs associated with the grassland include lupine, owl's clover, blue-eyed grass, and tomcat clover. This plant community occurs on disturbed sites. More substantially disturbed areas, such as SLC-3, are dominated by veldtgrass, black mustard, filaree, hottentot fig, and California goosefoot. Mowed weedy areas occur within the SLC-3 security fence and along road shoulders (U.S. Air Force, 1991f).

The mixed grassland-coastal sage scrub community is a transitional area between grassland, the primary plant community in disturbed areas, and coastal sage scrub, which is the next successional stage in plant community development. The area contains a mosaic of grassland and coastal sage scrub (U.S. Air Force, 1991f).

A riparian woodland community dominated by willows is adjacent to SLC-3 along Bear Creek and associated spring and seeps in tributary canyons, and in a small drainage ditch at the foot of the SLC-3W retention basin. In places, the riparian woodland plant community contains a dense understory of twinberry, blackberry, stinging nettle, and poison oak (U.S. Air Force, 1991f).

Burton Mesa chaparral near SLC-3 is characterized by dense shrubs such as Santa Cruz Island oak, chamise, coast ceanothus, Santa Barbara ceanothus, Purisima manzanita, shagbark or sand mesa manzanita, and Lompoc bush monkeyflower. A number of perennial and annual herbaceous plants also occurs in the Burton Mesa chaparral community. Species composition and vegetative cover vary among sites dependent on the shrub density. Several

Figure 3.14-5. SLC-3W Vegetation and Sensitive Habitat, Vandenberg AFB, California

of the shrubs found in Burton Mesa chaparral are local endemics, including the shagbark manzanita and the coast and Santa Barbara ceanothus (U.S. Air Force, 1991f). Blochman's or dune delphinium is a former Category 2 species that has been found in coastal chaparral on South Vandenberg AFB (Oyler et al., 1995).

Several non-native woodlands occur near SLC-3, the most common of which are tall, often monotypic stands of planted blue eucalyptus. Two stands occur near SLC-3 adjacent to Bear Creek. The blue eucalyptus leaf litter contains toxins that prevent germination of many plants. Planted stands of Monterey cypress also occur along Bear Creek. The edges of woodlands and clearings contain a sparse herbaceous cover dominated by wild oats, black mustard, and veldtgrass (U.S. Air Force, 1991f).

A survey of SLC-3W, associated intersections requiring modifications, and the disturbance at the Upper Stage/Processing Facility and Building 7525 was conducted (Fugro West, Inc., 1996). The vegetation in these areas is dominated by non-native plants such as hottentot fig, veldtgrass, filaree, plantain, and ripgut grass. The most common native species in areas less disturbed include California sagebrush, heather goldenbush, California buckwheat, common cudweed aster, and dune lupine.

**Concept B ROI.** Plant communities in the vicinity of SLC-6 include central coastal sage scrub, chaparral including maritime chaparral, grassland, riparian wetlands, eucalyptus (non-native woodlands), and ruderal areas (Figure 3.14-6). Ruderal vegetation is characterized by disturbance-tolerant, mostly non-native species, primarily introduced grasses such as brome, veldtgrass, wild oats, and fescues. In addition to these plant communities, north-facing slopes dominated by monkeyflower, coyote bush, and California sagebrush with Indian paintbrush, fern, miner's lettuce, and dudleya in the understory are located south of SLC-6. These represent a residual north-coastal flora comprising species more widespread 10,000 years ago during a cooler, moister period (U.S. Air Force, 1978).

Crisp and San Luis Obispo monardellas are two former Category 2 species found in sandy areas. Both have been reported to be present near SLC-6 (Oyler et al., 1995).

The boathouse area is dominated by non-native grassland with scattered coyote brush, California sagebrush, goldenbush, and herbs including vetch and locoweed. The area has been subject to cattle grazing for at least the past 60 years (U.S. Air Force, 1989a). Coastal strand occurs along Vandenberg AFB’s beaches. Native beach plants include beach saltbush, sea rocket, sand verbena, beach morning-glory, and beach burr. European beachgrass and ice plant, non-native species, are pervasive and spreading on most Vandenberg AFB beaches (Persons and Applegate, 1996).

Figure 3.14-6  SLC-6 Vegetation and Sensitive Habitat, Vandenberg AFB, California

The Boathouse Embayment includes three types of subtidal habitats. A rocky boulderfield covers the shoreward half of the bay, and a sandy bottom habitat occurs in the outer portion. The caissons, pilings, and riprap are the third habitat type in the bay. Dense algal growths cover much of the rocky substrate habitat within the embayment. These consist primarily of red algae, several species of brown algae, and two species of green algae. Surfgrass is also common (U.S. Air Force, 1978).

**3.14.2.2 Wildlife.** Vandenberg AFB contains a number of habitat types, which support a rich diversity of wildlife. Mammals, numerous species of birds, amphibians, and reptiles are present in adundance on the base. The coastline, nearshore waters, and Channel Islands also support a wide variety of aquatic life, including marine mammals and birds, fish, and invertebrates. Many of these species are Category 2 species, proposed for listing, or regionally rare.

A large number of rodent species occurs in all habitats, with many occurring in more than one plant community. Small carnivores include raccoons, long-tailed weasels, and striped skunks. Feral pigs forage in riparian zones, and mule deer are found in several habitat types. The larger, contiguous, relatively undisturbed tracts of vegetation on South Vandenberg AFB provide high-quality habitat for wide-ranging carnivores including a number of wildlife species recorded as declining in Santa Barbara County. These include the badger, a regionally rare mammal known to occur in coastal sage scrub and grasslands, and the mountain lion, another regionally rare mammal expected to occur in chaparral and riparian woodlands. Other carnivores include the bobcat, the black bear, the gray fox, and the coyote (U.S. Air Force, 1991f).

Amphibians such as ensatina, blackbelly slender salamander, and Pacific treefrogs may occur in coastal sage and chaparral communities and are also found, along with western toads, in riparian woodland areas. Reptiles such as western skink, western fence lizards, southern alligator lizards, and gopher snakes are found in several habitat types. The southwestern pond turtle is a former Category 2 species found on South Vandenberg AFB in Cañada Honda and Jalama creeks. Bear Creek does not support any deeper pool habitats that are essential for the survival of the turtle (U.S. Air Force, 1991f). The two-striped garter snake is also a former Category 2 species found in Cañada Honda Creek. The California horned lizard and the California legless lizard are former Category 2 species found on South Vandenberg AFB (Christopher, 1996a,b).

Several sensitive species may forage on coastal sage scrub and chaparral habitats. These include the northern harrier, the merlin, and the short-eared owl (all special concern species); the white-tailed kite and the tree swallow (both regionally rare); the Cooper's hawk and the prairie falcon (both special concern species and regionally rare); and the ferruginous hawk (former Category 2 and special concern species) (U.S. Air Force, 1991f).
Bell's sage is a former Category 2 and special concern species found in open Burton Mesa chaparral. A population has been identified at a location east of Lompoc Canyon, approximately 2 miles inland.

Three regionally rare and declining bird species (the Swainson's thrush, the warbling vireo, and the Wilson's warbler) nest in the Bear Creek riparian woodland. The Cooper's hawk (a special concern and regionally rare species) may also nest along Bear Creek. Both riparian woodland and non-native planted tree groves attract migrating flycatchers, kinglets, vireos, warblers, sparrows, and orioles. Several species of hawks, owls, and other common raptors roost and nest in the planted non-native tree groves (U.S. Air Force, 1991f).

Burrowing owls (former Category 2 and special concern species) prefer dry, open, grassy, usually treeless plains, occasionally with gently rolling hills. This species utilizes the same habitat for breeding and wintering. Although suitable habitat occurs on Vandenberg AFB, it appears that this species no longer nests there and is now only an uncommon-to-rare winter visitor to grassland and open scrub habitats. California horned larks (former Category 2 and special concern species) breed in grasslands in the Sudden Flats area (U.S. Air Force, 1994c). Loggerhead shrikes (former Category 2 and special concern species) prefer open country with lookout posts, scattered trees, and low scrub vegetation, and have been observed on South Vandenberg AFB (U.S. Air Force, 1994c). The grasshopper sparrow is a regionally rare bird that may forage in grasslands near SLC-6 (U.S. Air Force, 1989a).

The Santa Barbara Channel is located along the Pacific Flyway, at a biogeographical boundary between warm southern and cold northern ocean waters. As a result, an abundance and diversity of marine birds is found along the offshore waters and Channel Islands. As many as 30 species of seabirds are known to occur in the open ocean water of the continental shelf. The elegant tern (former Category 2 and special concern species) is a coastal area post-breeding visitor during late summer and early fall (U.S. Air Force, 1991f). Long-billed curlews (former Category 3 and special concern species) typically winter in coastal areas and are found at South Vandenberg AFB.

The Channel Islands are inhabited by breeding colonies of marine birds, with the largest colonies on San Miguel Island. These include Leach's and ashy storm-petrels; Brandt's, double-crested, and pelagic cormorants; pigeon guillemots; and Cassin's auklets. California's only nesting colony of brown pelicans occurs on Anacapa Island and an islet adjacent to Santa Cruz Island (U.S. Air Force, 1992b). Nesting sites for some of these species are also documented to exist on the mainland. These include Point Pedernales, Destroyer Rock, Point Arguello, Rocky Point, and Point Conception (see Figure 3.14-4) (U.S. Air Force, 1991f).

California sea lions and northern fur, northern elephant, and harbor seals use the northern Channel Islands as haul-out (resting), mating, and pupping areas. The largest concentrations occur on San Miguel Island. Harbor seals haul out at a total of 19 sites between Point Sal and Jalama Beach. Purisima Point and Rocky Point are the primary haul-out sites on Vandenberg AFB. California sea lions do not breed on Vandenberg AFB. However, Point Sal is used heavily as a haul-out site. San Miguel and San Nicolas islands are the major rookeries for California sea lions and northern elephant seals. Northern elephant seals are periodically observed on Vandenberg AFB. Effects to marine mammals have been monitored over several years from Vandenberg AFB launches and are described in Chapter 4.

Small-toothed whales including bottlenose, common and Pacific white-sided dolphins, and killer whales are common near Vandenberg AFB and in the Channel Islands. The gray whale (a former federally listed endangered species, now designated as recovered) is found close to shore off South Vandenberg AFB during migration from Baja, California, to the Bering Sea, between December and May and returns to Baja in November and December (U.S. Air Force, 1991f). Minke whales have been reported within a few miles of the leeward sides of San Miguel, Santa Rosa, Santa Cruz, and Anacapa islands.

A request, under Section 101(a)(5)(A) of the Marine Mammal Protection Act of 1972, as amended, for a letter of authorization for the incidental take of marine mammals during programmatic operations at Vandenberg AFB was submitted to the NMFS in July 1997 (Appendix H). If approved, Vandenberg AFB will be allowed incidental take for up to 20 space launches per year for the next 5 years.

Wildlife in the vicinity of SLC-2W consists of common regional animals as well as those species found in coastal environments. More common wildlife that may occur at SLC-2W include mule deer, jackrabbits, cottontails, and predatory animals such as the bobcat and the coyote. A high diversity of bird species may occur at SLC-2W.

**Concept A ROI.** Coyote and California ground squirrel burrows were observed throughout the site. Numerous birds observed foraging on site included the Northern harrier, the red-shouldered hawk, the red-tailed hawk, the American kestrel, the Anna's hummingbird, and the California towhee. The regionally rare mountain lion is expected to occur in the chaparral and riparian woodlands near SLC-3W.

**Concept B ROI.** Burrowing owls have been sighted near the boathouse area (Holmgren and Collins, 1995). Animals of the exposed rocky intertidal area in the Boathouse Embayment include the California mussel; the Pacific goose barnacle; and the common, purple, and ocher seastars. Abalone are also found in this area. Biological diversity within the embayment is highest in the rocky boulderfield habitat, which includes 12 species of benthic invertebrates, the most abundant being the snail *Mitrella carinata* and the seastar *Patiria miniata*. Subtidal sandy bottom surfaces within the embayment contain many benthic and infaunal invertebrates beneath the surface. Two polychaete worms, the burrowing shrimp and the clam *Tellina modesta*, are the most abundant. At least 297 species of fish occur in the Point Arguello region. Many of these pass through the mouth of the embayment. These consist mainly of inshore schooling species such as walleye surfperch, topsmelt, and pile surfperch (U.S. Air Force, 1978). Sea otters, seals, and sea lions also use the waters off Point Arguello.

**3.14.2.3 Threatened and Endangered Species.** A number of threatened and endangered species is known or expected to occur on Vandenberg AFB and in the adjacent offshore waters. Table 3.14-2 lists all of the federally and state-listed threatened and endangered species, species proposed for federal listing as threatened or endangered, and candidate species for federal listing (former Category 1 species) that are known to occur or that may

potentially occur in the Vandenberg AFB area. Species that are known or expected to occur on South Vandenberg AFB are discussed in more detail below. Former federal candidate Category 2 species, state species of special concern, and regionally rare and declining species on South Vandenberg AFB are discussed under the Vegetation and Wildlife subsections.

Several other listed plant species, the Gambel's watercress, the seaside's bird's beak, the Lompoc yerba santa, and the La Graciosa thistle, are not known to occur on South Vandenberg AFB, although they may occur on North Vandenberg AFB or in the overall vicinity (Oyler et al., 1995).

The unarmored threespine stickleback (fish) occurs on South Vandenberg AFB only as a transplanted population in C a ñ a d a Honda Creek (U.S. Air Force, 1991f) but also in San Antonio Creek on North Vandenberg AFB. The tidewater goby occurs on South Vandenberg AFB in the coastal lagoon and creek channel at Jalama Creek and has been observed in C a ñ a d a Honda Creek (U.S. Air Force, 1994c).

The southern steelhead trout, which was proposed for listing as federally endangered in August 1996, occurs in the Santa Ynez River and potentially in C a ñ a d a Honda Creek. However, none was identified during surveys conducted in 1994 and 1995. The California red-legged frog has been found in C a ñ a d a Honda and Jalama creeks on South Vandenberg AFB (U.S. Air Force, 1994c) and is reported to inhabit nearly all permanent lakes, streams, and ponds on Vandenberg AFB. In addition, red-legged frogs have been found in the retention ponds near SLC-6. Bear Creek does not support the deeper pool habitats essential for the survival of the red-legged frog (U.S. Air Force, 1991f). The California tiger salamander (federal candidate [former Category 1] and special concern species) is not known to occur on South Vandenberg AFB (Christopher, 1996a).

**Table 3.14-2. Threatened, Endangered, and Candidate Species Occurring or Potentially Occurring at Vandenberg AFB, California**

| Common Name | Scientific Name | Federal Status | State Status |
|---|---|---|---|
| **Plants** | | | |
| Beach layia | *Layia carnosa* | E | E |
| Gambel's watercress | *Rorippa gambelli* | E | T |
| Seaside's bird's beak | *Cordylanthus rigidus* ssp. *littoralis* | - | E |
| Lompoc yerba santa | *Eriodictyon capitatum* | C | R |
| Beach spectaclepod | *Dithyrea maritima* | - | T |
| La Graciosa thistle | *Cirsium loncholepis* | C | T |
| Surf thistle | *Cirsium rhothophilum* | C | T |
| **Fish** | | | |
| Unarmored threespine stickleback | *Gasterostreus aculeatus williamsonii* | E | E |
| Tidewater goby | *Eucyclogobius newberryi* | E | - |
| Steelhead trout | *Oncorhynchus mykiss irideus* | E | - |
| **Reptiles and Amphibians** | | | |
| California red-legged frog | *Rana aurora draytonii* | T | SC |
| Green sea turtle | *Chelonia mydas* | T | - |
| Loggerhead sea turtle | *Caretta caretta* | T | - |
| Pacific Ridley sea turtle | *Lepidochelys olivacea* | T | - |
| Leatherback sea turtle | *Dermochelys coriacea* | E | - |
| **Birds** | | | |
| California brown pelican | *Pelacanus occidentalis californicus* | E | E |
| Bald eagle | *Haliaeetus leucocephalus* | T | E |
| American peregrine falcon | *Falco peregrinus anatum* | E | E |
| California black rail | *Laterallus jamaicensis coturniculus* | - | T |
| Western snowy plover | *Charadrius alexandrinus nivosus* | T | SC |
| California least tern | *Sterna antillarum browni* | E | E |
| Western yellow-billed cuckoo | *Coccyzus americanus occidentalis* | - | E |
| Southwestern willow flycatcher | *Empidonax traillii extimus* | E | E |
| Least Bell's vireo | *Vireo bellii pusillus* | E | E |
| Belding's savannah sparrow[(a)] | *Passerculus sandwichensis beldingi* | - | E |
| Mountain plover | *Charadrius montanus* | C | - |
| **Mammals** | | | |
| Guadalupe fur seal | *Arctocephalus townsendi* | T | T |
| Steller sea lion | *Eumetopias jubatus* | T | - |
| Southern sea otter | *Enhydra lutris nereis* | T | - |
| Sei whale | *Balaenoptera borealis* | E | - |
| Blue whale | *Balaenoptera musculus* | E | - |
| Finback whale | *Balaenoptera physalus* | E | - |
| Humpback whale | *Megaptera novaeangliae* | E | - |
| Right whale | *Balaena glacialis* | E | - |
| Sperm whale | *Physeter catodon* | E | - |

Note: (a) Taxonomic status of subspecies is pending.
C = candidate (former Category C1)
E = endangered
R = rare (state designation)
SC = special concern (state designation)
T = threatened

Several federally listed bird species occur on South Vandenberg AFB. The southern bald eagle formerly nested in the Channel Islands and coastal Santa Barbara County but is now only a fall and winter visitor to these areas (U.S. Air Force, 1991f). The American peregrine falcon nests on rocky coastal cliffs on South Vandenberg AFB and the nearby Channel Islands and forages over the adjacent terraces and flats. Migrating and wintering individuals are also found at Vandenberg AFB.

California brown pelicans nest on the Channel Islands. They are found year-round in the coastal waters of Vandenberg AFB and roost at Point Pedernales, Destroyer Rock, Point Arguello, Rocky Point, and the Boathouse Breakwater (U.S. Air Force, 1994c). Brown pelicans generally forage close to shore, although they may venture farther out to sea during calm weather. While brown pelicans may use different sites to rest during the day, they return to land at night to roost in large numbers at particular sites. During the last quarter century, brown pelican nesting in California has been restricted to the offshore Channel Islands (National Aeronautics and Space Administration, 1993). California least terns nest from mid-April to August in sand dunes on North Vandenberg AFB but use the offshore water areas of South Vandenberg AFB for foraging and during migration (U.S. Air Force, 1991f).

The western snowy plover nests from March to September on approximately 12 miles of Vandenberg AFB beaches, from approximately 3.5 miles south of the Santa Ynez River mouth to approximately 1 mile north and on several miles of beaches and dunes from Purisima Point northward. This species nests in the vicinity of tidal waters in open to barren areas but does not nest colonially (Persons and Applegate, 1996). Western snowy plovers occur on the mainland coast, peninsulas, off-shore islands, and adjacent bays and estuaries. While adult western snowy plovers experienced a decline from the late 1970s to the late 1980s, the Vandenberg AFB population has remained relatively unchanged. The snowy plover winters at these locations and at Jalama Beach. Between March 1 and September 30 of each year, Vandenberg AFB limits recreational access to plover and least tern breeding beaches. This restriction is enforced by Vandenberg AFB game warden patrols.

The Least Bell's vireo, which nest on the upper Santa Ynez River, do not breed on Vandenberg AFB but may visit riparian woodlands at Cañada Honda, Spring, and Bear creeks (U.S. Air Force, 1991f). Southwestern willow flycatchers also breed along the Santa Ynez River but do not nest on South Vandenberg AFB, although Bear Creek apparently provides suitable habitat for this species (Holmgren and Collins, 1995). The western yellow-billed cuckoo is a bird of riparian habitats; occasional transients may forage in the Bear Creek willow woodlands (U.S. Air Force, 1991f). The California black rail and the Belding's savannah sparrow may occur at the Santa Ynez River estuary but are not known to occur any farther south on Vandenberg AFB (Holmgren and Collins, 1995; U.S. Air Force, 1991f). The mountain plover winters annually at the airfield on Vandenberg AFB.

The southern sea otter breeds year-round at Purisima Point off North Vandenberg AFB. No permanent population exists on South Vandenberg AFB, but sea otter are occasionally found feeding in kelp beds offshore (U.S. Air Force, 1994c). The southern sea otter is a federally threatened and state-listed rare species. These marine mammals tend to occupy relatively small ranges; the males of the species range slightly farther. Southern sea otters inhabit intertidal and shallow subtidal zones and are commonly associated with areas sustaining kelp beds. Breeding and pupping occur year-round. Factors attributed to the decline of and continued reduced numbers of southern sea otter populations include overharvesting until the first half of this century, gill and trammel netting mortalities, and limited food availability (National Aeronautics and Space Administration, 1993). The Guadalupe fur seal and the Stellar sea lion are very rare visitors to the Vandenberg AFB area. The Guadalupe fur seal was formerly abundant on the Channel Islands but is now only a rare summer visitor to San Miguel Island. Stellar sea lions used to breed on San Miguel Island, but none have been seen there since 1985.

Six species of endangered whales (the sei, blue, finback, humpback, right, and sperm) may occur in the offshore waters (U.S. Air Force, 1991f). In addition, four species of sea turtles (the green sea turtle, the loggerhead sea turtle, the Pacific Ridley sea turtle, and the leatherback sea turtle) may also occur in the offshore waters (U.S. Air Force, 1991f).

Several sensitive plant species may occur in coastal dune scrub near SLC-2W. Surf thistle and coast spectacle pod occur near SLC-2W. These plant species are both listed by the state of California as threatened. Coast spectacle pod is a federal candidate (former Category 1) species, while surf thistle is a former Category 2 species. Both of these species occur on active dunes. Because of this, localized demes (subsets of the overall population) are variable in numbers and distribution (National Aeronautics and Space Administration, 1993). Beach spectaclepod (also state threatened) is found in dunes near the community of Surf. Surf thistle (also state-threatened) is found in dunes and sandy bluffs along the coast between Surf and Point Arguello.

Two federally listed endangered species (the California least tern and the brown pelican) and two federally listed threatened species (the western snowy plover and the southern sea otter) occur in the vicinity of SLC-2W.

**Concept A ROI.** A population of endangered beach layia was located along Coast Road, approximately 1.3 miles west of SLC-3 (Oyler et al., 1995), which is adjacent to Bear Creek and near C a ñ a d a Honda Creek and the Santa Ynez River. These habitats support numerous sensitive species. No known sensitive species are known to be present at SLC-3W; however, suitable habitat is present at Bear Creek and Coast roads for sensitive plants that occur in the dune scrub habitats.

**Concept B ROI.** SLC-6 is near C a ñ a d a Honda Creek and cliffs, both of which support sensitive species. Peregrine falcons have been observed foraging over SLC-6 and occasionally roosting on structures at the complex on SLC-6 (Read, 1997). Red-legged frogs are known to occur in the retention ponds near the complex.

**3.14.2.4 Sensitive Habitats.** This analysis uses the Santa Barbara County Local Coastal Plan definition of environmentally sensitive habitat:

> "any area in which plant or animal life or their habitats are either rare or especially vulnerable because of their special nature or role in an ecosystem and which could be easily disturbed or degraded by human activities and developments."

Designated environmentally sensitive habitat in the ROI with the potential to be affected by the EELV program include butterfly trees, marine mammal hauling grounds, seabird nesting and roosting areas, white-tailed kite habitat, Burton Mesa chaparral, and wetlands including streams/riparian woodlands (U.S. Air Force, 1991f).

**Butterfly Trees.** The Monarch butterfly is a regionally rare and declining insect known to overwinter in the eucalyptus and cypress groves along Bear Creek near SLC-3 (U.S. Air Force, 1991f). Another major monarch overwintering area is located in Spring Canyon near SLC-3 (Read, 1997). The “butterfly trees” are protected as a monarch wintering habitat that is declining in California.

**Marine Mammal Hauling Grounds.** There are 3 miles of coastline between Oil Well Canyon and Point Pedernales designated as a marine ecological reserve. This includes a beach area south of Rocky Point used by harbor seals as haul-out and pupping areas. Vandenberg AFB and the California Department of Fish and Game have an MOA to limit access to this area to scientific research and military operations (U.S. Air Force, 1994c).

**Seabird Nesting and Roosting Areas.** Seabird nesting and roosting areas located on the Channel Islands and on South Vandenberg AFB are discussed under Wildlife, Section 3.14.2.2.

**White-tailed Kite Habitat.** White-tailed kite foraging habitat includes grassland and open coastal sage scrub. Kites are expected to forage in these habitats on South Vandenberg AFB primarily during the fall and winter. Potential roosting and nesting habitat occur in the willow, blue eucalyptus, and cypress trees along Bear Creek (U.S. Air Force, 1991f) and in the riparian habitat along the Santa Ynez River (Read, 1997).

**Wetlands.** Wetlands mapped by the USFWS on South Vandenberg AFB include areas along Bear, Spring, and C a ñ a d a Honda creeks; along the coast; and Lompoc, Grey, and Red Roof canyons (U.S. Department of the Interior, U.S. Fish and Wildlife Service, 1995).

**C a ñ a d a Honda Creek Habitat**. C a ñ a d a Honda Creek is the largest stream on South Vandenberg AFB (U.S. Air Force, 1988b). A perennially flowing stream, C a ñ a d a Honda Creek provides significant habitat for many wildlife species and for listed fish species. The stream supports a dense cover of vegetation, including riparian plant species such as arroyo willow, coyote brush, creek nettle, and bullrushes. Tule, cattails, and green algae densities

increase as the stream nears the interface with the Pacific Ocean (U.S. Air Force, 1985; 1988b).

C a ñ a d a Honda Creek has the most diverse assemblage of invertebrate species (approximately 25 species) on Vandenberg AFB. The more common of these invertebrates include stonefly, caddisfly, various snails, and amphipod crustaceans. This diversity of invertebrates is likely present because of the perennial nature of the stream and the density of riparian vegetation found within and on the banks of C a ñ a d a Honda Creek (U.S. Air Force, 1988b).

An introduced population of the federally listed endangered fish, unarmored threespine stickleback, persists in the perennially flowing portions of the stream (U.S. Air Force, 1988b).

Amphibians and reptiles occurring at C a ñ a d a Honda Creek include the western toad, the Pacific treefrog, the Pacific chorus frog, the red-legged frog, the western pond turtle, the common kingsnake, the common garter snake and the two-striped garter snake. Red-legged frog, western pond turtle, and western garter snake populations have declined because of habitat loss/alteration, harvesting for food, and/or introduced predators. The red-legged frog is federally listed as threatened under the Endangered Species Act; western pond turtles and two-striped garter snakes were formerly listed as federal Category 2 candidates. During summer, when the water flow decreases and portions of this stream become intermittent, amphibian and reptile populations may be reduced or localized to perennially inundated sections of the stream (Christopher, 1996a,b).

C a ñ a d a Honda Creek is an important environment for bird species as well. Avian species that may occur at this creek include woodpeckers, western wood peewees, common yellowthroats, and song sparrows. Winter migrants that may utilize this riparian corridor include ruby-crowned kinglets, hermit thrushes, and yellow-rumped warblers. Because of alteration or loss of riparian areas, bird species that depend on these habitats have declined in population. Yellow-billed cuckoos, long-eared owls, and willow flycatchers are among these dwindling bird species. Another reason for declines in these populations is brood parasitism by brown-headed cowbirds (U.S. Air Force, 1988b).

C a ñ a d a Honda Creek also provides a suitable environment for many mammalian species. Smaller mammals that may be found at C a ñ a d a Honda Creek include deer mice, dusky-footed woodrats, and Trowbridge shrews. Larger mammals commonly occurring in riparian woodlands include Virginia opossums, raccoons, striped skunks, and mule deer (U.S. Air Force, 1988b).

**Santa Ynez River**. The Santa Ynez River watershed drains approximately 900 square miles of land; approximately 45 square miles occurs on Vandenberg AFB (U.S. Air Force, 1988a). This river supports many sensitive species and becomes intermittent during the summer as water levels drop. This, along with high nutrient levels, supports dense, semi-aquatic plant growth. Invertebrate fauna are relatively less abundant and diverse than at C a ñ a d a Honda Creek, where water flows year-round, although invertebrates

such as oligocheate worms can thrive in the Santa Ynez River (U.S. Air Force, 1988b).

In contrast, vertebrate fauna are more diverse and abundant in the Santa Ynez River than in any other stream on Vandenberg AFB. Fish that are known to occur in the Santa Ynez River include mosquito fish, threespine sticklebacks, bass, bluegill sunfish, fathead minnows, arroyo chubs, and tidewater goby. The mouth of the Santa Ynez River forms a lagoon that periodically varies in temperature and salinity depending on the time of year and tidal fluctuations. Because this lagoon is often brackish, marine fish may be found including Pacific herring, starry flounder, and tidewater goby. A small extant native population of anadromus steelhead trout utilizes the Santa Ynez River watershed during spawning and early development (U.S. Air Force, 1988b).

The diversity of amphibian and reptile species on the Santa Ynez River is greater than that found on C a ñ a d a Honda Creek. In addition to those amphibian and reptile species found on C a ñ a d a Honda Creek (such as the western toad, the western pond turtle, the red-legged frog, the Pacific chorus frog, and the common garter snake), the Santa Ynez River supports bullfrogs, western terrestrial garter snakes, and common kingsnakes (Christopher, 1996). Gopher snakes occur in neighboring areas and may utilize this riparian area, preying on birds, small mammals, and other amphibian and reptile species.

Birds may occur among similar riparian environments such as the C a ñ a d a Honda Creek and the Santa Ynez River. Hairy and downy woodpeckers, as well as southwestern willow flycatchers, black phoebes, western wood peewees, warbling vireos, and black-headed grosbeaks, may be found in the Santa Ynez riparian corridor (U.S. Air Force, 1988c).

Mammal species associated with the Santa Ynez River tend to be similar to those at C a ñ a d a Honda Creek. In addition to those mentioned as present at C a ñ a d a Honda Creek, brush rabbits, bobcats, and feral pigs may be present (U.S. Air Force, 1988b).

**Burton Mesa Chaparral.** Burton Mesa chaparral occurs near SLC-3 and is considered a regionally rare and declining plant community with a highly localized occurrence (U.S. Air Force, 1991f). Several of the shrubs found in Burton Mesa chaparral on Vandenberg AFB are local endemics, including the shagbark manzanita and the coast and Santa Barbara ceanothus (U.S. Air Force, 1991f). The Bell's sage sparrow, a species of federal concern, is associated with Burton Mesa chapparal on North and South Vandenberg AFB.

**Other Sensitive Plant Communities.** Several plant communities that occur on Vandenberg AFB are considered sensitive because they contain sensitive plant species and/or are of limited extent. These include riparian woodland and associated freshwater herbaceous vegetation (U.S. Air Force, 1991f). These communities occur near SLC-3 and are described under Vegetation, Section 3.14.2.1.

**Concept A ROI**

**Wetlands**. An arroyo willow wetland has been identified in a drainage downstream of a concrete holding pond on SLC-3W (see Figure 4.13-5). Bear Creek Canyon wetlands are located adjacent to SLC-3. A small drainage ditch at the foot of the SLC-3W retention basin supports a willow scrub wetland.

**Concept B ROI**

**Wetlands.** Wetlands mapped by the USFWS include the evaporation and percolation ponds at SLC-6 (U.S. Department of the Interior, U.S. Fish and Wildlife Service, 1995). Three sites at SLC-6 exhibit wetland characteristics: a man-made ditch east of the former storage pad facility, a man-made trench south of the retention ponds, and a drainage south of the launch pad (see Figure 3.14-6). The first two locations have man-induced hydrology and are of low habitat value due to low vegetative cover and location, although the red-legged frog has recently been found at these locations (U.S. Air Force, 1994c). A field survey of the third wetland identified small patches of arroyo willow in a drainage that qualifies as a willow riparian wetland (ENSR Corporation, 1997b).

## 3.15 CULTURAL RESOURCES

Cultural resources include prehistoric and historic sites, structures, districts, artifacts, or any other physical evidence of human activity considered important to a culture, subculture, or community for scientific, traditional, religious, or any other reasons. For ease of discussion, cultural resources have been divided into archaeological resources (prehistoric and historic), historic buildings and structures, and native populations/traditional resources (e.g., Native American sacred or ceremonial sites). For Vandenberg AFB, the cultural resources section also discusses a fourth category, paleontological resources. There is no scientific or physical evidence for this category of resources at Cape Canaveral AS.

**Regulatory Framework.** Numerous laws and regulations require that possible effects to cultural resources be considered during the planning and execution of federal undertakings. These laws and regulations stipulate a process of compliance, define the responsibilities of the federal agency proposing the action, and prescribe the relationship among other involved agencies (e.g., the State Historic Preservation Officer [SHPO] and the Advisory Council on Historic Preservation). In addition to the NEPA, the primary laws that pertain to the treatment of cultural resources during environmental analysis are the National Historic Preservation Act (NHPA) (especially Sections 106 and 110) the Archaeological Resources Protection Act (ARPA), the American Indian Religious Freedom Act (AIRFA), and the Native American Graves Protection and Repatriation Act (NAGPRA).

Only those cultural resources determined to be potentially significant under the above-cited legislation are subject to protection from adverse impacts resulting from an undertaking. To be considered significant, a cultural resource must meet one or more of the criteria established by the National Park Service that would make that resource eligible for inclusion in the

National Register of Historic Places (National Register). The term "eligible for inclusion in the National Register" includes all properties that meet the National Register listing criteria, which are specified in the Department of the Interior regulations Title 36 CFR 60.4 and National Register Bulletin 15. Therefore, sites not yet evaluated may be considered potentially eligible for inclusion in the National Register and, as such, are afforded the same regulatory consideration as nominated properties. Whether prehistoric, historic, or traditional, significant cultural resources are referred to as "historic properties."

**Region of Influence.** For the purposes of this analysis, the term ROI is synonymous with the “area of potential effect” as defined under cultural resources legislation. In general, the ROI for cultural resources at each location, and for each concept, encompasses all areas requiring ground disturbance (e.g., areas of new facility/utility construction) and all buildings or structures requiring modification, renovation, demolition, or abandonment. The specific cultural resources ROIs for each concept at each location are described for Cape Canaveral AS in Sections 2.1.1.10 and 2.1.2.10 and for Vandenberg AFB in Sections 2.1.1.7 and 2.1.2.7. The Concept A/B ROI at each installation will encompass all of the facilities described in both the Concept A and Concept B ROIs.

### 3.15.1 Cape Canaveral AS

#### 3.15.1.1 Prehistoric and Historic Archaeological Resources.

Archaeological investigations at Cape Canaveral AS indicate that human occupation of the area first occurred approximately 4,000 years ago. Early settlement was focused within the Banana River salt marsh environment; however, over time, site distribution and size fluctuated, and there is archaeological evidence that the entire peninsula was exploited for a wide variety of marine, estuarine, and terrestrial resources. Occupation of the area is divided into seven cultural periods: the Archaic Period, the Orange Period, the Transitional Period, the Malabar I, IIA, and IIB Periods, and the Protohistoric or Seminole Period.

European exploration and contact with native populations of the Florida coast began in the 15th century; however, Ponce de Leon's discovery of St. Augustine in 1513 is the first known documentation of these activities. Numerous Spanish treasure ships navigated the area throughout the 1500s, and in 1564, a French colony was established near the mouth of the St. John’s River. Hostilities developed between the French and Spanish, and although the native populations remained somewhat independent of these activities, displacement from their native lands, European diseases, and slavery ultimately resulted in their dispersal and demise. By the 1760s, the Cape Canaveral area was inhabited by only a few Spaniards and, according to historical accounts, the area remained sparsely populated until 1843 when a lighthouse was established. Historic homesteading followed, and by 1880, several citrus farms existed along the Banana River. Maritime activities increased during the early 1900s, and additional homesteads and roads were established between the Banana River and the Atlantic coastline. Fishing, gardening, berry gathering, beekeeping, and fruit farming all flourished until the late 1940s when the U.S. government began purchasing land on the

peninsula for the establishment of a long-range proving ground and missile test center.

Numerous archaeological surveys have been conducted at Cape Canaveral AS (Bense and Philips, 1990; Cantley et al., 1994; Le Baron, 1884; Levy et al., 1984; Long, 1967; Moore, 1922; Rouse, 1951; Stirling, 1935; U.S. Army Corps of Engineers, 1988, 1989, 1990b, 1991; and Wiley, 1954). In 1992, the USACE synthesized data from several of these studies and developed a cultural resources sensitivity map for Cape Canaveral AS (New South Associates, 1996). Fifty-six prehistoric and historic archaeological sites have been recorded; 19 of these sites have been identified as potentially eligible for listing in the National Register.

**3.15.1.2 Historic Buildings and Structures.** In 1949, the Cape Canaveral Long-Range Proving Ground was formally established under the direction of the Air Force. Construction of the first missile launch pads, support facilities, and down-range tracking stations began in 1950, and throughout that decade military facilities and activities developed at a rapid pace. Various cruise-type missiles were tested during these years and the installation began to support the Intermediate Range and intercontinental ballistic missile (ICBM) programs. Activity at the installation peaked in 1966 with more than 30 operational launch complexes; however, over the next 10 years, programs and operations began to decline. Launch complexes and support buildings that had served their purposes were adapted to other uses (e.g., facilities supporting manned and unmanned space exploration, including NASA's Viking missions to Mars and Voyager missions to the outer planets), deactivated or put on standby status. Current launch programs include ballistic missile operations and government and commercial launch operations (New South Associates, 1996).

Historic building and structure surveys at Cape Canaveral AS include those conducted by the National Park Service (1980); Resource Analysts, Inc. of Bloomington, Indiana (Barton et al., 1983); and the USACE Construction Engineering Research Laboratories (CERL) (McCarthy et al., 1994; Turner et al., 1994). Of these surveys, 14 National Register-listed or eligible historic buildings and structures have been identified (New South Associates, 1996). Seven of the 14 properties (6 launch complexes [5/6, 13 MST, 14, 19, 26, 34] and the original Mission Control Building) comprise a National Historic Landmark district associated with the Man in Space program. The remaining seven properties are Launch Complexes 1/2, 3/4, 17, 21/22, 25, 31/32, and the Cape Canaveral Lighthouse, all of which are considered eligible for inclusion in the National Register.

**3.15.1.3 Native Populations/Traditional Resources.** At the time of European contact, the Cape Canaveral and Banana River areas were populated by tribal groups of the Ais Indian tribe. Settlements were described by early explorers as sparse and isolated, and historical accounts indicate that they remained so well into the 18th century (New South Associates, 1993). The Ais settlements closest to Cape Canaveral AS were the Ulumay villages along the Banana River. The settlements were numerous, changed with the seasons, and reflected a fishing and gathering subsistence; agriculture was not practiced. Dwellings were temporary, and tools and utensils were typically fashioned of conch shell or gourds.

After European contact, the Ais had easy access to trade items and precious metals from the Spanish and French. Because of their proximity to the Straits of Florida, they also took advantage of the numerous shipwrecks along the Florida coast. Wrecks were looted for their treasure, and survivors were typically taken in as slaves and later bartered back to the Europeans. As described above, by 1760, few Ais remained, their disappearance attributable to European diseases, encroachment of their land, and enslavement. A few are believed to have moved into southern Florida where they may have banded with other tribes to ultimately form the Seminole culture. Today, there are no known direct descendants of the Ais tribe remaining; the Seminole and Micosukee Tribes are recognized as the appropriate Native American cultures for consultation during the treatment of Ais remains.

Significant traditional sites are subject to the same regulations and are afforded the same protection as other types of historic properties. Traditional resources associated with the Ais could include archaeological sites, burial sites, mounds, ceremonial areas, caves, hillocks, water sources, plant habitat or gathering areas, or any other natural area important to this culture for religious or heritage reasons. By their nature, traditional resources sites often overlap with (or are components of) archaeological sites. As such, the National Register-listed or -eligible sites (as well as any archaeologically sensitive areas) could also be considered traditional sites or could contain traditional resources elements.

**Historic Property Status within the Concept A ROI**. Within the proposed direct ground-disturbing areas for Concept A, no National Register-listed or -eligible prehistoric or historic archaeological sites have been identified. However, within the ROI for this concept, archaeologically sensitive areas as well as one National Register-eligible prehistoric site (8BR914, located near SLC-41) have been recorded (Appendix I). Of the identified National Register-listed or -eligible buildings and structures, none is currently within the cultural resources ROI for Concept A. A recent assessment of the historical significance of SLC-41 and Hangar J indicates that neither facility is likely to be eligible for listing in the National Register; concurrence from the Florida SHPO is pending.

**Historic Property Status within the Concept B ROI.** Within the proposed direct ground-disturbing areas for Concept B, no National Register-listed or -eligible prehistoric or historic archaeological sites have been identified. However, within the ROI for this concept, archaeologically sensitive areas encompassing three National Register-eligible prehistoric and/or historic archaeological sites have been recorded. The sites are 8BR82A, 8BR83, and 8BR221, located near SLC-37 (see Appendix I).

Of the identified National Register-listed or eligible buildings and structures, none is currently within the cultural resources ROI for Concept B. A recent assessment of the historical significance of Building 75251 and Hangar C (Building 1348) indicates that Building 75251 is not likely to be eligible for inclusion in the National Register. However, Hangar C has been found to be associated with events and persons significant in American History and the history of Cape Canaveral AS. Concurrence from the Florida SHPO is pending regarding the assessments of these two facilities.

### 3.15.2 Vandenberg AFB

**3.15.2.1 Prehistoric and Historic Archaeological Resources.** Archaeological investigations of Vandenberg AFB indicate that human occupation of the area first occurred approximately 9,000 years ago. Early settlement was characterized by a hunting and gathering existence; however, over time, coastal villages began to develop that were occupied a large part of the year. Development of the plank canoe around Anno Domini (A.D.) 500 increased travel by some of the Chumash groups to the Channel Islands and encouraged ocean fishing; however, full development of the indigenous culture did not occur until approximately A.D 1150 when a number of permanent and semi-permanent villages with populations of 200 to 600 were established (Environmental Solutions, 1990). The three major cultural periods recognized in the prehistory of the Vandenberg AFB area are the Early Period (7000-1500 B.C.), the Middle Period (1500 B.C.-A.D. 1000), and the Late Period (1000-1850 A.D.). From the Late Period until the present, the area has supported populations of Native American peoples speaking dialects of the Chumash language.

European exploration of the area began in the middle 1500s; however, colonization (by the Spanish) did not take place until around 1788 with the establishment of Mission La Purisima Concepcion and Mission Santa Ynez. By the middle 1800s, most of the mission lands had been transferred into secular ranchos with a large portion of the area of South Vandenberg AFB included in the Lompoc Rancho Mexican land grant; several farms and ranches operated on the Lompoc Terrace between 1880 and the 1930s (Versar, Inc., 1991). In 1941, the U.S. Army acquired most of the land area now known as Vandenberg AFB to construct Camp Cooke; the installation was renamed Vandenberg AFB in 1958.

Numerous archaeological surveys have been conducted at Vandenberg AFB, and over 2,000 prehistoric and historic archaeological sites have been recorded within the boundary of the installation. Recorded sites span the entire time period described above and are highly variable in function and content. Prehistoric site types include dense shell middens, scatters of stone tools and debris, concentrations of ground stone milling tools, village sites, stone quarries, and temporary encampments (Environmental Solutions, Inc., 1990). Historic site types are varied and reflect activities associated with mission establishment, ranching, and military activities.

**3.15.2.2 Historic Buildings and Structures.** In 1941, the U.S. Army acquired 92,000 acres along the California coast between Point Sal and Point Arguello as a new military reservation (Camp Cooke). During the first five years, a variety of military activities took place at the installation, including use of a portion of the facility as a World War II prisoner of war camp between 1944 and 1946. In mid-1946, the installation was placed in caretaker status and most of the land leased for agriculture; however, by 1950, the base had been reactivated to support armored infantry training for the Korean War (Versar, Inc., 1991). In 1957, the northern 65,000 acres of Camp Cooke were transferred to the U.S. Air Force and became known as Cooke AFB; it was renamed Vandenberg AFB in 1958 when the Strategic Air Command became the host command for the installation. The southern portion of the

installation (approximately 20,000 acres) was controlled by the Navy as the Naval Missile Test Facility at Point Arguello until 1964, when it was also transferred to the Air Force. The present extent of the installation was completed in 1966, when an additional 15,000 acres was purchased from the Sudden Ranch.

Selected as the location for the construction of facilities to launch several types of intermediate and long-range ballistic missiles (e.g., Atlas, Thor, Titan), Vandenberg AFB missions have been largely associated with the launch of military and civilian payloads since the mid-1950s. In addition, Terrier and Hawk missile training exercises and launches of Nike/Asp sounding rockets took place between 1958 and 1960. SLC-3 (East and West), which is eligible for listing in the National Register, was originally constructed for the Air Force's space program under the supervision of the Navy and was designed to accommodate the Atlas D missile (Tri-Services Cultural Resources Research Center, 1996). Construction of SLC-6, which has been determined ineligible for listing in the National Register, began in the late 1950s as part of the Manned Orbiting Laboratory Project. The Space Transportation System launch facilities (including SLC-6) were constructed in the early 1980s; however, the project was suspended, and later canceled in 1986. The 30 SW is currently the host command at Vandenberg AFB and manages the WR, which conducts west coast military and civilian space and missile launch operations.

**3.15.2.3 Native Populations/Traditional Resources.** At the time of European contact, the Vandenberg AFB area was populated by peoples speaking one of the major languages (Purisimeno) of the Chumashan branch of the Hokan language family (Gibson, 1991). Explorers found the Chumash society quite complex with a variety of settlement patterns, customs, and beliefs and a currency-based economy. Villages were numerous and typically consisted of domed houses, granaries, ceremonial areas, game fields, and a burial ground. Tools were made of bone, shell, or steatite, and primary subsistence was from marine resources, the gathering of acorns, and small game. One of the most significant of the Chumash settlements in the vicinity of South Vandenberg AFB is the village of Nocto (currently identified as archaeological site #SBA-210), approximately two miles south of SLC-6; Nocto consisted of ten houses and is believed to have supported between 60 and 70 residents (Glassow, 1990). Additional Purisimeno villages were also located in the area now encompassed by North Vandenberg AFB.

For nearly 200 years after the first explorers made contact, the Chumash life and culture continued without European interference. However, in the mid-18th century, the Spanish began to colonize the area and establish missions. When it became apparent that the Chumash were not willing to give up their traditions and embrace Christianity, the priests and the Spanish military captured many of the Chumash and forced them to live and work at the missions. By 1833, thousands of Chumash had died from European-introduced diseases, many of their villages were abandoned, and many others had fled the area. Changes in governmental administration of the area (i.e., from mission rule to Mexican government rule, and, ultimately, to United States rule) did little to improve the living conditions of the Chumash peoples, and by 1850, the formerly vast and powerful Chumash nation was reduced to several small groups. In 1901, the U.S. government ceded 75

acres of reserved land next to the Santa Ynez mission to the Chumash. The Santa Ynez Reservation is the only land held by the Chumash today (Gibson, 1991); it is located approximately 20 miles east of Vandenberg AFB. Vandenberg AFB has maintained a cooperative and interactive relationship with the Chumash Indians for many years.

There are numerous traditional resources sites associated with the Chumash at Vandenberg AFB including prehistoric villages and campsites, rock art panels, burial sites, resource gathering areas, trails, and wetlands. In addition, there is a specifically identified traditional cultural property in the vicinity of Point Conception, referred to by some within the Chumash culture as the Western Gate because of its role in Chumash beliefs about death and the afterlife.

**3.15.2.4 Paleontological Resources.** Paleontological resources include examples of ancient organic life preserved as fossils. Fossils found in the vicinity of Vandenberg AFB include remains of both vertebrate and invertebrate animals. Remnants of Pleistocene Epoch (a period of time between 2 million and 8,000 years ago) terraces are found on South Vandenberg AFB, especially on the low marine terrace known as Sudden Flats, which extends west to the U.S. Coast Guard Lifeboat Rescue Station and Lookout Tower. Fossil remains found in this area include mammoth and horse fossils approximately 45,000 years old.

**Historic Property Status within the Concept A ROI**. Vandenberg AFB has completed archaeological surveys and inventories of the entire installation that satisfy the requirements of Section 110 of the NHPA. Approximately 2,200 prehistoric and historic sites have been identified and recorded, and a comprehensive survey report is in progress (Environmental Solutions, Inc., 1990; Glassow, 1990; Versar, Inc., 1991). Three archaeological sites have been identified in the vicinity of SLC-3; however, none of the three is located within the SLC-3W fenceline (Versar, Inc., 1991), and all three have been determined ineligible for inclusion in the National Register. In addition, no sites are located within the immediate areas where intersection widening would occur or where power poles require raising. However, the corner of Coast and Bear Creek roads is near known sites, one of which is National Register-eligible (Site #SBA 534). There are also no recorded sites in the direct construction areas associated with the modification of the entrance/exit driveway to Building 7525 or the construction area for the new USF (within the SLC-3W fallback area).

The entirety of Vandenberg AFB has been evaluated for historic buildings and structures potentially eligible for inclusion in the National Register. Specific features of SLC-3W (the MST and umbilical mast, the retention basin and deluge channel, and Building 770) have been determined eligible under the Cold War historic context (Tri-Services Cultural Resources Research Center, 1996). Building 8510, also identified for use within Concept A, has been determined eligible for inclusion in the National Register as a Cold War-era support facility associated with SLC-4.

There are no recorded fossils in the immediate vicinity of SLC-3W and no National Natural Landmarks within the Concept A ROI.

**Historic Property Status within the Concept B ROI.** Vandenberg AFB has completed archaeological surveys and inventories of the entire installation that satisfy the requirements of Section 110 of the NHPA. Approximately 2,200 prehistoric and historic sites have been identified and recorded, and a comprehensive survey report is in progress (Environmental Solutions, Inc., 1990; Glassow, 1990; Versar, Inc., 1991). Fifteen sites have been recorded near SLC-6; six have been recommended as eligible for inclusion in the National Register, and one (Site #SBA 2032) is near the location for the HIF. Underwater survey of the boathouse dock harbor did not identify any underwater archaeological resources (U. S. Department of the Interior, National Park Service, 1978).

All of the SLC-6 buildings and structures (inside and outside the fenceline) have been evaluated for eligibility for inclusion in the National Register and have been determined ineligible. Other facilities within the ROI for Concept B that have been determined eligible for inclusion in the National Register include the Point Arguello U. S. Coast Guard Lifeboat Rescue Station and Lookout Tower (adjacent to the South Vandenberg AFB Boat Dock) and Building 8510, which is a Cold War-era support facility associated with SLC-4.

The closest identified traditional resource site to the Concept B ROI is archaeological site #SBA 210, the site of the prehistoric village of Nocto (two miles south of SLC-6). However, site #SBA 2032, which is near the area proposed for the HIF (within the SLC-6 complex), may be associated with the village of Nocto, and may be a traditional resources site as well.

Fossils recorded near SLC-6, but not directly within the ROI, include fish, crab, and whale bone (U.S. Air Force, 1989a). There are no National Natural Landmarks within the Concept B ROI.

### 3.15.3 No-Action Alternative

**Cape Canaveral AS ROI**. The No-Action Alternative ROI at Cape Canaveral AS encompasses SLCs 17, 36, 40, and 41, all of which currently support the launch programs that would be replaced with implementation of the EELV program. Under the No-Action Alternative, these facilities would continue to be utilized to support those programs; however, none of these facilities would require modification. The National Register status of SLCs 17, 36, 40, and 41 is as follows: SLC-17 is eligible for listing on the National Register and is currently undergoing Historic American Buildings Survey/Historic American Engineering Record (HABS/HAER) recordation. SLC-36 is also eligible for inclusion in the National Register (New South Associates, 1996), and HABS/HAER recordation is complete. SLC-40 remains unevaluated; however, it was completely renovated in 1993, and all of its original primary components have been demolished. The historical significance of SLC-41 has been recently assessed, and it is unlikely that it is eligible for listing in the National Register; Florida SHPO concurrence is pending.

**Vandenberg AFB ROI**. The No-Action Alternative ROI at Vandenberg AFB encompasses SLCs 2W, 3E, and 4E, all of which currently support the launch programs that would be replaced with implementation of the EELV program. Under the No-Action Alternative, these facilities would continue to be utilized to support those programs; however, none of the facilities would require modification. SLCs 2W, 3E, and 4E have been evaluated for their eligibility for inclusion in the National Register, and specific components of all four complexes have been determined eligible (see Appendix I).

## 3.16 ENVIRONMENTAL JUSTICE

EO 12898, Environmental Justice, was issued by the President on February 11, 1994. Objectives of the EO, as it pertains to this EIS, include development of federal agency implementation strategies, identification of minority and low-income populations where proposed federal actions have disproportionately high and adverse human health and environmental effects, and participation of minority and low-income populations. Accompanying EO 12898 was a Presidential Transmittal Memorandum that referenced existing federal statutes and regulations to be used in conjunction with EO 12898. The memorandum addressed the use of the policies and procedures of the NEPA. Specifically, the memorandum indicates that, "Each Federal agency shall analyze the environmental effects, including human health, economic and social effects, of Federal actions, including effects on minority communities and low-income communities, when such analysis is required by the NEPA 42 U.S.C. Section 4321, et seq." Although an environmental justice analysis is not mandated by NEPA or by AFI 32-7061, DoD has directed that NEPA will be used as the primary approach to implement the provision of the EO.

Although EO 12898 provides no guidelines as to how to determine concentrations of minority or low-income populations, the demographic analysis provides information on the approximate locations of minority and low-income populations in the area potentially affected by the EELV program at Cape Canaveral AS and Vandenberg AFB. Most environmental impacts resulting from the Proposed Action would be expected to occur within Brevard County, Florida, and Santa Barbara County, California.

The 1990 Census of Population and Housing reports numbers of both minority and poverty residents. Minority populations included in the census are identified as Black; American Indian, Eskimo, or Aleut; Asian or Pacific Islander; Hispanic; or Other. Poverty status (used in this EIS to define low-income status) is reported as the number of families with income below poverty level ($12,764 for a family of four in 1989, as reported in the 1990 Census of Population and Housing).

### 3.16.1 Cape Canaveral AS

Most environmental impacts resulting from the Proposed Action at Cape Canaveral AS would be expected to occur within Brevard County, Florida. Based upon the 1990 Census of Population and Housing, Brevard County had a population of 398,978 persons. Of this total, 49,681 persons, or 12.45 percent, were minority, and 35,815 persons, or 9.13 percent, were low-income.

### 3.16.2 Vandenberg AFB

Most environmental impacts resulting from the Proposed Action at Vandenberg AFB would be expected to occur within Santa Barbara County, California. Based upon the 1990 Census of Population and Housing, Santa Barbara County had a population of 369,608 persons. Of this total, 124,534 persons, or 33.69 percent, were minority, and 45,226 persons, or 12.76 percent, were low-income.

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# 4.0 ENVIRONMENTAL CONSEQUENCES

## 4.1 INTRODUCTION

This chapter discusses the potential environmental consequences associated with the Proposed Action and the No-Action Alternative. To provide the context in which potential environmental impacts may occur, discussions of potential changes to the local communities, including employment and population, land use and aesthetics, transportation networks, and public utility systems, are included in this chapter. In addition, issues related to current and future management of hazardous materials and wastes and health and safety practices are discussed. Impacts to the physical and natural environment are evaluated for geology and soils, water resources, air quality, noise, orbital debris, biological resources, and cultural resources. An environmental justice analysis was conducted to examine potential disproportionately high and adverse impacts to low-income and minority populations. Environmental impacts may occur as a direct result of the proposed activities or as an indirect result of changes within the local communities.

Each section within this chapter discusses a separate resource area and describes the potential impacts resulting from implementation of the Proposed Action and No-Action Alternative. Mitigation measures are described, where applicable. The Proposed Action includes a discussion of the impacts of implementing the Concept A, Concept B, or Concept A/B EELV launch programs at Cape Canaveral AS and Vandenberg AFB. Each section also includes an analysis of the impacts resulting from the No-Action Alternative, which is the continuation of current launch vehicle programs to meet the requirements of government spacelift transportation programs under the NMM.

Means of mitigating substantial adverse environmental impacts that may result from implementation of the Proposed Action or No-Action Alternative are discussed as required by NEPA. Potential mitigation measures are described for those components likely to experience substantial and adverse changes under the Proposed Action or No-Action Alternative. Potential mitigation measures depend upon the particular resource affected. In general, however, mitigation measures are defined in CEQ regulations as actions that include:

- Avoiding the impact altogether by not taking an action or by not performing certain aspects of the action
- Minimizing the impacts by limiting the degree or magnitude of the action and its implementation
- Rectifying the impact by repairing, rehabilitating, or restoring the affected environment
- Reducing or eliminating the impact over time through preservation and maintenance operations during the life of the action

- Compensating for the impact by replacing or providing substitute resources or environments.

Mitigation measures that are clearly required by law or standard industry practices are generally considered to be part of the Proposed Action. Additional potential mitigation measures beyond those clearly required by law or standard practices are described under each resource area, where impacts have been identified. Such measures include those the Air Force could implement or those discretionary mitigations or choices available to other governmental bodies (such as permit conditions, etc.).

## 4.2 COMMUNITY SETTING

This section describes direct and indirect changes in employment and population and effects on the socioeconomic environment for the Proposed Action and No-Action Alternative.

### 4.2.1 Proposed Action

To identify the potential socioeconomic effects associated with construction and operation activities for the Proposed Action, estimated program-related employment and population information was obtained. The analysis included direct jobs (i.e., work directly for associated EELV activities) and indirect jobs (i.e., jobs created by goods and services purchased in the local communities). The direct and indirect job estimates and associated population numbers were calculated in conformance with established economic estimating guidelines for such analysis (U.S. Bureau of Economic Analysis, 1997c). Initial changes in economic activity in each region were used as inputs to a socioeconomic modeling system that utilizes the Regional Input-Output Modeling System (RIMS II) to provide estimates of total employment. All years referred to in this section are federal fiscal years (October through September), unless otherwise indicated.

#### 4.2.1.1 Concept A

##### 4.2.1.1.1 Concept A, Cape Canaveral AS

**Employment.** The number of direct and indirect jobs associated with launch activities at Cape Canaveral AS is anticipated to increase by up to 251 jobs during construction of EELV facilities between 1998 and 2000. Employment would decline from 1,210 under the Atlas IIA, Delta II, and Titan IVB launch programs to 240 when the EELV program is fully staffed in 2007 (Table 4.2-1). Although full staffing for Concept A launch activities would occur in 2003 at Cape Canaveral AS, for consistency within this EIS, the year 2007 has been selected for analysis purposes.

**Table 4.2-1. Jobs and Worker Migration - Concept A, Cape Canaveral AS**

| | 1997 | 1998 | 2000 | 2007 |
|---|---|---|---|---|
| Total Jobs[a] | 2,306 | 2,557 | 1,597 | 457 |
| Direct | 1,210 | 1,362 | 855 | 240 |
| Construction | 0 | 152 | 130 | 0 |
| Operation | 1,210 | 1,210 | 725 | 240 |
| Current Operation | 1,210 | 1,210 | 605 | 0 |
| EELV Operation | 0 | 0 | 120 | 240 |
| Indirect | 1,096 | 1,195 | 742 | 217 |
| Construction-related | 0 | 99 | 85 | 0 |
| Operation-related | 1,096 | 1,096 | 657 | 217 |
| Current Operation-related | 1,096 | 1,096 | 548 | 0 |
| EELV Operation-related | 0 | 0 | 109 | 217 |
| Net Change in Total Jobs | 0 | 251 | -709 | -1,849 |

Note: (a) Includes full- and part-time jobs.
EELV = Evolved Expendable Launch Vehicle

Sources: Estimates prepared for this study.

The number of indirect jobs associated with government launches supported within Brevard County would be reduced from its 1997 level of 1,096 to 217 by 2007.

By 2007, there would be a net decline of 970 direct and 879 indirect jobs within Brevard County, associated with the replacement of Atlas IIA, Delta II, and Titan IVB launch operations; however, employment in Brevard County is forecasted to increase from 231,553 in 1997 to 285,540 in 2007 (see Table 3.2-1). It was assumed that only 10 percent of the current launch program employees would leave Brevard County. Some of the workers approaching retirement age might decide to retire, but most of these workers would likely search for another job. The remaining 1,741 employees would be assumed to be transferred to EELV program operations, transferred by their employer to another business location, or seek other employment.

**Population.** The total number of persons associated with launch activities at Cape Canaveral AS (including all direct and indirect workers, plus members of their households) is anticipated to increase from its 1997 level of 6,227 to 6,904 during construction of EELV facilities, and then decline to a level of 1,235 when the EELV program is fully staffed in 2007 (Table 4.2-2). The population attributable to direct operation jobs would be reduced from 3,267 under the existing launch programs to 648 under the EELV program at full

**Table 4.2-2. Total Population by Type of Job - Concept A, Cape Canaveral AS**

| | 1997 | 1998 | 2000 | 2007 |
|---|---|---|---|---|
| Total Persons, by type of job[(a)] | 6,227 | 6,904 | 4,312 | 1,235 |
| Direct | 3,267 | 3,677 | 2,309 | 648 |
| Construction | 0 | 410 | 351 | 0 |
| Operation | 3,267 | 3,267 | 1,958 | 648 |
| Current Operation | 3,267 | 3,267 | 1,634 | 587 |
| EELV Operation | 0 | 0 | 324 | 0 |
| Indirect | 2,960 | 3,228 | 2,003 | 587 |
| Construction-related | 0 | 268 | 230 | 0 |
| Operation-related | 2,960 | 2,960 | 1,773 | 587 |
| Current Operation-related | 2,960 | 2,960 | 1,480 | 0 |
| EELV Operation-related | 0 | 0 | 294 | 587 |

Note: (a) Total population includes all workers holding direct or indirect jobs, plus their household members (assuming an average household size of 2.7 persons).

EELV = Evolved Expendable Launch Vehicle

Sources: Estimates prepared for this study.

employment; however, population in Brevard County is forecasted to increase from 460,824 in 1997 to 557,856 in 2007 (see Table 3.2-2).

The population attributable to indirect jobs resulting from launch programs within Brevard County would be reduced from its 1997 level of 2,960 to 587 by 2007. A temporary increase of 678 people in 1998 would be attributable to direct and indirect workers during the construction of EELV facilities.

The majority of the population attributable to EELV government activities would reside within the unincorporated area of Brevard County (with most of the direct population in unincorporated communities near Cape Canaveral AS), and in the cities of Cape Canaveral, Cocoa, Cocoa Beach, and Rockledge, which are all within 14 miles of Cape Canaveral AS. Much of the population effect in other cities, including Titusville (21 miles from Cape Canaveral AS), and Melbourne and Palm Bay (both 35 miles away), would be attributable to indirect workers. Some workers, both direct and indirect, would locate their households outside of Brevard County, principally in communities in Orange County, approximately 25 miles west of Cape Canaveral AS.

By 2007, there would be a net decline in population of 2,619 persons from direct jobs and 2,373 from indirect jobs within Brevard County. Incorporated cities within the ROI would lose the majority of residents leaving the county. It is assumed that only 10 percent of residents from the current launch operations would leave the ROI.

#### 4.2.1.1.2 Concept A, Vandenberg AFB

**Employment.** The number of direct and indirect jobs associated with launch activities at Vandenberg AFB is anticipated to increase slightly during construction of EELV facilities from 1,500 to 2,128 in 2000. Employment would decline thereafter as the requirement for direct operation workers is reduced from 646 under the existing launch systems to 135 in 2007 (Table 4.2-3); however, employment in Santa Barbara County is forecasted to increase from 229,107 in 1997 to 271,380 in 2007 (see Table 3.2-3). Although full staffing for Concept A launch activities would occur in 2006 at Vandenberg AFB, for consistency within this EIS, the year 2007 has been selected for analysis purposes.

The number of indirect jobs within Santa Barbara County would be reduced from its 1997 level of 854 to 179 by 2007. The number of indirect jobs would increase slightly in 2000 during construction of EELV facilities (see Table 4.2-3).

**Table 4.2-3. Jobs and Worker Migration - Concept A, Vandenberg AFB**

| | 1997 | 1998 | 2000 | 2007 |
|---|---|---|---|---|
| Total Jobs[(a)] | 1,500 | 1,500 | 2,128 | 314 |
| Direct | 646 | 646 | 964 | 135 |
| Construction | 0 | 0 | 318 | 0 |
| Operation | 646 | 646 | 646 | 135 |
| Current Operation | 646 | 646 | 646 | 0 |
| EELV Operation | 0 | 0 | 0 | 135 |
| Indirect | 854 | 854 | 1,164 | 179 |
| Construction-related | 0 | 0 | 310 | 0 |
| Operation-related | 854 | 854 | 854 | 179 |
| Current Operation-related | 854 | 854 | 854 | 0 |
| EELV Operation-related | 0 | 0 | 0 | 179 |
| Net Change in Total Jobs | 0 | 0 | 628 | -1,187 |

Note: (a) Includes full- and part-time jobs.
EELV = Evolved Expendable Launch Vehicle

Sources: Estimates prepared for this study.

By 2007, there would be a net decline of 1,187 direct and indirect jobs within Santa Barbara County. Only 10 percent of unemployed workers would leave the county. As discussed in Section 4.2.1.1.1, some workers would retire; others would search for another job.

**Population.** The total number of persons associated with launch activities at Vandenberg AFB (including all direct and indirect workers, plus members of their households) is anticipated to increase from a 1997 level of 4,051 to 5,746 during construction of EELV facilities, and decline to a level of 847 by 2007 (Table 4.2-4). The population attributable to direct operation jobs

**Table 4.2-4. Total Population by Type of Job - Concept A, Vandenberg AFB**

| | 1997 | 1998 | 2000 | 2007 |
|---|---|---|---|---|
| Total Persons, by type of job[a] | 4,051 | 4,051 | 5,746 | 847 |
| Direct | 1,744 | 1,744 | 2,603 | 365 |
| Construction | 0 | 0 | 859 | 0 |
| Operation | 1,744 | 1,744 | 1,744 | 365 |
| Current Operation | 1,744 | 1,744 | 1,744 | 0 |
| EELV Operation | 0 | 0 | 0 | 365 |
| Indirect | 2,307 | 2,307 | 3,143 | 482 |
| Construction-related | 0 | 0 | 836 | 0 |
| Operation-related | 2,307 | 2,307 | 2,307 | 482 |
| Current Operation-related | 2,307 | 2,307 | 2,307 | 0 |
| EELV Operation-related | 0 | 0 | 0 | 482 |

Note: (a) Total population includes all workers holding direct or indirect jobs, plus their household members (assuming an average household size of 2.7 persons).

EELV = Evolved Expendable Launch Vehicle

Sources: Estimates prepared for this study.

would be reduced from 1,744 under the existing launch programs to 365 under the EELV program; however, population in Santa Barbara County is forecasted to increase from 399,988 in 1997 to 445,415 in 2007 (see Table 3.2-4).

The population attributable to indirect jobs within Santa Barbara County would be reduced from its 1997 level of 2,307 to 482 by 2007. A small increase in the population attributable to indirect workers would occur during construction in 2000.

The majority of the population attributable to the EELV program would reside within the unincorporated area of Santa Barbara County (with most of the direct population located in unincorporated communities near Vandenberg AFB), and in the cities of Santa Maria and Lompoc, both of which are within 18 miles of Vandenberg AFB. Much of the population effect in other cities, including Santa Barbara (64 miles from Vandenberg AFB) and Carpinteria (76 miles), would be attributable to indirect workers. Some workers, both direct and indirect, would locate their households outside of Santa Barbara County, principally in communities in San Luis Obispo County, approximately 25 miles north of Vandenberg AFB.

#### 4.2.1.2 Concept B

##### 4.2.1.2.1 Concept B, Cape Canaveral AS

**Employment.** The number of direct and indirect jobs associated with launch activities at Cape Canaveral AS is anticipated to increase by up to 328 jobs during construction of EELV facilities in 2000. Employment would decline thereafter as the requirement for direct operation workers is reduced from 1,210 under the existing launch programs to 540 when the EELV program is fully staffed in 2007 (Table 4.2-5).

**Table 4.2-5. Jobs and Worker Migration - Concept B, Cape Canaveral AS**

| | 1997 | 1998 | 2000 | 2007 |
|---|---|---|---|---|
| Total Jobs[(a)] | 2,306 | 2,518 | 2,260 | 1,029 |
| Direct | 1,210 | 1,338 | 1,208 | 540 |
| Construction | 0 | 128 | 220 | 0 |
| Operation | 1,210 | 1,210 | 1,043 | 540 |
| Current Operation | 1,210 | 1,210 | 908 | 0 |
| EELV Operation | 0 | 0 | 135 | 540 |
| Indirect | 1,096 | 1,180 | 1,052 | 489 |
| Construction-related | 0 | 84 | 108 | 0 |
| Operation-related | 1,096 | 1,096 | 944 | 489 |
| Current Operation-related | 1,096 | 1,096 | 822 | 0 |
| EELV Operation-related | 0 | 0 | 122 | 489 |
| Net Change in Total Jobs | 0 | 212 | -46 | -1,277 |

Notes: (a) Includes full- and part-time jobs.
EELV = Evolved Expendable Launch Vehicle
Source: Estimates prepared for this study.

The number of indirect jobs supported within Brevard County would be reduced from its 1997 level of 1,096 to 489 by 2007; however, employment in Brevard County is forecasted to increase from 231,553 in 1997 to 285,400 in 2007 (see Table 3.2-1).

By 2007, there would be a net decline of 670 direct and 607 indirect jobs within Brevard County. With implementation of the EELV program and the associated reduction of 1,277 jobs, it was assumed that only 10 percent of the current residents would leave Brevard County. As discussed in Section 4.2.1.1, some workers would retire; others would search for another job. It was assumed that a small percentage of current residents would leave the county to search for other job opportunities or to retire. Most of the 1,247 persons who would change jobs would be transferred to support EELV program operations, transferred by their employer to another business location, or seek other employment.

**Population.** The total number of persons associated with launch activities at Cape Canaveral AS (including all direct and indirect workers, plus members of their households) is anticipated to increase from its 1997 level of 6,227 to 6,800 during construction of EELV facilities, and decline to a level of 2,779 persons by 2007 (Table 4.2-6). The population attributable to direct operation jobs would be reduced from 3,267 under the existing launch programs to 1,458 under the EELV program.

**Table 4.2-6. Total Population by Type of Job - Concept B, Cape Canaveral AS**

| | 1997 | 1998 | 2000 | 2007 |
|---|---|---|---|---|
| Total Persons, by type of job[(a)] | 6,227 | 6,800 | 6,102 | 2,779 |
| Direct | 3,267 | 3,614 | 3,260 | 1,458 |
| Construction | 0 | 347 | 446 | 0 |
| Operation | 3,267 | 3,267 | 2,815 | 1,458 |
| Current Operation | 3,267 | 3,267 | 2,450 | 0 |
| EELV Operation | 0 | 0 | 365 | 1,458 |
| Indirect | 2,960 | 3,186 | 2,841 | 1,321 |
| Construction-related | 0 | 227 | 292 | 0 |
| Operation-related | 2,960 | 2,960 | 2,550 | 1,321 |
| Current Operation-related | 2,960 | 2,960 | 2,550 | 0 |
| EELV Operation-related | 0 | 0 | 330 | 1,321 |

Note: (a) Total population includes all workers holding direct or indirect jobs, plus their household members (assuming an average household size of 2.7 persons).

EELV = Evolved Expendable Launch Vehicle

Sources: Estimates prepared for this study.

The population attributable to indirect jobs within Brevard County would be reduced from its current level of 2,960 to 1,321 by 2007. A small increase in the population of 292 attributable to indirect workers would occur in the year 2000 during construction of EELV facilities.

The majority of the population associated with Concept B would reside within the unincorporated area of Brevard County (see Section 4.2.1.1.1).

By 2007, there would be a net decline in population of 3,448 persons within Brevard County; however, population in Brevard County is forecasted to increase from 460,824 in 1997 to 557,856 in 2007 (see Table 3.2-2).

#### 4.2.1.2.2 Concept B, Vandenberg AFB

**Employment.** The number of direct and indirect jobs associated with launch activities at Vandenberg AFB is anticipated to increase slightly during construction of EELV facilities in 1998 through 2000 from 1,500 to 1,714. Employment would decline thereafter as the requirement for direct operation workers is reduced from 646 under the existing launch programs to 400 in 2007 (Table 4.2-7).

The number of indirect jobs supported within Santa Barbara County would be reduced from its 1997 level of 854 to 529 by 2007.

During construction of EELV facilities in 2000, there would be a net increase of up to 108 direct and 105 indirect jobs within Santa Barbara County. By 2007, there would be a net decline of 571 direct and indirect jobs within Santa Barbara County; however, employment in Santa Barbara County is

**Table 4.2-7. Jobs and Worker Migration - Concept B, Vandenberg AFB**

| | 1997 | 1998 | 2000 | 2007 |
|---|---|---|---|---|
| Total Jobs[(a)] | 1,500 | 1,625 | 1,714 | 929 |
| Direct | 646 | 709 | 754 | 400 |
| Construction | 0 | 63 | 108 | 0 |
| Operation | 646 | 646 | 646 | 400 |
| Current Operation | 646 | 646 | 646 | 0 |
| EELV Operation | 0 | 0 | 0 | 400 |
| Indirect | 854 | 916 | 960 | 529 |
| Construction-related | 0 | 61 | 105 | 0 |
| Operation-related | 854 | 854 | 854 | 529 |
| Current Operation-related | 854 | 854 | 854 | 0 |
| EELV Operation-related | 0 | 0 | 0 | 529 |
| Net Change in Total Jobs | 0 | 124 | 213 | -571 |

Note: (a) Includes full- and part-time jobs.
EELV = Evolved Expendable Launch Vehicle

Sources: Estimates prepared for this study.

forecasted to increase from 229,107 in 1997 to 271,380 in 2007 (see Table 3.2-3).

By 2007, 571 current Santa Barbara County residents would lose direct or indirect jobs associated with current launch operations, but most of them would remain in the county. It was assumed that only 10 percent would leave the county in search of other job opportunities, to retire, or would be transferred by their current employer.

**Population.** The total number of persons associated with government launch activities at Vandenberg AFB (including all direct and indirect workers, plus members of their households) is anticipated to increase from its current level of 4,051 to 4,626 by the year 2000 during construction of EELV facilities, and then decline to a level of 2,508 persons by 2007. The population attributable to direct operation jobs would be reduced from 1,744 under the current launch programs to 1,080 under the EELV program (Table 4.2-8).

The population attributable to indirect jobs within Santa Barbara County would be reduced from its 1997 level of 2,307 to 1,428 by 2007. A small increase in the population attributable to indirect workers would occur during construction of the EELV facilities.

The majority of the population attributable to Concept B would reside within the unincorporated area of Santa Barbara County (see Section 4.2.1.2.1).

By 2007, there would be a net decline in population of 1,543 persons within Santa Barbara County; however, the county population is forecasted to increase from 399,988 in 1997 to 445,415 in 2007 (see Table 3.2-4). With implementation of the EELV program and the associated reduction of 1,543

**Table 4.2-8. Total Population by Type of Job - Concept B, Vandenberg AFB**

| | 1997 | 1998 | 2000 | 2007 |
|---|---|---|---|---|
| Total Persons, by type of job[(a)] | 4,051 | 4,387 | 4,626 | 2,508 |
| Direct | 1,744 | 1,914 | 2,036 | 1,080 |
| Construction | 0 | 170 | 292 | 0 |
| Operation | 1,744 | 1,744 | 1,744 | 1,080 |
| Current Operation | 1,744 | 1,744 | 1,744 | 0 |
| EELV Operation | 0 | 0 | 0 | 1,080 |
| Indirect | 2,307 | 2,472 | 2,591 | 1,428 |
| Construction-related | 0 | 166 | 284 | 0 |
| Operation-related | 2,307 | 2,307 | 2,307 | 1,428 |
| Current Operation-related | 2,307 | 2,307 | 2,307 | 0 |
| EELV Operation-related | 0 | 0 | 0 | 1,428 |

Note: (a) Total population includes all workers holding direct or indirect jobs, plus their household members (assuming an average household size of 2.7 persons).

EELV = Evolved Expendable Launch Vehicle

Sources: Estimates prepared for this study.

residents, only 11 percent of the residents would be assumed to leave the ROI. The incorporated cities within the ROI would lose the majority of residents assumed to leave the county.

#### 4.2.1.3 Concept A/B

##### 4.2.1.3.1 Concept A/B, Cape Canaveral AS

**Employment**. The number of direct and indirect jobs associated with launch activities at Cape Canaveral AS is anticipated to increase slightly during construction of EELV facilities between 1998 and 2000. Employment would decline thereafter as the requirement for direct operation workers is reduced from 1,210 under the Atlas IIA, Delta II, and Titan IVB launch programs to 590 in 2007 at full employment (Table 4.2-9).

The number of indirect jobs associated with launches supported within Brevard County would be reduced from its 1997 level of 1,096 to 534 in 2007 at full employment; however, employment in the county is forecasted to increase from 231,553 in 1997 to 285,540 in 2007 (see Table 3.2-1). A small increase in the number of indirect jobs would occur in 2000 during construction of EELV facilities.

Additionally, there would be a net increase of up to 295 direct and 193 indirect jobs within Brevard County. At full employment in 2007, there would be a net decline of 1,182 jobs.

**Population.** The total number of persons associated with launch activities at Cape Canaveral AS (including all direct and indirect workers, plus members of their households) is anticipated to increase from its 1997 level of 6,227 to

**Table 4.2-9. Jobs and Worker Migration - Concept A/B, Cape Canaveral AS**

| | 1997 | 1998 | 2000 | 2007 |
|---|---|---|---|---|
| Total Jobs[a] | 2,306 | 2,769 | 2,499 | 1,124 |
| Direct | 1,210 | 1,490 | 1,350 | 590 |
| Construction | 0 | 280 | 295 | 0 |
| Operation | 1,210 | 1,210 | 1,055 | 590 |
| Current Operation | 1,210 | 1,210 | 908 | 0 |
| EELV Operation | 0 | 0 | 148 | 590 |
| Indirect | 1,096 | 1,279 | 1,149 | 534 |
| Construction-related | 0 | 183 | 193 | 0 |
| Operation-related | 1,096 | 1,096 | 956 | 534 |
| Current Operation-related | 1,096 | 1,096 | 822 | 0 |
| EELV Operation-related | 0 | 0 | 134 | 534 |
| Net Change in Total Jobs | 0 | 463 | 193 | -1,182 |

Note: (a) Includes full- and part-time jobs.
EELV = Evolved Expendable Launch Vehicle
Sources: Estimates prepared for this study.

7,477 during construction of EELV facilities, and then decline to a level of 3,036 at full employment in 2007; however, the Brevard County population is forecasted to increase from 460,824 in 1997 to 557,856 in 2007 (see Table 3.2-2). The population attributable to direct operation jobs would be reduced from 3,267 under the current launch programs to 1,593 by 2007 (Table 4.2-10).

**Table 4.2-10. Total Population by Type of Job - Concept A/B, Cape Canaveral AS**

| | 1997 | 1998 | 2000 | 2007 |
|---|---|---|---|---|
| Total Persons, by type of job[a] | 6,227 | 7,477 | 6,747 | 3,036 |
| Direct | 3,267 | 4,023 | 3,645 | 1,593 |
| Construction | 0 | 756 | 797 | 0 |
| Operation | 3,267 | 3,267 | 2,849 | 1,593 |
| Current Operation | 3,267 | 3,267 | 2,450 | 0 |
| EELV Operation | 0 | 0 | 398 | 1,593 |
| Indirect | 2,960 | 3,454 | 3,102 | 1,443 |
| Construction-related | 0 | 495 | 521 | 0 |
| Operation-related | 2,960 | 2,960 | 2,580 | 1,443 |
| Current Operation-related | 2,960 | 2,960 | 2,220 | 0 |
| EELV Operation-related | 0 | 0 | 361 | 1,443 |

Note: (a) Total population includes all workers holding direct or indirect jobs, plus their household members (assuming an average household size of 2.7 persons).
EELV = Evolved Expendable Launch Vehicle
Sources: Estimates prepared for this study.

The majority of the population attributable to Concept A/B would reside within the unincorporated area of Brevard County (see Section 4.2.1.1.1).

By 2007, there would be a net decline in population of 3,191 persons with implementation of the EELV program. There would be an increase of 1,250 persons during construction activities. The incorporated cities within the ROI would lose the majority of the 10 percent of workers that are assumed to leave the ROI.

#### 4.2.1.3.2 Concept A/B, Vandenberg AFB

**Employment.** The number of direct and indirect jobs associated with launch activities at Vandenberg AFB is anticipated to increase slightly during construction activities associated with the EELV program from 1998 until 2002. Employment would decline thereafter as the requirement for direct operation workers is reduced from 646 to 415 at full EELV employment in 2007 (Table 4.2-11).

**Table 4.2-11. Jobs and Worker Migration - Concept A/B, Vandenberg AFB**

| | 1997 | 1998 | 2000 | 2007 |
|---|---|---|---|---|
| Total Jobs[(a)] | 1,500 | 1,625 | 2,341 | 964 |
| Direct | 646 | 709 | 1,072 | 415 |
| Construction | 0 | 63 | 426 | 0 |
| Operation | 646 | 646 | 646 | 415 |
| Current Operation | 646 | 646 | 646 | 0 |
| EELV Operation | 0 | 0 | 0 | 415 |
| Indirect | 854 | 916 | 1,269 | 549 |
| Construction-related | 0 | 61 | 415 | 0 |
| Operation-related | 854 | 854 | 854 | 549 |
| Current Operation-related | 854 | 854 | 854 | 0 |
| EELV Operation-related | 0 | 0 | 0 | 549 |
| Net Change in Total Jobs | 0 | 124 | 841 | -536 |

Note: (a) Includes full- and part-time jobs.
EELV = Evolved Expendable Launch Vehicle
Sources: Estimates prepared for this study.

The number of indirect jobs within Santa Barbara County would be reduced from its 1997 level of 854 to 549 by 2007. A small increase of 415 indirect jobs would occur in 2000 during construction of EELV facilities.

During construction of EELV facilities, there would be a total net increase of 841 jobs within Santa Barbara County. By 2007, there would be a net decline of 536 direct and indirect jobs; however, employment in Santa Barbara County is forecasted to increase from 229,107 in 1997 to 271,380 in 2007 (see Table 3.2-3).

By 2007, 536 residents would lose direct and indirect jobs associated with current launch programs. It was assumed that only 10 percent of current residents would leave the county.

**Population.** The total number of persons associated with Vandenberg AFB launch activities (including all direct and indirect workers, plus members of their households) is anticipated to increase from a 1997 level of 4,051 to 6,322 by 2000 during the construction of EELV facilities. The population would decline thereafter to a level of 2,602 by 2007 (Table 4.2-12). The population attributable to direct operation jobs would be reduced from 1,744 under the current launch programs to 1,212 during peak EELV launch operations in 2007.

**Table 4.2-12. Total Population by Type of Job - Concept A/B, Vandenberg AFB**

| | 1997 | 1998 | 2000 | 2007 |
|---|---|---|---|---|
| Total Persons, by type of job[a] | 4,051 | 4,387 | 6,322 | 2,602 |
| Direct | 1,744 | 1,914 | 2,895 | 1,212 |
| Construction | 0 | 170 | 1,150 | 0 |
| Operation | 1,744 | 1,744 | 1,744 | 1,121 |
| Current Operation | 1,744 | 1,744 | 1,744 | 0 |
| EELV Operation | 0 | 0 | 0 | 1,121 |
| Indirect | 2,307 | 2,472 | 3,427 | 1,482 |
| Construction-related | 0 | 166 | 1,120 | 0 |
| Operation-related | 2,307 | 2,307 | 2,307 | 1,482 |
| Current Operation-related | 2,307 | 2,307 | 2,307 | 0 |
| EELV Operation-related | 0 | 0 | 0 | 1,482 |

Note: (a) Total population includes all workers holding direct or indirect jobs, plus their household members (assuming an average household size of 2.7 persons).

EELV = Evolved Expendable Launch Vehicle

Sources: Estimates prepared for this study.

The population attributable to indirect jobs within Santa Barbara County would be reduced from its 1997 level of 2,307 to 1,482 by 2007; however, the Santa Barbara County population is forecasted to increase from 399,988 in 1997 to 445,415 in 2007 (see Table 3.2-4). A small increase in the population attributable to indirect workers would occur during construction of the EELV facilities.

The majority of the population attributable to the EELV program would reside within the unincorporated area of Santa Barbara County (see Section 4.2.1.2.1).

### 4.2.2 No-Action Alternative

#### 4.2.2.1 Cape Canaveral AS

**Employment.** Under the No-Action Alternative, the number of direct jobs associated with launch activities at Cape Canaveral AS is anticipated to remain at its 1997 level of 1,210 through 2007 with continuation of the Atlas IIA, Delta II, and Titan IVB launch systems. The number of indirect jobs associated with current launch programs within Brevard County would remain at its 1997 level of 1,096 through 2007. Total employment in Brevard County is forecasted to increase from 231,553 to 285,540 between 1997 and 2007.

**Population.** The total number of persons associated with launch activities at Cape Canaveral AS (including all direct and indirect workers, plus members of their households) is anticipated to remain at its 1997 level of 6,227 through 2007 under the No-Action Alternative. The population attributable to direct and indirect jobs associated with current launch programs would remain at its 1997 level of 3,267 and 2,960, respectively. The Brevard County population is forecasted to increase from 460,824 to 557,856 between 1997 and 2007.

The majority of the population attributable to the existing launch programs resides within the unincorporated area of Brevard County (with most of the direct population in unincorporated communities near Cape Canaveral AS), and in the cities of Cape Canaveral, Cocoa, Cocoa Beach, and Rockledge. Much of the population effect in other cities, including Titusville, Melbourne, and Palm Bay, is attributable to indirect workers. Some workers, both direct and indirect, locate their households outside of Brevard County, principally in communities in Orange County.

#### 4.2.2.2 Vandenberg AFB

**Employment.** Under the No-Action Alternative, the number of direct jobs associated with government launch activities at Vandenberg AFB is anticipated to remain at its 1997 level of 646 through 2007 with continuation of the Atlas IIA, Delta II, and Titan IVB launch systems. The number of indirect jobs associated with current launch programs within Santa Barbara County would remain at its current level of 854 through 2007 under the No-Action Alternative. Total employment in Santa Barbara County is forecasted to increase from 229,107 to 271,380 between 1997 and 2007.

**Population.** The total number of persons associated with launch activities at Vandenberg AFB (including all direct and indirect workers, plus members of their households) is anticipated to remain at its 1997 level of 4,051 through 2007 under the No-Action Alternative. The population attributable to direct and indirect jobs associated with current launch programs would remain at its 1997 level of 1,744 and 2,307, respectively. The Santa Barbara County population is forecasted to increase from 399,988 to 445,415 between 1997 and 2007.

The majority of the population attributable to the current launch programs resides within the unincorporated area of Santa Barbara County (with most of the direct population in unincorporated communities near Vandenberg AFB), and in the cities of Santa Maria and Lompoc. Much of the population effect in other cities, including Santa Barbara and Carpinteria, is attributable to indirect workers. Some workers, both direct and indirect, locate their households outside of Santa Barbara County, principally in communities in San Luis Obispo County.

## 4.3 LAND USE AND AESTHETICS

### 4.3.1 Proposed Action

#### 4.3.1.1 Concept A

##### 4.3.1.1.1 Concept A, Cape Canaveral AS

**Regional Land Use.** Concept A activities would be compatible with existing and planned land uses in the ROI; therefore, incompatible land uses would not result.

**Cape Canaveral AS Land Use.** Construction and operation activities associated with Concept A would occur primarily at SLC-41, an area that is currently designated for space launch activities. Proposed EELV uses would be consistent with the Base Comprehensive Plan and the mission of the Air Force at Cape Canaveral AS as "the best source of development space for new launch facilities is the old pads, remediated and rebuilt" (45 Space Wing, 1995c). The proposed EELV launch program would not result in conversion of prime agricultural land or cause a decrease in the utilization of land.

**Coastal Zone Management.** SLC-41 does not lie within the FCMA no-development zone, so construction and modification of facilities is consistent with the FCMA. Additionally, the contractor would coordinate with 45 SW Civil Engineering prior to design of EELV facilities to ensure adherence to all siting standards. However, SLC-41 does lie within the coastal zone and is subject to a federal coastal zone consistency determination as outlined in the FCMA, which is administered by the FDCA. The effects of the EELV program on the coastal zone will be evaluated. The Air Force will prepare a Coastal Zone Consistency Determination for the EELV program and submit it to the FDCA for review.

**Recreation.** EELV launches would not result in a loss of public recreation activities in the area because there are no public beaches in the launch area on Cape Canaveral AS. Neither public beaches nor other public facilities would be closed as a result of launch activities; however, recreational fishing activities available to KSC and Cape Canaveral AS personnel may be restricted during a launch. This restriction would be temporary and is not considered an adverse impact because limitations due to launch activities are routine at the installation.

**Aesthetics.** Views of Cape Canaveral AS from public beaches, marine vessels, and surrounding communities would be altered slightly by new construction at SLC-41. However, views of Cape Canaveral AS are primarily limited to marine traffic on the east and west and distant off-site beach areas and small communities to the south. Although EELV operations at SLC-41 would modification and demolition of existing structures, abandonment of buildings, and construction of new facilities, the aesthetic view of the site, an existing launch facility, would not change noticeably as a result of these activities. In addition, all views are distant views. Therefore, construction and operations under Concept A would not affect the area's aesthetic quality nor would they obscure any scenic views.

No adverse land use impacts are anticipated from Concept A EELV activities at Cape Canaveral AS; therefore, no mitigation measures would be required.

#### 4.3.1.1.2 Concept A, Vandenberg AFB

**Regional Land Use.** Concept A activities would be compatible with existing and planned land uses in the ROI; therefore, incompatible land uses would not result.

**Vandenberg AFB Land Use.** Construction and operations associated with Concept A would occur primarily at SLC-3W, an area currently designated for space launch activities. Proposed EELV uses would be consistent with the Base Comprehensive Plan and the Air Force mission at Vandenberg AFB. The proposed EELV activities would not result in conversion of prime agricultural land or cause a decrease in land utilization.

**Coastal Zone Management.** As defined in the Coastal Zone Management Plan (CZMP), federal activities in, or affecting, a coastal zone must be consistent with the CZMP. Since the EELV program would result in public beach closures, a coastal zone consistency determination is required to support EELV program activities. The California Coastal Commission administers the CZMP. The effects of the EELV program on the coastal zone will be evaluated, and the Air Force will prepare a Coastal Zone Consistency Determination for the EELV program and submit it to the California Coastal Commission for review.

**Recreation.** Under Concept A, Jalama Beach and Ocean Beach county parks would be closed for all launches from SLC-3W. A maximum of 10 launches would occur during the peak year (2007). The parks would be closed for up to 8 hours per launch event. No mitigation measures are available to reduce this impact; however, beach closures during launch activities are routine at the installation.

**Aesthetics.** Views of Vandenberg AFB from public beaches, marine vessels, and railroad tracks would be slightly altered by Concept A construction activities. The nearest public views are those seen by passengers aboard the Southern Pacific Railroad line that runs through the base. Views of South Vandenberg AFB are limited by topography. Although EELV operations at SLC-3W would require modification and demolition of existing structures, abandonment of buildings, and construction of new facilities, the aesthetic view of the site, an existing launch facility, would not change noticeably as a result of these activities. In addition, most public views are distant views. Therefore, construction and operations under Concept A would not alter the aesthetic quality of the area nor would they obscure any scenic views. Prior to design of EELV facilities, the contractor would coordinate with 30 SW Civil Engineering to ensure adherence to facility design standards.

Other than beach closures, no land use impacts are anticipated; therefore, no mitigation measures are required.

#### 4.3.1.2 Concept B

##### 4.3.1.2.1 Concept B, Cape Canaveral AS

**Regional Land Use.** As discussed in Section 4.3.1.1.1, under Regional Land Use, the EELV program would be compatible with existing and planned land uses in the ROI; therefore, incompatible land uses would not result.

**Cape Canaveral AS Land Use.** Construction and operation activities associated with Concept B would occur primarily at SLC-37, an area currently designated for space launch activities. As discussed in Section 4.3.1.1.1, under Cape Canaveral AS Land Use, no impacts to land use on Cape Canaveral AS are expected from EELV activities.

**Coastal Zone Management.** SLC-37 does not lie within the no-development zone, so construction and modification of facilities is consistent with the FCMA. Additionally, the contractor would coordinate with 45 SW Civil Engineering prior to design of EELV facilities to ensure adherence to all siting standards. As discussed in Section 4.3.1.1.1, under Coastal Zone Management, a Coastal Zone Consistency Determination for EELV program activities will be prepared.

**Recreation.** Recreation impacts resulting from Concept B implementation at SLC-37 would be similar to those described in Section 4.3.1.1.1, under Recreation.

**Aesthetics.** Aesthetic impacts at SLC-37 resulting from Concept B would be similar to those described under Section 4.3.1.1.1, under Aesthetics.

No adverse land use impacts are anticipated from EELV activities; therefore, no mitigation measures would be required.

##### 4.3.1.2.2 Concept B, Vandenberg AFB

**Regional Land Use.** As discussed in Section 4.3.1.1.2, under Regional Land Use, the EELV program would be compatible with existing and planned land uses in the ROI; therefore, incompatible land uses would not result.

**Vandenberg AFB Land Use.** Construction and operation activities associated with Concept B would occur primarily at SLC-6, an area currently designated for space launch activities. As discussed in Section 4.3.1.1.2, under Vandenberg AFB Land Use, no impacts to land use on Vandenberg AFB are expected from EELV activities.

**Coastal Zone Management.** As discussed under Section 4.3.1.1.2, under Coastal Zone Management, a coastal zone consistency determination for EELV activities will be prepared.

**Recreation.** Under Concept B, Ocean Beach County Park would not be closed during SLC-6 launches. Jalama Beach County Park would be closed for launches with azimuths of between 140 and 180 degrees. Assuming that all launches during the peak year (2007) would utilize this range of azimuths, a maximum of 10 closures of Jalama Beach County Park would be required.

The park would be closed for up to 8 hours per launch event. No mitigation measures are available to reduce this impact.

**Aesthetics.** Aesthetic impacts at SLC-6 resulting from Concept B would be similar to those described under Section 4.3.1.1.2, under Aesthetics.

Other than beach closures, no land use impacts are anticipated; therefore, no mitigation measures would be required.

#### 4.3.1.3 Concept A/B

##### 4.3.1.3.1 Concept A/B, Cape Canaveral AS

**Regional Land Use.** As discussed in Sections 4.3.1.1.1 and 4.3.1.2.1, under Regional Land Use, the EELV program would be compatible with existing and planned land uses in the ROI; therefore, incompatible land uses would not result.

**Cape Canaveral AS Land Use.** Construction and operation activities associated with Concept A/B would occur primarily at SLC-41 and SLC-37, areas currently designated for space launch activities. As discussed in Sections 4.3.1.1.1 and 4.3.1.2.1, under Cape Canaveral AS Land Use, no impacts to land use on Cape Canaveral AS are expected from EELV activities.

**Coastal Zone Management.** A federal coastal zone consistency determination as discussed in Sections 4.3.1.1.1 and 4.3.1.2.1, under Coastal Zone Management, would be required for Concept A/B activities.

**Recreation.** Recreation impacts resulting from implementation of Concept A/B at SLC-41 and SLC-37 would be similar to those described under Concepts A and B, Sections 4.3.1.1.1 and 4.3.1.2.1, under Recreation.

**Aesthetics.** Aesthetic impacts at SLC-41 and SLC-37 resulting from Concept A/B would be similar to those described under Sections 4.3.1.1.1 and 4.3.1.2.1, under Aesthetics.

No adverse land use impacts are anticipated from EELV activities; therefore, no mitigation measures would be required.

##### 4.3.1.3.2 Concept A/B, Vandenberg AFB

**Regional Land Use.** As discussed in Sections 4.3.1.1.2 and 4.3.1.2.2, under Regional Land Use, the EELV program would be compatible with existing and planned land uses in the ROI; therefore, incompatible land uses would not result.

**Vandenberg AFB Land Use.** Construction and operation activities associated with Concept A/B would occur primarily at SLC-3W and SLC-6, areas currently designated for space launch activities. As discussed in Sections 4.3.1.1.2 and 4.3.1.2.2, under Vandenberg AFB Land Use, no impacts to land use on Vandenberg AFB are expected from EELV activities.

**Coastal Zone Management.** As discussed in Sections 4.3.1.1.2 and 4.3.1.2.2, under Coastal Zone Management, a coastal zone consistency determination for EELV activities will be prepared.

**Recreation.** Under Concept A/B, Jalama Beach and Ocean Beach county parks would be closed for all launches from SLC-3W; a maximum of 7 launches is planned for the peak year (2007). As discussed in Section 4.3.1.2.2, launches from SLC-6 would require closure of Jalama Beach County Park, depending on the launch azimuth. A maximum of 7 launches would occur from SLC-6 during the peak year. The parks would be closed for up to 8 hours per launch event. No mitigation measures are available to reduce this impact.

**Aesthetics.** Aesthetic impacts at SLC-3W and SLC-6 resulting from Concept A/B would be similar to those described under Sections 4.3.1.1.2 and 4.3.1.2.2, under Aesthetics.

Other than unavoidable beach closures, no other land use impacts are anticipated; therefore, no mitigation measures would be required.

### 4.3.2 No-Action Alternative

**4.3.2.1 Cape Canaveral AS.** Under the No-Action Alternative, no changes in land use are proposed, and no construction or modification of facilities would occur; therefore, no impacts to land use and aesthetics are expected.

**4.3.2.2 Vandenberg AFB.** Under the No-Action Alternative, county beaches would continue to be closed for as many as six launches per year. No mitigation measures are available to reduce this impact. No other land use and aesthetics impacts are anticipated because no changes in land use and no construction or modification of facilities is proposed.

## 4.4 TRANSPORTATION

This section describes the effects on key roadways and railroads expected to be impacted by the Proposed Action and No-Action Alternative.

### 4.4.1 Proposed Action

The ADT generated by the EELV program proposed for Cape Canaveral AS and Vandenberg AFB is expected to be less than 50 percent of the ADT generated by the current launch activities that would be replaced by this project. As a result, traffic volumes generated under the Proposed Action on the key roadways used to support the EELV program should be less than those under the existing launch programs.

**Roadways**

The effects on roadway traffic were assessed by estimating the number of trips generated by employees, visitors, and service vehicles associated with construction and operations. These trips were distributed to the roadway system based on existing travel patterns. This analysis is based on existing data on roadway capacities, existing and projected traffic volumes and patterns, and standards established by state local transportation agencies.

Trip generation was estimated by applying the trip rates from the ITE Trip Generation Manual, 5th Edition, combined with other project trip generation data, to obtain daily traffic volumes. Peak-hour traffic volumes generated under the Proposed Action were distributed to the installation and local road networks using trip distribution patterns from current launch programs. To determine traffic effects from the Proposed Action on local roadways, traffic volumes from each EELV concept were compared to the baseline year (1996).

**Railways**

Railroad lines in the Cape Canaveral AS area fall outside the launch pad safety corridor for the station. The main line of the Southern Pacific Railroad passes through the launch pad safety corridor at Vandenberg AFB. An average of four passenger and eight freight trains pass through Vandenberg AFB each day. Launches from Vandenberg AFB are coordinated with the railroad. Therefore, no impacts to railroad systems are expected at either location.

**4.4.1.1 Concept A.** Direct and indirect traffic impacts were determined for key local roadways related to Concept A and are discussed in this section. Under Concept A, project-related traffic is expected to increase slightly during construction of EELV facilities between 1998 and 2000, but to decline during the operational phase as employment decreases.

**4.4.1.1.1 Concept A, Cape Canaveral AS.** At the peak period of the construction phase, peak-hour traffic generated by construction workers would add approximately 250 vehicles to Samuel C. Phillips Parkway/Hangar Road. Approximately 50 vehicles would exit Cape Canaveral AS to the west on the NASA Causeway, and the remaining 200 vehicles would continue south and exit Cape Canaveral AS at Gate 1. This construction traffic is likely to increase the peak-hour traffic to approximately 2,100 vehicles on Samuel C. Phillips Parkway/Hangar Road, which would continue to operate at LOS A (Table 4.4-1). Although the local road system would experience a temporary increase in traffic, the increase is not expected to change projected LOS on key local roads.

By 2015, EELV activities would be expected to generate approximately 150 trips during the evening peak hour on Samuel C. Phillips Parkway. Approximately 50 vehicles would exit Cape Canaveral AS to the west by way of the NASA Causeway, and the remaining 100 vehicles would continue south and exit Cape Canaveral AS at Gate 1 (see Table 4.4-1). The roadway would continue to operate at LOS A. No measurable changes in peak-hour traffic are expected on Samuel C. Phillips Parkway/Hangar Road north of the project area. The local road system would experience a reduction in traffic entering and exiting the station. The reductions are not expected to change projected LOS on key local roads. No adverse impacts are anticipated; therefore, no mitigation measures would be required.

**4.4.1.1.2 Concept A, Vandenberg AFB.** At the peak period of the construction phase of the project, peak-hour traffic generated by construction workers would add approximately 350 vehicles to Coast and Bear Creek roads. This construction traffic is likely to increase the PHV on these roads

from the project location to Ocean Avenue (Table 4.4-2). The LOS on Bear Creek Road would change from A to B. When distributed to the local road system, the construction-related traffic would increase the PHV exiting the base by approximately 200 vehicles at each exit location, Ocean Avenue and the Santa Maria Gate. This temporary increase in the peak-hour traffic due to construction activities would not have a long-range measurable effect on the projected LOS of any local road segments.

**Table 4.4-1. Peak-Hour Volumes, Concept A**
**Cape Canaveral AS**

| Roadway | Segment/ No. of Lanes | Capacity (vehicles per hour) | 1996[(a)] PHV | LOS | 2000 PHV | 2000 LOS | 2015 PHV | 2015 LOS |
|---|---|---|---|---|---|---|---|---|
| SR A1A | Samuel C. Phillips Parkway, south; 4-lane | 8,000 | 3,950 | C | 4,300 | C | 5,300 | C |
| SR A1A | Samuel C. Phillips Parkway, east; 4-lane | 8,000 | 3,750 | B | 3,900 | B | 3,850 | B |
| NASA Causeway | Between US 1 and Samuel C. Phillips Parkway; 4-lane | 8,000 | 1,750 | A | 1,850 | A | 1,750 | A |
| Samuel C. Phillips Parkway/Hangar Road | Between SR 401 (Gate 1) and SR 401 (Gate 6) on CCAS 4-lane | 8,000 | 1,900 | A | 2,100 | A | 1,350 | A |

Note: (a) Peak-hour volume based on 10 percent of average daily traffic from Brevard County traffic counts.
CCAS = Cape Canaveral Air Station
LOS = level of service
NASA = National Aeronautics and Space Administration
PHV = peak-hour volume
SR = State Route

Source: Brevard County, undated

**Table 4.4-2. Peak-Hour Volumes, Concept A**
**Vandenberg AFB**

| Roadway | Segment/ No. of Lanes | Capacity (vehicles per hour) | 1996[(a)] PHV | LOS | 2000 PHV | 2000 LOS | 2015 PHV | 2015 LOS |
|---|---|---|---|---|---|---|---|---|
| Coast Road | Between SLC-6 and Bear Creek Road; 2-lane | 2,800 | 350 | A | 350 | A | 0 | A |
| Bear Creek Road | Between Coast Road and Ocean Avenue; 2-lane | 2,800 | 350 | A | 700 | B | 100 | A |
| 13th Street | Between Ocean Avenue and Santa Maria Gate; 2-lane | 2,800 | 1,550 | D | 1,700 | D | 1,400 | D |
| Ocean Avenue | Between Bear Creek Road and SR; 4-lane | 8,000 | 250 | A | 400 | A | 100 | A |
| SR 1 | Between Santa Maria Gate and SR 135; 4-lane | 8,000 | 1,550 | B | 1,700 | B | 1,400 | B |

Note: (a) Peak-hour volume based on 10 percent of average daily traffic from Santa Barbara County traffic counts.
LOS= level of service
PHV= peak-hour volume
SR = State Route

Source: Santa Barbara County Planning Department, 1996

By 2015, EELV program activities are expected to generate approximately 100 trips during the evening peak hour. Peak-hour traffic on Coast and Bear Creek roads is expected to decline. The LOS on these roads would remain the same or improve as a result of the reduced peak-hour traffic volume (see Table 4.4-2). Approximately 52 percent of the project-related traffic, or 50 vehicles, is expected to travel east on Ocean Avenue from Bear Creek Road toward Lompoc and SR 246. The remaining 50 vehicles would travel north on 13th Street, exiting the base at the Santa Maria Gate. As a result, it is estimated that approximately 250 fewer vehicles would enter the local road system at each of the base gates. Although the local road system would experience a reduction in traffic, the reductions are not expected to change projected LOS. No adverse impacts are anticipated; therefore, no mitigation measures would be required.

**4.4.1.2 Concept B.** Direct and indirect traffic impacts were determined for key local roadways related to Concept B and are discussed in this section. Under Concept B, project-related traffic is expected to increase slightly during construction of EELV facilities between 1998 and 2000, but decline during the operational phase as employment decreases.

**4.4.1.2.1 Concept B, Cape Canaveral AS.** At the peak period of the construction phase of the project, peak-hour traffic generated by construction workers would add approximately 250 vehicles to Samuel C. Phillips Parkway/Hangar Road. Approximately 50 vehicles would exit Cape Canaveral AS to the west on the NASA Causeway, and the remaining 200 vehicles

would continue south and exit Cape Canaveral AS at Gate 1 (Table 4.4-3). This construction traffic is likely to increase the PHV on Samuel C. Phillips Parkway/Hangar Road south of the project location to approximately 2,100 vehicles. Samuel C. Phillips Parkway/Hangar Road would continue to operate at LOS A. Although the local road system would experience an increase in traffic, the increase is not expected to change projected LOS on key local roads.

By 2015, EELV program activities are expected to generate approximately 350 trips during the evening peak hour on Samuel C. Phillips Parkway; the LOS would not be affected by the reduced traffic volume. Approximately 50 vehicles would exit Cape Canaveral AS to the west on the NASA Causeway, and the remaining 300 vehicles would continue south and exit Cape Canaveral AS at Gate 1 (see Table 4.4-3). No measurable changes in peak-hour traffic volume are expected on Samuel C. Phillips Parkway/Hangar Road north of the project area. The local road system would experience a reduction in traffic entering and exiting the station, but LOS on key local roads would not change. No adverse impacts are anticipated; therefore, no mitigation measures would be required.

**Table 4.4-3. Peak-Hour Volumes, Concept B**
**Cape Canaveral AS**

| Roadway | Segment/No. of Lanes | Capacity (vehicles per hour) | 1996[(a)] PHV | 2000 PHV | 2000 LOS | 2015 PHV | 2015 LOS |
|---|---|---|---|---|---|---|---|
| SR A1A | Samuel C. Phillips Parkway, south; 4-lane | 8,000 | 3,950 | 4,300 | C | 5,350 | C |
| SR A1A | Samuel C. Phillips Parkway, east; 4-lane | 8,000 | 3,750 | 3,900 | B | 3,950 | B |
| Samuel C. Phillips Parkway/Hangar Road | Between SR 401 (Gate 1) and SR 401 (Gate 6) on CCAS 4-lane | 8,000 | 1,900 | 2,100 | A | 1,500 | A |
| NASA Causeway | Between US 1 and Samuel C. Phillips Parkway; 4-lane | 8,000 | 1,750 | 1,850 | A | 1,800 | A |

Note: (a) Peak-hour volume based on 10 percent of average daily traffic from Brevard County traffic counts.
CCAS = Cape Canaveral Air Station
LOS = level of service
NASA = National Aeronautics and Space Administration
PHV = peak-hour volume
SR = State Route

Source: Brevard County, undated

**4.4.1.2.2 Concept B, Vandenberg AFB.** At the peak period of the construction phase of the project, peak-hour traffic generated by construction workers would add approximately 150 vehicles to Coast and Bear Creek roads. This construction traffic is likely to increase the PHV on these roads from the project location to Ocean Avenue (Table 4.4-4). The LOS on Bear Creek Road would change from A to B. When distributed to the local road system, the construction-related traffic would increase the PHV exiting the base by approximately 50 vehicles at each exit location, Ocean Avenue and the Santa Maria Gate. This increase in the peak-hour traffic would not have a permanent measurable effect on the projected LOS for any local road segments.

By 2015, EELV activities are expected to generate approximately 250 trips during the evening peak hour. Peak-hour traffic on Bear Creek Road is expected to decline, but the LOS would not change (see Table 4.4-4). Approximately 52 percent of the project-related traffic, or 150 vehicles, is expected to travel east on Ocean Avenue from Bear Creek Road towards Lompoc and SR 246. The remaining 100 vehicles would travel north on 13th Street, exiting the base at the Santa Maria Gate. As a result, it is estimated that approximately 150 fewer vehicles would enter the local road system at each of the base gates. Although the local road system would experience a reduction in traffic, the reductions are not expected to change projected LOS. No adverse impacts are anticipated; therefore, no mitigation measures would be required.

**Table 4.4-4. Peak-Hour Volumes, Concept B Vandenberg AFB**

| Roadway | Segment/No. of Lanes | Capacity (vehicles per hour) | 1996 PHV[(a)] | 2000 PHV | 2000 LOS | 2015 PHV | 2015 LOS |
|---|---|---|---|---|---|---|---|
| Coast Road | Between SLC-6 and Bear Creek Road; 2-lane | 2,800 | 50 | 50 | A | 50 | A |
| Bear Creek Road | Between Coast Road and Ocean Avenue; 2-lane | 2,800 | 350 | 500 | B | 250 | A |
| 13th Street | Between Ocean Avenue and Santa Maria Gate; 2-lane | 2,800 | 1,550 | 1,600 | D | 1,500 | D |
| Ocean Avenue | Between Bear Creek Road and SR 1; 4-lane | 8,000 | 250 | 300 | A | 200 | A |
| SR 1 | Between Santa Maria Gate and SR 135; 4-lane | 8,000 | 1,550 | 1,600 | B | 1,500 | B |

Note: (a) Peak-hour volume based on 10 percent of average daily traffic from Santa Barbara County traffic counts.
LOS = level of service
PHV = peak-hour volume
SR = State Route

Source: Santa Barbara County Planning Department, 1996

**4.4.1.3 Concept A/B.** Direct and indirect traffic impacts were determined for key local roadways related to Concept A/B and are discussed in this section. Under Concept A/B, project-related traffic is expected to increase slightly during construction activities related to EELV and to decline during operations.

**4.4.1.3.1 Concept A/B, Cape Canaveral AS.** During construction, peak-hour traffic generated by construction workers would add approximately 500 vehicles to Samuel C. Phillips Parkway/Hangar Road. This construction traffic is likely to increase PHV on Samuel C. Phillips Parkway/Hangar Road south of the project location to approximately 2,300 vehicles. The LOS on Samuel C. Phillips Parkway/Hangar Road would remain at LOS A. Approximately 100 vehicles would exit Cape Canaveral AS to the west by way of the NASA Causeway, and the remaining 400 vehicles would continue south and exit Cape Canaveral AS at Gate 1 (Table 4.4-5). The construction-related traffic would create a temporary increase in the peak-hour traffic and the LOS on SR A1A east of the station would change from B to C.

By 2015, EELV program activities would be expected to generate approximately 400 trips during the peak evening hour. Peak-hour traffic on Samuel C. Phillips Parkway is expected to decline; however, the LOS would not be affected by the reduced traffic volume. Approximately 100 vehicles would exit Cape Canaveral AS to the west on the NASA Causeway, and the

**Table 4.4-5. Peak-Hour Volumes, Concept A/B Cape Canaveral AS**

| Roadway | Segment/No. of Lanes | Capacity (vehicles per hour) | 1996[a] PHV | 2000 PHV | 2000 LOS | 2015 PHV | 2015 LOS |
|---|---|---|---|---|---|---|---|
| SR A1A | Samuel C. Phillips Parkway, south; 4-lane | 8,000 | 3,950 | 4,400 | C | 5,350 | C |
| SR A1A | Samuel C. Phillips Parkway, east; 4-lane | 8,000 | 3,750 | 4,050 | C | 4,000 | B |
| Samuel C. Phillips Parkway/ Hangar Road | Between SR 401 (Gate 1) and SR 401 (Gate 6) on CCAS 4-lane | 8,000 | 1,900 | 2,300 | A | 1,550 | A |
| NASA Causeway | Between US 1 and Samuel C. Phillips Parkway; 4-lane | 8,000 | 1,750 | 1,800 | A | 1,800 | A |

Note: (a) Peak-hour volume based on 10 percent of average daily traffic from Brevard County traffic counts.
CCAS = Cape Canaveral Air Station
LOS = level of service
NASA = National Aeronautics and Space Administration
PHV = peak-hour volume
SR = State Route

Source: Brevard County, undated

remaining 300 would continue south and exit Cape Canaveral AS at Gate 1 (see Table 4.4-5). No measurable changes in peak-hour traffic are expected on Samuel C. Phillips Parkway/Hangar Road north of the project area. Although the local road system would experience a reduction in traffic, the reductions are not expected to change projected LOS. No adverse impacts are anticipated; therefore, no mitigation measures would be required.

**4.4.1.3.2 Concept A/B, Vandenberg AFB.** At the peak period of the construction phase of the project, peak-hour traffic generated by construction workers would add approximately 500 vehicles to Coast and Bear Creek roads. This construction traffic is likely to increase the PHV on these roads from the project location to Ocean Avenue (Table 4.4-6). The LOS on Bear Creek Road would change from A to C, and the LOS on 13th Street would change from D to E. When distributed to the local road system, the construction-related traffic would increase PHV exiting the base by approximately 250 vehicles at each exit location, Ocean Avenue and the Santa Maria Gate. During EELV construction activities, the LOS on Ocean Avenue would temporarily change.

By 2015, EELV program activities are expected to generate approximately 300 trips during the evening peak hour. Peak-hour traffic on Coast and Bear Creek roads is expected to decline. The LOS on Bear Creek Road would improve from LOS C to LOS A, and the LOS on 13th Street would improve

**Table 4.4-6. Peak-Hour Volumes, Concept A/B Vandenberg AFB**

| Roadway | Segment/No. of Lanes | Capacity (vehicles per hour) | 1996 PHV[(a)] | 2000 PHV | 2000 LOS | 2015 PHV | 2015 LOS |
|---|---|---|---|---|---|---|---|
| Coast Road | Between SLC-6 and Bear Creek Road; 2-lane | 2,800 | 350 | 350 | A | 50 | A |
| Bear Creek Road | Between Coast Road and Ocean Avenue; 2-lane | 2,800 | 350 | 850 | C | 300 | A |
| 13th Street | Between Ocean Avenue and Santa Maria Gate; 2-lane | 2,800 | 1,550 | 1,800 | E | 1,500 | D |
| Ocean Avenue | Between Bear Creek Road and SR 1; 4-lane | 8,000 | 250 | 500 | B | 200 | A |
| SR 1 | Between Santa Maria Gate and SR 135; 4-lane | 8,000 | 1,550 | 1,800 | B | 1,500 | B |

Note: (a) Peak-hour traffic based on 10 percent of average daily traffic from Santa Barbara County traffic counts.
LOS = level of service
PHV= peak-hour volume
SR = State Route

Source: Santa Barbara County Planning Department, 1996

from LOS E to LOS D (see Table 4.4-6). Approximately 52 percent of the project-related traffic, or 150 vehicles, is expected to travel east on Ocean Avenue from Bear Creek Road toward Lompoc and SR 246. The remaining 150 vehicles would travel north on 13th Street, exiting the base at the Santa Maria Gate. As a result, it is estimated that approximately 150 fewer vehicles would enter the local road system at each of the exits as a result of Concept A/B implementation. No adverse impacts are anticipated; therefore, no mitigation measures would be required.

### 4.4.2 No-Action Alternative

Direct and indirect traffic impacts determined for key local roadways related to the No-Action Alternative are discussed in this section. Project-related traffic would continue at existing volumes throughout the analysis period, and there would be no changes to the existing roadways within the ROI as a result of launch vehicle programs.

**4.4.2.1 Cape Canaveral AS.** Traffic volumes on key local roadways at Cape Canaveral AS under the No-Action Alternative would include the current traffic generated by existing launch operations. Existing launch operations are estimated to contribute approximately 800 vehicles to the peak-hour volume on Samuel C. Phillips Parkway/Hangar Road. Approximately 150 vehicles exit the station on the NASA Causeway, with the remaining vehicles using the southern gate at SR 401. The launch-related traffic comprises approximately 40 percent of the peak-hour traffic on Samuel C. Phillips Parkway/Hangar

Road, which is expected to continue to operate at LOS A under the No-Action Alternative (Table 4.4-7).

**Table 4.4-7. Peak-Hour Volumes, No-Action Alternative Cape Canaveral AS**

| Roadway | Segment/No. of Lanes | Capacity (vehicles per hour) | 1996[a] PHV | 2000 PHV | 2000 LOS | 2015 PHV | 2015 LOS |
|---|---|---|---|---|---|---|---|
| SR A1A | Samuel C. Phillips Parkway, south; 4-lane | 8,000 | 3,950 | 4,200 | C | 5,500 | C |
| SR A1A | Samuel C. Phillips Parkway, east; 4-lane | 8,000 | 3,750 | 3,800 | B | 4,200 | C |
| Samuel C. Phillips Parkway/ Hangar Road | Between SR 401 (Gate 1) and SR 401 (Gate 6) on CCAS 4-lane | 8,000 | 1,900 | 1,900 | A | 1,900 | A |
| NASA Causeway | Between US 1 and Samuel C. Phillips Parkway; 4-lane | 8,000 | 1,750 | 1,800 | A | 1,900 | A |

Note: (a) Peak-hour volume based on 10 percent of average daily traffic from Brevard County traffic counts.
CCAS = Cape Canaveral Air Station
LOS = level of service
NASA = National Aeronautics and Space Administration
PHV = peak-hour volume
SR = State Route

Source: Brevard County, undated

**4.4.2.2 Vandenberg AFB.** Traffic volumes on key local roadways at Vandenberg AFB under the No-Action Alternative would include the current traffic generated by existing launch operations, which are estimated to contribute approximately 350 vehicles to the peak-hour volume on Coast and Bear Creek roads. Approximately 200 vehicles exit the base at Ocean Avenue, east toward Lompoc and SR 246. The remaining 150 vehicles travel north on 13th Street and exit the base at the Santa Maria Gate (Table 4.4-8).

## 4.5 UTILITIES

The utility systems addressed in this analysis include the facilities and infrastructure used for potable water supply, wastewater collection and treatment, solid waste disposal, and electricity. Direct and indirect changes in future utility consumption for the Proposed Action and the No-Action

**Table 4.4-8. Peak-Hour Volumes, No-Action Alternative Vandenberg AFB**

| Roadway | Segment/No. of Lanes | Capacity (vehicles per hour) | 1996 PHV[a] | 2000 PHV | 2000 LOS | 2015 PHV | 2015 LOS |
|---|---|---|---|---|---|---|---|
| Coast Road | Between SLC-6 and Bear Creek Road; 2-lane | 2,800 | 350 | 350 | A | 350 | A |
| Bear Creek Road | Between Coast Road and Ocean Avenue; 2-lane | 2,800 | 350 | 350 | A | 350 | A |
| 13th Street | Between Ocean Avenue and Santa Maria Gate; 2-lane | 2,800 | 1,550 | 1,550 | D | 1,750 | D |
| Ocean Avenue | Between Bear Creek Road and SR 1; 4-lane | 8,000 | 250 | 250 | A | 250 | A |
| SR 1 | Between Santa Maria Gate and SR 135; 4-lane | 8,000 | 1,550 | 1,550 | B | 2,150 | B |

Note: (a) Peak-hour traffic based on 10 percent of average daily traffic from Santa Barbara County traffic counts.
LOS = level of service
PHV = peak-hour volume
SR = State Route

Source: Santa Barbara County Planning Department, 1996

Alternative were estimated based on project-related requirements and per capita average daily use within the applicable ROI.

### 4.5.1 Proposed Action

This section describes direct and indirect changes in utility consumption for the Proposed Action. Impacts for each utility system were determined for the average construction period and for peak launch periods. Under the Proposed Action, direct and indirect project-related employment and population are expected to decrease (see Section 4.2). As a result, demands on those utilities affected by changes in population and employment within each region would also decrease from the amounts expected to occur under the No-Action Alternative. Additional facilities required by the Proposed Action are expected to create minimal increases for some utilities. However, these project-related fluctuations in utility usage would be small in comparison to changes associated with projected growth within each region.

#### 4.5.1.1 Concept A

##### 4.5.1.1.1 Concept A, Cape Canaveral AS

**Water Supply.** During construction, potable water usage would be greater than that required under the No-Action Alternative. As a result, average daily water consumption on Cape Canaveral AS would increase slightly between 1998 and 2000. The current average demand is approximately 0.75 MGD and the system has a capacity of 3 MGD; no impacts are anticipated during construction.

Employment decreases as a result of implementing Concept A would reduce the requirements for potable water on station by approximately 43,700 gpd by 2015, or approximately 6 percent. Deluge water required to support launches would consume approximately 1.2 million gallons during the peak launch year (2015). This is 0.6 million gallon less than that estimated for the No-Action Alternative, or a 34-percent decrease. Reductions in potable water from domestic and industrial uses under Concept A would be approximately 45,200 gpd, and no impacts to the potable water system are expected on station. Project-related population decreases within the ROI would reduce potable water consumption off-station by approximately 60,300 gpd. These changes in potable water requirements are not expected to have any impacts on regional water systems, and the systems would continue to operate within capacity.

**Wastewater.** Construction of facilities would increase wastewater generation between 1998 and 2000. The current system has a permitted capacity of 0.8 MGD and a peak daily flow of approximately 0.6 MGD. The increase can be absorbed by the existing system, and no impacts are anticipated.

During the operational phase, employment on station would decrease and the amount of wastewater would decrease. By the peak launch year (2015), wastewater generation is expected to be reduced by approximately 43,700 gpd, which would result in an on-station reduction of wastewater requiring treatment and disposal of approximately 7 percent. The amount of wastewater associated with Concept A launches would be approximately 464,000 gallons less than that estimated for the No-Action Alternative in 2015. During that year, approximately 80 percent of deluge water, or 920,000 gallons, used during launch activities would be discharged to percolation ponds near the launch pad or would be routed to the existing treatment plant on-site for treatment. The WWTP can treat approximately 200,000 gpd of contaminated deluge water, if required. The daily peak flow is expected to be approximately 0.55 MGD, and the WWTP would continue to operate within capacity.

Population decreases would reduce wastewater generation within the ROI and would result in a reduction of the requirements for wastewater treatment and disposal off station by approximately 40,200 gpd. Regional systems would continue to operate within capacity, and no impacts are anticipated.

**Solid Waste.** Several thousand tons of construction debris are expected to be generated over the 2-year construction period as a result of facility demolition, construction, and modification. Of this, approximately 3 to 5 percent of construction solid waste is expected to be recycled; the rest would be disposed of in the on-station construction landfill, which has approximately 7 acres of permitted capacity for construction and demolition debris.

During the operational phase, solid waste generated would be approximately 1.9 tons per day less than that of the No-Action Alternative, reducing the amount of solid waste generated on station by approximately 23 percent in 2015. Project-related population decreases within the ROI would reduce the generation of solid waste by approximately 1.4 tons per day. The combined reduction is expected to reduce the amount of solid waste disposed in the

Brevard County Landfill by 3.3 tons per day in 2015, which would be a beneficial impact on solid waste disposal facilities within the region.

**Electricity.** Increases in electrical consumption during construction are expected to be minimal. During the operational phase, electricity consumption would increase slightly as the result of new facilities being operated on the station. However, this increase in electrical consumption would not impact the station's electrical distribution system. No measurable changes in electrical consumption as a result of Concept A are expected to occur off station within the ROI. Therefore, no impacts to electrical consumption are expected.

#### 4.5.1.1.2 Concept A, Vandenberg AFB

**Water Supply.** During construction, potable water usage would exceed that required under the No-Action Alternative. As a result, average daily water consumption on Vandenberg AFB would increase slightly between 2000 and 2002. The existing system would be capable of absorbing the increase, and no impacts are anticipated during construction.

By 2007, employment decreases as a result of Concept A implementation would reduce the requirements for potable water on base by approximately 23,000 gpd, or approximately 0.7 percent. Deluge water requirements for launch activities are expected to be 500,000 gallons, approximately 280,000 gallons less than that needed under the No-Action Alternative during the peak launch year (2007). Reductions in potable water from domestic and industrial uses under Concept A would be approximately 24,000 gpd, and no impacts to the potable water system would occur on the base. Project-related population decreases within the ROI would reduce potable water consumption by approximately 36,600 gpd. These changes are not expected to have any impacts on regional water systems, and the systems would continue to operate within capacity.

**Wastewater.** Construction of facilities to support Concept A would slightly increase wastewater generation between 2000 and 2002. The existing system is capable of absorbing the increase. Therefore, no impacts are anticipated during construction.
During the operational phase of EELV, employment on base as a result of Concept A would decrease and the amount of wastewater generated would be reduced. By the peak launch year (2007), daily wastewater generation is expected to be reduced by approximately 23,000 gpd, which would result in an on-base reduction of wastewater requiring treatment and disposal of approximately 1.8 percent.

Project-related population decreases would reduce wastewater generation within the project's ROI and would result in a reduction of the requirements for wastewater treatment and disposal off base by 24,400 gpd. The combined reduction is expected to reduce the amount of wastewater treatment and disposal in Lompoc Regional WWTP by 47,400 gpd by 2007. These reductions in wastewater are not expected to impact wastewater treatment and disposal facilities.

Approximately 80 percent, or 400,000 gallons, of deluge water used during launch activities would be collected and transported by tanker truck with a capacity of 2,000 to 4,000 gallons per load from the origination point to the IWTP during the peak launch year. The wastewater generation associated with Concept A launches would be 224,000 gallons less than that estimated for the No-Action Alternative in 2007. The IWTP is currently using only one pond pending the completion of the engineering analysis for integrity. Each launch event would generate approximately 40,000 gallons of wastewater, which would require up to 20 truck trips from the launch pad to the IWTP and up to 44 days for disposal in the existing evaporation pond. This would be 60 fewer truck trips and up to 132 fewer days of evaporation per launch than those estimated for the No-Action Alternative. This would result in deluge wastewater generation that is less than that experienced under current operations. The IWTP would continue to operate within capacity.

**Solid Waste.** Several thousand tons of construction debris are expected to be generated over the 2-year construction period as a result of facility demolition, construction, and modification. Of this, approximately 3 to 5 percent of construction solid waste is expected to be recycled; the rest would be disposed of in the on-base construction landfill, which has a 95-year life.

During the operational phase, the amount of solid waste generated would be approximately 1 ton per day, or approximately 1.7 percent less than that of the No-Action Alternative. Project-related population decreases within the ROI related to Concept A would reduce the generation of solid waste by approximately 0.9 ton per day by 2007, which would be a beneficial impact on the solid waste disposal facilities within the region.

**Electricity.** Increases in electrical consumption during construction are expected to be minimal. During the operational phase, electricity consumption would increase slightly as the result of new facilities being operated on the base. However, the increase in electrical consumption would not impact the base's electrical distribution system. No measurable changes in electrical consumption as a result of Concept A are expected to occur off base within the ROI. Therefore, no impacts to electrical consumption are expected.

#### 4.5.1.2 Concept B

##### 4.5.1.2.1 Concept B, Cape Canaveral AS

**Water Supply.** During construction, potable water use would be approximately 3,300 gpd greater than use by existing launch programs, and average daily water consumption on Cape Canaveral AS would increase by less than one-half percent. No impacts are anticipated.

Project-related employment decreases would reduce the requirements for potable water on station by approximately 30,200 gpd, or approximately 4 percent, by 2015. There are currently no plans to use deluge water for Concept B launches. However, washdown of the pad after a launch using solid boosters would consume approximately 6,000 gallons of potable water, or 36,000 gallons during the peak launch year, or approximately 2 percent of

the deluge water estimated for the No-Action Alternative in 2015. Reductions in potable water from domestic and industrial uses under Concept B would be approximately 34,800 gpd, and no impacts to the potable water system on the station would occur. Project-related population decreases within the ROI would reduce potable water consumption off-station by approximately 42,800 gpd. These changes in potable water requirements are not expected to have any impacts on regional water systems, and the systems would continue to operate within capacity.

**Wastewater.** Construction of facilities to support Concept B would generate approximately 2,000 gallons of wastewater each day between 1998 and 2000, adding less than one-half of 1 percent to the wastewater disposal and treatment facility on Cape Canaveral AS. The WWTP would continue to operate within capacity, and no impacts are anticipated during construction.

During the operational phase, employment on station as a result of Concept B implementation would decrease and therefore would reduce the generation of wastewater. By the peak launch year (2015), wastewater generation is expected to be reduced by approximately 30,200 gpd, which would result in an on-station reduction of wastewater requiring treatment and disposal of approximately 5 percent. Wastewater generation associated with Concept B launches would be 1,348,000 gallons less than estimated for the No-Action Alternative in 2015. Approximately 36,000 gallons of deluge water used during launch activities would be discharged to percolation ponds near the launch pad or be routed to the existing treatment plant on site in 2015. The WWTP can treat approximately 200,000 gpd of contaminated deluge water, if required. The daily peak flow is expected to be approximately 0.57 MGD and the WWTP would continue to operate within its permitted capacity. Project-related population decreases would reduce wastewater generation within the ROI and would result in a reduction of the requirements for wastewater treatment and disposal off station by approximately 28,500 gpd. Regional systems would continue to operate within capacity, and no impacts are anticipated.

**Solid Waste.** Approximately 5,000 to 8,000 tons of construction debris are expected to be generated over the 2-year construction period as a result of facility demolition and modification. Of this, approximately 150 to 400 tons are expected to be recycled, with fewer than 11 tons per day requiring disposal. It is expected that the disposal would occur in the on-station construction landfill, which has approximately 7 acres of permitted capacity for construction and demolition debris disposal.

During the operational phase, solid waste generated would be less than that of the No-Action Alternative by approximately 1.3 tons per day. This would reduce the amount of solid waste generated on station by approximately 16 percent in 2015. Project-related population decreases within the ROI would reduce the generation of solid waste by approximately 1 ton per day. The combined reduction is expected to reduce the amount of solid waste disposed in the Brevard County Landfill by 2.3 tons per day in 2015, which would be a beneficial impact on the solid waste disposal facilities within the region.

**Electricity.** Increases in electrical consumption during construction are expected to be minimal. During the operational phase, electricity consumption would increase slightly as the result of new facilities being operated on the station. However, this increase in electrical consumption would not impact the station's electrical distribution system. No measurable changes in electrical consumption as a result of Concept B activities are expected to occur off station within the ROI. Therefore, no impacts to electrical consumption are expected.

#### 4.5.1.2.2 Concept B, Vandenberg AFB

**Water Supply.** During construction, potable water usage would exceed that required by the No-Action Alternative. As a result, average daily water consumption on Vandenberg AFB would increase slightly between 1998 and 2001. The existing system would be capable of absorbing the increase, and no impacts are anticipated during construction.

By 2007, employment decreases as a result of Concept B implementation would reduce the requirements for potable water on base by approximately 11,100 gpd, or approximately 0.3 percent, by 2007. There are currently no plans to use deluge water for Concept B launches. However, water flushing at the pad after a launch using solid boosters would consume approximately 6,000 gallons of potable water, or 24,000 gallons during the peak launch year. Flushing water usage associated with Concept B launches would be only 3 percent of the deluge water estimated for the No-Action Alternative by 2007. Reductions in potable water from domestic and industrial uses under Concept B would be approximately 13,000 gpd, and no impacts to the potable water system would occur on the base. Project-related population decreases within the ROI would reduce potable water consumption by approximately 18,800 gpd off base. These changes are not expected to have any impacts on regional water systems, and the systems would continue to operate within capacity.

**Wastewater.** Construction of facilities to support Concept B would generate approximately 2,000 gallons of wastewater between 1998 and 2001. As a result, the additional wastewater would add less than one-half of 1 percent to the wastewater disposal and treatment facility. The existing system is capable of absorbing the increase. Therefore, no impacts are anticipated during construction.

During the operational phase, employment on base as a result of Concept B implementation would decrease and the amount of wastewater generated would be reduced. By the peak launch year (2007), daily wastewater generation is expected to be reduced by approximately 11,100 gpd, which would result in an on-base reduction of wastewater requiring treatment and disposal of approximately 0.9 percent.

Project-related population decreases would reduce wastewater generation within the ROI and would result in a reduction of the requirements for wastewater treatment and disposal off base by 12,500 gpd. The combined reduction is expected to reduce the amount of wastewater treatment and disposal in Lompoc Regional WWTP by 23,600 gpd in 2007. Reductions in wastewater from domestic uses are not expected to exceed current

operations, and no impacts to wastewater treatment and disposal would occur within the region.

Flushing water used after launches would be collected and transported by tanker trucks with a capacity of 2,000 to 4,000 gallons per load from the origination point to IWTP and discharged directly into the evaporation ponds. Flushing water associated with Concept B launches would be 600,000 gallons less than the deluge water estimated for the No-Action Alternative in 2007. The IWTP is currently using only one pond pending the completion of the engineering analysis for integrity. Each launch event would generate 6,000 gallons of wastewater, which would require up to 3 truck trips and up to 7 days for disposal in the existing evaporation pond. This would be 77 fewer truck trips and up to 169 fewer days of evaporation per launch than those estimated for the No-Action Alternative. This would result in industrial wastewater generation that is less than that experienced under current operations. The IWTP would continue to operate within capacity.

**Solid Waste.** Approximately 5,000 to 8,000 tons of construction debris are expected to be generated over the 30-month construction period as a result of facility demolition, construction, and modification. Of this, approximately 150 to 400 tons are expected to be recycled, fewer than 8.5 tons per day would be disposed in the on-base construction landfill, which has a 95-year life.

During the operational phase, the amount of solid waste generated would be approximately 0.5 ton per day less than that of the No-Action Alternative. This would reduce the amount of solid waste generated on base by approximately 0.8 percent by 2007. Project-related population decreases within the ROI related to the Concept B program would reduce the generation of solid waste by approximately 0.4 ton per day in 2007, which would be a beneficial effect on the solid waste disposal facilities within the region.

**Electricity.** Increases in electrical consumption during construction are expected to be minimal. During the operational phase, electricity consumption would increase slightly as the result of new facilities being operated on the base. However, the increase in electrical consumption would not impact the base's electrical distribution system. No measurable changes in electrical consumption as a result of Concept B activities are expected to occur off base within the ROI. Therefore, no impacts to electrical consumption are expected. No adverse impacts are anticipated; therefore, no mitigation measures would be required.

#### 4.5.1.3 Concept A/B

##### 4.5.1.3.1 Concept A/B, Cape Canaveral AS

**Water Supply.** During construction, potable water use would be greater than use by existing systems, and average daily water consumption on Cape Canaveral AS would increase slightly. No impacts are anticipated.

Project-related employment decreases would reduce the requirements for potable water on station by approximately 27,900 gpd by 2015, or approximately 3.7 percent. Deluge and flushing water required to support

launches would consume approximately 674,000 gallons of potable water during the peak launch year. This is approximately 1,050,000 gallons of potable water usage less than estimated for the No-Action Alternative, or a 61-percent decrease. Reductions in potable water from domestic and industrial uses under Concept A/B would be approximately 30,000 gpd, and no impacts to the potable water system on the station would occur. Project-related population decreases within the ROI would reduce potable water consumption off station by approximately 43,000 gpd. These changes in potable water requirements are not expected to have any impacts on regional water systems, and the systems would continue to operate within capacity.

**Wastewater.** Construction of facilities to support Concept A/B would slightly increase wastewater generation between 1998 and 2000. The WWTP would continue to operate within capacity and no impacts are anticipated during construction.

During the operational phase, employment on station as a result of Concept A/B would decrease and therefore would reduce the generation of wastewater. By the peak launch year, wastewater generation is expected to be reduced by approximately 27,900 gpd, which would result in an on-station reduction of wastewater requiring treatment and disposal of approximately 4.5 percent. The total amount of wastewater associated with Concept A/B launches would be 840,000 gallons less than that estimated for the No-Action Alternative by 2015. Approximately 544,000 gallons of deluge and flushing water used during launch activities would be discharged into percolation ponds near the launch pad during the peak launch year or routed to the treatment plant on-site for treatment. The WWTP can treat approximately 200,000 gpd as an alternative to discharging wastewater into percolation ponds. The daily peak flow in 2015 is expected to be approximately 0.57 MGD, and the WWTP would continue to operate within capacity. Project-related population decreases would reduce wastewater generation within the ROI and would result in a reduction of the requirements for wastewater treatment and disposal off station by approximately 28,700 gpd. Regional systems would continue to operate within capacity and no impacts are anticipated.

**Solid Waste.** Several thousand tons of construction debris are expected to be generated over the 2-year construction period as a result of facility demolition and modification. Of this, approximately 3 to 5 percent of construction solid waste is expected to be recycled; the rest would require disposal. It is expected that the disposal would occur in the on-station construction landfill, which has over 127 acres of potential available capacity. Approximately 7 acres of permitted capacity are for construction and demolition debris disposal.

During the operational phase, solid waste generated by the employees would decrease over that of the No-Action Alternative by approximately 1.2 tons per day. This would reduce the amount of solid waste generated on station by approximately 15 percent by 2015. Project-related population decreases within the ROI would reduce the generation of solid waste by approximately 1 ton per day. The combined reduction is expected to reduce the amount of solid waste disposed in the Brevard County Landfill by 2.2 tons per day in

2015, which would be a beneficial impact on the solid waste disposal facilities within the region.

**Electricity.** Increases in electrical consumption during construction are expected to be minimal. During the operational phase, electricity consumption would increase slightly as the result of new facilities being operated on the station. However, this increase in electrical consumption would not impact the station's electrical distribution system. No measurable changes in electrical consumption as a result of Concept A/B activities are expected to occur off station within the ROI. Therefore, no impacts to electrical consumption are expected.

#### 4.5.1.3.2 Concept A/B, Vandenberg AFB

**Water Supply.** During construction, potable water usage would exceed that required under the No-Action Alternative. As a result, average daily water consumption on Vandenberg AFB would increase slightly between 1998 and 2002. The existing system would be capable of absorbing the increase and no impacts are anticipated during construction.

Employment decreases as a result of Concept A/B implementation would reduce the requirements for potable water on base by approximately 10,400 gpd by 2007, or approximately 0.3 percent. Deluge and flushing water requirements for launch activities are expected to be 374,000 gallons, approximately 400,000 gallons less than needed under the No-Action Alternative during the peak launch year, or a 52-percent decrease. Reductions in potable water from domestic and industrial uses under Concept A/B would be approximately 12,000 gpd, and no impacts to the potable water system would occur on the base. Project-related population decreases within the ROI would reduce potable water consumption by approximately 20,000 gpd off base. These changes are not expected to have any impacts on regional water systems, and the systems would continue to operate within capacity.

**Wastewater.** Construction of facilities to support Concept A/B would increase the generation of wastewater between 1998 and 2002. The existing system would be capable of absorbing the increase. Therefore, no impacts are anticipated during construction.

During the operational phase, employment on base as a result of Concept A/B implementation would decrease and the amount of wastewater generated would be reduced. By the peak launch year, daily wastewater generation is expected to be reduced by approximately 10,400 gpd, which would result in an on-base reduction of wastewater requiring treatment and disposal of approximately 0.8 percent.

Project-related population decreases would reduce wastewater generation within the project's ROI and would result in a reduction of the requirements for wastewater treatment and disposal off base by 13,300 gpd. The combined reduction is expected to reduce the amount of wastewater treatment and disposal in Lompoc Regional WWTP by 23,700 gpd in 2007. These reductions are not expected to impact wastewater treatment and disposal facilities.

Approximately 300,000 gallons of deluge and flushing water used during launch activities would be collected and transported by tanker trucks with a capacity of 2,000 to 4,000 gallons per load from the origination point to the IWTP during the peak launch year. This amount would be 320,000 gallons less than estimated for the No-Action Alternative by 2007. The IWTP is currently using only one pond pending the completion of the engineering analysis for integrity. Each launch event would generate up to 40,000 gallons of wastewater, which would require up to 20 truck trips and up to 44 days for disposal in the existing evaporation pond. This would be 77 fewer truck trips and up to 169 fewer days of evaporation per launch over those estimated for the No-Action Alternative. This would result in industrial wastewater generation that is less than that experienced under current operations. The IWTP would continue to operate within capacity.

**Solid Waste.** Several thousand tons of construction debris are expected to be generated over the 3.5-year construction period as a result of facility demolition and modification. Of this, approximately 3 to 5 percent is expected to be recycled; the rest would require disposal. It is expected that the disposal would occur in the on-base construction landfill, which has a 95-year life.

During the operational phase, the amount of solid waste generated would be approximately 0.5 ton per day less than that of the No-Action Alternative. This would reduce the amount of solid waste generated on base by approximately 0.8 percent by 2007. Project-related population decreases within the ROI related to Concept A/B would reduce the generation of solid waste by approximately 0.5 ton per day, which would be a beneficial impact on the solid waste disposal facilities within the region.

**Electricity.** Increases in electrical consumption during construction are expected to be minimal. During the operational phase, electricity consumption would increase slightly as the result of new facilities being operated on the base. However, this increase in electrical consumption is not expected to impact the base's electrical distribution system. No measurable changes in electrical consumption as a result of Concept A/B activities are expected to occur off base within the ROI. Therefore, no impacts to electrical consumption are expected.

### 4.5.2 No-Action Alternative

#### 4.5.2.1 Cape Canaveral AS

Utility consumption for government launch programs at Cape Canaveral AS would continue at current levels, as described in Section 3.5.1, and all systems would continue to operate within capacity. No impacts are anticipated.

#### 4.5.2.2 Vandenberg AFB

Utility consumption for government launch programs at Vandenberg AFB would continue at current levels, as described in Section 3.5.2, and all systems would continue to operate within capacity. No impacts are anticipated.

## 4.6 HAZARDOUS MATERIALS AND HAZARDOUS WASTE MANAGEMENT

This section addresses potential environmental impacts caused by hazardous materials/waste management practices associated with the Proposed Action and No-Action Alternative, including the potential impacts on the ongoing remediation activities at existing contaminated sites.

The Air Force will continue to remediate all contamination associated with sites proposed for use under the EELV program. Delays or restrictions on facility use or launch sites may occur depending on the extent of contamination and the results of remedial actions determined for contaminated sites.

Regulatory standards and guidelines have been applied in determining the potential impacts associated with the use of hazardous materials and the generation of hazardous wastes. The following criteria were used to identify potential impacts:

- Amount of hazardous materials brought onto the installations to support the EELV program that could result in exposure to the environment or public through release or disposal practices
- Hazardous waste generation that could increase regulatory requirements
- Pollution prevention practices to be utilized during the EELV program to prevent and/or improve environmental impacts associated with launch operations
- EELV program activities that would affect IRP activities.

### 4.6.1 Proposed Action

#### 4.6.1.1 Concept A

Activities proposed under Concept A were analyzed for their potential to impact the existing hazardous material and waste management programs. The impact analysis was conducted by comparing the amount of hazardous materials/waste associated with the EELV program to quantities utilized for current launch vehicle systems. Table 4.6-1 presents the quantities of hazardous waste that would be generated under Concept A.

**Table 4.6-1. Hazardous Waste Generated Per Launch, Concept A[(a)]**

| RCRA Hazardous Waste | Quantity (lbs) MLV | Quantity (lbs) HLV |
|---|---|---|
| Ignitable DOO1 RCRA Wastes | 980 | 1,340 |
| Halogenated Solvents FOO1/FOO2 RCRA Wastes | 0 | 0 |
| Toxic DOO4 EPA Wastes | 40 | 110 |
| Corrosive DOO2 RCRA Waste | 5,500 | 5,500 |
| Commercial Chemical Products (U) RCRA Wastes | 3,100 | 3,100 |
| Acutely Hazardous Waste (P) RCRA Wastes | 0 | 0 |
| Reactive DOO3 RCRA Wastes | 500 | 500 |
| State-Regulated Wastes | 0 | 0 |
| Miscellaneous Wastes | 50 | 50 |
| Total | 10,170 | 10,600 |

Note: (a) Data provided by contractor.
HLV = heavy lift variant
lbs = pounds
MLV = medium lift variant
RCRA = Resource Conservation and Recovery Act

#### 4.6.1.1.1 Concept A, Cape Canaveral AS

**Hazardous Materials Management.** The types of hazardous materials proposed for use for Concept A activities would be similar to those used at Cape Canaveral AS for current launch vehicle programs. Table 4.6-2 provides a comparison of hazardous materials to be used per launch and in the peak year (2015) for Concept A with the quantities utilized for current launch vehicle systems.

Implementation of Concept A would increase the amount of hazardous materials used on Cape Canaveral AS by approximately 190,000 pounds per year. This increase in hazardous material use is due to the increased number of annual launches under Concept A compared to current programs.

Although launch rates would increase, less processing would occur on site. Launch vehicle components would be shipped to Cape Canaveral AS in flightworthy condition, reducing on-site prelaunch preparations. Payload

**Table 4.6-2. Total Hazardous Materials Used for Concept A and for Current Launch Vehicle Systems, Cape Canaveral AS[(a)]**

| Launch Vehicle System | Number of Launches | Hazardous Materials Used (lbs/launch) | Total Hazardous Materials Used in 2015 (lbs) |
|---|---|---|---|
| EELV Concept A[(b)] | | | 374,830 |
| MLV | 22 | 15,850 | |
| HLV | 1 | 26,130 | |
| No-Action Alternative[(b)(c)] | | | 184,520 |
| Atlas IIA | 7 | 17,670 | |
| Delta II | 3 | 7,210 | |
| Titan IVB | 1 | 39,200 | |

Note: (a) Table does not include propellants.
(b) Data provided by contractor.
(c) Government launches only; no commercial launches included.
EELV = Evolved Expendable Launch Vehicle
HLV = heavy lift variant
lbs = pounds
MLV = medium lift variant

fairings would arrive cleaned, bagged, and ready for storage. No cleaning of payload fairings would occur on site, reducing the amount of hazardous materials utilized for on-site launch processing.

The amount of liquid propellants stored on the installation would increase due to the increased number of launches; no solid rocket motor propellant would be utilized. Table 2.1-1 and 2.2-2 list propellant quantities for Concept A and the No-Action Alternative, respectively.

Cape Canaveral AS has the mechanisms in place to store and manage the increased quantity of hazardous materials, including liquid propellants. All activities would be conducted in accordance with existing regulations for the use and storage of hazardous materials.

Section 4.7, Health and Safety, describes impacts associated with transportation of hazardous materials/fuels.

**Hazardous Waste Management.** The types of hazardous waste generated under Concept A would be similar to wastes generated by current launch vehicle systems. Table 4.6-3 provides a comparison of the quantities of hazardous waste generated per launch and in the peak year (2015) for Concept A to the quantities generated by current programs.

Implementation of Concept A would increase the amount of hazardous waste generated on Cape Canaveral AS by approximately 83,000 pounds per year. This increase in hazardous waste generation is due to the increased number of annual launches under Concept A.

**Table 4.6-3. Total Hazardous Waste Generation for Concept A and for Current Launch Vehicle Systems, Cape Canaveral AS[a]**

| Launch Vehicle System | Number of Launches | Hazardous Waste Generated (lbs/launch) | Total Hazardous Waste Generated in 2015 (lbs) |
|---|---|---|---|
| EELV Concept A[b] | | | 234,340 |
| MLV | 22 | 10,170 | |
| HLV | 1 | 10,600 | |
| No-Action Alternative[b][c] | | | 151,300 |
| Atlas IIA | 7 | 9,240 | |
| Delta II | 3 | 16,810 | |
| Titan IVB | 1 | 36,190 | |

Note: (a) Table does not include propellants.
(b) Data provided by contractor.
(c) Government launches only; no commercial launches included.
EELV = Evolved Expendable Launch Vehicle
HLV = heavy lift variant
lbs = pounds
MLV = medium lift variant

Cape Canaveral AS has the mechanisms in place to store, manage, and dispose of hazardous waste, including additional propellant waste. Hazardous wastes would be handled in accordance with all federal, state, and Air Force regulations. Since wastes from Concept A would be similar to wastes currently handled by Cape Canaveral AS, no adverse impacts are anticipated.

**Pollution Prevention.** As required under Air Force pollution prevention goals, Cape Canaveral AS must reduce hazardous waste disposal by 50 percent by December 31, 1997, from their 1992 baseline. The increased volume of hazardous waste generation under Concept A could affect the installation's ability to meet this goal. Concept A activities should be coordinated with installation environmental personnel to reduce the impact of increased hazardous waste on pollution prevention goals.

No Class I ODSs would be used for any Concept A activities at Cape Canaveral AS. The only potential use for Class II ODSs is the use of refrigerants in the heating, ventilation and air conditioning (HVAC) system. Shipping components to the launch site in flightworthy condition and minimizing prelaunch processing would reduce pollution at the site. A Hazardous Material Management Plan would be prepared to outline plans to reduce to as near zero as possible the use of Class II ODSs and EPCRA 313 chemicals.

**Installation Restoration Program.** The PCB-contaminated soil at SLC-41 will be addressed prior to commencement of EELV construction activities. Some areas of contamination may be paved over (capped) prior to construction in lieu of disturbing the contaminated soil. Prior to beginning construction at SLC-41, activities would be coordinated through IRP personnel to minimize impacts to remediation activities and EELV program activities.

Although groundwater contamination is present at the VIB (Building 70500), no construction is proposed at this site under the EELV program. IRP investigations at the VIB would not be impacted by Concept A activities.

Compliance with all applicable federal, state, local, and Air Force regulations regarding the use, storage, handling, and disposal of hazardous substances would reduce the potential for impacts; therefore, no mitigation measures would be required.

#### 4.6.1.1.2 Concept A, Vandenberg AFB

**Hazardous Materials Management.** The types of hazardous materials proposed for use for Concept A activities would be similar to those used at Vandenberg AFB for current launch vehicle programs. Table 4.6-4 provides a comparison of the quantities of hazardous materials to be used per launch and in the peak year (2007) for Concept A with the quantities utilized for current launch vehicle systems.

**Table 4.6-4. Total Hazardous Materials Used for Concept A and for Current Launch Vehicle Systems, Vandenberg AFB[(a)]**

| Launch Vehicle System | Number of Launches | Hazardous Materials Used (lbs/launch) | Total Hazardous Materials Used in 2007 (lbs) |
|---|---|---|---|
| EELV Concept A[(b)] | | | 158,500 |
| MLV | 10 | 15,850 | |
| HLV | 0 | 26,130 | |
| No-Action Alternative[(b)(c)] | | | 74,640 |
| Atlas IIA | 3 | 17,670 | |
| Delta II | 3 | 7,210 | |
| Titan IVB | 0 | 39,200 | |

Note: (a) Table does not include propellants.
(b) Data provided by contractor.
(c) Government launches only; no commercial launches included.
EELV = Evolved Expendable Launch Vehicle
HLV = heavy lift variant
lbs = pounds
MLV = medium lift variant

Implementation of Concept A would increase the amount of hazardous materials used on Vandenberg AFB by approximately 84,000 pounds per year. This increase in hazardous material use is due to the increased number of annual launches under Concept A compared to current programs. Although launch rates are scheduled to increase, less processing would occur on site, as discussed in Section 4.6.1.1.1.

The amount of liquid propellant stored on the installation would increase due to the increase in number of launches; no solid rocket motor propellant would be required. Tables 2.1-1 and 2.2-2 list propellant quantities for Concept A and the No-Action Alternative, respectively.

Vandenberg AFB has the mechanisms in place to store and manage the increased quantity of hazardous materials, including liquid propellant. All activities would be conducted in accordance with existing regulations for the use and storage of hazardous materials.

Section 4.7, Health and Safety, describes impacts associated with transportation of hazardous materials/fuels.

**Hazardous Waste Management.** The types of hazardous waste generated under Concept A would be similar to wastes generated by current launch vehicle systems. Table 4.6-5 provides a comparison of the quantities of hazardous waste generated per launch and in the peak year (2007) for Concept A to the quantities generated by current programs.

**Table 4.6-5. Total Hazardous Waste Generation for Concept A and for Current Launch Vehicle Systems, Vandenberg AFB[(a)]**

| Launch Vehicle System | Number of Launches | Hazardous Waste Generated (lbs/launch) | Total Hazardous Waste Generated in 2007 (lbs) |
|---|---|---|---|
| EELV Concept A[(b)] | | | 101,700 |
| MLV | 10 | 10,170 | |
| HLV | 0 | 10,600 | |
| No-Action Alternative[(b)(c)] | | | 78,150 |
| Atlas IIA | 3 | 9,240 | |
| Delta II | 3 | 16,810 | |
| Titan IVB | 0 | 36,190 | |

Note: (a) Table does not include propellants.
(b) Data provided by contractor.
(c) Government launches only; no commercial launches included.
EELV = Evolved Expendable Launch Vehicle
HLV = heavy lift variant
lbs = pounds
MLV = medium lift variant

Implementation of Concept A would increase the amount of hazardous waste generated on Vandenberg AFB by approximately 23,500 pounds per year. This increase in hazardous waste generation is due to the increased number of annual launches under Concept A compared to current programs. Vandenberg AFB has the mechanisms in place to store, manage, and dispose of hazardous waste, including additional propellant waste. Hazardous wastes would be handled in accordance with all federal, state, and Air Force regulations. Since wastes from Concept A would be similar to wastes currently handled by Vandenberg AFB, no adverse impacts are anticipated.

**Pollution Prevention.** Pollution prevention impacts on Vandenberg AFB from Concept B activities are the same as discussed for Cape Canaveral in Section 4.6.1.1.1.

**Installation Restoration Program.** IRP Site 6, located at SLC-3W, has been recommended for NFRAP. EELV construction activities would not impact

investigations at the site. EELV activities are not expected to impact investigations at IRP Site 7, Bear Creek Pond.

There are several AOCs associated with the SLC-3 area and one AOC at Building 7525 that could delay proposed EELV construction activities. It has not yet been determined whether these sites require remediation; further investigations are planned.

Compliance with all applicable federal, state, local, and Air Force regulations regarding the use, storage, handling, and disposal of hazardous substances would reduce the potential for impacts; therefore, no mitigation measures would be required.

#### 4.6.1.2 Concept B

Activities proposed under Concept B were analyzed for their potential impacts on the existing hazardous material and waste management programs from associated hazardous material usage and waste generation. The impact analysis was conducted by comparing the amount of hazardous material/ waste associated with the EELV program to quantities utilized for current launch vehicle systems. Table 4.6-6 presents the quantities of hazardous waste that would be generated under Concept A.

##### 4.6.1.2.1 Concept B, Cape Canaveral AS

**Hazardous Materials Management.** The types of hazardous materials proposed for use for Concept B activities would be similar to those used at Cape Canaveral AS for current launch vehicle programs. Table 4.6-7 provides a comparison of hazardous materials to be used per launch and in the peak year (2015) for Concept B with the quantities utilized for current launch vehicle systems.

**Table 4.6-6. Hazardous Waste Generated Per Launch, Concept B[a]**

| Hazardous Waste Generated Per Launch | Quantity (lbs) |
|---|---|
| Ignitable DOO1 RCRA Wastes | 3,570 |
| Halogenated Solvents FOO1/FOO2 RCRA Wastes | 0 |
| Non-halogenated Solvents FOO3/FOO4/F005 RCRA | 890 |
| Corrosive DOO2 RCRA Wastes | 5,500 |
| Toxic DOO4-DOO12 RCRA Wastes | 1,700 |
| Commercial Chemical Products (U) RCRA Wastes | 430 |
| Acutely Hazardous Waste (P) RCRA Wastes | 0 |
| Reactive DOO3 RCRA Wastes | 20 |
| State-Regulated Wastes | 10,500 |
| Miscellaneous (Remediation) Wastes | 4,340 |
| Total | 26,950 |

Note: (a) Data provided by contractor.
lbs = pounds
RCRA = Resource Conservation and Recovery Act

**Table 4.6-7. Total Hazardous Materials Used for Concept B and for Current Launch Vehicle Systems, Cape Canaveral AS[a]**

| Launch Vehicle System | Number of Launches | Hazardous Materials Used (lbs/launch) | Total Hazardous Materials Used in 2015 (lbs) |
|---|---|---|---|
| EELV Concept B[b] | | | 205,390 |
| MLV | 22 | 8,930 | |
| HLV | 1 | 8,930 | |
| No-Action Alternative[b][c] | | | 184,520 |
| Atlas IIA | 7 | 17,670 | |
| Delta II | 3 | 7,210 | |
| Titan IVB | 1 | 39,200 | |

Note: (a) Table does not include propellants.
(b) Data provided by contractor.
(c) Government launches only; no commercial launches included.
EELV = Evolved Expendable Launch Vehicle
HLV = heavy launch vehicle
lbs = pounds
MLV = medium launch vehicle

Implementation of Concept B would increase the amount of hazardous materials used on Cape Canaveral AS by approximately 21,000 pounds per year. This increase is due to the increased number of annual launches under Concept B. Although launch rates are scheduled to increase, less processing would occur on site, as discussed in Section 4.6.1.1.1.

Quantities of propellant stored on the installation would increase due to the increase in launches. Tables 2.1-6 and 2.2-2 list propellant quantities for Concept B and the No-Action Alternative, respectively.

Cape Canaveral AS has the mechanisms in place to store and manage hazardous materials, including hazardous propellants. All activities would be conducted in accordance with existing regulations for the use and storage of hazardous materials.

Section 4.7, Health and Safety, describes impacts associated with transportation of hazardous materials/fuels.

**Hazardous Waste Management.** The types of hazardous waste generated under Concept B would be similar to wastes generated by current launch vehicle systems. Table 4.6-8 provides a comparison of the quantities of hazardous waste generated per launch and in the peak year (2015) for Concept B to the quantities generated by current programs.

**Table 4.6-8. Total Hazardous Waste Generation for Concept B and for Current Launch Vehicle Systems, Cape Canaveral AS[(a)]**

| Launch Vehicle System | Number of Launches | Hazardous Waste Generated (lbs/launch) | Total Hazardous Waste Generated in 2015 (lbs) |
|---|---|---|---|
| EELV Concept B[(b)] | | | 619,850 |
| MLV | 22 | 26,950 | |
| HLV | 1 | 26,950 | |
| No-Action Alternative[(b)(c)] | | | 151,300 |
| Atlas IIA | 7 | 9,240 | |
| Delta II | 3 | 16,810 | |
| Titan IVB | 1 | 36,190 | |

Note: (a) Table does not include propellants.
(b) Data provided by contractor.
(c) Government launches only; no commercial launches included.
EELV = Evolved Expendable Launch Vehicle
HLV = heavy launch vehicle
lbs = pounds
MLV = medium launch vehicle

Implementation of Concept B would increase the amount of hazardous waste generated on Cape Canaveral AS by approximately 470,000 pounds per year. This increase in hazardous waste generation is due to the increased number of annual launches under Concept B compared to current programs.

The additional hazardous waste generated by Concept B activities would be handled as discussed in Section 4.6.1.1.1. Since wastes from Concept B would be similar to wastes currently handled by Cape Canaveral AS, no adverse impacts are anticipated.

**Pollution Prevention.** Pollution prevention impacts on Cape Canaveral AS from Concept B activities are the same as discussed for Concept A in Section 4.6.1.1.1.

**Installation Restoration Program.** NASA is currently investigating activities at the SLC-37 IRP site. EELV program activities and remediation activities could conflict depending on the results of the investigation and program schedules. Prior to EELV construction activities at SLC-37, coordination with IRP personnel would occur in order to minimize impacts to remediation activities and EELV program activities.

#### 4.6.1.2.2 Concept B, Vandenberg AFB

**Hazardous Materials Management.** The types of hazardous materials proposed for use for Concept B activities would be similar to those used at Vandenberg AFB for current launch vehicle programs. Table 4.6-9 provides a comparison of hazardous materials to be used per launch and in the peak year (2007) for Concept B with the quantities utilized for current launch vehicle systems.

**Table 4.6-9. Total Hazardous Materials Used for Concept B and for Current Launch Vehicle Systems, Vandenberg AFB[(a)]**

| Launch Vehicle System | Number of Launches | Hazardous Materials Used (lbs/launch) | Total Hazardous Materials Used in 2007 (lbs) |
|---|---|---|---|
| EELV Concept B[(b)] | | | 89,300 |
| MLV | 8 | 8,930 | |
| HLV | 2 | 8,930 | |
| No-Action Alternative[(b)(c)] | | | 74,640 |
| Atlas IIA | 3 | 17,670 | |
| Delta II | 3 | 7,210 | |
| Titan IVB | 0 | 39,200 | |

Note: (a) Table does not include propellants.
(b) Data provided by contractor.
(c) Government launches only; no commercial launches included.
EELV = Evolved Expendable Launch Vehicle
HLV = heavy launch vehicle
lbs = pounds
MLV = medium launch vehicle

Implementation of Concept B would increase the amount of hazardous materials used on Vandenberg AFB by approximately 15,000 pounds per year. This increase in hazardous materials is due to the increased number of annual launches under Concept B compared to current programs. Although launch rates are scheduled to increase, less processing would occur on site, as discussed in Section 4.6.1.1.1.

Propellant quantities stored on the installation would increase due to the expanded launch schedule. Tables 2.1-6 and 2.2-2 list propellant quantities for Concept B and the No-Action Alternative, respectively.

Vandenberg AFB has the mechanisms in place to legally store and manage hazardous materials, including hazardous propellants. All activities would be conducted in accordance with existing regulations for the use and storage of hazardous materials.

Section 4.7, Health and Safety, describes impacts associated with transportation of hazardous materials/fuels.

**Hazardous Waste Management**. The types of hazardous waste generated under Concept B would be similar to wastes generated by current launch vehicle systems. Table 4.6-10 provides a comparison of the quantities of hazardous waste generated per launch and in the peak year (2007) for Concept B to the quantities generated by current programs.

**Table 4.6-10. Total Hazardous Waste Generation for Concept B and for Current Launch Vehicle Systems, Vandenberg AFB[(a)]**

| Launch Vehicle System | Number of Launches | Hazardous Waste Generated (lbs/launch) | Total Hazardous Waste Generated in 2007 (lbs) |
|---|---|---|---|
| EELV Concept B[(b)] | | | 269,500 |
| MLV | 8 | 26,950 | |
| HLV | 2 | 26,950 | |
| No-Action Alternative[(b)(c)] | | | 78,150 |
| Atlas IIA | 3 | 9,240 | |
| Delta II | 3 | 16,810 | |
| Titan IVB | 0 | 36,190 | |

Note: (a) Table does not include propellants.
(b) Data provided by contractor.
(c) Government launches only; no commercial launches included.
EELV = Evolved Expendable Launch Vehicle
HLV = heavy launch vehicle
lbs = pounds
MLV = medium launch vehicle

Implementation of Concept B would increase the amount of hazardous waste generation on Vandenberg AFB by approximately 190,000 pounds per year. This increase in hazardous waste generation is due to the increased number of annual launches.
The additional hazardous waste generated from Concept B activities would be managed as discussed in Section 4.6.1.1.2. Since wastes from Concept B would be similar to wastes currently handled by Vandenberg AFB, no adverse impacts are anticipated.

**Pollution Prevention.** Pollution prevention impacts on Vandenberg AFB from Concept B activities are the same as discussed for Concept A, Cape Canaveral AS, in Section 4.6.1.1.1.

**Installation Restoration Program.** IRP investigations will continue at AOC-89 at SLC-6. EELV activities and remediation activities could conflict depending on the results of the investigations. However, remediation, if

necessary, could likely be implemented without interfering with the EELV program schedule. 30 CES/CEV would be contacted prior to any construction or modification near an IRP site. Measures should be taken to ensure worker safety during remediation if construction and modification is occurring simultaneously with clean-up activities.

#### 4.6.1.3 Concept A/B

Concept A/B was analyzed for its potential impacts on the existing hazardous material and waste management programs from associated hazardous material usage and waste generation. Impact analysis was conducted by comparing the amount of hazardous material/waste associated with the EELV program to current launch vehicle quantities.

##### 4.6.1.3.1 Concept A/B, Cape Canaveral AS

**Hazardous Materials Management.** The types of hazardous materials proposed for use for Concept A/B activities would be similar to those used at Cape Canaveral AS for current launch vehicle programs. Table 4.6-11 provides a comparison of hazardous materials to be used per launch and in the peak year (2015) for Concept A/B with the quantities utilized for current launch vehicle systems.

Implementation of Concept A/B would increase the amount of hazardous materials used on Cape Canaveral AS by approximately 148,000 pounds per year. This increase in hazardous material use is due to the increased number of annual launches.

Although launch rates are scheduled to increase, less processing would occur on site, as discussed in Section 4.6.1.1.1.

Propellant quantities stored on the installation would increase due to the expanded launch schedule. However, since solid rocket motors would not be used for Concept A, the number of solid propellants stored on Cape

**Table 4.6-11. Total Hazardous Materials Used for Concept A/B and for Current Launch Vehicle Systems, Cape Canaveral AS[a]**

| Launch Vehicle System | Number of Launches | Hazardous Materials Used (lbs/launch) | Total Hazardous Materials Used in 2015 (lbs) |
|---|---|---|---|
| Concept A/B Total | | | 332,420 |
| EELV Concept A[b] | | | |
| MLV | 12 | 15,850 | |
| HLV | 1 | 26,130 | |
| EELV Concept B[b] | | | |
| MLV | 11 | 8,930 | |
| HLV | 2 | 8,930 | |
| No-Action Alternative[b][c] | | | 184,520 |
| Atlas IIA | 7 | 17,610 | |
| Delta II | 3 | 7,210 | |
| Titan IVB | 1 | 39,200 | |

Note: (a) Table does not include propellants.
(b) Data provided by contractor.
(c) Government launches only; no commercial launches included.
EELV = Evolved Expendable Launch Vehicle
HLV = heavy lift variant (Concept A); heavy launch vehicle (Concept B)
lbs = pounds
MLV = medium lift variant (Concept A); medium launch vehicle (Concept B)

Canaveral AS would be reduced. Tables 2.1-1, 2.1-6, and 2.2-2 list propellant quantities for Concept A, Concept B, and the No-Action Alternative, respectively.

Although additional launches would increase the amount of hazardous materials stored on base, Cape Canaveral AS has the mechanisms in place to legally store and manage the materials. All activities would be conducted in accordance with existing regulations for the use and storage of hazardous materials.

Section 4.7, Health and Safety, describes impacts associated with transportation of hazardous materials/fuels.

**Hazardous Waste Management.** The types of hazardous waste generated under Concept A/B would be similar to wastes generated by current launch vehicle systems. Table 4.6-12 provides a comparison of the quantities of hazardous waste generated per launch and in the peak year (2015) for Concept A/B to the quantities generated by current programs.

Implementation of Concept A/B would increase the amount of hazardous waste generated on Cape Canaveral AS by approximately 330,000 pounds per year. This increase in hazardous waste generation is due to the increased number of annual launches.

**Table 4.6-12. Total Hazardous Waste Generated for Concept A/B and for Current Launch Vehicle Systems, Cape Canaveral AS[a]**

| Launch Vehicle System | Number of Launches | Hazardous Waste Generated (lbs/launch) | Total Hazardous Waste Generated in 2015 (lbs) |
|---|---|---|---|
| Concept A/B Total | | | 482,990 |
| EELV Concept A[b] | | | |
| MLV | 12 | 10,170 | |
| HLV | 1 | 10,600 | |
| EELV Concept B[b] | | | |
| MLV | 11 | 26,950 | |
| HLV | 2 | 26,950 | |
| No-Action Alternative[b][c] | | | 151,300 |
| Atlas IIA | 7 | 9,240 | |
| Delta II | 3 | 16,810 | |
| Titan IVB | 1 | 36,190 | |

Note: (a) Table does not include propellants.
(b) Data provided by contractor.
(c) Government launches only; no commercial launches included.
EELV = Evolved Expendable Launch Vehicle
HLV = heavy lift variant (Concept A); heavy launch vehicle (Concept B)
lbs = pounds
MLV = medium lift variant (Concept A); medium launch vehicle(Concept B)

The additional hazardous waste generated by Concept A/B activities would be handled as discussed in Section 4.6.1.1.1. Since wastes from Concept A/B would be similar to wastes currently handled by Cape Canaveral AS, no adverse impacts are anticipated.

**Pollution Prevention.** Pollution prevention impacts on Cape Canaveral AS from Concept A/B activities are the same as discussed for Concept A in Section 4.6.1.1.1.

**Installation Restoration Program.** Both concepts would move forward under Concept A/B; therefore, effects on the IRP would be similar to the combined effects described in Sections 4.6.1.1.1 and 4.6.1.2.1.

#### 4.6.1.3.2 Concept A/B, Vandenberg AFB

**Hazardous Materials Management.** The types of hazardous materials proposed for use for Concept A/B activities would be similar to those used at Vandenberg AFB for current launch vehicle programs. Table 4.6-13 provides a comparison of hazardous materials to be used per launch and in the peak year (2007) for Concept A/B with the quantities utilized for current launch vehicle systems.

Implementation of Concept A/B would increase the amount of hazardous materials used on Vandenberg AFB by approximately 98,800 pounds per

**Table 4.6-13. Total Hazardous Materials Used for Concept A/B and for Current Launch Vehicle Systems, Vandenberg AFB[a]**

| Launch Vehicle System | Number of Launches | Hazardous Materials Used (lbs/launch) | Total Hazardous Materials Used in 2007 (lbs) |
|---|---|---|---|
| Concept A/B Total | | | 173,460 |
| EELV Concept A[b] | | | |
| MLV | 7 | 15,850 | |
| HLV | 0 | 26,130 | |
| EELV Concept B[b] | | | |
| MLV | 5 | 8,930 | |
| HLV | 2 | 8,930 | |
| No-Action Alternative[b][c] | | | 74,640 |
| Atlas IIA | 3 | 17,670 | |
| Delta II | 3 | 7,210 | |
| Titan IVB | 0 | 39,200 | |

Note: (a) Table does not include propellants.
(b) Data provided by contractor.
(c) Government launches only; no commercial launches included.
EELV = Evolved Expendable Launch Vehicle
HLV = heavy lift variant (Concept A); heavy launch vehicle (Concept B)
lbs = pounds
MLV = medium lift variant (Concept A); medium launch vehicle (Concept B)

year. This increase in hazardous material use is due to the increased number of annual launches.

Although launch rates are scheduled to increase, less processing would occur on site, as discussed in Section 4.6.1.1.1.

Propellant quantities stored on the installation would increase due to the expanded launch schedule. However, since solid rocket motors are not used for Concept A, the amount of solid propellants stored on Vandenberg AFB would be reduced. Tables 2.1-1, 2.1-6 and 2.2-2 list propellant quantities for Concept A, Concept B, and the No-Action Alternative, respectively.

Vandenberg AFB has the mechanisms in place to legally store and manage hazardous materials, including hazardous propellants. All activities would be conducted in accordance with existing regulations for the use and storage of hazardous materials.

Impacts associated with transportation of hazardous materials/fuels are described in Section 4.7, Health and Safety.

**Hazardous Waste Management.** The types of hazardous waste generated under Concept A/B would be similar to wastes generated by current launch vehicle systems. Table 4.6-14 provides a comparison of the quantities of

**Table 4.6-14. Total Hazardous Waste Generated for Concept A/B and for Current Launch Vehicle Systems, Vandenberg AFB[a]**

| Launch Vehicle System | Number of Launches | Hazardous Waste Generated (lbs/launch) | Total Hazardous Waste Generated in 2007 (lbs) |
|---|---|---|---|
| Concept A/B Total | | | 259,840 |
| EELV Concept A[b] | | | |
| MLV | 7 | 10,170 | |
| HLV | 0 | 10,600 | |
| EELV Concept B[b] | | | |
| MLV | 5 | 26,950 | |
| HLV | 2 | 26,950 | |
| No-Action Alternative[b][c] | | | 78,150 |
| Atlas IIA | 3 | 9,240 | |
| Delta II | 3 | 16,810 | |
| Titan IVB | 0 | 36,190 | |

Note: (a) Table does not include propellants.
(b) Data provided by contractor.
(c) Government launches only; no commercial launches included.
EELV = Evolved Expendable Launch Vehicle
HLV = heavy lift variant (Concept A); heavy launch vehicle (Concept B)
lbs = pounds
MLV = medium lift variant (Concept A); medium launch vehicle (Concept B)

hazardous waste generated per launch and in the peak year (2007) for Concept A to the quantities generated by current programs.

Implementation of Concept A/B would increase the amount of hazardous waste generated on Vandenberg AFB by approximately 180,000 pounds per year. This increase in hazardous waste generation is due to the increased number of annual launches.

The additional hazardous waste generated by Concept A/B activities would be handled as discussed in Section 4.6.1.1.1. Wastes from Concept A/B would be of similar nature to wastes currently handled by Vandenberg AFB; therefore, no adverse impacts are anticipated.

**Pollution Prevention.** Pollution prevention impacts on Vandenberg AFB from Concept A/B activities are the same as discussed for Cape Canaveral Concept A in Section 4.6.1.1.1.

**Installation Restoration Program.** Both concepts would move forward under Concept A/B; therefore, effects on the IRP would be similar to the combined effects described in Sections 4.6.1.1.1 and 4.6.1.2.1.

### 4.6.2 No-Action Alternative

#### 4.6.2.1 Cape Canaveral AS

Under the No-Action Alternative, types and amounts of hazardous materials and hazardous waste would be similar to those used and generated on the installation under current operations. These amounts are listed in Section 3.6, Tables 3.6-1 through 3.6-6.

#### 4.6.2.2 Vandenberg AFB

Under the No-Action Alternative, types and amounts of hazardous materials and hazardous waste would be similar to those used and generated on the installation, as under current operations. These amounts are listed in Section 3.6, Tables 3.6-1 through 3.6-6.

## 4.7 HEALTH AND SAFETY

### 4.7.1 Proposed Action

#### 4.7.1.1 Concept A

##### 4.7.1.1.1 Concept A, Cape Canaveral AS

**Regional Safety.** Cape Canaveral AS regional safety programs for Concept A launch operations would be the same as regional safety programs for the current launch operations described in Section 3.7.1.1, unless otherwise noted below.

A System Safety Program Plan (SSPP) would be prepared prior to EELV launch activities to identify and evaluate potential hazards and reduce associated risks to a level acceptable to Range Safety.

Impact debris corridors would be updated to provide EELV-specific parameters due to vehicle and payload configurations. An EELV-specific debris impact area would be calculated.

Hazardous materials, such as propellants, ordnance, and booster/payload components, would be transported in accordance with DOT regulations for interstate shipment of hazardous substances (Title 49 CFR 100-199) to ensure the shipment would not catch fire, explode, or release toxic materials. Liquid propellants used to fuel launch vehicle components would be shipped via land from manufacturing locations in the United States directly to Cape Canaveral AS. Propellants would be shipped in one of the following containers:

- MMH - DOT-specification MC 338 stainless steel cargo tank; non-DOT-specification 4BW stainless steel cylinder
- $N_2O_4$ - DOT-specification MC 338 stainless steel cargo tank; DOT-specification 105J500W stainless steel rail tank car; DOT-specification 110W500 stainless steel multi-unit tank car tanks

- RP-1 - MC 301 and MC 302 cargo tank; 1A1 drum
- $LO_2$; $LH_2$ - MC 338 cargo tank.

Special handling requirements for shipment of MMH and $N_2O_4$ include following certified and approved routes, extensive driver qualifications, and various state notification requirements.

**On-Station Safety.** On-station safety programs for Concept A launch operations would be the same as on-station safety programs for the current launch operations described in Section 3.7.1.2, unless otherwise noted herein.

For Concept A launches using the SUS, $NO_2$ and MMH concentrations would be predicted using REEDM prior to a launch to determine a THC. THC exposure concentrations for $NO_2$ and MMH would be compared to Tier 1, Tier 2, and Tier 3 exposure criteria (see Section 3.7.2.2). As a result of this comparison and risk estimation, emergency response would be provided as described in Section 3.7.2.2.

A summary of REEDM-predicted ambient air concentrations for $NO_x$ and hydrazine compounds to assess air quality impacts during nominal and aborted Concept A launches is presented in Section 4.10.1.1.1. The REEDM-predicted concentrations are screening concentrations; a systematic search for worst-case meteorology was not conducted. It is conservatively assumed that all NO in $NO_x$ would be converted to $NO_2$. Table 4.7-1 summarizes a comparison of REEDM-predicted $NO_2$ concentrations from a nominal and aborted launch to exposure criteria. Peak 30-minute average concentrations for nominal and aborted launches are less than Tier 1 exposure criteria.

Table 4.7-2 summarizes a comparison of REEDM-predicted hydrazine compound concentrations to exposure criteria. Peak 30-minute average hydrazine compound concentrations during aborted launches do not exceed the lowest Tier 2 value for hydrazine compounds; Tier 1 values have not been recommended for hydrazine. Based on this analysis, Cape Canaveral AS personnel and the general public are predicted not to be at risk during nominal and aborted Concept A launches.

A description of fire protection, alarm, and fire suppression systems is provided in Section 2.1.1.4. As stated in Section 2.1.1.4, the facilities

**Table 4.7-1. Comparison of REEDM-Predicted $NO_2$ Air Concentrations to Recommended Exposure Criteria, Concept A**

| Vehicle | $NO_2$ Peak 1-Hour Average Concentration Increment (ppm) | | Exposure Criteria 60-Minute TWA (ppm) |
|---|---|---|---|
| | Nominal Launch[a] | Abort | Tier 1 |
| MLV-D | 0.114 | 0.114 | 0.2 |
| MLV-A | 0.114 | NA | 0.2 |
| HLV-L | 0.162 | 0.057 | 0.2 |
| HLV-G | 0.162 | NA | 0.2 |

Note: (a) Values in a peak 30-minute concentration.
HLV = heavy lift variant
MLV = medium lift variant
NA = not applicable
$NO_2$ = nitrogen dioxide
ppm = parts per million
REEDM = Rocket Exhaust Effluent Diffusion Model
TWA = time-weighted average

**Table 4.7-2. Comparison of REEDM-Predicted Hydrazine Compound Air Concentrations to Recommended Exposure Criteria, Concept A**

| Vehicle | Hydrazine Compound Peak 30-Minute Average Concentration Increment (ppm) | Lowest Exposure Criteria 60-Minute TWA (ppm) |
|---|---|---|
| | Abort | Tier 2[a] |
| MLV-D | 0.025 | 2.0 |
| MLV-A | 0.0 | 2.0 |
| HLV-L | 0.015 | 2.0 |
| HLV-G | 0.0 | 2.0 |

Note: (a) Tier 1 exposure criteria do not exist.
HLV = heavy lift variant
MLV = medium lift variant
ppm = parts per million
REEDM = Rocket Exhaust Effluent Diffusion Model
TWA = time-weighted average

associated with Concept A launches would be designed to meet ESQD criteria. The FTS for Concept A vehicles is described in Section 2.1.1.1.

#### 4.7.1.1.2 Concept A, Vandenberg AFB

**Regional Safety.** Vandenberg AFB regional safety programs for Concept A launch systems would be the same as regional safety programs for the current launch systems as described in Section 3.7.3.1 and 4.7.1.1.1.

Transportation of hazardous materials would occur as described in Section 4.7.1.1.1 for Cape Canaveral AS.

**On-Base Safety.** On-base safety programs for Concept A launch systems would be the same as on-base safety programs for the current launch systems described in Section 3.7.3.2, unless otherwise noted below. As discussed in Section 4.7.1.1.1, $NO_2$ and MMH would be predicted using REEDM prior to a launch to determine a THC for Concept A launches using the SUS. Section 4.7.1.1 addresses risk estimation through comparison of $NO_2$ and hydrazine compound exposure concentrations to Tier 1, Tier 2, and Tier 3 exposure criteria.

The REEDM-predicted $NO_x$ and hydrazine compound air concentrations used to assess air quality impacts for nominal and aborted Concept A launches, presented in Section 4.10.1.1.1, also apply to Vandenberg AFB. Therefore, the conclusions drawn in Section 4.7.1.1.1 regarding comparison of REEDM-predicted $NO_x$ and hydrazine compound air concentrations to exposure criteria are the same. Based on this analysis, Vandenberg AFB personnel and the general public are predicted not to be at risk during nominal and aborted Concept A launches.

Specific fire protection systems, FTSs, and ESQD criteria for Concept A launches are the same as those presented in Section 4.7.1.1.1 for Cape Canaveral AS.

#### 4.7.1.2 Concept B

##### 4.7.1.2.1 Concept B, Cape Canaveral AS

**Regional Safety.** Cape Canaveral AS regional safety programs for Concept B launch operations would be the same as regional safety programs for the current launch operations as described in Section 3.7.2.1 and 4.7.1.1.1.

Transportation of hazardous materials would occur as described in Section 4.7.1.1.1 for Cape Canaveral AS.

**On-Station Safety.** On-station safety programs for Concept B launch operations would be the same as on-station safety programs for the current launch operations described in Section 3.7.2.2, unless otherwise noted herein.

For Concept B launches using the HUS, $NO_2$, HCl, and hydrazine compound concentrations would be predicted using REEDM prior to a launch to determine a THC. Similarly, HCl concentrations would be predicted for DIV-M+ vehicle launches. THC exposure concentrations for these chemicals would be compared to Tier 1, Tier 2, and Tier 3 exposure criteria (see Section 3.7.2.2). As a result of this comparison and risk estimation, emergency response procedures would be implemented as described in Section 3.7.2.2.

A summary of REEDM-predicted ambient air concentrations for $NO_x$, HCl, and hydrazine compounds to assess air quality impacts during normal and aborted Concept B launches is presented in Section 4.10.1.2.1. As described in Section 4.7.1.1.1, the REEDM-predicted concentrations are screening concentrations; a systematic search for worst-case meteorology was not conducted. It is conservatively assumed that all NO in $NO_x$ would be converted to $NO_2$.

Tables 4.7-3 , 4.7-4, and 4.7-5 summarize a comparison of REEDM-predicted $NO_2$, HCl, and hydrazine compound concentrations to exposure criteria, respectively. Estimated $NO_2$ and HCl exposure concentrations do not exceed Tier 1 exposure criteria. Estimated hydrazine compound exposure concentrations do not exceed the lowest Tier 2 exposure criteria for hydrazine compounds; Tier 1 values have not been recommended for hydrazine. Based on this analysis, Cape Canaveral AS personnel and the general public are predicted not to be at risk during nominal and aborted Concept B launches.

**Table 4.7-3. Comparison of REEDM-Predicted $NO_2$ Air Concentrations to Recommended Exposure Criteria, Concept B**

| Vehicle | $NO_2$ Peak 1-Hour Average Concentration Increment (ppm) | | Exposure Criteria 60-Minute TWA (ppm) |
|---|---|---|---|
| | Nominal Launch[(a)] | Abort | Tier 1 |
| DIV-S | 0.102 | 0.053 | 0.2 |
| DIV-M | 0.109 | NA | 0.2 |
| DIV-M+ | 0.119 | NA | 0.2 |
| DIV-H | 0.020 | NA | 0.2 |

Note: (a) Value is a peak 30-minute concentration.
DIV-H = heavy launch vehicle
DIV-M = medium launch vehicle
DIV-M+ = medium launch vehicle with solid rocket motor strap-ons
DIV-S = small launch vehicle
NA = not applicable
$NO_2$ = nitrogen dioxide
ppm = parts per million
REEDM = Rocket Exhaust Effluent Diffusion Model
TWA = time-weighted average

**Table 4.7-4. Comparison of REEDM-Predicted HCl Concentrations to Recommended Exposure Criteria, Concept B**

| Vehicle | HCl Peak Puff Concentration Increment (ppm) | | Exposure Criteria Ceiling Limit (ppm) |
|---|---|---|---|
| | Nominal Launch | Abort | Tier 1 |
| DIV-M+ | 0.293 | 0.023 | 10.0 |

DIV-M+ = medium launch vehicle with solid rocket motor strap-ons
HCl = hydrochloric acid
ppm = parts per million

A description of fire protection, alarm, and fire suppression systems is provided in Section 2.1.2.4. As stated in Section 2.1.2.4, facilities associated with Concept B launches would be designed to meet ESQD criteria. The FTS for Concept B vehicles is described in Section 2.1.2.1.

**Table 4.7-5. Comparison of REEDM-Predicted Hydrazine Compound Air Concentrations to Recommended Exposure Criteria, Concept B**

| Vehicle | Hydrazine Compound Peak 30-Minute Average Concentration Increment (ppm) | Lowest Exposure Criteria 60-Minute TWA (ppm) |
|---|---|---|
| | Abort | Tier 2[(a)] |
| DIV-S | 0.009 | 2.0 |
| DIV-M | 0.0 | 2.0 |
| DIV-M+ | 0.0 | 2.0 |
| DIV-H | 0.0 | 2.0 |

Note: (a) Tier 1 exposure criteria do not exist.
DIV-H = heavy launch vehicle
DIV-M = medium launch vehicle
DIV-M+ = medium launch vehicle with solid rocket motor strap-ons
DIV-S = small launch vehicle
ppm = parts per million
REEDM = Rocket Exhaust Effluent Diffusion Model
TWA = time-weighted average

#### 4.7.1.2.2 Concept B, Vandenberg AFB

**Regional Safety.** Vandenberg AFB regional safety programs for Concept B launch operations would be the same as regional safety programs for the current launch operations as described in Section 3.7.2.1 and 4.7.1.1.1.

Transportation of hazardous materials would occur as described in Section 4.7.1.1.1 for Cape Canaveral AS.

**On-Base Safety.** On-base safety programs for Concept B launch operations would be the same as on-base safety programs for the current launch operations described in Section 3.7.2.2, unless otherwise noted herein.

Specific FTS, ESQD criteria, and site security measures for Concept B launches are the same as those presented in Section 4.7.1.2.1 for Cape Canaveral AS. The fire protection systems are the same as those described in Section 4.7.1.2.1, except at Vandenberg AFB, where an existing tank above the launch complex would be utilized for fire suppression.

As discussed in Section 4.7.1.2.1, $NO_2$, HCl (for the DIV-M+ vehicle only), and hydrazine compound concentrations would be predicted using REEDM prior to a launch to determine a THC for applicable Concept B launches. Section 4.7.1.1.1 discusses risk estimation through comparison of $NO_2$, HCl, and hydrazine compound exposure concentrations to Tier 1, Tier 2, and Tier 3 exposure criteria.

The REEDM-predicted $NO_x$, HCl, and hydrazine compound air concentrations to assess air quality impacts for nominal and aborted Concept B launches, presented in Section 4.10.1.2.1, also apply to Vandenberg AFB. Therefore, the conclusions drawn in Section 4.7.1.2.1 regarding comparison of REEDM-predicted $NO_x$, HCl, and hydrazine compound air concentrations to exposure criteria are the same. Based on this analysis, Vandenberg AFB personnel and the general public are predicted not to be at risk during nominal and aborted Concept B launches.

#### 4.7.1.3 Concept A/B

##### 4.7.1.3.1 Concept A/B, Cape Canaveral AS

**Regional Safety.** Cape Canaveral AS regional safety programs for Concept A/B launch operations would be the same as regional safety programs for Concept A (Section 4.7.1.1.1) and Concept B (Section 4.7.1.2.1) launch.

**On-Station Safety.** Cape Canaveral AS on-station safety programs for Concept A/B launch operations would be the same as on-station safety programs for Concept A (Section 4.7.1.1.1) and Concept B (Section 4.7.1.2.1) launch operations. Conclusions regarding REEDM-predicted toxic air concentrations to assess air quality impacts for nominal and aborted launches would be the same as for Concept A and Concept B launch operations.

Based on this analysis, Cape Canaveral AS personnel and the general public are predicted not to be at risk during nominal and aborted Concept A/B launches.

##### 4.7.1.3.2 Concept A/B, Vandenberg AFB

**Regional Safety.** Vandenberg AFB regional safety programs for Concept A/B launch operations would be the same as regional safety programs for Concept A (Section 4.7.1.1.2) and Concept B (Section 4.7.1.2.2) launch operations.

**On-Base Safety.** Vandenberg AFB on-base safety programs for Concept A/B launch operations would be the same as on-base safety programs for Concept A (Section 4.7.1.1.2) and Concept B (Section 4.7.1.2.2) launch operations. Conclusions regarding REEDM-predicted toxic air concentrations to assess air quality impacts for nominal and aborted launches would be the same as for Concept A and Concept B launch operations.

Based on this analysis, Vandenberg AFB personnel and the general public are predicted not to be at risk during nominal and aborted Concept A/B launches.

### 4.7.2 No-Action Alternative

**4.7.2.1 Cape Canaveral AS.** The current regional and on-station safety programs described in Section 3.7.2 would remain in effect. Some vehicles would utilize solid rocket motors and would therefore produce an HCl toxic plume. However, Cape Canaveral AS personnel and the general public are predicted not to be at risk during nominal or aborted launches. Under the No-Action Alternative, no additional health and safety risks would be incurred beyond current operating levels.

**4.7.2.2 Vandenberg AFB.** The current regional and on-station safety programs described in Section 3.7.2 would remain in effect. Some vehicles would utilize solid rocket motors and would therefore produce an HCl toxic plume. However, Vandenberg AFB personnel and the general public are predicted not to be at risk during nominal or aborted launches. Under the

No-Action Alternative, no additional health and safety risks would be incurred beyond current operating levels.

## 4.8 GEOLOGY AND SOILS

### 4.8.1 Proposed Action

#### 4.8.1.1 Concept A

##### 4.8.1.1.1 Concept A, Cape Canaveral AS

**Geologic Setting.** EELV program activities would require modification of existing facilities and construction of new facilities at SLC-41, which has been extensively altered in the past. Major modifications would include changing the existing site topography through excavation and grading, as required, to support modifications to the transporter track system, and facility modifications and new construction. Construction of EELV facilities at SLC-41 would substantially alter the topography of the site beyond changes that result from natural erosion or deposition. Construction of these facilities would not change the physiography of the region, nor would it impact any unique geologic features or geologic features of unusual scientific value.

**Soils.** Construction would occur primarily within the previously disturbed SLC-41 site and along existing road corridors. Depending on final design and grading plans, approximately 24,000 cubic yards of cut and fill material would be required. Unsuitable cut material would be removed from the project area to a spoil site located off station or at other approved locations. The earthwork required to construct the launch facility would uncover and disturb soils and increase the potential for wind and water erosion of these exposed soils.

Appropriate measures to reduce wind and water erosion would be implemented. Grading and construction procedures would be designed to minimize topographic changes. The design would include balancing the amount of cut and fill to maximize the use of local material, where possible. Additional measures for erosion control may include temporary seeding (for areas of the site where disturbance has temporarily ceased), permanent seeding, mulching, sod stabilization, and vegetative buffer strips. Sediment and erosion controls can also include engineered structures to divert or store flow, or limit runoff. These devices include earth dikes that channel flow to desired locations; silt fences to intercept sediment; drainage swales; sediment traps; check dams; level spreaders; subsurface drains; and other structures used to control or direct surface discharge and limit/control erosion.

The Environmental Resources Permit and Storm Water Pollution Prevention Plan would include specific measures that would be implemented to control both wind and water erosion of soils before and during construction activities. Sediment and erosion controls generally address pollutants in storm water generated from the site during construction. Storm water management measures are generally implemented before and during construction and primarily result in reductions of pollutants in storm water. Storm water management measures include infiltration of runoff on site; flow attenuation by vegetation or natural depressions; outfall velocity dissipation devices;

storm water retention structures and artificial wetlands; and storm water detention structures. For many sites, a combination of these controls may be appropriate. Additional measures include best management practices.

Utilization of SLC-41 for the EELV program would have a beneficial impact upon soils. Currently, SLC-41 is used to launch Titan IVB rockets, which use solid rocket propellants. The ground cloud created by solid rocket propellant causes deposition of HCl and aluminum oxide on the soil adjacent to the launch site, resulting in temporary acidification and an increase of aluminum in soils. Concept A launch vehicles would only use liquid fuels, which would vaporize during launch, thus no deposition on the soil or temporary acidification would occur.

Launch anomalies could result in impacts to near-field soils due to contamination from rocket propellant. In the unlikely occurrence of a launch anomaly, any spilled propellant would be collected and disposed of by a certified disposal subcontractor in accordance with the SPCC Plan. Contaminated soils would be removed and treated as hazardous waste in accordance with federal, state, and local regulations. Short-term impacts to soils may result, but long-term impacts would not be significant.

Standard construction practices and adherence to permit requirements would minimize adverse impacts to geology and soils; therefore, no mitigation measures would be required.

#### 4.8.1.1.2 Concept A, Vandenberg AFB

**Geologic Setting.** EELV program activities would require modification of existing facilities and construction of new facilities at SLC-3W, which has been extensively altered in the past. Construction of EELV facilities at SLC-3W would substantially alter the topography of the site beyond those changes that would result from natural erosion or deposition. Construction of these facilities would not change the physiography of the region, nor would it impact any unique geologic features or geologic features of unusual scientific value.

Geologic concerns in the Vandenberg AFB area are the potential effects of erosion and landslides, primarily related to cut and fill activities during project construction, and earthquakes that could occur during program operations.

The SLC-3W site is not in a potential landslide area or near sand dunes (U.S. Air Force, 1989a). The nearest active fault, the Hosgri Fault, 2.5 miles northwest of the site, is capable of causing sustained ground shaking and/or surface rupture. Construction of new facilities and/or modification of existing facilities would incorporate earthquake-resistant design as required by building codes to reduce the potential for impacts from a seismic event, including surface rupture. Site foundations would incorporate site-specific engineering designs appropriate to maintain structural integrity during extended periods of ground shaking.

**Soils.** Construction would occur primarily within the existing fenceline of the previously disturbed SLC-3W area. Depending on final design and grading plans, approximately 142,000 cubic yards of cut and fill material would be required. The fill material would most likely come from the Manzanita Borrow

Area on Vandenberg AFB. Unsuitable cut material would be returned to the embankment cut, which would be regraded prior to site revegetation. Some spoil material would be disposed of in the on-base landfill. The earthwork required for new construction would uncover and disturb soils and increase the potential for wind and water erosion of these exposed soils.

Appropriate measures to reduce wind and water erosion at the stock pile and construction sites would be implemented (see Section 4.8.1.1.1).

Launch anomaly impacts would be similar to those described in Section 4.8.1.1.1, under Soils.

Standard construction practices and adherence to permit requirements would minimize adverse impacts to geology and soils; therefore, no mitigation measures would be required.

#### 4.8.1.2 Concept B

##### 4.8.1.2.1 Concept B, Cape Canaveral AS

**Geologic Setting.** EELV program activities would require modification of existing facilities and construction of new facilities at SLC-37, which has been altered extensively in the past. Major modifications at the site would include changing the existing site topography through excavation and grading. Construction of EELV facilities at SLC-37 would substantially alter the topography of the site beyond those changes that would result from natural erosion or deposition. Construction of these facilities would not change the physiography of the region, nor would it impact any unique geologic features or geologic features of unusual scientific value.

**Soils.** Construction would occur primarily within the previously disturbed SLC-37 area or along existing road corridors. Depending on final design and grading plans, approximately 10,000 to 18,000 cubic yards of material would be excavated, and 220,000 to 360,000 cubic yards of fill would be required. Fill material would come from borrow areas located off station. Unsuitable cut material would be removed from the project area to a spoil site located on Cape Canaveral AS, or to other approved locations. The earthwork required to construct the launch facility would uncover and disturb soils and increase the potential for wind and water erosion of these exposed soils.

Appropriate measures to reduce wind and water erosion at the stock pile and construction sites would be implemented (see Section 4.8.1.1.1).

Launch anomaly impacts would be similar to those described in Section 4.8.1.1.1, under Soils.

For some small vehicle missions, a third stage containing solid propellant would be utilized. However, this stage would fire in orbit, and no acid deposition of solid propellants on soils would occur.

Under Concept B, only the commercial DIV-M+ launch vehicle would utilize solid rocket motors. A maximum of eight DIV-M+ commercial launches would occur per year under Concept B. Impacts from the use of solid rocket motors

would result in the deposition of HCl from the exhaust cloud on the soil adjacent to the launch site, resulting in a temporary acidification of soils. The deposition of aluminum oxide particulates on soils adjacent to the launch site would also increase the concentration of aluminum in nearby soils.

The impact of multiple launches on the near-field soil could include a reduction in the capacity of the soil to buffer the temporary acidification observed following a launch and increased concentrations of metals. Impacts on far-field soils (over 0.6 mile from the launch site) are relatively insignificant because the deposition of particulates and chlorides is less than 3 percent of the maximum observed near the launch site (National Aeronautics and Space Administration, 1995).

The potential deposition of aluminum oxide per launch is expected to be minimal. Acidification impacts are temporary in nature, and results from monitoring of space shuttle launches show no long-term effects in the soils' buffering capacity (U.S. Air Force, 1994c). No measurable direct or indirect, short- or long-term effects on soil chemistry are expected as a result of Concept B launch activities.

The Port of Canaveral Dock would be utilized for receiving/unloading of EELV program components. This dock has recently been modified and would meet the requirements of the EELV program. However, if this dock were unavailable to the EELV program, the U.S. Air Force Roll-On/Roll-Off Dock would be utilized. This dock would require limited dredging to accommodate the turning radius of the transport vehicle/dolly in the egress area. Dredging would occur in previously dredged areas only, thus eliminating impacts to undisturbed sediments.

Standard construction practices and adherence to permit requirements would minimize adverse impacts to geology and soils; therefore, no mitigation measures would be required.

#### 4.8.1.2.2 Concept B, Vandenberg AFB

**Geologic Setting.** EELV program activities would require modification of existing facilities and construction of new facilities at SLC-6, which has been altered extensively in the past. Major modifications would include changing the existing site topography through excavation and grading. Construction of EELV facilities at SLC-6 would substantially alter the topography of the site beyond those changes that would result from natural erosion or deposition. Construction of these facilities would not change the physiography of the region, nor would it impact any unique geologic features or geologic features of unusual scientific value.

Geologic concerns in the Vandenberg AFB area are the potential effects of erosion and landslides, primarily related to cut and fill activities during project construction, and earthquakes that could occur during program operations.

The nearest active fault, the Hosgri Fault, 7.5 miles northwest of the site, is capable of causing sustained ground shaking and/or surface rupture. Construction of new facilities or modification of existing facilities would incorporate earthquake-resistant design as required by building codes to

reduce the potential of significant impacts occurring from a seismic event, including surface rupture. Site foundations would incorporate site-specific engineering designs appropriate to maintain structural integrity during extended periods of ground shaking.

The SLC-6 site is not located near sand dunes, but it is in a potential landslide area (U.S. Air Force, 1989a). SLC-6 is approximately 1.5 miles from the coast; therefore, it is unlikely that the site would be subject to slope failures of the sea cliff. The site has experienced previous erosion near the drainages bounding the site. This erosion problem has subsequently been stabilized. The SLC-6 launch complex has not experienced landsliding in the past.

**Soils.** SLC-6 is underlain by soils that have a high erosion potential. An erosion control program, conducted as part of site maintenance activities for SLC-6, has stabilized most slopes so that erosion has been minimized.

Construction would occur primarily within the previously disturbed SLC-6 area or along existing road corridors. Depending on final design and grading plans, approximately 4,500 to 7,500 cubic yards of material would be excavated and 80,000 to 135,000 cubic yards of fill material would be required at SLC-6. Fill material would most likely come from the Vandenberg AFB Manzanita Borrow Area. Unsuitable cut material would be removed from the project area to the Manzanita Spoil Site, or to other approved locations. Topsoil would be removed and stockpiled on site for re-spreading on disturbed areas for revegetation and erosion control after completion of construction. The earthwork required to construct the launch facility would uncover and disturb soils and increase the potential for wind and water erosion of these exposed soils.

Appropriate measures to reduce wind and water erosion at the stock pile and construction sites would be implemented (see Section 4.8.1.1.1).

Launch anomaly impacts would be similar to those described in Section 4.8.1.1.1, under Soils.

For some small-vehicle missions, under Concept B, a third stage containing solid propellant would be utilized. However, this stage would fire in orbit and no deposition of solid propellants on soils would occur.

Under Concept B, only the commercial DIV-M+ launch vehicle would utilize solid rocket motors. A maximum of four DIV-M+ commercial launches would occur per year under Concept B. Impacts from the use of solid rocket propellants are described in Section 4.8.1.2.1, under Soils.

The South Vandenberg AFB boat dock area would be utilized for receiving/unloading of EELV components. The harbor channel would be dredged to the level of its prior dredging depth, thus eliminating impacts to undisturbed sediments. Approximately 20,000 cubic yards of sediment would be dredged; dredged material would be disposed of in accordance with USACE permit requirements.

Standard construction practices and adherence to permit requirements would minimize adverse impacts to geology and soils; therefore, no mitigation measures would be required.

#### 4.8.1.3 Concept A/B

##### 4.8.1.3.1 Concept A/B, Cape Canaveral AS

**Geologic Setting.** Under Concept A/B, both SLC-41 and SLC-37 would be utilized for EELV activities. Impacts to physiography and geology for these sites would be similar to the combined effects discussed for Concepts A and B in Sections 4.8.1.1.1 and 4.8.1.2.1, under Geologic Setting.

**Soils.** Under Concept A/B, both SLC-41 and SLC-37 would be utilized. Impacts to soils at these sites would be similar to the combined effects discussed for Concepts A and B in Sections 4.8.1.1.1 and 4.8.1.2.1, under Soils.

As discussed in Sections 4.8.1.1.1 and 4.8.1.2.1, standard construction practices and adherence to permit requirements would minimize adverse impacts to geology and soils. Therefore, no impacts are anticipated, and no mitigation measures would be required.

##### 4.8.1.3.2 Concept A/B, Vandenberg AFB

**Geologic Setting.** Under Concept A/B, both SLC-3W and SLC-6 would be utilized. Impacts to physiography and geology at these sites would be similar to the combined effects discussed for Concepts A and B in Sections 4.8.1.1.2 and 4.8.1.2.2, under Geologic Setting.

**Soils.** Under Concept A/B, both SLC-3W and SLC-6 would be utilized. Impacts to soils for these sites are discussed under Sections 4.8.1.1.2 and 4.8.1.2.2, under Soils.

As discussed in Sections 4.8.1.1.2 and 4.8.1.2.2, standard construction practices and adherence to permit requirements would minimize adverse impacts to geology and soils. Therefore, no impacts are anticipated, and no mitigation measures would be required.

### 4.8.2 No-Action Alternative

#### 4.8.2.1 Cape Canaveral AS

Under the No-Action Alternative, no new construction or facility modification would occur. A maximum of 11 launches per year would take place. Since existing programs utilize solid rocket propellant, the potential impact to soils is greater than that of either Concept A (only liquid fuels) or B (smaller amount of launches utilizing solid rocket propellant) of the EELV program. However, impacts to soils are temporary and minimal, as described in Section 4.8.1.2.1, under Soils. No adverse impacts to geology or soils are expected from continuation of existing launch programs.

#### 4.8.2.2 Vandenberg AFB

A maximum of six launches per year would occur under this concept. Some of these launches would use solid rocket propellant. Impacts from the No-Action Alternative at Vandenberg AFB would be similar to the impacts described in Section 4.8.2.1, Cape Canaveral AS.

## 4.9 WATER RESOURCES

Impacts to water resources could result from any of the following project-related effects:

- Degradation of surface or groundwater quality such that existing use would be impaired
- Interference with natural drainage patterns
- A shortage in the water supply system
- Development within a 100-year floodplain.

Potential impacts to wetlands are discussed under Section 4.14, Biological Resources.

### 4.9.1 Proposed Action

#### 4.9.1.1 Concept A

##### 4.9.1.1.1 Concept A, Cape Canaveral AS

**Groundwater.** The majority of water used for Concept A would be deluge water (50,000 gallons per launch) and acoustic suppression water (3,000 to 9,000 gallons per launch) for a maximum of 59,000 gallons per launch. Smaller amounts of water would be utilized for launch complex washdown, fire suppressant, and potable uses. During the peak launch year (2015), Concept A launch activities (6 launches) would require approximately 1,357,000 gallons of water.

The city of Cocoa, which pumps water from the Floridan aquifer, is contracted to supply 6,500,000 gpd of water per day to Cape Canaveral AS and Patrick AFB. Maximum water use at Cape Canaveral AS and Patrick AFB is 1,000,000 and 3,800,000 gpd, respectively, which includes water to support current launch programs (45 Space Wing, 1995). On the day of a launch, Concept A would require approximately 3.5 percent of the excess available water. Based on this small, incremental increase of water use per launch, Concept A would not noticeably affect the quantity of water available to Cape Canaveral AS or the surrounding area or increase the amount of water withdrawn from the Floridan aquifer on a daily basis. With the discontinuation of the current systems, water demand would be reduced. According to the general plan for Cape Canaveral AS, the city of Cocoa has sufficient adequacy and reliability of supply sources to meet usage demands and water quality standards (45 Space Wing, 1995). Therefore, adverse impacts to

groundwater resources are not expected, and no mitigation measures would be required.

**Surface Water.** Grading around SLC-41 for the proposed EELV program would alter the existing surface drainage patterns at the site through excavation, grading, and the creation of impervious surfaces. This site has been previously disturbed, so natural drainage patterns no longer exist. Design of the proposed project would not substantially alter the existing drainage course. Therefore, adverse impacts to natural drainages are not anticipated.

Portions of the area for construction of the two proposed assembly facilities south of SLC-41 lie within the 100-year floodplain. Construction of these facilities could result in impacts associated with modification of the floodplain. Although construction and operation of these facilities would take place in a floodplain, they would not noticeably increase the potential for floods. Although these structures would be built within the 100-year floodplain, no adverse environmental impacts to water quantity or quality are expected. The Air Force will prepare a FONPA in compliance with requirements established in EO 11988. The FONPA must be signed by SAF/MIQ prior to initiation of construction activities that could affect floodplains.

Impacts from erosion, and specific measures to control both wind and water erosion of soils during and after construction, are addressed in Section 4.8.1.1.1, under Geology and Soils.

Since the construction area for the EELV program is greater than 5 acres, an NPDES permit for storm water discharge associated with construction activity would also be required. The objectives of this permit are to: (1) identify pollutant sources that may affect the quality of discharges of storm water associated with construction activities; and (2) identify, construct, and implement storm water pollution preventive measures and best management practices to reduce pollutants in storm water discharges from the construction site both during and after construction. This permit would require implementation of storm water control measures to reduce potential impacts to surface water.

Standard construction practices and adherence to permit requirements and applicable regulations would minimize adverse impacts to water resources; therefore, no mitigation measures would be required.

**Water Quality.** Water quality in the area of SLC-41 could be affected as a result of contamination of surface waters by the launch exhaust cloud. However, Concept A launches would utilize liquid propellants only, which would result in fewer impacts to water quality than the current launch vehicle systems that utilize solid rocket propellant. Liquid propellant is rapidly combusted during a launch and almost completely burned. Therefore, very little propellant would be deposited on the launch pad or in the surrounding area. Adverse impacts to surface water and groundwater quality resulting from the exhaust cloud are not expected.

Launches would require use of deluge and acoustic suppression water. Approximately 10,000 of the 59,000 gallons of deluge and acoustic suppression water used per launch would be vaporized, or percolate into the soil, during launch. Residual deluge water generated during vehicle launches is a potential source of contamination to adjacent surface waters and groundwater. However, deluge water would be retained in the flame duct after launches, tested for water quality characteristics, and released to grade in accordance with the FDEP Industrial Wastewater Discharge permit requirements. Deluge water would be released at a controlled rate to ensure that water percolates into the ground. If contaminant concentrations in the treated deluge water are too high, and the water cannot be released to grade, it would be released to the WWTP. Wastewater would be disposed of in accordance with applicable federal, state, and local regulations. Storm water runoff prior to washdown would be contained to avoid the potential for impacts to surface water resources. Storm water runoff would be tested and treated, if necessary, prior to release. Soils in the vicinity of SLC-41 have a very rapid permeability rate and should be able to handle all water releases associated with launches at this site. Adverse impacts to surface water and groundwater quality resulting from deluge and storm water runoff are not anticipated.

Under normal flight conditions, vehicle stages that do not reach orbit have trajectories that result in ocean impact. Stages that reach initial orbit would eventually re-enter the atmosphere as a result of orbital decay. Corrosion of stage hardware would contribute various metal ions to the water column. Due to the slow rate of corrosion in the deep-ocean environment and the large quantity of water available for dilution, toxic concentrations of metals are not likely to occur. Relatively small amounts of propellant would also be released into the ocean along with the various spent stages. Because of the limited number of launch events scheduled, the small amount of residual propellants present, and the large volume of water available for dilution, no adverse impacts are expected from the re-entry of spent stages.

On-pad accidental or emergency releases of small quantities of propellants are unlikely to occur. However, if there is a release, spilled propellants would be collected and disposed of by a certified disposal subcontractor in accordance with the SPCC plan. Potential contamination of groundwater and/or surface water resulting from accidental or emergency spills of propellants during fueling would be minimized through adherence to strict safety procedures. Potential leakage or spills from propellant storage tanks would be contained in holding basins that surround the tanks. Any accidental or emergency release of propellants after fueling would be collected in the flume located directly beneath the launch vehicle and channeled to an impermeable concrete catch basin. Contaminants collected in the catch basin would be disposed of in accordance with appropriate state and federal regulations. No discharges of contaminated water are expected to result from EELV operations at SLC-41, and no adverse impacts to water quality are anticipated.

Launch anomalies could result in impacts to local water bodies due to contamination from rocket propellant. In the unlikely occurrence of a launch anomaly, spilled propellant could enter water bodies close to the launch pad. At Cape Canaveral AS, they could enter the Atlantic Ocean or the Banana

River. Short-term impacts to the near-shore environments may result, but long-term impacts would not be significant due to the buffering capacity of the Atlantic Ocean and Banana River.

Adherence to permit requirements and applicable regulations would minimize adverse impacts to water quality; therefore, no mitigation measures would be necessary.

#### 4.9.1.1.2 Concept A, Vandenberg AFB

**Groundwater.** Until recently, the potable water supply for Vandenberg AFB was obtained solely from groundwater sources. These sources had been affected by a severe overdraft. Vandenberg AFB now receives supplemental potable water from the State Water Project, which does not draw from aquifers in the area. This will relieve the overdraft situation and allow the aquifer to eventually recharge. EELV program activities are not expected to affect groundwater resources, and no mitigation measures would be required.

**Surface Water.** Vandenberg AFB can purchase up to 1.46 billion gallons of water per year from the State Water Project. In the peak launch year (2007), there would be 6 EELV launches, each using approximately 59,000 gallons of deluge water, or approximately 1.5 percent of the available water per day for each launch. Based on this small, incremental amount of water use per launch, Concept A activities would not noticeably affect the quantity of water available to Vandenberg AFB or the surrounding area.

Grading for new construction around SLC-3W would alter the existing surface drainage patterns at the site through excavation, grading, and the creation of impervious surfaces. This site has been previously disturbed, so natural drainage patterns no longer exist. Design of the new facilities would not substantially alter the existing drainage courses. Therefore, adverse impacts to natural drainages are not anticipated. Impacts from erosion are addressed in Section 4.8, under Soils and Geology.

Because the construction area for the EELV program is greater than 5 acres, a NPDES permit for storm water discharge associated with construction activity would be required (see Section 4.9.1.1.1, under Surface Water). This permit would require implementation of storm water control measures to prevent impacts to surface water.

Standard construction practices and adherence to permit requirements and regulations would minimize adverse impacts to water resources; therefore, no mitigation measures would be required.

**Water Quality.** Water quality in the area of SLC-3W could be affected as a result of contamination of surface waters by the exhaust cloud. As described in Section 4.9.1.1.1, under Water Quality, Concept A launches would use only liquid propellant, which would result in fewer impacts to water quality than the current launch vehicles, which utilize solid rocket propellant. Adverse impacts to surface water and groundwater quality resulting from the exhaust cloud are not expected.

Launches would require use of deluge and acoustic suppression water. Approximately 10,000 of the 59,000 gallons of deluge water used per launch would be vaporized, or percolate into the soil, during launch. Residual deluge water generated during vehicle launches is a potential source of contamination to adjacent surface waters and groundwater; however, no direct discharge is expected to occur during launches from SLC-3W. After a launch, the launch pad would be washed down. Deluge and washdown water would be collected, tested, and treated, if necessary, prior to disposal as industrial wastewater at the SLC-6 treatment plant. If the water is classified as hazardous, it would be containerized and disposed of properly. Storm water runoff prior to washdown would be contained and tested, prior to disposal at the SLC-6 treatment plant, to avoid the potential for impacts to surface water resources. Adverse impacts to surface water and groundwater resulting from deluge or storm water runoff are not anticipated.

Potential impacts from vehicle stages that do not reach orbit, on-pad accidental or emergency releases of propellants, and launch anomalies are discussed in Section 4.9.1.1.1, under Water Quality. No adverse impacts are anticipated.

Adherence to permit requirements and regulations would minimize adverse impacts to water quality; therefore, no mitigation measures would be required.

#### 4.9.1.2 Concept B

##### 4.9.1.2.1 Concept B, Cape Canaveral AS

**Groundwater.** Concept B launches may not require the use of deluge water. However, a maximum of 200,000 to 300,000 gallons of water may be sprayed into the flame deflector to cool the rocket exhaust and minimize damage to the launch pad. The majority of water use for Concept B would occur during a launch. If water were used for every launch during the peak year (23 launches), Concept B activities would require approximately 6,900,000 gallons of water for that year.

As stated in Section 4.9.1.1.1, Groundwater, the city of Cocoa is contracted to supply 6,500,000 gpd to Cape Canaveral AS and Patrick AFB. This quantity includes water to support current launch programs. During Concept B launches, approximately 17.6 percent of the excess available water that day would be required. Based on this increase of water use per launch, it is assumed that Concept B would not significantly affect the quantity of water available to Cape Canaveral AS or the surrounding area or noticeably increase the amount of water withdrawn from the Floridan aquifer on a daily basis. With the discontinuation of current launch vehicle operations, water demand would be reduced. According to the general plan, the City of Cocoa has sufficient adequacy and reliability of supply sources to meet usage demands and water quality standards (45 Space Wing, 1995). Therefore, adverse impacts to groundwater are not expected, and mitigation measures would not be required.

**Surface Water.** Grading around SLC-37 would alter the existing surface drainage patterns at the site through excavation, grading, and the creation of impervious surfaces. This site has been previously disturbed, so natural

drainage patterns no longer exist. Design of the proposed facilities would not substantially alter the existing drainage course. Therefore, adverse impacts to natural drainages are not anticipated. Impacts from erosion are addressed in Section 4.8, under Soils and Geology.

Since the construction area for the EELV program is greater than 5 acres, an NPDES permit for storm water discharge associated with construction activity is required (see Section 4.9.1.1.1, under Surface Water). This permit would require implementation of storm water control measures to prevent impacts to surface water.

The discharge of dredged or fill material into, or the excavation of soils from, Waters of the United States, which include special aquatic sites such as wetlands, is regulated under Section 404 of the CWA (U.S. Environmental Protection Agency, 1987). Construction for Concept B would require a permit under Section 404 of the CWA and Section 10 of the Rivers and Harbors Act of 1899 from the USACE. Section 404 requires that measures be taken to: (1) avoid and (2) minimize impacts to Waters of the United States. In the 404 permit, a mitigation monitoring plan would be developed in coordination with appropriate resource agencies, and a final plan would be approved by the USACE. Given compliance with 404 permit regulations, no adverse impacts to water resources are expected.

Standard construction practices and adherence to permit requirements and applicable regulations would minimize impacts to water resources; therefore, no mitigation measures would be required.

**Water Quality.** Launches may require the use of up to 300,000 gallons of deluge water. Residual water is a potential source of contamination to adjacent surface waters and groundwater; however, no direct discharge is expected to occur during launches from SLC-37. Deluge water would be retained in the flame duct after launches, tested for water quality characteristics, and released to grade in accordance with the FDEP Industrial Wastewater Discharge permit requirements. Deluge water would be released at a controlled rate to ensure that water percolates into the ground. If concentrations of contaminants in the treated deluge water are too high, and water cannot be released to grade, it would be released to the WWTP. Wastewater would be disposed of in accordance with applicable federal, state, and local requirements. Storm water runoff prior to washdown would be contained to avoid the potential for impacts to surface water resources. Storm water runoff would be tested and treated, if necessary, prior to release. Soils in the vicinity of SLC-37 have a very rapid permeability rate and should be able to handle all water releases associated with launches at this site. Adverse impacts to surface water and groundwater resulting from deluge or storm water runoff are not anticipated.

Potential impacts from vehicle stages that do not reach orbit, on-pad accidental and emergency releases of propellant, and launch anomalies are discussed in Section 4.9.1.1.1, under Water Quality. No adverse impacts are anticipated.

For some small vehicle missions, a third stage containing solid propellant would be utilized. However, this stage would ignite in orbit, and no deposition of propellant on surface waters would occur. Therefore, no adverse impacts to water quality are anticipated.

Water quality in the area of SLC-37 could be affected as a result of contamination of surface waters by the exhaust cloud. Under Concept B activities, only the commercial DIV-M+ launch vehicle would utilize solid rocket motors. A maximum of 8 DIV-M+ launches would occur in one year. During a launch, the solid propellant is released in the exhaust ground cloud produced by vehicle launch and surface water. The effect of the ground cloud on water quality would be a function of the exhaust cloud composition, distance to surface water, duration of its contact with the water, wind speed and direction, and other atmospheric conditions. The exhaust ground cloud would consist primarily of HCl, $Al_2O_3$, and $CO_2$. The primary concern associated with the ground cloud impacts on water quality is the formation of large quantities of HCl, much of which would stay aloft and disperse over a large area in the atmosphere. Depending on the wind direction, most of the exhaust could drift over the Banana River or the Atlantic Ocean, which may result in a brief acidification of surface waters from HCl. The large volume and buffering capacities of the Atlantic Ocean and Banana River would neutralize any acidification that may occur as a result of HCl deposition. Aluminum oxide is relatively insoluble because of the pH of local surface waters and is not expected to cause elevated aluminum levels. Therefore, no adverse impacts to surface water are expected from the use of the solid rocket motors, and no mitigation measures would be required.

Exhaust cloud deposits and propellant residues remain on the pad and are deposited in near-field soils after a launch. These residues would be washed from the pad during post-launch washdown or by storm water, which would be retained in catch basins. This water would then be analyzed and discharged to percolation ponds if it meets regulatory requirements. If contaminant concentrations are too high and the water cannot be released to grade, it would be released to the WWTP. Wastewater would be disposed of in accordance with applicable federal, state, and local regulations. Thus, Concept B launches would not adversely affect groundwater quality in the surficial aquifer.

Launch anomalies could result in impacts to local water bodies due to contamination from rocket propellant. In the unlikely occurrence of a launch anomaly, spilled propellant could enter water bodies close to the launch pad. At Cape Canaveral AS, propellant could enter the Atlantic Ocean or the Banana River. Potential contamination would primarily occur from solid rocket motor propellant. Solid propellant would cause contamination in the form of acidification from HCl and the deposition of aluminum oxide. Recovered solids would be removed from near-shore ocean and/or river environments and treated as hazardous waste in accordance with federal, state, and local regulations. Short-term impacts to the near-shore environments may result, but long-term impacts would not be significant due to the buffering capacity of the Atlantic Ocean and Banana River.

Adherence to permit requirements and applicable regulations would minimize adverse impacts to water quality; therefore, no mitigation measures would be required.

#### 4.9.1.2.2 Concept B, Vandenberg AFB

**Groundwater.** Water required to support EELV programs would be supplied from the State Water Project and not from local wells in the area. No adverse impacts to groundwater resources are anticipated, and no mitigation measures would be required.

**Surface Water.** As discussed in Section 4.9.2.1.2, Concept B launches are not expected to utilize deluge water. However, a maximum of 200,000 to 300,000 gallons of water may be used to cool the rocket exhaust and minimize damage to the launch pad. During the peak year, there would be 6 launches each, using up to 300,000 gallons of water. These activities would require approximately 7.5 percent of the available water per day for each launch. Based on the small, incremental amount of water use per launch, Concept B activities would not noticeably affect the quantity of water available to Vandenberg AFB or the surrounding area.

Surface water around SLC-6 drains through erosion control ditches into a small arroyo located on the north side of SLC-6. Grading would alter the existing surface drainage patterns at the site through excavation, grading, and the creation of impervious surfaces. This site has been previously disturbed, so natural drainage patterns no longer exist. Design of the proposed facilities would not substantially alter the existing drainage courses on the site. Therefore, adverse impacts to natural drainages are not anticipated. Impacts from erosion are addressed in Section 4.8, under Geology and Soils.

Since the construction area for the EELV program is greater than 5 acres, an NPDES permit for storm water discharge associated with construction activity would be required (see Section 4.9.1.1.1, under Surface Water). This permit would require implementation of storm water control measures to prevent impacts to surface water.

Impacts related to dredging are addressed in Section 4.9.1.2.1, under Surface Water. This discussion includes mitigation measures to prevent impacts.

Standard construction practices and adherence to permit requirements and applicable regulations would minimize adverse impacts to water resources; therefore, no mitigation measures would be required.

**Water Quality.** Launches may require the use of approximately 300,000 gallons of deluge water. Residual water is a potential source of contamination to adjacent surface waters and groundwater; however, no direct discharge is expected to occur during launches from SLC-6. During a launch, the launch pad may be sprayed with deluge water. After launch of the EELV, the launch pad would be washed down. This water would be collected, tested, and treated, if necessary, prior to disposal as industrial wastewater at the SLC-6 treatment plant. If the water is classified as

hazardous, it would be containerized and disposed of properly. Storm water runoff prior to washdown would be contained and tested, prior to disposal at the SLC-6 treatment plant, to avoid the potential for impacts to surface water resources. Adverse impacts to surface water or groundwater resulting from deluge or storm water runoff are not anticipated.

Potential impacts from vehicle stages that do not reach orbit, on-pad accidental or emergency releases, and launch anomalies are discussed in under Section 4.9.1.1.1, Water Quality. No adverse impacts are anticipated.

For some small-vehicle missions under Concept B, a third stage containing solid propellant would be utilized. However, this stage would ignite in orbit, and no deposition of propellant on surface waters would occur. Therefore, no adverse impacts to water quality are anticipated.

Water quality in the area of SLC-6 could be affected as a result of contamination of surface waters by the exhaust cloud. Under Concept B activities, only the commercial DIV-M+ launch vehicle would utilize solid rocket motors. A maximum of four DIV-M+ commercial launches is proposed for one year. Impacts would be the same as described in Section 4.9.1.1.1, under Water Quality.

In studies conducted at SLC-2W, some trace metals were identified in surface soils near the pad. The amounts were so small that it was hard to determine whether they were background metals or were derived from launch activities. Based on the lack of substantial accumulation of metals and other surface contaminants at the site, it was assumed that they are neither deposited in appreciable amounts nor accumulate over time. In addition, the lack of high concentrations of metals downgradient of the pad suggests no long-term accumulation of such contaminants off site (ENSR Corporation, 1996). Based on these findings, aluminum oxide deposits are not expected to cause elevated aluminum levels in nearby soils or water bodies. Therefore, adverse water quality impacts to surface water are not expected.

Exhaust cloud deposits and propellant residues remain on the pad and are deposited in near-field soils after a launch. These residues would be washed from the pad by a post-launch washdown or by storm water, which would be retained in catch basins. This water would then be analyzed and treated prior to disposal as industrial wastewater at the SLC-6 treatment plant. Concept B wastewater and storm water would not be allowed to percolate into the local groundwater. Therefore, no adverse impacts to groundwater are anticipated.

Adherence to permit requirements and applicable regulations would minimize adverse impacts to water quality; therefore, no mitigation measures would be required.

### 4.9.2 Concept A/B

#### 4.9.2.1 Concept A/B, Cape Canaveral AS

**Groundwater.** Impacts to groundwater would be similar to the combined effects for Concepts A and B discussed in Sections 4.9.1.1.1 and 4.9.1.2.1. A maximum of 4,667,000 gallons of water per year would be required to

support launches during the peak year. However, impacts would be similar to those described for Concept B in Section 4.9.1.2.1, under Groundwater, because the maximum water use per launch would be 300,000 gallons. Concept A/B launches would use a maximum of 17.6 percent of the excess water available on the day of the launch. Based on this increase of water use during a launch, Concept A/B launches would not noticeably affect the quantity of water available to Cape Canaveral AS or the surrounding area, or increase the amount of water withdrawn from the aquifer on a daily basis. With the discontinuation of current launch vehicle operations, water demand would be reduced. Therefore, adverse impacts to groundwater are not anticipated, and mitigation measures would not be required.

**Surface Water.** Impacts to surface water would be similar to those discussed in Sections 4.9.1.1.1 and 4.9.1.2.1, under Surface Water. No adverse impacts are anticipated.

As discussed in Sections 4.9.1.1.1 and 4.9.1.2.1, under Surface Water, standard construction practices and adherence to permit requirements and applicable regulations would minimize adverse impacts to water resources; therefore, no mitigation measures would be required.

**Water Quality.** Impacts to water quality would be similar to those discussed in Sections 4.9.1.1.1 and 4.9.1.2.1, under Water Quality. No adverse impacts to groundwater or surface water quality are anticipated; therefore, no mitigation measures would be required.

#### 4.9.2.2 Concept A/B, Vandenberg AFB

**Groundwater.** As described in Section 4.9.1.1.2, under Groundwater, water required to support EELV programs would be supplemented by the State Water Project. No adverse impacts to groundwater resources are anticipated from Concept A/B activities, and no mitigation measures would be required.

**Surface Water.** Concept A/B activities would require use of up to 2,513,000 gallons of water during the peak year. However, impacts would be similar to those described in Section 4.9.1.2.2, under Surface Water, because the maximum water use per launch would be 300,000 gallons. Concept A/B launches would use a maximum of up to 7.5 percent of the water available on the day of the launch. Based on the small, incremental amount of water use per launch, Concept A/B launches would not noticeably affect the quantity of water available to Vandenberg AFB or the surrounding area. Existing water use includes current launch vehicles, so impacts to water use would likely be less than anticipated. Impacts to surface water would be similar to those discussed in Sections 4.9.1.1.2 and 4.9.1.2.2, Surface Water.

As discussed under Sections 4.9.1.1.2 and 4.9.1.2.2, Surface Waters, standard construction practices and adherence to permit requirements and applicable regulations would minimize adverse impacts to water resources; therefore, no mitigation measures would be required.

**Water Quality.** Impacts to water quality would be similar to those discussed in Sections 4.9.1.1.2 and 4.9.1.2.2, Water Quality. No adverse impacts to groundwater or surface water quality are anticipated; therefore, no mitigation measures would be required.

### 4.9.3 No-Action Alternative

#### 4.9.3.1 Cape Canaveral AS

**Groundwater.** Under the No-Action Alternative, a maximum of approximately 1,730,000 gallons of deluge water would be required to support 11 launches. The Atlas IIA launch vehicle uses a maximum of 200,000 gallons of water per launch. Therefore, Atlas IIA would require 11.8 percent of the excess water available on the day of a launch. The No-Action Alternative would not significantly affect the quantity of water available to Cape Canaveral AS or the surrounding area or increase the amount of water withdrawn from the Floridan aquifer on a daily basis. Impacts to groundwater are not anticipated, and mitigation measures would not be required.

**Surface Water.** Adverse impacts to surface water are not anticipated since no construction or modification of facilities is planned; therefore, no mitigation measures would be required.

**Water Quality.** The existing launch vehicles use solid rocket propellant, so impacts from the No-Action Alternative would be similar to those described under Section 4.9.1.2.1, Water Quality. Adverse impacts to surface and groundwater quality are not anticipated; therefore, no mitigation measures would be required.

#### 4.9.3.2 Vandenberg AFB

**Groundwater.** As stated in Section 4.9.1.1.2, Groundwater, Vandenberg AFB has sufficient water to support No-Action Alternative launches. No adverse impacts to groundwater resources are expected, and no mitigation measures would be required.
**Surface Water.** Under the No-Action Alternative, a maximum of 920,000 gallons of water would be required to support 6 launches. The Atlas IIA launch vehicle uses a maximum of 200,000 gallons of water per launch. Therefore, Atlas IIA would require 5 percent of the water available on the day of a launch. The No-Action Alternative would not significantly affect the quantity of water available to Vandenberg AFB or the surrounding area. Adverse impacts to surface water are not anticipated; therefore, no mitigation measures would be required.

**Water Quality.** Some of the existing launch vehicles use solid rocket propellant, so impacts from the No-Action Alternative would be similar to those described under Section 4.9.1.2.2, under Water Quality. Adverse impacts to surface and groundwater quality are not anticipated; therefore, no mitigation measures would be required.

## 4.10 AIR QUALITY (LOWER ATMOSPHERE)

### 4.10.1 Proposed Action

Air quality impacts could occur during facility construction, pre- and post-launch processing operations, and from vehicle launch. Effects from vehicle launch on the lower atmosphere are addressed in this section; effects from vehicle launch on the upper atmosphere are addressed in Section 4.11.

Construction-related impacts could result from construction equipment (exhaust emissions) and construction activities (fugitive dust emissions) over an intermittent period of about two years (beginning as early as 1998 and ending as late as 2002).

Operational impacts could occur from: (1) mobile sources such as support vehicles, commercial transport vehicles, and personal vehicles; (2) point sources such as heating/power plants, generators, storage tanks, and flares; (3) processes such as solvent cleaning, coating, and post-launch pad cleanup; and (4) vehicle launch.

Construction activities include renovation of existing structures and roads, construction of new facilities, and demolition of existing facilities. Analysis of construction emission sources includes estimating the amount of uncontrolled fugitive dust that would be emitted from disturbed surface areas and gaseous emissions from construction equipment and construction workers' vehicles.

Transportation emissions were calculated based on expected deliveries, support vehicle operation, and personal vehicle traffic. Results were compared to existing mobile source emissions.

No new major point sources are necessary to support the EELV program. Emission sources that would be required are typical of light industrial activities already occurring at Cape Canaveral AS and Vandenberg AFB (e.g., power generators, utility boilers, shop activities, painting and surface coating operations, solvent degreasing, vehicle assembly, fuels storage). Emissions were calculated for these activities and compared to existing conditions.

Launch emissions were modeled to determine their impact on the ambient air quality concentrations in the lower troposphere. This modeling was conducted using the REEDM air quality dispersion model (Brady et al., 1997). The REEDM model predicts the incremental increases in the concentrations of criteria and toxic pollutants. These increases were compared with federal and state ambient air quality standards. The following sections describe additional emission models used for each location.

Several launches, each with its associated support activities, would occur each year. The criteria pollutant emissions were totaled for the peak launch year, and this total was compared with regional annual air emissions and regulatory thresholds.

The health effects of air pollution differ among pollutants, which are sometimes referred to as contaminants of concern. $SO_2$, $NO_x$, and $PM_{10}$ are respiratory irritants. Particulate matter may also interfere with oxygen

exchange within the human respiratory system as a result of deposition of respirable particles in the lungs. CO decreases the ability of the blood to carry oxygen. VOCs include several different compounds that may have varying health effects. HAPs are specific VOCs and particulates posing acute or chronic health hazards. HAPs associated with pre-launch and post-launch processing include organic HAPs from solvent and coating use and hydrazine from vehicle fueling. Organic HAPs have compound-specific health hazards, such as irritation of the eyes, nose, and throat; dizziness; headaches; and nausea. Chronic (long-term) exposure can cause damage to internal organs; some organic HAPs are suspected carcinogens. Hydrazine can irritate eyes, nose, throat, and skin, and is a suspect carcinogen. Caustic or acidic pollutants, such as $NH_3$ or HCl, can also irritate mucus membranes.

In addition to causing direct health effects, VOCs and $NO_x$ participate in photochemical reactions to cause ground-level ozone (smog), a respiratory irritant.

#### 4.10.1.1 Concept A

**4.10.1.1.1 Concept A - Cape Canaveral AS.** Potential air quality impacts from Concept A operations could result from the general sources described in Section 4.10.1. Vehicle components would be delivered by truck and airplane; emissions from both forms of delivery have been calculated and compared to existing mobile source emissions. Fuels used in the Concept A vehicles would include kerosene fuel (RP-1), cryogenic gases ($LO_2$ and $LH_2$), hydrazines (MMH and $N_2H_4$), $N_2O_4$, and a small amount of PG-2. Emissions from the handling and storage of these fuels have been calculated and compared to existing emissions.

Facility Construction

Emissions generated by facility construction activities would be in the form of either gaseous or particulate pollutant emissions. Gaseous emissions would occur from heavy-duty construction equipment and vehicle travel to and from the site by construction workers. Emissions would consist primarily of combustion products. Particulate matter in the form of dust emissions would also be generated during the construction phase from excavation, earth moving, construction of buildings, and traffic on unpaved surface areas.

Facility construction for Concept A at Cape Canaveral AS would involve extensive renovation and some new construction at SLC-41. The disturbed area would total 9.6 acres (net of buildings), including 5.6 acres of the SLC-41 site and the 4 acres south of the site associated with construction of the assembly facilities and transporter rail. All calculations were made on the basis of average emissions per year over the construction period.

New and renovated structures within the disturbed acreage would include four support operations buildings and five gas or propellant storage/handling facilities. Additional buildings on station, but remote from the launch site, have also been scheduled for renovations and were included in all calculations. Square footage of all individual structures has been estimated from scale site plan drawings considering facilities with similar purposes at

other military properties. Total new building floor space would be approximately 369,800 square feet. The surface area associated with paving modifications includes the sum of a factor for new pavement related to new building construction, plus all pavement that would be renovated for road and utility improvements. Sources for construction factors include The R. S. Means Building Construction Cost Data Index (1997) and actual ratios from at other government facilities (see Appendix J). Construction-related emissions for Concept A activities are provided in Table 4.10-1.

Local concentrations of criteria pollutants would increase during the construction phase. The $PM_{10}$ emissions during the construction period would cause slightly elevated levels of $PM_{10}$ in the immediate vicinity of the work site. However, particulate matter concentrations would fall off rapidly with distance from the construction site; the distance of particulate fallout would depend on the wind speed at the time. Further, these increased concentrations would occur only temporarily, during construction, and would decrease again after construction is completed.

**Table 4.10-1. Construction-Related Emissions - Concept A, Cape Canaveral AS Average Annual Emissions Over Construction Period**

| | VOC | $NO_x$ | CO | $SO_2$ | $PM_{10}$ |
|---|---|---|---|---|---|
| Grading Equipment (lbs/day): | 1.2 | 7.7 | 1.7 | 0.5 | 1.3 |
| Asphalt Paving (lbs/day): | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Stationary Equipment (lbs/day): | 31.7 | 25.9 | 5.6 | 1.7 | 1.5 |
| Mobile Equipment (lbs/day): | 30.2 | 301.0 | 306.1 | 17.2 | 22.7 |
| Architectural Coatings (lbs/day): | 35.4 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Emissions (lbs/day): | 99.0 | 337.6 | 313.4 | 19.4 | 25.5 |
| Total Emissions (tpy): | 11.4 | 38.8 | 36.0 | 2.2 | 2.9 |
| Construction Commuter Automobiles (tpy): | 1.7 | 2.7 | 12.9 | 0.1 | 6.4 |
| Total Construction-Related Activities (tpy): | 13.1 | 41.5 | 48.9 | 2.3 | 9.3 |
| Brevard County 1995 Total (tpy, for comparison) | 24,983 | 26,122 | 13,4743 | 27,524 | 35,090 |

CO = carbon monoxide
lbs = pounds
$NO_x$ = nitrogen oxides
$PM_{10}$ = particulate matter equal to or less than 10 microns in diameter
$SO_2$ = sulfur dioxide
tpy = tons per year
VOC = volatile organic compound

Dust from construction activities should have minimal impacts on local communities either on or off site, based on the assumption that the dust from construction would be periodic and disperse relatively quickly. Exposure to nuisance dust above permissible exposure limits (established occupational health and safety standards) would be possible but unlikely (based on historical and expected construction activities). If exceedance of exposure limit is established, health and safety procedures would need to be implemented by the construction contractor(s) to minimize emission or exposure to dust (e.g., respirator protection, limit access to working zones) and to maintain compliance with OSHA requirements. Environmental regulations may require use of wetting agents applied to road surfaces to minimize total suspended particles.

Brevard County currently meets the FAAQS and NAAQS for ozone, $SO_2$, $NO_x$, CO, and $PM_{10}$. Because the area is in attainment for these pollutants, the FDEP has not been required to establish specific emission reduction measures. Construction emissions of criteria pollutants would not be sufficient to jeopardize the attainment status for these pollutants. Baseline emissions in Brevard County are below the levels that would cause nonattainment, and the peak-year construction emissions are only a small fraction of the baseline.

The U.S. EPA is currently drafting a revised NAAQS, which would include a lower standard for ozone, and a standard for particles less than 2.5 microns in diameter ($PM_{2.5}$). Based on the new NAAQS, the attainment status of Brevard County may change, particularly for ozone. Given this situation, emissions of ozone precursors (VOC and $NO_x$) should be minimized to prevent impacts relative to standards and regulatory thresholds that could apply in the future.

Although no impacts have been identified, emissions could be reduced by implementing standard procedures, such as vigorous water application during ground-disturbing activities, which would be utilized to mitigate fugitive dust emissions by at least 50 percent (U.S. Environmental Protection Agency, 1985). Decreasing the time period during which newly graded sites are exposed to the elements, coupled with the use of windbreaks, could further minimize airborne dust concentrations. Efficient scheduling of equipment use, implementation of a phased construction schedule to reduce the number of units operating simultaneously, and performance of regular vehicle engine maintenance could mitigate combustive emission impacts. Implementation of these measures could reduce combustive emission and air quality effects from construction activities associated with the Proposed Action by 10 to 25 percent. Emissions of VOC from architectural coatings could be mitigated by selecting coatings with low VOC content.

Operations

**Pre- and Post-Launch Processing.** Pre- and post-launch processing would result in minor amounts of air emissions from the following activities:

- Vehicle preparation, and assembly
- Vehicle fueling
- Mobile sources such as support equipment, commercial transport vehicles (including trucks and aircraft), and personal vehicles
- Point sources such as heating/power plants, generators, incinerators and storage tanks.

Emissions from pre- and post-launch processing include criteria pollutants and toxic or irritant pollutants (including HAPs). Emissions of criteria pollutants could cause or contribute to the nonattainment of NAAQS or FAAQS for the region. Emissions of pollutants can also cause localized health effects.

**Vehicle Preparation and Assembly.** The manufacturing of Concept A vehicle components occurs off site, and emissions have not been included in the scope of this EIS. The components arrive complete, requiring only final on-site safety and quality checks prior to assembly.

Some chemical use occurs in the vehicle preparation and assembly stages, as described in Section 4.6, Hazardous Materials and Hazardous Waste Management. Some of the materials used would evaporate, resulting in air emissions. Examples of these air emissions sources include: solvents from adhesives and coatings, methylene chloride from paint remover, and isopropanol for surface cleaning. Spray painting could cause a small amount of particulate emissions from airborne paint particles; however, these emissions are expected to be minimal.

In addition to chemical usage, some air emissions could be generated from mechanical processing. For example, grinding and sanding operations could release particulate emissions. However, there would be no large-scale

operations that would generate air emissions, and therefore emissions from mechanical processing are expected to be minimal.

Permitting for specific pieces of preparation and assembly equipment must be addressed under the Florida permitting requirements (FAC 62-210 through 213). Each piece of equipment must comply with the emission, opacity, odor, and toxics limits in these regulations.

Cape Canaveral AS has submitted a Title V Operating Permit application, which is under review by the FDEP. If the EELV program proceeds prior to the completion of FDEP review of the application, new stationary sources associated with the program would require permitting under the existing construction and operating permit program. Cape Canaveral AS could then change the Title V Operating Permit application to accurately reflect any new equipment. If the EELV program is implemented after completion of the FDEP review, new stationary source equipment would either be addressed or documented as minimal under the operating permit program. To address the changes, an amendment to the Operating Permit would be required. If the changes are minimal, they could be implemented without a permit revision.

The contractor has committed to implementing the EELV program without the use of any Class I ODSs. The use of Class II ODSs (for refrigeration, etc.) would be minimized or eliminated.

Emissions of VOC from chemical use could be reduced by limiting the overall chemical usage in preparation at Cape Canaveral AS. Chemical substitution could minimize the usage of HAPs; emissions of VOC and particulates from post-launch refurbishment could be mitigated by designing the SLC to minimize refurbishment. Emissions of VOCs from architectural coatings could be mitigated by selecting coatings with low VOC content.

**Vehicle Fueling.** Fueling of hydrogen for the CUS would involve some venting of hydrogen during bulk fuel transfer, fuel system checkout, and post-launch fuel system purging. Vented hydrogen would be controlled using a flare, which uses propane as auxiliary fuel. Emissions of combustion products from the hydrogen control flares were estimated using EPA AP-42 standard factors for external combustion. Emission rates would be very small (significantly less than 1 ton/year of all pollutants).

EPA AP-42 emission factors have been used to estimate emissions from RP-1 storage and fueling for the common booster(s). Estimates have been made for working emissions, caused by filling and emptying the storage tanks (including line purges), and breathing emissions, caused by daily warming and cooling of the tanks in the sunlight. Because RP-1 is not a very volatile fuel, emissions from RP-1 storage tanks are small (about 50 pounds per year). Currently, it is not anticipated that vapor control would be necessary for RP-1 storage and transfer equipment at Cape Canaveral AS. The final determination for control requirements would depend on the results of the Florida permitting process.

Emissions from hydrazine and $N_2O_4$ loading would be controlled by a combination of sealed transfer systems, wet scrubbing, and oxidation. The loading of MMH used in the SUS would be controlled using the existing fuel

vapor incineration system (FVIS), which uses propane and excess air to oxidize the MMH into $CO_2$, nitrogen gas, and water. The FVIS is currently being used for the Titan IVB program to control emissions of A-50. The loading of $N_2O_4$ used in the SUS would be controlled using the existing oxidizer vapor scrubber system (OVSS), which uses a 25-percent sodium hydroxide solution as the scrubbing medium in a 4-tower, 1,500-gallon scrubber system. The sodium hydroxide solution converts $N_2O_4$ into aqueous sodium nitrate and aqueous sodium nitrite.

Hydrazine emissions are listed as HAP emissions. Emission rates of $N_2O_4$ are minimal compared to other sources of nitrogen oxides (much less than 1 ton per year).

After vehicle launch, the SLC must be cleaned and repaired. Surfaces are cleaned using an abrasive blaster, applying ablative coatings, and touching up or repainting painted surfaces. Particulate emissions from sandblasting have been estimated based on estimated abrasive use and a particulate emission factor. VOC emissions from coatings were obtained from the chemical usage described in Section 4.6, Hazardous Materials and Hazardous Waste Management, and an estimated evaporation rate.

Emissions could be reduced by using sealed transfer systems, wet scrubbing, and oxidation when loading hydrazine and $N_2O_4$. The final determination for control devices would depend on the results of the Florida permitting process.

**Mobile Sources.** Mobile sources of emissions for the baseline include vehicle deliveries, vehicle assembly and on-site transport, and personal automobile use and miscellaneous supply traffic.

Vehicle Deliveries. Concept A vehicle components would be delivered by truck and airplane. Truck emissions have been calculated using pounds of emissions per vehicle mile traveled. Emission factors were taken from the MOBILE 5a and PART5 computer models; emissions from required escort cars for oversized loads were calculated similarly.

Because the ROI for Cape Canaveral AS includes all of Brevard County, transportation emissions have been calculated for all Brevard County vehicular traffic that would be directly related to the EELV program.

Deliveries made by truck were assumed to involve round-trip traffic to and from the northern county line (50 percent) or the southern county line (50 percent). Travel along Interstate 95 was assumed.

It was assumed that aircraft deliveries would be made using a C-17 aircraft. Emissions from the C-17 aircraft were calculated using C-17A aircraft emission factors associated with landing and take-off. These factors are from Pratt & Whitney calculations and Procedures for Emission Inventory Preparation, Volume IV: Mobile Sources, "Modifications to Guidance Document, Chapter 5: Emissions from Aircraft" (U.S. Environmental Protection Agency, 1991). Aircraft would be used to transport boosters and CUSs. It was assumed that one aircraft would be used for each component delivered.

Vehicle Assembly and On-Site Transport. Assembly of the vehicle components and on-site transport of the vehicle involves emissions from mobile sources, several of which are standard vehicles (trucks, forklifts). Emissions from these sources were estimated using VMT and the emission factors available in the MOBILE 5a and PART5 computer models. Other mobile sources (cranes, specialized transport vehicles) are not standard and have no associated standard emission factors. Emissions from these vehicles have been calculated using hours of operation, rated capacity (in horsepower), and the stationary source AP-42 emission factors for the appropriate engine types. Pollutant activities from these sources are relatively minor, and general estimates were used where specific data were not available.

Personal Automobile Use and Miscellaneous Supply Traffic. Emissions from automobile use and supply traffic were calculated based on both on-site and off-site emissions. The method of calculation is based on VMT and the emission factors available in MOBILE5a and PART5 computer models, discussed in detail in Section 3.10.2. A surge in automobile traffic prior to launch has been accounted for in the calculations.

Emissions from mobile sources could be mitigated by minimizing trip occurrences and trip lengths, and by improving emissions controls on mobile sources. Potential operational mitigation measures would focus on land use or transportation planning and management measures to reduce motor vehicle pollution. Types of potential mitigation measures would include: (1) use of centralized parking areas and shuttle systems to reduce personal vehicle use on station; (2) promotion of carpools and vanpools by providing a rider matching service, preferential parking, and financial incentives; (3) improvements such as bicycle lanes, storage facilities, and showers to increase the use of bicycling as a mode of transportation; and (4) on-station location of facilities that would reduce the need for off-station travel (e.g., childcare facilities, cafeterias, postal machines, automated tellers). These measures would reduce VMT, vehicle trips, and peak-hour travel, and therefore reduce both regional and localized vehicle-related emissions of criteria pollutants.

**Point Sources.** Point sources would include combustion sources, such as boilers and internal combustion engines. There would be no new fuel-fired boilers or heaters for this concept; some existing equipment would be used. However, some propane combustion would be required for operation of the hydrogen control flare and the FVIS. Emissions from other point sources such as spray booths and solvent cleaning equipment have been included in the total emission calculations for vehicle preparation and assembly. Permitting for specific pieces of preparation and assembly equipment must be addressed under the Florida permitting requirements (FAC 62-210 through 213). Stationary sources must be addressed under the Title V program to determine whether a Title V permit modification would be required.

Emissions from boilers and other external combustion sources were estimated based on the program's estimated utility requirements. Propane usage is provided in therms per day, and EPA AP-42 emission factors were used to calculate emission estimates from combustion of propane.

Emissions from internal combustion sources have been estimated based on the use of three emergency generators (two 1,000 kW and one 350 kW) operating an assumed 52 hours/year (one weekly one-hour test); and three small engines (welders, compressors) of 50-brake horsepower each, operating an assumed 500 hours/year. EPA AP-42 emission factors have been used to calculate emissions estimates from combustion of these sources.

The duration and magnitude of emissions associated with vehicle preparation and assembly are such that any increase in localized air pollutant concentrations would be relatively small and short-lived. Local effects would be consistent with the effects from similar light industrial activities. Exposure to pollutant levels in the ambient air above permissible exposure limits would be possible but unlikely (based on similar historical and expected operational activities). Any health risks would more likely be associated with improper ventilation of pollutants. Health risks to on-site personnel could be minimized by providing proper ventilation of pollutants and compliance with OSHA requirements.

Regional impacts affecting maintenance of ambient air quality standards must be addressed in combination with other sections of the program. These impacts are addressed under Regional Air Quality Impacts, and are summarized in Table 4.10-5.

Launch Activities

**Launch Emissions.** The rapid combustion of fuel during vehicle launch produces emissions. The release of unburned fuel and the generation of $NO_x$ from the heat generated by launch also produce emissions. In addition, the baking and scouring effect of the launch exhaust on the launch pad may produce a small amount of particulates and combustion product emissions.

Concept A launch vehicles would use a booster that burns RP-1 and $LO_2$. The composition of the after-burning emissions is very similar to that of the Atlas IIA core booster. Launches from Cape Canaveral AS are primarily GTO missions, and the flight trajectory typical of such a mission was used to estimate the amount of booster mass emitted into the lower atmosphere (0-3,000 feet). The launch vehicles would spend 29 seconds in the lower atmosphere for a GTO mission.

The chemicals of concern include the tropospheric criteria pollutants for which NAAQS apply ($NO_x$ as $NO_2$, and CO) and tropospheric precursors to ozone ($NO_x$ and reactive VOCs). Table 4.10-2 summarizes the total mass of the various chemicals of concern released into the lower atmosphere from vehicle exhaust and after-burning during a GTO mission.

**Table 4.10-2. Summary of Flight Emissions Deposited in the Lower Atmosphere, Concept A[(a)] (in tons)**

| Launch Vehicle | Particulate | $NO_x$ | CO | VOC |
|---|---|---|---|---|
| MLV-A | 0.0 | 0.74 | 0.0 | 0.0 |
| MLV-D | 0.0 | 0.74 | 0.0 | 0.0 |
| HLV-L | 0.0 | 2.23 | 0.0 | 0.0 |
| HLV-G | 0.0 | 2.23 | 0.0 | 0.0 |

Note: (a) Assumes a geosynchronous transfer orbit mission.
CO = carbon monoxide
HLV = heavy lift variant
MLV = medium lift variant
$NO_x$ = nitrogen oxides
VOC = volatile organic compound

Localized air quality impacts were assessed using the REEDM model. REEDM produces peak puff and 30-minute average concentration estimates. Many ambient air quality standards are expressed as 1-, 8-, and 24-hour averages, or an instantaneous ceiling. Launch emissions occur over periods of minutes, and the launch plume rapidly clears the pad. An 8-hour average concentration was developed, assuming air quality impacts during 30 minutes of the 8-hour period. A maximum 8-hour average was developed by dividing the 30-minute average by 16. REEDM can also predict a peak puff concentration estimate as the puff moves over the receptor site. Tables for peak hourly and daily CO and $NO_x$ predictions were produced. Rather than producing tables of each toxic hydrazine compound, the concentrations were summed for all hydrazine compounds. Separate tables of $NH_3$ concentrations were compiled when relevant, and tables for peak puff HCl concentrations were also compiled.

In practice, the REEDM results are compared with Tier 1, Tier 2, and Tier 3 recommended exposure criteria prior to allowing a launch to proceed (see Section 3.7, Health and Safety).

The REEDM modeling exercises should be interpreted as screening tools; a systematic search for the worst-case meteorology beyond simple low wind speed conditions was not conducted. The worst-case modeling scenario depends on a number of factors including where the receptors of importance are located relative to the launch pad, the vertical profile of wind speed and direction, the atmospheric stability and the height of the mixed layer, and the stability/thickness of any capping inversion.

The predicted incremental concentrations for nominal (normal) launches for Concept A vehicles are presented in Table 4.10-3.

**Table 4.10-3. Summary of REEDM-Predicted Ambient Air Concentration Increments During Nominal Launches, Concept A**

| CO | Peak 8-hour average concentration increment (ppm) | NAAQS/FAAQS 8-hour average (ppm) |
|---|---|---|
| MLV-D | 0.0 | 9 |
| MLV-A | 0.0 | 9 |
| HLV-L | 0.0 | 9 |
| HLV-G | 0.0 | 9 |
| **$NO_x$** | **Maximum 1-hour average concentration increment (ppm)** | **OSHA PEL ceiling (ppm)** |
| MLV-D | 0.114 | 5 |
| MLV-A | 0.114 | 5 |
| HLV-L | 0.162 | 5 |
| HLV-G | 0.162 | 5 |

CO = carbon monoxide
FAAQS = Florida Ambient Air Quality Standards
HLV = heavy lift variant
MLV = medium lift variant
NAAQS = National Ambient Air Quality Standards
$NO_x$ = nitrogen oxides
OSHA = Occupational Safety and Health Administration
PEL = Permissible Exposure Level
ppm = parts per million
REEDM = Rocket Exhaust Effluent Dispersion Model

Table 4.10-3 indicates that since the launch would be a transient source, the 8-hour average CO concentration increment would only be a small fraction of the NAAQS and FAAQS.

The NAAQS for $NO_x$ is an annual standard, and the annual average is not substantially perturbed by the transient releases from launches. For comparison purposes, the Permissible Exposure Level (PEL) is shown, although this limit is not directly applicable to the EELV program. The PEL is a worker exposure limit; EELV program activities are not required to comply with this limit. The PEL is from the federal OSHA standards codified under Title 29 CFR 1910, Subpart Z. For conservative purposes, it has been assumed that all NO in $NO_x$ is converted to $NO_2$ rapidly. In the absence of an applicable regulatory standard, the results indicate that the predicted $NO_x$ maximum 30-minute average (NO + $NO_2$) concentration increment would be a small fraction of the OSHA PEL.

Additional details and modeling results are presented in Appendix J. Regional impacts affecting maintenance of ambient air quality standards must be addressed in combination with other sections of the program.

**Launch Failure Emissions.** In addition to scheduled launches, on rare occasions, a launch could fail. Such a failure would result in deflagration, in which the fuel from all stages is explosively burned. Deflagrations result in a hot, buoyant ground cloud that is dispersed in the first 10,000 feet. Although the release of pollutants is an unscheduled event, it is important to consider the air quality impacts and any consequent risks that may arise. The air quality concentrations of criteria pollutants normally released during a successful launch might be larger for an aborted launch. An even more important concern is that there may be significant concentrations of toxic compounds that are normally released at much higher flight elevations, or that are released only because of uncontrolled combustion processes. The toxic compounds in the ground cloud can drift downwind and pose some degree of threat to at-risk animal and plant populations.

Emissions from launch failures have been estimated using the Aerospace fireball deflagration model (Brady et al., 1997) (Table 4.10-4). This model estimates the fate of the propellants and oxidants that are on board the vehicle. For the model runs, it was assumed that deflagration would occur on the launch pad. The possible fates of the propellants and oxidants are (1) combustion reaction with other propellants producing chemicals of concern and other reaction products; (2) thermal decomposition due to the high temperatures in the fireball; and (3) secondary non-combustion conversion to a chemical of concern or some other reaction product. The fractional masses of each propellant and oxidant for each fate were estimated utilizing the fireball model and then input into the REEDM model. The total emissions resulting from the deflagration fireball were estimated from the fate mass fractions and the total load of propellants and oxidants on the vehicle.

**Table 4.10-4. Summary of REEDM-Predicted Ambient Air Concentration Increments During Aborted Launches, Concept A**

| CO | Peak 8-hour average concentration increment (ppm) | NAAQS/FAAQS 8-hour average (ppm) |
|---|---|---|
| MLV-D | 0.225 | 9 |
| MLV-A | 0.130 | 9 |
| HLV-L | 0.413 | 9 |
| HLV-G | 0.244 | 9 |
| **$NO_x$** | **Maximum 1-hour average concentration increment (ppm)** | **OSHA PEL ceiling (ppm)** |
| MLV-D | 0.227 | 5 |
| MLV-A | NA | 5 |
| HLV-L | 0.139 | 5 |
| HLV-G | NA | 5 |
| **$NH_3$** | **Maximum 30-minute average concentration increment (ppm)** | **OSHA PEL 8-hour average (ppm)** |
| MLV-D | NA | 50 |
| MLV-A | 0.004 | 50 |
| HLV-L | NA | 50 |
| HLV-G | 0.003 | 50 |
| **Hydrazine Compounds** | **Maximum 30-minute average concentration increment (ppm)** | **OSHA PEL 8-hour average (ppm)** |
| MLV-D | 0.025 | 1 |
| MLV-A | 0.0 | 1 |
| HLV-L | 0.015 | 1 |
| HLV-G | 0.0 | 1 |

CO = carbon monoxide
FAAQS = Florida Ambient Air Quality Standards
HLV = heavy lift variant
MLV = medium lift variant
NAAQS = National Ambient Air Quality Standards
$NH_3$ = ammonia
$NO_x$ = nitrogen oxides
NA = not applicable
OSHA = Occupational Safety and Health Administration
PEL = Permissible Exposure Level
ppm = parts per million
REEDM = Rocket Exhaust Effluent Dispersion Model

Concept A chemical of concern emissions from deflagration for each vehicle are summarized in Appendix J.

$NH_3$ was predicted by REEDM for the MLV-A and HLV-G abort scenarios. In the absence of an applicable regulatory standard, the OSHA PEL is shown for comparison, although it does not directly apply. The incremental concentrations are typical of rural ambient concentrations and would not pose any short-term health hazards.

For MLV-A and HLV-G vehicles, REEDM did not predict NO or $NO_2$ incremental concentrations during an abort. In the absence of an applicable regulatory standard, the results indicate that the predicted $NO_x$ concentration increment would be a small fraction of the OSHA PEL.
Hydrazine compound concentrations have been estimated by REEDM for aborts of each launch vehicle. In the absence of an applicable regulatory standard, the OSHA PEL is shown for comparison. The maximum concentrations of hydrazine compounds are actually predicted for the smaller launch vehicle, possibly due to increased buoyancy making the final centerline height larger and the ground level concentrations smaller.

Regional Air Quality Impacts

Regional air quality impacts are best summarized by totaling the emissions in the ROI associated with the program. Criteria pollutants are of concern for long-term impacts over the entire air quality region (Brevard County).

Annual emission rates depend on the proposed launch schedule (see Table 2.1-3). The emission summary for selected years from 2001 to 2020 is presented in Appendix J. The year of peak emissions into the lower atmosphere at Cape Canaveral AS is 2015 (Table 4.10-5).

**Table 4.10-5. Emission Comparison, Concept A - Cape Canaveral AS[(a)]**

| | Emissions (in tons)[(b)] | | | | |
|---|---|---|---|---|---|
| | VOC | $NO_x$ | CO | $SO_2$ | $PM_{10}$ |
| Launches | 0.0 | 18.5 | 0.0 | 0.0 | 0.0 |
| Preparation, Assembly, and Fueling | 18.0 | 0.0 | 0.0 | 0.0 | 7.6 |
| Mobile Sources | 5.1 | 15.0 | 38.9 | 0.6 | 43.0 |
| Point Sources | 0.3 | 4.6 | 0.9 | 0.2 | 0.3 |
| Total | 23.4 | 38.0 | 39.8 | 0.8 | 50.9 |
| Brevard County 1995 Total (for comparison) | 24,983 | 26,122 | 13,4743 | 27,524 | 35,090 |

Notes: (a)Includes emissions into the lower atmosphere (<3,000 feet) only.
(b)Emissions are based on launch rates shown in Table 2.1-3 for the peak emissions year at Cape Canaveral AS (2015)
AS = Air Station
CO = carbon monoxide
$NO_x$ = nitrogen oxides
$PM_{10}$ = particulate matter equal to or less than 10 microns in diameter
$SO_2$ = sulfur dioxide
VOC = volatile organic compound

Peak-year operation emissions of criteria pollutants would not jeopardize the attainment status for these pollutants, assuming that the attainment status criteria are the same in 2015 and everything else remains equal in Brevard County. Current baseline emissions in Brevard County are below the levels that would cause nonattainment, and the peak-year operation emissions would be only a small fraction of the county baseline. In addition, based on current emissions estimates, Concept A would result in a reduction of emissions from the baseline for all criteria pollutants.

**4.10.1.1.2 Concept A - Vandenberg AFB.** Localized air quality impacts can be addressed for Vandenberg AFB in a manner similar to that used for Cape Canaveral AS using methods described in Appendix J. Because of the attainment status and regulatory framework at Vandenberg AFB, regional air quality impacts must be assessed using additional thresholds and criteria, as described below.

Vandenberg AFB is situated in an area designated by the EPA as being in nonattainment of the ozone standard. The EELV program at this location would need to comply with air conformity requirements as defined in 40 CFR, 51 Subpart W, Section 176(c) of the CAA. The conformity rule defines the applicability criteria, including several source exemptions and de minimis emission thresholds, which determine if a federal action in a nonattainment area must conform or is exempt from conforming with the applicable SIP. If the total of indirect and direct emissions of a criteria pollutant in nonattainment exceeds the defined de minimis thresholds, a formal Air Conformity Determination is required. Requirements of an Air Conformity Determination include a public participation process and the demonstration of conformity with the SIP. General conformity prohibits the federal government from engaging in an activity that does not conform to the applicable SIP. Completion of an air conformity applicability analysis or an Air Conformity Determination does not exempt the federal action from any other requirements of the applicable SIP, the NEPA, or the CAA. Appendix K presents the required air conformity applicability analysis for the EELV program at Vandenberg AFB.

Changes associated with the EELV program would need to be documented in the ENVVEST reporting for Vandenberg AFB. Specifically, emissions from any stationary sources associated with EELV activities would need to be reported as part of the emissions from a source group. If emissions from any source group exceed applicable Title V permitting minimums, implementation of the ENVVEST program can be affected.

Under the current Rule 1301 source groups, the EELV stationary sources would likely fall under either the designation “Range Group” or “Commercial Space.” Actual emissions from each source group for 1994 are summarized in the table “Summary of Actual Emissions by SIC Major Group Code,” prepared by U.S. Air Force on April 24, 1997, and included in Appendix J. Based on this summary, $NO_x$ emissions from the “Range Group” source group were 20.3 tons for 1994, compared to a Rule 1301 threshold of 25 tons. Emissions of $NO_x$ from this group can therefore increase by 4.7 tons before the ENVVEST program is affected. The $NO_x$ emissions from the “Commercial Space” source group were 0.3 ton for 1994; emissions from this group can therefore increase by 24.7 tons before the ENVVEST program is affected.

The Concept A contractor plans to use existing boilers and heaters ($NO_x$ sources) for this program. The existing boilers and heaters will be used for the EELV program instead of their current uses. The total estimated emissions of $NO_x$ from these point sources is 4.5 tons per year, as shown in Table 4.10-10. These emissions will replace the baseline emissions (emissions associated with the current Atlas, Delta, and Titan programs). The total estimated baseline emissions of $NO_x$ from point sources is 8.1 tons, as shown in Table 3.10-9. Therefore, implementing the Concept A EELV program is expected to decrease $NO_x$ emissions by 3.6 tons per year. Because total emissions are expected to decrease, the EELV activities are not likely to negatively impact implementation of the ENVVEST program.

Facility Construction

Facility construction for Concept A operations at Vandenberg AFB would involve major renovation and selective new construction at SLC-3W. Major modifications would involve disturbing approximately 33 acres within the fence line at SLC-3W. Stripping, excavating, site clearing, backfilling, and compaction are expected to take place on about 16 acres per year. Ultimately, a total of 78,226 square feet has been assumed to require repaving. A combined total of 195,565 square feet of buildings and other structures would be constructed or renovated. Most of the construction would involve modifications to existing structures within the SLC-3W fenceline.

All emissions of pollutants were developed using an approach identical to that described for Cape Canaveral AS in Section 4.10.1.1.1, and in Appendix J. Climatological parameters used in the calculation reflect wind speed and rainfall days appropriate to the Los Angeles, California, area (Table 4.10-6).

**Table 4.10-6. Construction-Related Emissions - Concept A, Vandenberg AFB Average Annual Emissions Over Construction Period**

| Equipment | VOC | $NO_x$ | CO | $SO_2$ | $PM_{10}$ |
|---|---|---|---|---|---|
| Grading Equipment (lbs/day): | 4.0 | 25.4 | 5.5 | 1.7 | 4.5 |
| Asphalt Paving (lbs/day): | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 |
| Stationary Equipment (lbs/day): | 15.8 | 12.9 | 2.8 | 0.9 | 0.8 |
| Mobile Equipment (lbs/day): | 15.0 | 151.1 | 150.3 | 7.0 | 11.3 |
| Architectural Coatings (lbs/day): | 25.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Emissions (lbs/day): | 60.0 | 189.4 | 158.6 | 9.6 | 16.5 |
| Total Emissions (tpy): | 6.9 | 21.8 | 18.2 | 1.1 | 1.9 |
| Construction Commuter Automobiles (tpy) | 1.7 | 1.7 | 19.6 | 0.1 | 8.0 |
| Total Construction-Related Activities (tpy) | 8.6 | 23.5 | 37.8 | 1.2 | 9.9 |
| Santa Barbara County 1995 Total (tpy, for comparison) | 44,664 | 13,994 | 102,509 | 1,290 | 29,374 |

CO = carbon monoxide
lbs = pounds
$NO_x$ = nitrogen oxides
$PM_{10}$ = particulate matter equal to or less than 10 microns in diameter
$SO_2$ = sulfur dioxide
tpy = tons per year
VOC = volatile organic compound

In addition to emissions that are directly construction-related, there would be emissions associated with commuter traffic (see Appendix J).

Local concentrations of criteria pollutants would increase during the construction phase as described in Section 4.10.1.1.1. Dust from construction activities should have minimal impacts on local communities on- and off-site. Impacts would be similar to those discussed for Cape Canaveral AS in Section 4.10.1.1.1.

The expected emissions of ozone precursors (VOC and $NO_x$) and $PM_{10}$ from construction are small compared with the county baseline. However, since the SCCAB is in non-attainment for ozone and $PM_{10}$ for state standards, these emissions would still be mitigated to the extent feasible.

Construction emissions of $SO_2$, $NO_x$, and CO would not jeopardize the attainment status for these pollutants. Baseline emissions in the SCCAB are below levels that would cause nonattainment, and the peak-year construction emissions are only a small fraction of the county baseline.

According to SBCAPCD Rule 202, permits are not required for engines used in construction activities. However, if the combined emissions from all construction equipment used to construct a stationary source that requires a permit have the potential to exceed 25 tons per year of $SO_2$, $NO_x$, $PM_{10}$, or VOC, emissions offsets must be obtained and the owner must demonstrate that no ambient air quality standard would be violated.

Measures to reduce emissions during the construction phase would be similar to those discussed for Cape Canaveral AS.

Operations

**Pre- and Post-launch Processing.** Pre- and post-launch processing for Concept A operations at Vandenberg AFB would result in minor amounts of air emissions from activities similar to those described in Section 4.10.1.1.1. Emissions of criteria pollutants could cause or contribute to the nonattainment of NAAQS or CAAQS for the region. Emissions of pollutants can also cause localized health effects.

**Vehicle Preparation and Assembly.** Procedures for vehicle preparation and assembly would be similar to those described in Section 4.10.1.1.1. Permitting for specific pieces of preparation and assembly equipment must be addressed under the California regional permitting requirements (SBCAPCD Regulation II). The use of toxic chemicals must be addressed under CCR 17-93000 et seq. (Toxic Air Contaminants); an Air Toxics “Hot Spots” questionnaire may need to be submitted. Changes would need to be documented in the ENVVEST reporting and could affect the status of Vandenberg AFB with regard to operating permit requirements.
Measures to reduce emissions would be taken during vehicle preparation and assembly similar to those discussed for Cape Canaveral AS.

**Vehicle Fueling.** Fueling of hydrogen for the CUS involves some venting of hydrogen during bulk fuel transfer, fuel system checkout, and post-launch fuel system purging. Emissions of combustion products from the hydrogen control flares have been estimated as described in Section 4.10.1.1.1.

Emission from RP-1 storage and fueling were estimated as described for Cape Canaveral AS in Section 4.10.1.1.1, and emissions would be minimal (less than 50 pounds per year). Existing RP-1 storage and handling equipment at SLC-3W has been permitted under Operating Permit 7397-02. This permit may need to be modified to allow for the changes in equipment and increased throughput (over the current 78,000 gallon-per-year limit). There are no vapor control requirements for the existing RP-1 equipment. The final determination for control requirements for the new equipment would depend on the results of the SBCAPCD permitting process.

A combination of sealed transfer systems and portable scrubbers would be used to control emissions from hydrazine and $N_2O_4$ loading. The loading of MMH used in the SUS would be controlled using an existing portable bubble-cap scrubber, which uses water to trap hydrazine fuels. An existing portable scrubber similar to the oxidizer vapor scrubber system used for Titan IV operations would be used to control the loading of $N_2O_4$ used in the SUS.

Emissions of hydrazine are listed as HAP emissions. Emissions of $N_2O_4$ are minimal compared to other sources of nitrogen oxides (much less than 1 ton per year). The wet scrubbing systems have been permitted by SBCAPCD; these permits may need to be modified to reflect the change in operations.

After vehicle launch, the SLC must be cleaned and repaired. Surfaces are cleaned using a wire brush system, ablative coatings are applied, and painted surfaces are touched up or repainted. Particulate emissions from sandblasting were estimated based on typical abrasive use and a particulate emission factor, with an estimated 90-percent emissions reduction due to use of wire brushes instead of an abrasive blast system. VOC emissions from coatings were obtained from the chemical usage described in Section 4.6, Hazardous Materials and Hazardous Waste Management, and an estimated evaporation rate.

Emissions from the vehicle fueling operations could be reduced through the same measures described for Cape Canaveral AS. The final determination for control devices would depend on the results of the SBCAPCD permitting process.

**Mobile Sources.** Mobile sources of emissions would be the same as described in Section 4.10.1.1.1.

Vehicle Deliveries

Concept A vehicle components would be delivered by truck and aircraft. Emissions have been calculated as described in Section 4.10.1.1.1. Emission factors were taken from the EMFAC 7f and PART5 computer models; emissions from required escort cars for oversized loads were calculated similarly.

Because the ROI for Vandenberg AFB includes all of the SCCAB, transportation emissions have been calculated for all vehicular traffic in Santa Barbara, San Luis Obispo, and Ventura counties directly related to the EELV program.

Deliveries made by truck were assumed to involve round-trip traffic to and from the northern San Luis Obispo County line (50 percent) or the eastern Ventura County line (50 percent).

Aircraft emissions were estimated using the procedures described for Cape Canaveral AS in Section 4.10.1.1.1.

Vehicle Assembly and On-Site Transport. Assembly of the vehicle components and on-site transport of the vehicle would involve emissions from mobile sources (see Section 4.10.1.1.1). Emissions from these sources were estimated using VMT and the emission factors available in the EMFAC 7f and PART5 computer models. Other mobile sources emissions were calculated as described in Section 4.10.1.1.1.

Personal Automobile Use and Miscellaneous Supply Traffic. Emissions from automobile use and supply traffic were calculated based on both on- and off-site emissions. Emissions were calculated using VMT and the emission factors available in the EMFAC 7f and PART5 computer models. A surge in automobile traffic prior to launch has been accounted for in the calculations.

Emissions from mobile sources could be reduced by minimizing trip occurrences and trip lengths, and by improving emissions controls on mobile sources, as described in Section 4.10.1.1.1.

**Point Sources.** Point sources would include combustion sources, such as boilers and internal combustion engines (see Section 4.10.1.1.1). Also, some equipment currently at Vandenberg AFB would be used for the EELV program. Emissions from other point sources such as spray booths and solvent cleaning equipment have been included in the total emission calculations for vehicle preparation and assembly. Permitting for specific pieces of preparation and assembly equipment must be addressed under the SBCAPCD permitting requirements (Regulation II), and changes must be reflected in the ENVVEST reporting.

Emissions from boilers and other external combustion sources were estimated based on the estimated utility requirements for the program. Natural gas usage is provided in therms per day, and general EPA AP-42 emission factors were used to estimate emissions from combustion of natural gas.

Emissions from internal combustion sources were estimated based on the use of three emergency generators (two 1,000 kW and one 350 kW) operating an assumed 52 hours/year (one weekly one-hour test); and three small engines (welders, compressors, etc.) of 50 brake horsepower each, operating an assumed 500 hours/year. EPA AP-42 emission factors were used to calculate emissions estimates from combustion of these sources.

Emissions from point sources could be reduced through the use of propane instead of residual oil or solid fuel.

Impacts would be similar to those discussed in Section 4.10.1.1.1.

Regional impacts affecting maintenance of ambient air quality standards must be addressed in combination with other sections of the program. These impacts are addressed under Regional Air Quality Impacts and are summarized in Table 4.10-10.

Launch Activities

**Launch Emissions.** Vehicle launch emissions would occur as described in Section 4.10.1.1.1.

Concept A launch vehicles would use a booster that burns RP-1 and $LO_2$. The composition of the after-burning emissions is very similar to that of the Atlas IIA core booster. Launches from Vandenberg AFB are primarily LEO missions, and the flight trajectory for such a mission was used to estimate the amount of booster mass emitted into the lower atmosphere (0-3,000 feet) ROI. The launch vehicles would spend only 19 seconds in the lower atmosphere for an LEO mission.

The chemicals of concern include the tropospheric criteria pollutants for which NAAQS apply ($NO_x$, $NO_2$, and CO) and tropospheric precursors to ozone ($NO_x$ and reactive VOCs). Table 4.10-7 summarizes the total mass of the various chemicals of concern released into the lower atmosphere from vehicle exhaust and after-burning during a LEO mission.

Localized air quality impacts have been assessed using the REEDM model (Table 4.10-8). The REEDM modeling for Vandenberg AFB should be interpreted as a screening tool; a systematic search for the worst-case meteorology was not conducted. In some, but not all cases, both a Vandenberg AFB and Cape Canaveral AS simulation were run for each launch vehicle. The differences in the predictions are minor owing to similar

**Table 4.10-7. Summary of Flight Emissions Deposited in the Lower Atmosphere, Concept A[(a)] (in tons)**

| Launch Vehicle | Particulate | $NO_x$ | CO | VOC |
|---|---|---|---|---|
| MLV-A | 0.0 | 0.48 | 0.0 | 0.0 |
| MLV-D | 0.0 | 0.48 | 0.0 | 0.0 |
| HLV-L | 0.0 | 1.44 | 0.0 | 0.0 |
| HLV-G | 0.0 | 1.44 | 0.0 | 0.0 |

Note: (a) Assumes a low-Earth orbit mission.
CO = carbon monoxide
HLV = heavy lift variant
MLV = medium lift variant
$NO_x$ = nitrogen oxides
VOC = volatile organic compound

**Table 4.10-8. Summary of REEDM-Predicted Ambient Air Concentration Increments for $NO_x$ During Nominal Launches, Concept A**

| | Maximum 1-hour average concentration increment (ppm) | CAAQS 1-hour average $NO_2$ standard (ppm) |
|---|---|---|
| MLV-D | 0.114 | 0.25 |
| MLV-A | 0.114 | 0.25 |
| HLV-L | 0.162 | 0.25 |
| HLV-G | 0.162 | 0.25 |

CAAQS = California Ambient Air Quality Standards
HLV = heavy lift variant
MLV = medium lift variant
$NO_2$ = nitrogen dioxide
$NO_x$ = nitrogen oxides
ppm = parts per million
REEDM = Rocket Exhaust Effluent Dispersion Model

meteorological inputs. Therefore, the modeling results presented in Section 4.10.1.1.1 also apply to Vandenberg AFB.

Additional details and modeling results are presented in Appendix J. Regional impacts affecting maintenance of ambient air quality standards must be addressed in combination with other sections of the program.

**Launch Failure Emissions.** Emissions from launch failures at Vandenberg AFB have been estimated using the Aerospace fireball deflagration model (Brady et al., 1997) (Table 4.10-9). The mass emission rates calculated from Concept A launch failures are the same at Vandenberg AFB as those shown for Cape Canaveral AS in Section 4.10.1.1.1.

The CAAQS has an hourly $NO_2$ standard of 0.25 ppm. For conservative purposes, all NO in $NO_x$ is assumed to convert to $NO_2$ rapidly. The REEDM-predicted $NO_x$ (NO + $NO_2$) incremental concentrations resulting from the aborts of Concept A vehicles have been summarized in Table 4.10-9.

For the MLV-A and HVL-G vehicles, REEDM did not predict NO or $NO_2$ incremental concentrations during an abort. The results indicate that in the

**Table 4.10-9. Summary of REEDM-Predicted Ambient Air Concentration Increments for $NO_x$ During Aborted Launches, Concept A**

| | Peak 1-hour average concentration increment (ppm) | CAAQS 1-hour average $NO_2$ standard (ppm) |
|---|---|---|
| MLV-D | 0.114 | 0.25 |
| MLV-A | NA | 0.25 |
| HLV-L | 0.057 | 0.25 |
| HLV-G | NA | 0.25 |

CAAQS = California Ambient Air Quality Standards
HLV = heavy lift variant
MLV = medium lift variant
NA = not applicable
$NO_2$ = nitrogen dioxide
$NO_x$ = nitrogen oxides
ppm = parts per million
REEDM = Rocket Exhaust Effluent Dispersion Model

worst case, the predicted maximum hourly $NO_x$ concentration increment is one-half of the hourly $NO_2$ standard.

Regional Air Quality Impacts

Regional impacts on the lower atmosphere are best summarized by totaling the emissions in the ROI associated with the program. Criteria pollutants are of concern for long-term impacts over the entire air quality region (SCCAB).

Annual emission rates depend on the proposed launch schedule (see Table 2.1-3). Many of the emission-generating activities occur once per vehicle launch. Launch emissions are summarized for the peak year (2007) in Table 4.10-10. A summary of launch emissions for other key years between 2001 and 2020 is presented in Appendix J.

The expected emissions of ozone precursors (VOC and $NO_x$) and $PM_{10}$ from peak-year operation are minimal compared with the county baseline. However, since the SCCAB is in nonattainment for ozone and $PM_{10}$ for state standards, these emissions would still be mitigated to the extent feasible.

Peak-year operation emissions of $SO_2$, $NO_x$, and CO would not jeopardize the attainment status for these pollutants, assuming that attainment status criteria are the same in the peak year, and everything else remains equal in Santa Barbara County. Baseline emissions in the SCCAB are below the levels that would cause nonattainment, and the peak-year construction emissions are only a small fraction of the county baseline.

Based on current emissions estimates, Concept A would result in a reduction of emissions from the baseline for all criteria pollutants. The final system design would need to be compared with the permitting and regulatory requirements listed in Section 3.10 to determine the required action.

**Table 4.10-10. Emission Comparison, Concept A - Vandenberg AFB[(a)]**

| | Emissions (in tons)[(b)] | | | | |
|---|---|---|---|---|---|
| | VOC | $NO_x$ | CO | $SO_2$ | $PM_{10}$ |
| Launches | 0.0 | 4.8 | 0.0 | 0.0 | 0.0 |
| Preparation, Assembly, and Fueling | 7.5 | 0.0 | 0.0 | 0.0 | 0.3 |
| Mobile Sources | 2.2 | 4.4 | 27.5 | 0.2 | 34.5 |
| Point Sources | 0.3 | 4.5 | 0.9 | 0.2 | 0.3 |
| Total | 10.0 | 13.7 | 28.4 | 0.5 | 35.1 |
| Santa Barbara County 1995 Total (for comparison) | 44,664 | 13,994 | 102,509 | 1,290 | 29,374 |

Notes: (a) Includes emissions into the lower atmosphere (<3,000 feet) only.
(b) Emissions are based on launch rates shown in Table 2.1-3 for the peak emissions year at Vandenberg AFB (2007).
CO = carbon monoxide
$NO_x$ = nitrogen oxides
$PM_{10}$ = particulate matter equal to or less than 10 microns in diameter
$SO_2$ = sulfur dioxide
VOC = volatile organic compound

Based upon current estimates of stationary source emissions and the emissions estimates from the ENVVEST source categories, it does not appear that installation of new stationary sources to support the EELV program would trigger new requirements under SBCAPCD Rule 1301. Vandenberg AFB would need to consider EELV operations when determining whether ENVVEST emission reduction goals are being met.

#### 4.10.1.2 Concept B

**4.10.1.2.1 Concept B - Cape Canaveral AS.** Air quality impacts from Concept B operations would result from the general sources described in Section 4.10.1.1. Vehicle components would be delivered by truck, aircraft, rail, and barge; emissions from these vehicles were calculated and compared to existing mobile source emissions. Fuels used in the Concept B vehicles include cryogenic gases ($LO_2$ and $LH_2$), hydrazines (A-50 and $N_2H_4$), $N_2O_4$, and solid rocket propellant. Emissions from the handling and storage of these fuels were calculated and compared to existing emissions.

Facility Construction

Emissions generated by facility construction activities would be in the form of either gaseous or particulate pollutant emissions. Combustion product emissions would occur from construction equipment and worker vehicle travel to and from the site by construction workers, and particulate matter would occur from construction, as discussed for Concept A in Section 4.10.1.1. Facility construction for Concept B at Cape Canaveral AS would involve renovation and new construction at SLC-37 (Pads 37A and 37B) and at other locations on Cape Canaveral AS. A total of approximately 70 acres (net of buildings) would be disturbed as part of site clearing, stripping, excavating, backfilling, and compaction operations. Building renovations and new construction would involve approximately 823,600 square feet, with over 85 percent within the launch facilities area and the remainder remote from the

launch site. Square footage for all individual structures was estimated from scale site plan drawings considering facilities with similar purposes at other military properties. All calculations were made on the basis of average annual emissions over the construction period.

Construction emissions have been calculated using the methods described for Concept A in Section 4.10.1.1. Table 4.10-11 provides a summary of construction-related emissions.

**Table 4.10-11. Construction-Related Emissions - Concept B, Cape Canaveral AS Average Annual Emissions Over Construction Period**

| | VOC | $NO_x$ | CO | $SO_2$ | $PM_{10}$ |
|---|---|---|---|---|---|
| Grading Equipment (lbs/day): | 8.1 | 51.7 | 11.2 | 3.4 | 9.0 |
| Asphalt Paving (lbs/day): | 0.9 | 0.0 | 0.0 | 0.0 | 0.0 |
| Stationary Equipment (lbs/day): | 63.9 | 52.1 | 11.3 | 3.5 | 3.0 |
| Mobile Equipment (lbs/day): | 60.8 | 612.0 | 616.2 | 34.6 | 45.6 |
| Architectural Coatings (lbs/day): | 50.2 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Emissions (lbs/day): | 183.9 | 715.8 | 638.6 | 41.5 | 57.7 |
| Total Emissions (tpy): | 21.2 | 82.3 | 73.4 | 4.8 | 6.6 |
| Construction Commuter Automobiles (tpy): | 1.7 | 2.6 | 12.2 | 0.1 | 6.1 |
| Total Construction-Related Activities (tpy): | 22.9 | 84.9 | 85.6 | 4.7 | 12.7 |
| Brevard County 1995 Total (tpy, for comparison) | 24,983 | 26,122 | 13,4743 | 27,524 | 35,090 |

CO = carbon monoxide
lbs = pounds
$NO_x$ = nitrogen oxides
$PM_{10}$ = particulate matter equal to or less than 10 microns in diameter
$SO_2$ = sulfur dioxide
tpy = tons per year
VOC = volatile organic compound

In addition to emissions that are directly construction-related, there would be emissions associated with commuter traffic. VMT for employees, including commuting distances and non-work trips, were calculated (see Appendix J).

Measures could be taken to reduce fugitive dust emissions from ground-disturbing activities and combustive emissions from construction equipment; these measures would be similar to those described for Concept A in Section 4.10.1.1.1.

Local concentrations of criteria pollutants would increase during the construction phase, as described in Section 4.10.1.1.1. Impacts would be temporary, local, and minor.

Dust from construction activities should have minimal impacts on local communities, either on or off site.

Brevard County currently meets the FAAQS and NAAQS for ozone, $SO_2$, $NO_x$, CO, and $PM_{10}$. Because the area is in attainment for these pollutants, the FDEP has not been required to establish specific emission reduction measures. As discussed in Section 4.10.1.1.1, the PSD process does not provide a mechanism for dealing with non-stationary sources such as motor vehicles and aircraft.

Construction emissions of criteria pollutants would not jeopardize the attainment status for these pollutants. Current Brevard County baseline emissions are below the levels that would cause nonattainment, and the peak-year construction emissions would be only a small fraction of the baseline.

Operations

**Pre- and Post-Launch Processing.** Pre- and post-launch processing for Concept B operations at Cape Canaveral AS would result in minor amounts of air emissions as described in Section 4.10.1.1.1.

Emissions from pre-launch and post-launch processing would include criteria pollutants and toxic or irritant pollutants (including HAPs). Emissions of criteria pollutants could cause or contribute to the nonattainment of NAAQS or FAAQS for the region. Emissions of pollutants can also cause localized health effects.

**Vehicle Preparation and Assembly.** Manufacturing of Concept B vehicle components would occur off site; emissions have not been included in the scope of this EIS. The components would arrive complete, requiring only final on-site safety and quality checks prior to assembly.

Some chemical use would occur in the vehicle preparation and assembly stages. Emissions from chemical use and permitting requirements would be similar to those described in Section 4.10.1.1.1. A discussion of the Title V Operating Permit Application and associated requirements is provided in Section 4.10.1.1.1.

The EELV contractor has committed to implementing the program without the use of any Class I ODSs. The use of Class II ODSs (for refrigeration, etc.) would be minimized or eliminated.

Emissions of VOCs could be reduced as described in Section 4.10.1.1.1.

**Vehicle Fueling.** Fueling of hydrogen would involve some venting of hydrogen during bulk fuel transfer, fuel system checkout, and post-launch fuel system purging. Vented hydrogen would be controlled using a flare, which uses propane as auxiliary fuel. Emissions of combustion products from the hydrogen control flares have been estimated using EPA AP-42 standard factors for external combustion. Emission rates would be very small (significantly less than 1 ton/year of all pollutants).

A combination of sealed transfer systems, wet scrubbing, and oxidation would be used to control emissions from hydrazine and $N_2O_4$ loading. The loading of hypergolic fuel used in the CUS would be controlled using packed-tower

scrubber technology. Water is contacted with the exhaust gas in a counter-current-packed tower that allows for intimate air-water contact. The hydrazine fuel is absorbed by the water phase. The loading of $N_2O_4$ would be controlled using similar scrubber equipment. The system uses a caustic (sodium hydroxide) solution to convert $N_2O_4$ into aqueous nitrates and nitrites. An alternative to sodium hydroxide would be potassium hydroxide, which would have the benefit of creating a fertilizer product instead of a liquid hazardous waste.

Emissions of hydrazine are listed as HAPs. Emissions of $N_2O_4$ are minimal compared to other sources of nitrogen oxides (much less than 1 ton per year).

After vehicle launch, the SLC must be cleaned and repaired. Surfaces are cleaned using an abrasive blaster, ablative coatings are applied, and painted surfaces are touched up or repainted. Particulate emissions from sandblasting were estimated based on estimated abrasive use and a particulate emission factor. VOC emissions from coatings were obtained from coating use estimates.

Emissions from transfer of hydrazine and $N_2O_4$ could be reduced by using sealed transfer systems, wet scrubbing, and oxidation. Further mitigation could be achieved using expanded capture and control systems. The final determination for control devices would depend on the results of the Florida permitting process.

**Mobile Sources.** Mobile emission sources are described in Section 4.10.1.1.1.

Vehicle Deliveries. Concept B vehicle components would be delivered by truck, aircraft, rail, and barge. Truck emissions have been calculated using pounds of emissions per vehicle mile traveled. Emission factors were taken from the MOBILE 5a and PART5 computer models; emissions from required escort cars for oversized loads were calculated similarly.

Transportation emissions have been calculated as described in Section 4.10.1.1.1.

Concept B aircraft deliveries were assumed to be made using a C-5 Galaxy aircraft. Emissions from the C-5 aircraft associated with landing and take-off were calculated using the factors available in the Calculation Methods for Criteria Air Pollutant Emission Inventories (Jagielski and O'Brien, 1994).

It was assumed that Concept B barge deliveries would be made in an unpowered barge maneuvered by two tugboats of 900 horsepower each. A 1-hour-approach and a 2-hour return for the tugboats was assumed for emission estimates.

Vehicle Assembly and On-Site Transport. Assembly of the vehicle components and on-site transport of the vehicle would involve emissions from mobile sources. Emissions were calculated as described in Section 4.10.1.1.1.

Personal Automobile Use and Miscellaneous Supply Traffic. Emissions from automobile use and supply traffic were calculated as described in Section 4.10.1.1.1. Emissions from mobile sources could be reduced through implementation of measures described in Section 4.10.1.1.1.

**Point Sources.** Calculation of point source emissions would be the same as discussed in Section 4.10.1.1.1. Permitting for specific pieces of preparation and assembly equipment must be addressed under the Florida permitting requirements (FAC 62-210 through 213).

Regional impacts affecting maintenance of ambient air quality standards must be addressed in combination with other sections of the program. These impacts are addressed under Regional Air Quality Impacts and are summarized in Table 4.10-15.

Launch Activities

**Launch Emissions.** Vehicle launch emissions would occur as described in Section 4.10.1.1.1.

Concept B launch vehicles would use a booster that burns $LH_2$ and $LO_2$. The composition of the after-burning emissions would be very clean, essentially resulting in only water, unburned fuel, and oxy-hydrogen radicals. The primary flight trajectory of launches from Cape Canaveral AS is GTO. This trajectory was used to estimate the amount of booster mass emitted into the lower atmosphere (0-3,000 feet). The launch vehicles would spend only 29 seconds in the lower atmosphere for a GTO mission.

The chemicals of concern include the tropospheric criteria pollutants for which NAAQS apply ($NO_x$, CO) and tropospheric precursors to ozone ($NO_x$ and reactive VOCs). Table 4.10-12 summarizes the total mass of the various chemicals of concern released into the lower atmosphere from vehicle exhaust and after-burning during a GTO mission.

**Table 4.10-12. Summary of Flight Emissions Deposited in the Lower Atmosphere, Concept B[(a)] (in tons)**

| Launch Vehicle | Particulate | $NO_x$ | CO | HCl | VOC |
|---|---|---|---|---|---|
| DIV-S | 0.0 | 0.56 | 0.0 | 0.0 | 0.0 |
| DIV-M | 0.0 | 0.56 | 0.0 | 0.0 | 0.0 |
| DIV-M+ | 4.19 | 0.74 | 0.0 | 2.16 | 0.0 |
| DIV-H | 0.0 | 1.69 | 0.0 | 0.0 | 0.0 |

Note: (a) Assumes a geosynchronous transfer orbit mission.
CO = carbon monoxide
DIV-H = heavy launch vehicle
DIV-M = medium launch vehicle
DIV-M+ = medium launch vehicle with solid rocket motor strap-ons
DIV-S = small launch vehicle
HCl = hydrochloric acid
$NO_x$ = nitrogen oxides
VOC = volatile organic compound

Emissions from launch operations (into the lower atmosphere) could be mitigated by the primary use of cryogenic fuels instead of solid rocket fuels, hydrazines, and/or $N_2O_4$.

Localized air quality impacts were assessed using the REEDM model, similar to the assessments made for Concept A in Section 4.10.1.1.1. The model results are presented in Table 4.10-13. Table 4.10-13 indicates that the 8-hour average concentration increment for CO would be only a very small fraction of the NAAQS and FAAQS.

The NAAQS for $NO_x$ is an annual standard, and the annual average is not substantially perturbed by the transient releases from launches. For comparison purposes, the OSHA PEL is shown, although this limit is not directly applicable. For conservative purposes, it has been assumed that all NO in $NO_x$ is converted to $NO_2$ rapidly.

The predicted ambient concentrations of NO or $NO_2$ for nominal launches actually show the effects of the increased buoyancy due to the extreme heat release of the three boosters. Due to increased plume rise, the

**Table 4.10-13. Summary of REEDM-Predicted Ambient Air Concentration Increments During Nominal Launches, Concept B**

| CO | Maximum 8-hour average concentration increment (ppm) | NAAQS/FAAQS 8-hour average (ppm) |
|---|---|---|
| DIV-S | 0.0 | 9 |
| DIV-M | 0.0 | 9 |
| DIV-M+ | 0.0 | 9 |
| DIV-H | 0.0 | 9 |
| **$NO_x$** | **Maximum 30-minute average concentration increment (ppm)** | **OSHA PEL ceiling (ppm)** |
| DIV-S | 0.102 | 5 |
| DIV-M | 0.109 | 5 |
| DIV-M+ | 0.119 | 5 |
| DIV-H | 0.020 | 5 |
| **HCl** | **Peak puff concentration increment (ppm)** | **OSHA PEL ceiling (ppm)** |
| DIV-M+ | 0.293 | 5 |

CO = carbon monoxide
DIV-H = heavy launch vehicle
DIV-M = medium launch vehicle
DIV-M+ = medium launch vehicle with solid rocket motor strap-ons
DIV-S = small launch vehicle
FAAQS = Florida Ambient Air Quality Standards
HCl = hydrochloric acid
NAAQS = National Ambient Air Quality Standards
$NO_x$ = nitrogen oxides
OSHA = Occupational Safety and Health Administration
PEL = Permissible Exposure Level
ppm = parts per million
REEDM = Rocket Exhaust Effluent Dispersion Model

concentrations at the ground decrease significantly. The results indicate that the highest predicted $NO_x$ concentration increment would be a very small fraction of the OSHA PEL.

**Launch Failure Emissions.** As discussed in Section 4.10.1.1.1, a launch could fail on the pad. Emissions from launch failures have been estimated using the Aerospace fireball deflagration model (Brady et al., 1997) (Table 4.10-14). The Concept B emissions of chemicals of concern from deflagration for each vehicle are summarized in Appendix J.

NO or $NO_2$ incremental concentrations during an abort were predicted by REEDM for only the DIV-S vehicle configuration.

Ammonia was predicted by REEDM for all Concept B abort scenarios. The resulting maximum 30-minute average concentrations have been compared to the OSHA PEL, although they do not directly apply. Emissions would be a very small fraction of this PEL.

**Table 4.10-14. Summary of REEDM-Predicted Ambient Air Concentration Increments During Aborted Launches, Concept B**

| CO | Maximum 8-hour average concentration increment (ppm) | NAAQS/FAAQS 8-hour average (ppm) |
|---|---|---|
| DIV-S | 0.0007 | 9 |
| DIV-M | NA | 9 |
| DIV-M+ | 0.0007 | 9 |
| DIV-H | NA | 9 |
| **$NO_x$** | **Maximum 30-minute average concentration increment (ppm)** | **OSHA PEL ceiling (ppm)** |
| DIV-S | 0.105 | 5 |
| DIV-M | NA | 5 |
| DIV-M+ | NA | 5 |
| DIV-H | NA | 5 |
| **$NH_3$** | **Maximum 8-hour average concentration increment (ppm)** | **NAAQS/FAAQS 8-hour average (ppm)** |
| DIV-S | 0.041 | 50 |
| DIV-M | 0.002 | 50 |
| DIV-M+ | 0.002 | 50 |
| DIV-H | 0.002 | 50 |
| **Hydrazine Compounds** | **Maximum 30-minute average concentration increment (ppm)** | **OSHA PEL ceiling (ppm)** |
| DIV-S | 0.009 | 1 |
| DIV-M | 0.0 | 1 |
| DIV-M+ | 0.0 | 1 |
| DIV-H | 0.0 | 1 |
| **HCl** | **Peak puff concentration increment (ppm)** | **OSHA PEL ceiling (ppm)** |
| DIV-M+ | 0.023 | 5 |

CO = carbon monoxide
DIV-H = heavy launch vehicle
DIV-M = medium launch vehicle
DIV-M+ = medium launch vehicle with solid rocket motor strap-ons
DIV-S = small launch vehicle
FAAQS = Florida Ambient Air Quality Standards
HCl = hydrochloric acid
NA = not applicable
NAAQS = National Ambient Air Quality Standards
$NH_3$ = ammonia
$NO_x$ = nitrogen oxides
OSHA = Occupational Safety and Health Administration
PEL = Permissible Exposure Level
REEDM = Rocket Exhaust Effluent Dispersion Model

Hydrazine compound concentrations were estimated by REEDM for each launch vehicle for the abort scenario when the upper stage fuels could be combusted. As discussed previously, there is no NAAQS or FAAQS for hydrazine; the OSHA PEL is shown for comparison, although it does not directly apply. The maximum concentrations of hydrazine compounds resulting from the use of the DIV-S with its HUS are larger than any of the other Concept B configurations.

Chlorine in the form of HCl was predicted for the DIV-M+ vehicles (commercial only). There is no NAAQS or FAAQS for HCl. For comparison purposes, the PEL is shown, although this limit is not directly applicable. Peak puff concentrations are a small fraction of the OSHA PEL ceiling limit. The largest

concentrations occur under nominal launch conditions and are so small that they do not appear to pose any short-term health hazards.

Additional details and modeling results are presented in Appendix J. Regional impacts affecting maintenance of ambient air quality standards must be addressed in combination with other sections of the program.

Regional Air Quality Impacts

Regional impacts on the lower atmosphere are best summarized by totaling the emissions into the ROI associated with the program. Criteria pollutants are of concern for long-term impacts over the entire air quality region (Brevard County). Emissions from the launch itself were modeled using REEDM to determine local impacts. Other EELV-related air emissions are generally of longer duration, lower mass emission rate, and are spread over Cape Canaveral AS and the air quality region. Short-term criteria pollutant concentrations are therefore not of concern for launch support activities.

Annual emission rates would depend on the proposed launch schedule (see Table 2.1-8). Many of the emission-generating activities occur once per vehicle launch. Peak-year emissions are summarized in Table 4.10.15. Emission summaries for key years between 2001 and 2020 are presented in Appendix J.

**Table 4.10-15. Emission Comparison, Concept B - Cape Canaveral AS[(a)]**

| | Emissions (in tons)[(b)] | | | | |
|---|---|---|---|---|---|
| | VOC | $NO_x$ | CO | $SO_2$ | $PM_{10}$ |
| Launches | 0.0 | 15.1 | 0.0 | 0.0 | 37.2 |
| Preparation, Assembly, and Fueling | 15.2 | 0.0 | 0.0 | 0.0 | 2.8 |
| Mobile Sources | 10.1 | 23.0 | 73.2 | 1.0 | 61.7 |
| Point Sources | 0.5 | 4.2 | 1.1 | 0.4 | 0.1 |
| Total | 25.8 | 42.3 | 74.3 | 1.4 | 101.8 |
| Brevard County 1995 Total (for comparison) | 24,983 | 26,122 | 134,743 | 27,524 | 35,090 |

Note: (a) Includes emissions into the lower atmosphere (<3,000 feet) only.
(b) Emissions are based upon launch rates shown in Table 2.1-8 for the peak emission year at Cape Canaveral AS (2015).
AS = Air Station
CO = carbon monoxide
$NO_x$ = nitrogen oxides
$PM_{10}$ = particulate matter equal to or less than 10 microns in diameter
$SO_2$ = sulfur dioxide
VOC = volatile organic compound

Peak-year operation emissions of criteria pollutants would not jeopardize the attainment status for these pollutants. Baseline emissions in Brevard County are below the levels that would cause nonattainment, and the peak-year operation emissions are only a small fraction of the county baseline. In addition, based on current emissions estimates, a reduction of emissions from the baseline for all criteria pollutants would occur under Concept B.

**4.10.1.2.2 Concept B - Vandenberg AFB.** Localized air quality impacts have been addressed for Vandenberg AFB in a manner similar to that described in Section 4.10.1.1.2. Because of the attainment status and regulatory framework at Vandenberg AFB, regional air quality impacts must be assessed using additional thresholds and criteria. As described in Section 4.10.1.1.2, an air conformity applicability analysis is required to determine if the total of direct and indirect emissions of a criteria pollutant in a nonattainment area caused by the federal action equals or exceeds de minimis thresholds (see Appendix K).

Changes associated with the EELV program would need to be documented in the ENVVEST reporting for Vandenberg AFB, as discussed for Concept A in Section 4.10.1.1.1. The Concept B contractor plans to use new boilers and heaters ($NO_x$ sources) for this program. These new boilers and heaters will be installed and used for the EELV program; boilers and heaters associated with the current Atlas, Delta, and Titan programs will either no longer be used, or their usage will be reduced. The total estimated emissions of $NO_x$ from the new point sources is 4.2 tons per year, as shown in Table 4.10-20. These emissions will replace the baseline emissions (emissions associated with the current Atlas, Delta, and Titan programs). The total estimated baseline emissions of $NO_x$ from point sources is 8.1 tons, as shown in Table 3.10-9. Therefore, implementing the Concept B EELV program is expected to decrease $NO_x$ emissions by 3.9 tons per year. Because total emissions are expected to decrease, the EELV activities are not likely to negatively impact implementation of the ENVVEST program.

Facility Construction

Emissions generated by facility construction activities are described in Sections 4.10.1.1.1 and 4.10.1.1.2.

Facility construction for Concept B operations at Vandenberg AFB would involve extensive renovation and some new construction at SLC-6. Construction would involve disturbing 49.7 acres within the SLC-6 fenceline over a 32-month period. Stripping, excavating, site clearing, backfill, and compaction are expected to take place on about 19 acres per year. Ultimately, a total of 337,675 square feet has been projected as requiring repaving. A combined total of 844,188 square feet of buildings and other structures would be constructed or renovated. Nearly all of the facilities construction would involve modifications to existing structures within the SLC-6 fenceline. Additional renovation would include work planned for Buildings 520, 838, 398, and 330 (all facilities remote to SLC-6).

All emissions of pollutants were developed using an approach identical to that used for Cape Canaveral AS and are included in Appendix J. Climatological parameters specific to the Los Angeles, California, area were used to reflect wind speed and rainfall days appropriate to the site.

In addition to emissions that are directly construction-related, there would be emissions associated with commuter traffic (see Section 4.10.1.1.1).

Measures to reduce emissions during the construction phase would be similar to those described for Cape Canaveral AS.

Local concentrations of criteria pollutants would increase during the construction phase, as described in Section 4.10.1.1.1 (Table 4.10-16).

**Table 4.10-16. Construction-Related Emissions - Concept B, Vandenberg AFB Average Annual Emission Over Construction Period**

| Equipment | VOC | $NO_x$ | CO | $SO_2$ | $PM_{10}$ |
|---|---|---|---|---|---|
| Grading Equipment (lbs/day) | 5.1 | 32.9 | 7.1 | 2.2 | 5.8 |
| Asphalt Paving (lbs/day) | 0.8 | 0.0 | 0.0 | 0.0 | 0.0 |
| Stationary Equipment (lbs/day) | 58.7 | 47.9 | 10.4 | 3.2 | 2.8 |
| Mobile Equipment (lbs/day) | 55.9 | 562.4 | 559.3 | 26.1 | 41.9 |
| Architectural Coatings (Non-Residential) (lbs/day) | 48.2 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Emissions (lbs/day): | 168.7 | 643.2 | 576.7 | 31.5 | 50.5 |
| Total Emissions (tpy): | 19.4 | 74.0 | 66.3 | 3.6 | 5.8 |
| Construction Commuter Automobiles (tpy) | 1.3 | 1.2 | 15.6 | 0.1 | 5.4 |
| Total activities (Construction and Commuter) (tpy) | 20.7 | 75.2 | 81.9 | 3.7 | 11.2 |
| Santa Barbara County 1995 Total (tpy, for comparison) | 44,664 | 13,994 | 102,509 | 1,290 | 29,374 |

CO = carbon monoxide
lbs = pounds
$NO_x$ = nitrogen oxides
$PM_{10}$ = particulate matter equal to or less than 10 microns in diameter
$SO_2$ = sulfur dioxide
tpy = tons per year
VOC = volatile organic compound

Dust from construction activities should have minimal impacts to local communities either on or off site, similar to those discussed for Concept A in Section 4.10.1.1.1.
The expected emissions of ozone precursors (VOC and $NO_x$) and $PM_{10}$ from construction would be minimal compared with the county baseline. However, since the SCCAB is in non-attainment for ozone and $PM_{10}$, these emissions would still be mitigated to the extent feasible.

Construction emissions of $SO_2$, $NO_x$, and CO would not jeopardize the attainment status for these pollutants. Baseline emissions in the SCCAB are below levels that would cause nonattainment, and the peak-year construction emissions are only a small fraction of the county baseline.

According to SBCAPCD Rule 202, permits are not required for engines used in construction activities. However, if the combined emissions from all construction equipment used to construct a stationary source that requires a permit have the potential to exceed 25 tons per year of $SO_2$, $NO_x$, $PM_{10}$, or VOC, emissions offsets must be obtained, and the owner must demonstrate that no ambient air quality standard would be violated.

Operations

**Pre- and Post-Launch Processing.** Pre- and post-launch processing for Concept B operations at Vandenberg AFB would result in minor amounts of air emissions from activities similar to those discussed for Cape Canaveral AS in Section 4.10.1.1.1. Emissions of criteria pollutants could cause or contribute to the nonattainment of NAAQS or CAAQS for the region. Emissions of pollutants can also cause localized health effects.

**Vehicle Preparation and Assembly.** Procedures for vehicle preparation and assembly would be similar to those described in Section 4.10.1.1.2. Measures to reduce emissions during vehicle preparation and assembly would be similar to those discussed in Section 4.10.1.1.1.

**Vehicle Fueling.** Fueling of hydrogen for the CUS would be the same as described in Section 4.10.1.2.1.

Emissions from hydrazine and $N_2O_4$ loading would be controlled by a combination of sealed transfer systems and portable scrubbers. The loading of MMH used in the CUS would be controlled using an existing portable bubble-cap scrubber, which uses water and citric acid to trap hydrazine fuels. An existing portable scrubber similar to the oxidizer vapor scrubber system used for Titan IVB operations would be used to control the loading of $N_2O_4$ used in the CUS.

Emissions of hydrazine are listed as HAPs emissions. Emissions of $N_2O_4$ are minimal compared to other sources of nitrogen oxides. The wet scrubbing systems have been permitted by SBCAPCD, but have since been exempted from permitting requirements. If permits are necessary, these permits would need to be modified to reflect the change in operation.
After vehicle launch, the SLC must be cleaned and repaired, as described in Section 4.10.1.2.1.

**Mobile Sources.** Mobile sources of emissions would be the same as those described in Section 4.10.1.1.1.

Vehicle Deliveries. Concept B vehicle components would be delivered by truck, aircraft, barge, or rail. Truck emissions were calculated using pounds of emissions per VMT based on EMFAC 7f and PART5 emission factors; emissions from required escort cars for oversized loads were calculated similarly.

Because the ROI for Vandenberg AFB includes all of the SCCAB, transportation emissions were calculated for all vehicular traffic that would take place in Santa Barbara, San Luis Obispo, and Ventura counties directly related to the EELV program.

It is assumed that deliveries made by truck would involve round-trip traffic to and from the northern San Luis Obispo County line (50 percent) or the eastern Ventura County line (50 percent).

Emissions from aircraft and barge operations were calculated as described in Section 4.10.1.2.1.

Vehicle Assembly and On-Site Transport. Assembly of the vehicle components and on-site transport of the vehicle would involve emissions from mobile sources which were estimated as described in Section 4.10.1.1.2.

Personal Automobile Use and Miscellaneous Supply Traffic. Emissions from automobile use and supply traffic were calculated based on both on- and off-site emissions. It was assumed that each vehicle would travel once per day to and from one of the nearest major towns (Lompoc and Santa Maria). Emissions were calculated using vehicle miles traveled and the emission factors in the EMFAC 7f and PART5 computer models. A surge in automobile traffic prior to launch has been accounted for in the calculations.

**Point Sources.** Point sources would be the same as those described in Section 4.10.1.1.1. Some equipment currently at Vandenberg AFB would be used for the EELV program. Emissions were calculated as described in Section 4.10.1.1.2. Permitting for specific pieces of preparation and assembly equipment must be addressed under the SBCAPCD permitting requirements (Regulation II), and changes must be noted in the ENVVEST reporting.

The duration and magnitude of emissions associated with vehicle preparation and assembly are described in Section 4.10.1.1.1.
Regional impacts affecting maintenance of ambient air quality standards must be addressed in combination with other sections of the program. These impacts are addressed under Regional Air Quality Impacts and are summarized in Table 4.10-20.

Launch Activities

**Launch Emissions.** Vehicle launch emissions would occur as described in Section 4.10.1.1.1.

The chemicals of concern include the tropospheric criteria pollutants for which NAAQS apply ($NO_x$, and CO) and tropospheric precursors to ozone ($NO_x$ and reactive VOCs). Table 4.10-17 summarizes the total mass of the various chemicals of concern released into the lower atmosphere from vehicle exhaust and after-burning during a LEO mission from Vandenberg AFB.

**Table 4-10-17. Summary of Flight Emissions Deposited in the Lower Atmosphere, Concept B[(a)] (in tons)**

| Launch Vehicle | Particulate | $NO_x$ | CO | HCl | VOC |
|---|---|---|---|---|---|
| DIV-S | 0.0 | 0.37 | 0.0 | 0.0 | 0.0 |
| DIV-M | 0.0 | 0.37 | 0.0 | 0.0 | 0.0 |
| DIV-M+ | 2.71 | 0.48 | 0.0 | 1.40 | 0.0 |
| DIV-H | 0.0 | 1.10 | 0.0 | 0.0 | 0.0 |

Note: (a) Assumes a low-Earth orbit mission.
CO = carbon monoxide
DIV-H = heavy launch vehicle
DIV-M = medium launch vehicle
DIV-M+ = medium launch vehicle with solid rocket motor strap-ons
DIV-S = small launch vehicle
HCl = hydrochloric acid
$NO_x$ = nitrogen oxides
VOC = volatile organic compound

Localized air quality impacts were assessed using the REEDM model as described in Section 4.10.1.1.1.

The CAAQS has an hourly $NO_2$ standard of 0.25 ppm. For conservative purposes, all NO in $NO_x$ is assumed to convert to $NO_2$ rapidly. The REEDM-predicted $NO_x$ (NO + $NO_2$) incremental concentrations resulting from the aborts of Concept B vehicles are summarized in Table 4.10-18.

**Table 4.10-18. Summary of REEDM-Predicted Ambient Air Concentration Increments for $NO_x$ During Nominal Launches, Concept B**

| | Peak Puff concentration increment (ppm) | CAAQS 1-hour average $NO_2$ standard (ppm) |
|---|---|---|
| DIV-S | 0.102 | 5 |
| DIV-M | 0.109 | 5 |
| DIV-M+ | 0.119 | 5 |
| DIV-H | 0.020 | 5 |

CAAQS = California Ambient Air Quality Standards
DIV-H = heavy launch vehicle
DIV-M = medium launch vehicle
DIV-M+ = medium launch vehicle with solid rocket motor strap-ons
DIV-S = small launch vehicle
$NO_2$ = nitrogen dioxide
$NO_x$ = nitrogen oxides
ppm = parts per million
REEDM = Rocket Exhaust Effluent Dispersion Model

The predicted ambient concentrations of NO or $NO_2$ for nominal launches show the effects of the increased buoyancy due to the extreme heat release of the three boosters. Due to increased plume rise, the concentrations at the ground decrease significantly. The results indicate that in the worst case, the predicted $NO_x$ concentration increment is a very small fraction of the OSHA PEL.

**Launch Failure Emissions.** Emissions from launch failures at Vandenberg AFB were estimated using the Aerospace fireball deflagration model (Brady et al., 1997) (Table 4.10-19). The mass emission rates calculated from Concept A launch failures are the same at Vandenberg AFB as those shown for Cape Canaveral AS in Section 4.10.1.2.1.

**Table 4.10-19. Summary of REEDM-Predicted Ambient Air Concentration Increments for $NO_x$ During Aborted Launches, Concept B**

| | Peak Puff concentration increment (ppm) | CAAQS 1-hour average $NO_2$ standard (ppm) |
|---|---|---|
| DIV-S | 0.105 | 5 |
| DIV-M | NA | 5 |
| DIV-M+ | NA | 5 |
| DIV-H | NA | 5 |

CAAQS = California Ambient Air Quality Standards
DIV-H = heavy launch vehicle
DIV-M = medium launch vehicle
DIV-M+ = medium launch vehicle with solid rocket motor strap-ons
DIV-S = small launch vehicle
NA = not applicable
$NO_2$ = nitrogen dioxide
$NO_x$ = nitrogen oxides
ppm = parts per million
REEDM = Rocket Exhaust Effluent Dispersion Model

NO or $NO_2$ incremental concentrations during an abort were predicted by REEDM only for the DIV-S vehicle configuration.

Additional details and modeling results are presented in Appendix J. Regional impacts affecting maintenance of ambient air quality standards must be addressed in combination with other sections of the program.

Regional Air Quality Impacts

Cumulative impacts on the lower atmosphere are best summarized by totaling the emissions into the ROI associated with the program. Criteria pollutants are of concern for long-term impacts over the entire air quality region (SCCAB). Emissions from the launch itself were modeled using REEDM to determine local impacts. Other EELV-related air emissions would generally be of longer duration, lower mass emission rate, and are spread over Vandenberg AFB and the air quality region. Short-term criteria pollutant concentrations are therefore not of concern for launch support activities.

Annual emission rates depend on the proposed launch schedule (see Table 2.1-8). The complete emission summary for the years 2001 to 2020 is detailed in Appendix J. Peak emissions into the lower atmosphere at Vandenberg AFB would occur in 2007. The launch schedule and estimated emissions are presented in Table 4.10-20.

**Table 4.10-20. Emission Comparison, Concept B - Vandenberg AFB[(a)]**

| | Emissions (in tons)[(b)] | | | | |
|---|---|---|---|---|---|
| | VOC | $NO_x$ | CO | $SO_2$ | $PM_{10}$ |
| Launches | 0.0 | 5.4 | 0.0 | 0.0 | 5.4 |
| Preparation, Assembly, and Fueling | 6.6 | | | | 1.2 |
| Mobile Sources | 6.7 | 10.8 | 83.9 | 0.5 | 78.0 |
| Point Sources | 0.5 | 4.2 | 1.1 | 0.4 | 0.1 |
| Total | 13.8 | 20.3 | 84.9 | 0.9 | 84.7 |
| Santa Barbara County 1995 Total (for comparison) | 44,664 | 13,994 | 102,509 | 1,290 | 29,374 |

Notes: (a) Includes emissions into the lower atmosphere (<3,000 feet) only.
(b) Emissions are based upon launch rates shown in Table 2.1-8 for the peak emissions year at Vandenberg AFB (2007).
CO = carbon monoxide
$NO_x$ = nitrogen oxides
$PM_{10}$ = particulate matter equal to or less than 10 microns in diameter
$SO_2$ = sulfur dioxide
VOC = volatile organic compound

The expected emissions of ozone precursors (VOC and $NO_x$) and $PM_{10}$ from peak-year operation are small compared with the county baseline. However, since the SCCAB is in nonattainment for ozone and $PM_{10}$, these emissions would still be mitigated to the extent feasible.

Peak-year operation emissions of $SO_2$, $NO_x$, and CO would not jeopardize the attainment status for these pollutants. Baseline emissions in the SCCAB are below the levels that would cause nonattainment, and the peak-year operation emissions are only a small fraction of the county baseline.

Based on current emissions estimates, Concept B would result in a reduction of emissions from the baseline for all criteria pollutants. The final system design would need to be compared with the permitting and regulatory requirements listed in Section 3.10 to determine required action.

Based on current stationary source emission estimates, and the current emissions estimates from ENVVEST source categories, it does not appear that installation of new stationary sources for Concept B would trigger new requirements under SBCAPCD Rule 1301. Vandenberg AFB will need to consider EELV operations when planning to meet ENVVEST emission reduction goals.

#### 4.10.1.3 Concept A/B

Overall emission estimates were calculated as the sum of emissions from specific activities. Concept A/B emission estimates were calculated as the sum of emissions from the specific activities described for Concepts A and B in Sections 4.10.1.1 and 4.10.1.2, respectively.

**4.10.1.3.1 Concept A/B - Cape Canaveral AS.** Air quality impacts from Concept A/B would be similar to the combined effects described in Sections 4.10.1.1 and 4.10.1.2 for Concepts A and B, respectively.

Facility Construction

Under Concept A/B, the construction emissions described for Concept A in Section 4.10.1.1 and for Concept B in Section 4.10.1.2 would occur. Because the construction schedules would be staggered somewhat for the two concepts, and given that there is some flexibility in the construction schedules, it is difficult to predict the total average annual construction emissions for both concepts. Total construction emissions, roughly estimated as the sum of average annual emissions for Concepts A and B for VOCs, $NO_x$, CO, $SO_2$, and $PM_{10}$ would be 36.0, 126.4, 134.5, 7.0, and 22.0 tons per year, respectively.

Operations

Emissions associated with Concept A/B operational activities would be the same for each launch vehicle as described for Concepts A and B in Section 4.10.1.1 and 4.10.1.2, respectively. Table 4.10-21 presents the emissions associated with Concept A/B operational activities, and reflects the sum of Concepts A and B emissions in the peak year.

Launch Activities

Launch emissions associated with Concept A/B for nominal and abort scenarios would be the same for each launch vehicle as described for Concepts A and B in Section 4.10.1.1 and 4.10.1.2, respectively (see Table 4.10-21).

Regional Air Quality Impacts

Regional impacts on the lower atmosphere include emissions associated with preparing and launching Concept A and Concept B vehicles. Criteria

**Table 4.10-21. Emission Comparison, Concept A/B - Cape Canaveral AS[(a)]**

| | Emissions (in tons)[(b)] | | | | |
|---|---|---|---|---|---|
| | VOC | $NO_x$ | CO | $SO_2$ | $PM_{10}$ |
| Launches | 0.0 | 21.4 | 0.0 | 0.0 | 16.8 |
| Preparation, Assembly, and Fueling | 19.1 | 0.0 | 0.0 | 0.0 | 5.9 |
| Mobile Sources | 12.0 | 29.8 | 88.2 | 1.2 | 78.2 |
| Point Sources | 0.8 | 8.7 | 2.0 | 0.6 | 0.4 |
| Total | 31.9 | 60.0 | 90.2 | 1.8 | 101.3 |
| Brevard County 1995 Total (for comparison) | 24,983 | 26,122 | 134,743 | 27,524 | 35,090 |

Notes: (a) Includes emissions into the lower atmosphere (<3,000 feet) only.
(b) Emissions are based upon launch rates shown in Table 2.1-11 for the peak emissions year at Cape Canaveral AS (2015).
AS = Air Station
CO = carbon monoxide
$NO_x$ = nitrogen oxides
$PM_{10}$ = particulate matter equal to or less than 10 microns in diameter
$SO_2$ = sulfur dioxide
VOC = volatile organic compound

pollutants are of concern for long-term impacts over the entire air quality region (Brevard County).

Annual emission rates depend on the proposed launch schedule (see Table 2.1-11). The emission summary for key years between 2001 and 2020 is detailed in Appendix J. Peak emissions into the lower atmosphere at Cape Canaveral AS would occur during 2015 for Concept A/B (see Table 4.10-21).

Peak-year operation emissions of criteria pollutants would not jeopardize the attainment status for these pollutants. Baseline emissions in Brevard County are below the levels that would cause nonattainment and the peak-year operation emissions are only a small fraction of the county baseline. Also, based on current emissions estimates, Concept A/B would result in a reduction of emissions from the baseline for all criteria pollutants.

**4.10.1.3.2 Concept A/B - Vandenberg AFB.** Air quality impacts from Concept A/B would be similar to the combined effects described in Sections 4.10.1.1 and 4.10.1.2.

Changes associated with the EELV program would need to be documented in the ENVVEST reporting for Vandenberg AFB, as discussed for Concept A in Section 4.10.1.1.1. The Concept A contractor plans to use existing boilers and heaters ($NO_x$ sources) for this program. The existing boilers and heaters will be used for the EELV program instead of their current uses. The Concept B contractor plans to use new boilers and heaters ($NO_x$ sources) for this program. These new boilers and heaters will be installed and used for the EELV program. Boilers and heaters associated with the current Atlas, Delta, and Titan programs will either no longer be used or their usage will be reduced. The total estimated emissions of $NO_x$ from the point sources associated with Concept A/B is 8.7 tons per year, as shown in Table 4.10-22. These emissions will replace the baseline emissions (emissions associated with the current Atlas, Delta, and Titan programs). The total estimated baseline emissions of $NO_x$ from point sources is 8.1 tons, as shown in Table 3.10-9. Therefore, implementing the Concept A/B EELV program is expected to increase $NO_x$ emissions by 0.6 tons per year. Based on the 1994 emissions summary shown in Appendix J, this increase would not be sufficient to cause any source group to exceed the Rule 1301 threshold of 25 tons of $NO_x$. Therefore, the EELV activities are not likely to negatively impact implementation of the ENVVEST program.

**Table 4.10-22. Emission Comparison, Concept A/B - Vandenberg AFB[a]**

| | Emissions (in tons)[b] | | | | |
|---|---|---|---|---|---|
| | VOC | $NO_x$ | CO | $SO_2$ | $PM_{10}$ |
| Launches | 0.0 | 7.9 | 0.0 | 0.0 | 10.8 |
| Preparation, Assembly, and Fueling | 9.9 | 0.0 | 0.0 | 0.0 | 1.1 |
| Mobile Sources | 6.8 | 11.7 | 86.1 | 0.6 | 87.1 |
| Point Sources | 0.8 | 8.7 | 2.0 | 0.6 | 0.4 |
| Total | 17.5 | 28.2 | 88.1 | 1.2 | 99.5 |
| Brevard County 1995 Total (for comparison) | 24,983 | 26,122 | 134,743 | 27,524 | 35,090 |

Notes: (a) Includes emissions into the lower atmosphere (<3,000 feet) only.
(b) Emissions are based upon launch rates shown in Table 2.1-11 for the peak emissions year at Vandenberg AB (2007).
CO = carbon monoxide
$NO_x$ = nitrogen oxides
$PM_{10}$ = particulate matter equal to or less than 10 microns in diameter
$SO_2$ = sulfur dioxide
VOC = volatile organic compound

Facility Construction

For Concept A/B, construction for the facilities for both contractors would proceed. The construction emissions described for Concept A in Section 4.10.1.1.1 and for Concept B in Section 4.10.1.2.1 would occur. As part of the Air Conformity Applicability Analysis (see Appendix K), estimates of annual construction emissions were performed based on the proposed construction schedule.

Operations

Emissions associated with Concept A/B operational activities would be the same for each launch vehicle as described for Concepts A and B in Sections 4.10.1.1 and 4.10.1.2, respectively. Table 4.10-22 presents the emissions associated with Concept A/B operational activities, and reflects the sum of Concepts A and B emissions in the peak year.

Launch Activities

Launch emissions associated with Concept A/B for nominal and abort scenarios would be the same for each launch vehicle as described for Concepts A and B in Sections 4.10.1.1 and 4.10.1.2, respectively (see Table 4.10-22).
As discussed in Section 4.10.1.1.2, an air conformity applicability analysis for EELV activities is provided in Appendix K.

Regional Air Quality Impacts

Regional impacts on the lower atmosphere include emissions associated with preparing and launching Concept A and Concept B vehicles. Criteria pollutants are of concern for long-term impacts over the entire air quality region (SCCAB).

Annual emission rates depend on the proposed launch schedule (see Table 2.1-11). Emission summaries for key years between 2001 and 2020 are detailed in Appendix J. Peak emissions into the lower atmosphere at Vandenberg AFB would occur during 2007. The launch schedule and estimated emissions are presented in Table 4.10-22.

The expected emissions of ozone precursors (VOC and $NO_x$) and $PM_{10}$ from peak-year operations would be minimal compared with the county baseline. However, since the SCCAB is in nonattainment for ozone and $PM_{10}$ for state standards, these emissions would still be mitigated to the extent feasible.

Peak-year operation emissions of $SO_2$, $NO_x$, and CO would not be sufficient to jeopardize the attainment status for these pollutants. Baseline emissions in the SCCAB are below the levels that would cause nonattainment, and the peak-year operation emissions would be only a small fraction of the county baseline.

Based on current emissions estimates, Concept A/B would result in a reduction of emissions from the baseline for all criteria pollutants. The final system design would need to be compared with the permitting and regulatory requirements listed in Section 3.10 to determine required action.

### 4.10.2 No-Action Alternative

Emissions associated with the No-Action Alternative would be those associated with continued use of the Atlas, Delta, and Titan vehicles to meet the government portion of the NMM. Operations would continue as described in Section 3.10. The calculations in this section assume the use of Atlas IIA, Delta II, and Titan IVB vehicles.

Air quality impacts and health effects would be similar to those associated with the Proposed Action. In addition to the chemicals of concern associated with the Proposed Action, ODSs used as part of the degreasing operations for the No-Action Alternative have the potential to damage the stratospheric ozone layer. Damage to the stratospheric ozone layer can cause health hazards in the form of increased skin cancer rates.

Air quality impacts from No-Action Alternative operations would result from the general sources described in Section 4.10.1. Deliveries of vehicle components occur by truck and aircraft; emissions from both forms of delivery have been calculated and compared to existing mobile source emissions. Fuels used in the No-Action Alternative vehicles include kerosene fuel (RP-1), cryogenic gases ($LO_2$ and $LH_2$), hydrazines (MMH, A-50, and $N_2H_4$), $N_2O_4$, and solid rocket fuels. Emissions from the handling and storage of these fuels have been calculated and compared to existing emissions.

**4.10.2.1 Cape Canaveral AS.** Emissions from the No-Action Alternative would occur from the following sources: vehicle launch; vehicle preparation, assembly, and fueling; mobile sources such as support equipment, commercial transport vehicles (including trucks and aircraft), and personal vehicles; and point sources such as heating/power plants, generators, incinerators and storage tanks.

Estimates were divided into two categories: emissions that are directly launch-related and infrastructure emissions. Launch-related emissions were estimated on a pounds-per-launch basis; infrastructure emissions were estimated on a pounds-per-day basis and were assumed to take place regardless of the number of launches conducted per year.

Emissions were calculated using the methods and assumptions used to calculate the baseline emissions described in Section 3.10. In addition to the emissions from refrigeration units (ODSs), fire suppression and some degreasing operations would also produce emissions. Total ODS emissions associated with the Atlas, Delta, and Titan operations are difficult to estimate for the No-Action Alternative at Cape Canaveral AS because of ongoing efforts to reduce or eliminate the use of ODSs. Depending on the success of these efforts, ODS emissions may be zero.

Emissions from pre- and post-launch processing include criteria pollutants and toxic or irritant pollutants (including HAPs). Emissions of criteria pollutants could cause or contribute to the nonattainment of NAAQS or FAAQS for the region. Emissions of pollutants can also cause localized health effects.

Launch emissions and their associated impacts would be similar to those associated with baseline activities (see Section 3.10).

For comparison purposes, localized air quality impacts were assessed using the REEDM model, as described for Concepts A and B in Sections 4.10.1.1.1 and 4.10.1.2.1, respectively. Titan and Delta launches were modeled, and results for nominal scenarios are presented in Tables 4.10-23 and 4.10-24, respectively.

**Table 4.10-23. Summary of REEDM-Predicted Ambient Air Concentration Increments During Nominal Launches (Titan IV and Delta II)**

| CO | Maximum 8-hour average concentration increment (ppm) | NAAQS 8-hour average (ppm) |
|---|---|---|
| Titan IVB-A | 0.14 | 9 |
| Delta II-7925 | 0.69 | 9 |
| $NO_x$ | Maximum 8-hour average concentration increment (ppm) | CAAQS $NO_2$ 1 hour average (ppm) |
| Titan IVB-A | 0.07 | 0.25 |
| Delta II-7925 | 0.01 | 0.25 |
| HCl | Peak puff concentration increment (ppm) | OSHA PEL ceiling (ppm) |
| Titan IVB-A | 3.32 | 5 |
| Delta II-7925 | 1.43 | 5 |

CAAQS = California Ambient Air Quality Standards
CO = carbon monoxide
HCl = hydrochloric acid
NAAQS = National Ambient Air Quality Standards
$NO_2$ = nitrogen dioxide
$NO_x$ = nitrogen oxides
OSHA = Occupational Safety and Health Administration
PEL = Permissible Exposure Level
ppm = parts per million
REEDM = Rocket Exhaust Effluent Dispersion Model

**Table 4.10-24. Summary of REEDM-Predicted Ambient Air Concentration Increments During Aborted Launches (Titan IV and Delta II)**

| CO | Maximum 8-hour average concentration increment (ppm) | NAAQS 8-hour average (ppm) |
|---|---|---|
| Titan IVB-A | 0.86 | 9 |
| Delta II-7925 | 2.07 | 9 |
| $NO_x$ | Maximum 8-hour average concentration increment (ppm) | CAAQS $NO_2$ 1-hour average (ppm) |
| Titan IVB-A | 4.18 | 0.25 |
| Delta II-7925 | 0.17 | 0.25 |
| $NH_3$ | Maximum 8-hour average concentration increment (ppm) | OSHA PEL 8-hour average (ppm) |
| Titan IVB-A | 1.58 | 50 |
| Delta II-7925 | 0.07 | 50 |
| Hydrazine Compounds | Maximum 8-hour average concentration increment (ppm) | OSHA PEL 8-hour average (ppm) |
| Titan IVB-A | 0.27 | 1 |
| Delta II-7925 | 0.01 | 1 |
| HCl | Peak puff concentration increment (ppm) | OSHA PEL ceiling (ppm) |
| Titan IVB-A | 0.84 | 5 |
| Delta II-7925 | 0.26 | 5 |

CAAQS = California Ambient Air Quality Standards
CO = carbon monoxide
HCl = hydrochloric acid
NAAQS = National Ambient Air Quality Standards
$NO_2$ = nitrogen dioxide
$NO_x$ = nitrogen oxides
OSHA = Occupational Safety and Health Administration
PEL = Permissible Exposure Level
ppm = parts per million
REEDM = Rocket Exhaust Effluent Dispersion Model

As with the Proposed Action, impacts from the No-Action Alternative on the lower atmosphere are best summarized by totaling the emissions into the ROI associated with the program. Annual emission rates would depend on the proposed launch schedule. Many of the emission-generating activities would occur once per vehicle launch. A No-Action Alternative launch schedule for 2001 through 2020 based on the government portion of the NMM was developed. The peak $NO_x$ emissions would occur during 2015. Emissions are summarized for 2015 in Table 4.10-25.

**Table 4.10-25. No-Action Alternative Emission Comparison, Cape Canaveral AS[a]**

| | Emissions (in tons)[b] | | | | |
|---|---|---|---|---|---|
| | VOC | $NO_x$ | CO | $SO_2$ | $PM_{10}$ |
| Launches | 0 | 7.5 | 0 | 0 | 59.2 |
| Preparation, Assembly, and Fueling | 8.9 | 0 | 0 | 0 | 3.6 |
| Mobile Sources | 24.8 | 62.0 | 213.7 | 2.7 | 122.8 |
| Point Sources | 1.0 | 22.9 | 6.2 | 17.7 | 1.0 |
| Total | 34.6 | 92.3 | 220.0 | 20.4 | 186.6 |
| Brevard County 1995 Total (for comparison) | 24,983 | 26,122 | 134,743 | 27,524 | 35,090 |

Notes: (a) Includes emissions into the lower atmosphere (<3,000 feet) only.
(b) Emissions are based upon launch rates shown in Appendix J for the peak emissions year at Vandenberg AB (2007).
CO = carbon monoxide
$NO_x$ = nitrogen oxides
$PM_{10}$ = particulate matter equal to or less than 10 microns in diameter
$SO_2$ = sulfur dioxide
VOC = volatile organic compound

It is important to note that the launch schedule developed for the No-Action Alternative does not include any commercial launches. For this reason, there are fewer launches per year shown for the No-Action Alternative than for the Proposed Action.

Emissions of several chemicals of concern into the lower atmosphere in the peak years for each of the launch concepts are presented in Table 4.10-26 for Cape Canaveral AS.

**Table 4.10-26. Lower Atmosphere Launch Emissions, Cape Canaveral AS (2015)**

| | Number of launches | Tons/Year | | |
|---|---|---|---|---|
| | | $NO_x$ | $PM_{10}$ | HCl |
| Concept A | 23 | 18.5 | 0.0 | 0.0 |
| Concept B | 23 | 15.1 | 25.1 | 13.0 |
| Concept A/B | 26 | 21.4 | 16.8 | 8.6 |
| No-Action Alternative[a] | 11 | 7.5 | 59.2 | 29.9 |

Note: (a) Government launches only.
HCl = hydrochloric acid
$NO_x$ = nitrogen oxides
$PM_{10}$ = particulate matter equal to or less than 10 microns in diameter

The EELV program concepts are considerably cleaner in terms of the particulate and chlorine loading than those of the No-Action Alternative. The No-Action Alternative vehicles seem to produce less $NO_x$ emissions than the EELV systems, but this is due to the large difference in the number of launches between the Proposed Action and No-Action Alternative. Although the No-Action Alternative includes fewer launches than the Proposed Action, it would produce more $PM_{10}$ and HCl emissions.

**Vandenberg AFB.** Emissions from the No-Action Alternative would be similar to those described in Section 4.10.2.1. Although the No-Action Alternative includes fewer launches than the Proposed Action, it would produce more $PM_{10}$ and HCl emissions.

Emissions were calculated using the methods and assumptions used to calculate the baseline emissions described in Sections 3.10 and 4.10.2.1. Launch emissions and their associated impacts would be similar to those associated with baseline activities described in Section 3.10.

As with the Proposed Action, impacts from the No-Action Alternative on the lower atmosphere are best summarized by totaling the emissions into the ROI associated with the program (Table 4.10-27). The peak year is defined as the year with the highest predicted $NO_x$ emissions, not the year with the most launches.

**Table 4.10-27. No-Action Alternative Emission Comparison, Vandenberg AFB[(a)]**

| | Emissions (in tons)[(b)] | | | | |
|---|---|---|---|---|---|
| | VOC | $NO_x$ | CO | $SO_2$ | $PM_{10}$ |
| Launches | 0.0 | 2.4 | 0.0 | 0.0 | 34.9 |
| Preparation, Assembly, and Fueling | 3.4 | 0.0 | 0.0 | 0.0 | 1.3 |
| Mobile Sources | 8.7 | 15.2 | 117.2 | 0.8 | 103.8 |
| Point Sources | 0.2 | 8.1 | 1.2 | 0.6 | 0.5 |
| Total | 12.3 | 25.7 | 118.4 | 1.4 | 140.5 |
| Santa Barbara County 1995 Total (for comparison) | 44,664 | 13,994 | 102,509 | 1,290 | 29,374 |

Notes: (a) Government launches only.
(b) Includes emissions into the lower atmosphere (<3,000 feet) only.
AFB = Air Force Base
CO = carbon monoxide
$NO_x$ = nitrogen oxides
$PM_{10}$ = particulate matter equal to or less than 10 microns in diameter
$SO_2$ = sulfur dioxide
VOC = volatile organic compound

Emissions of several chemicals of concern into the lower atmosphere in the peak years for each of the launch concepts are presented in Table 4.10-28 for Vandenberg AFB launches.

**Table 4.10-28. Lower Atmosphere Launch Emissions, Vandenberg AFB**

| | Peak Year | Number of launches | Tons/Year $NO_x$ | $PM_{10}$ | HCl |
|---|---|---|---|---|---|
| Concept A | 2007 | 10 | 4.8 | 0.0 | 0.0 |
| Concept B | 2007 | 10 | 5.4 | 5.4 | 2.8 |
| Concept A/B | 2007 | 14 | 7.9 | 10.8 | 5.6 |
| No-Action Alternative[(a)] | 2008 | 4 | 2.4 | 34.9 | 17.6 |

Note: (a) Government launches only.
AFB = Air Force Base
HCl = hydrochloric acid
$NO_x$ = nitrogen oxides
$PM_{10}$ = particulate matter equal to or less than 10 microns in diameter

The Proposed Action is considerably cleaner in terms of particulates and chlorine loading than the No-Action Alternative. The No-Action Alternative does seem to produce less $NO_x$ emissions than the Proposed Action, but this is due to the large difference in the number of launches between the alternatives. Although the No-Action Alternative includes fewer launches than the Proposed Action, it would produce more $PM_{10}$ and HCl emissions.

## 4.11 AIR QUALITY (UPPER ATMOSPHERE)

Emissions into the upper atmosphere are not subject to any specific regulatory requirements. The upper atmosphere ROI consists of the upper troposphere, where weather systems can mix and remove pollutants after a few days to a few weeks, and the stratosphere, where the emissions are removed very slowly and can circle the earth. In the stratosphere, ODSs, including $NO_x$, $Cl_x$, and alumina particles, are the primary chemicals of concern.

### 4.11.1 Proposed Action

This section addresses potential impacts to the upper atmosphere associated with implementation of the EELV program. Because the upper atmosphere is common to both Cape Canaveral AS and Vandenberg AFB, the discussion focuses upon impacts related to implementation of Concept A, Concept B, and Concept A/B.

**4.11.1.1 Concept A.** Concept A launch vehicles would use a booster that burns RP-1 and $LO_2$. The composition of the after-burning emissions is very similar to that of the Atlas II core engine. There are four Concept A configurations that are distinguished by the type of upper stage and by the number of boosters strapped together (see Section 2.1.1). The boosters burn until they are well above the stratosphere, and no upper-stage emissions are emitted into the stratosphere.

Two flight trajectories (LEO and GTO) were used to estimate the amount of booster mass emitted into the lower atmosphere (0 to 3,000 feet) and the upper atmosphere (3,000 to 164,000 feet). The upper atmosphere ROI was divided into the three layers; the time of travel for each trajectory to pass through each layer is summarized in Table 4.11-1.

**Table 4.11-1. Description of Flight Trajectories Used to Estimate the Fraction of Engine Burn Time in Atmospheric Layers**

| Layer Designation | Layer Top Elevation (feet) | Trajectory 1 (GTO) (seconds) | Trajectory 2 (LEO) (seconds) |
|---|---|---|---|
| Lower Atmosphere | 3,000 | 29 | 19 |
| Lower Troposphere | 10,000 | 50 | 33 |
| Upper Troposphere | 49,000 | 95 | 72 |
| Stratosphere | 164,000 | 173 | 155 |

GTO = geosynchronous transfer orbit
LEO = low-Earth orbit

Table 4.11-2 summarizes the total mass of the various ODSs that would be released into the upper atmosphere from vehicle exhaust and after-burning during a GTO mission. This table shows that, in the troposphere, the only ODS emitted in any substantial amount would be $NO_x$. In the stratosphere, the only pollutant emitted is CO from carbon in the burned RP-1 fuel. In the stratosphere, however, the influence of CO on the upper-air chemistry is marginal; consequently, CO is not considered an effective ODS.

The emission rates were estimated for each year, and the year of peak $NO_x$ emissions for the upper atmosphere was selected. The emission rates peaked for the year 2015 for Cape Canaveral AS and for 2014 for Vandenberg AFB. For estimation purposes, it was assumed that all Cape Canaveral AS launches would be GTO missions and that all Vandenberg AFB launches would be LEO missions. The peak annual launch emissions for the upper atmosphere and the stratosphere (Table 4.11-3) were calculated as the sum of using the emissions per vehicle flight (Table 4.11-2).

Concept A launches would produce no emissions into the stratosphere of any effective ODSs, and would therefore not cause any degradation of the stratospheric ozone layer.

**Table 4.11-2. Summary of Flight Emissions into Upper Atmospheric Layers, Concept A[(a)] (in tons)**

| Atmosphere Layer | Particulate | $NO_x$ | CO | $Cl_x$ |
|---|---|---|---|---|
| | MLV-A (CUS) | | | |
| Lower Troposphere | 0.0 | 0.28 | 0.0 | 0.0 |
| Upper Troposphere | 0.0 | 0.50 | 1.00 | 0.0 |
| Stratosphere | 0.0 | 0.0 | 58.47 | 0.0 |
| | MLV-D (SUS) | | | |
| Lower Troposphere | 0.0 | 0.28 | 0.0 | 0.0 |
| Upper Troposphere | 0.0 | 0.50 | 1.00 | 0.0 |
| Stratosphere | 0.0 | 0.0 | 58.47 | 0.0 |
| | HLV-L (SUS) | | | |
| Lower Troposphere | 0.0 | 0.83 | 0.0 | 0.0 |
| Upper Troposphere | 0.0 | 1.50 | 3.01 | 0.0 |
| Stratosphere | 0.0 | 0.0 | 175.42 | 0.0 |
| | HLV-G (CUS) | | | |
| Lower Troposphere | 0.0 | 0.83 | 0.0 | 0.0 |
| Upper Troposphere | 0.0 | 1.50 | 3.01 | 0.0 |
| Stratosphere | 0.0 | 0.0 | 175.42 | 0.0 |

Note: (a) Assumes a geosynchronous transfer orbit mission.
$Cl_x$ = chlorine compounds
CO = carbon monoxide
CUS = Cryogenic Upper Stage
HLV = heavy lift variant
MLV = medium lift variant
$NO_x$ = nitrogen oxides
SUS = Storable Upper Stage

**Table 4.11-3. Summary of ODS Emissions, Concept A (tons per year)[(a)]**

| ODS | Upper Atmosphere (>49,000 feet) | Stratosphere (49,000 to 164,000 feet) |
|---|---|---|
| Particulates | 0 | 0 |
| $Cl_x$ | 0 | 0 |
| $NO_x$ | 22.9 | 0 |
| CO | 1,893 | 1,862 |

Note: (a) Emissions are based upon launch rates shown in Table 2.1-3 for peak emission years at each installation (2015 at Cape Canaveral AS, 2014 at Vandenberg AFB).
$Cl_x$ = chlorine compounds
CO = carbon monoxide
$NO_x$ = nitrogen oxides
ODS = ozone-depleting substance

**4.11.1.2 Concept B.** Concept B launch vehicles would use a booster that burns $LH_2$ and $LO_2$. The composition of the after-burning emissions is very clean, essentially resulting in only water, unburned fuel, and oxy-hydrogen radicals. There are five Concept B configurations that are distinguished by the type of upper stage and by the number and type of boosters strapped together (see Section 2.1.2). The boosters would burn until they are well above the stratosphere and no upper-stage emissions are emitted into the stratosphere. The flight trajectories modeled were the same as those described in Section 4.11.1.1 for Concept A (see Table 4.11-1).

The ODSs include $NO_x$, alumina particles, and $Cl_x$. CO is also tracked, but its role in the upper atmospheric chemistry is so small that it is not considered an effective ODS. Table 4.11-4 summarizes the total mass of the various ODSs

released into the atmosphere from vehicle exhaust and after-burning during a GTO mission.

**Table 4.11-4. Summary of Flight Emissions into Upper Atmospheric Layers, Concept B[(a)] (in tons)**

| Atmosphere layer | Particulate | $NO_x$ | CO | $Cl_x$ |
|---|---|---|---|---|
| | DIV-S (HUS) | | | |
| Lower Troposphere | 0.0 | 0.21 | 0.0 | 0.0 |
| Upper Troposphere | 0.0 | 0.38 | 0.0 | 0.0 |
| Stratosphere | 0.0 | 0.0 | 0.0 | 0.0 |
| | DIV-M (CUS) | | | |
| Lower Troposphere | 0.0 | 0.21 | 0.0 | 0.0 |
| Upper Troposphere | 0.0 | 0.38 | 0.0 | 0.0 |
| Stratosphere | 0.0 | 0.0 | 0.0 | 0.0 |
| | DIV-M+ (CUS) | | | |
| Lower Troposphere | 2.02 | 0.21 | 0.0 | 1.04 |
| Upper Troposphere | 8.34 | 0.47 | 0.33 | 4.30 |
| Stratosphere | 14.03 | 0.0 | 9.49 | 7.33 |
| | DIV-H (CUS) | | | |
| Lower Troposphere | 0.0 | 0.63 | 0.0 | 0.0 |
| Upper Troposphere | 0.0 | 1.14 | 0.0 | 0.0 |
| Stratosphere | 0.0 | 0.0 | 0.0 | 0.0 |

Note: (a) Assumes a low-Earth orbit mission.
$Cl_x$ = chlorine compounds
CO = carbon monoxide
CUS = Cryogenic Upper Stage
DIV-H = heavy launch vehicle
DIV-M = medium launch vehicle
DIV-M+ = medium launch vehicle with solid rocket motor strap-ons
DIV-S = small launch vehicle
HUS = Hypergolic Upper Stage
$NO_x$ = nitrogen oxides

In the troposphere, the only ODS deposited from configurations with no strap-on solid rocket motors in any substantial amount is $NO_x$ (see Table 4.11-4). The stratospheric ODS emissions come only from configurations that use strap-on solid rocket motors.

The emission rates were estimated for each year, and the year of peak $NO_x$ emissions for the upper atmosphere was selected. The emission rates peaked in the year 2015 for Cape Canaveral AS and in 2008 for Vandenberg AFB. For estimation purposes, it was assumed that all Cape Canaveral AS launches would be GTO missions and that all Vandenberg AFB launches would be LEO missions. The peak annual emissions for each upper atmospheric layer from all Concept B launches (Table 4.11-5) were estimated as the sum of the emissions per vehicle flight (see Table 4.11-4).

**Table 4.11-5. Summary of ODS Emissions, Concept B (tons per year)[(a)]**

| ODS | Upper Atmosphere (>49,000 feet) | Stratosphere (49,000 to 164,000 feet) |
|---|---|---|
| Particulates | 162.3 | 85.1 |
| $Cl_x$ | 83.6 | 43.8 |
| $NO_x$ | 22.7 | 0.0 |
| CO | 58.6 | 56.7 |

Note: (a) Emissions are based upon launch rates shown in Table 2.1-8 for peak emission years at each installation (2015 at Cape Canaveral AS, 2008 at Vandenberg AFB).
$Cl_x$ = chlorine compounds
CO = carbon monoxide
$NO_x$ = nitrogen oxides
ODS = ozone-depleting substance

Concept B government launch vehicles would not release ODSs into the stratosphere; however, the DIV-M+ (commercial only) launches would add ODSs. The projected emission rates are smaller than the baseline launch emissions described in Section 3.11. Even with commercial launches, Concept B would result in reductions of ODSs in the stratosphere from the current launch vehicles.

**4.11.1.3 Concept A/B.** Under Concept A/B, both Concept A and Concept B vehicles would be developed and launched. For analysis purposes, a nearly exact division of the Concept A and B launch rates has been assumed for each vehicle type (see Table 2.1-11). Concept A and B ODS emissions are described in Sections 4.11.1.1 and 4.11.1.2, respectively. The flight trajectories used to estimate the amount of booster mass emitted into atmosphere are summarized in Table 4.11-1.

The emission rates were estimated for each year, and the year of peak $NO_x$ emissions for the upper atmosphere was selected. The emission rates peaked in the year 2015 for Cape Canaveral AS and in 2007 for Vandenberg AFB.

The same assumption regarding use of LEO and GTO trajectories at each installation was utilized. The peak annual emissions for each upper atmospheric layer from all launches (Table 4.11-6) were estimated as the sum of the emissions per vehicle flight (see Tables 4.11-2 and 4.11-4).

Concept A/B launches would discharge emissions of alumina particulates and $Cl_x$ into the stratosphere as a result of using solid rocket motors for Concept B commercial launches. However, as discussed in Section

**Table 4.11-6. Summary of ODS Emissions, Concept A/B (tons per year)[a]**

| ODS | Upper Atmosphere (<49,000 feet) | Stratosphere (49,000 to 164,000 feet) |
|---|---|---|
| Particulates[b] | 157.0 | 84.7 |
| $Cl_x$ | 80.9 | 43.7 |
| $NO_x$ | 32.3 | 0.0 |
| CO | 1359.4 | 1337.1 |

Notes: (a) Emissions are based upon launch rates shown in Table 2.1-11 for peak emission years at each installation (2015 at Cape Canaveral AS, 2007 at Vandenberg AFB).
(b) Concept B commercial launches only.
$Cl_x$ = chlorine compounds
CO = carbon monoxide
$NO_x$ = nitrogen oxides
ODS = ozone-depleting substance

4.11.1.2, Concept A/B launches would result in reductions of ODSs in the stratosphere from current launch systems.

### 4.11.2 No-Action Alternative

Emissions from the government component of launches based on the NMM were estimated assuming continuation of existing launch programs (Atlas IIA, Delta II, Titan IVB). The annual launch schedule is presented in Appendix J. The tropospheric $NO_x$ emissions were used to determine the peak years for emissions. Peak $NO_x$ emissions would occur in 2015 for Cape Canaveral AS and in 2008 for Vandenberg AFB. No-Action Alternative emissions for the upper atmosphere and the stratosphere are provided in Table 4.11-7. Emissions of alumina particulates and chlorine from the No-Action Alternative launches would be greater than the estimated emissions for Concepts A and B, or for Concept A/B.

**Table 4.11-7. Summary of the Annual Emissions Resulting from the No-Action Alternative (in tons)**

| | Cape Canaveral AS (2015) | | Vandenberg AFB (2008) | |
|---|---|---|---|---|
| Pollutant | Upper Atmosphere | Stratosphere | Upper Atmosphere | Stratosphere |
| Particulates | 368.2 | 174.1 | 296.1 | 162.7 |
| $NO_x$ | 10.9 | 0.6 | 5.2 | 0.6 |
| CO | 527.3 | 516.0 | 227.4 | 222.7 |
| $Cl_x$ | 185.3 | 87.5 | 148.7 | 81.6 |

$Cl_x$ = chlorine compounds
CO = carbon monoxide
$NO_x$ = nitrogen oxides

## 4.12 NOISE

Potential impacts due to noise and sonic boom exposure are discussed in this section. The potential impacts on wildlife are described in Section 4.14, Biological Resources.

### 4.12.1 Proposed Action

The proposed EELV system has not yet been launched; consequently, actual vehicle noise measurements are not available. Launch and ascent noise were computed by the RNOISE model recently developed for launch vehicle analysis (Plotkin et al., 1997) (see Appendix F). Sonic booms were computed using the U.S. Air Force PCBoom3 model (Plotkin, 1996) (see Appendix F).

#### 4.12.1.1 Concept A

Noise analysis was performed for two vehicles (one three-engine heavy and one single-engine medium) at Cape Canaveral AS and Vandenberg AFB. The selected missions analyzed include: HLV-G (94-degree azimuth) and MLV-D (92-degree azimuth) at Cape Canaveral AS and HLV-L (181-degree azimuth), MLV-D (181-degree azimuth), MLV-A (158-degree azimuth), and MLV-A (186-degree azimuth) at Vandenberg AFB. Three medium vehicle launches were analyzed for Vandenberg AFB so as to assess the difference between various missions of the same vehicle type.

It was found that the noise and sonic boom footprints for the medium vehicles were similar among the missions analyzed, differing primarily according to the launch azimuth. The footprint from one mission can be approximated by that from another simply by rotating it to the corresponding azimuth. Launch direction is more important for sonic boom, with its crescent-shaped footprints, than for rocket noise, for which the highest level contours are approximately circular. In the following analysis, noise contours are shown for one heavy and one medium vehicle launch at each site. The effect of other launch azimuths is discussed.

The peak year launch rates for Concept A (see Table 2.1-3) are 22 per year from Cape Canaveral and 10 per year from Vandenberg. These are considerably less than one per day, the rate at which cumulative program noise metrics such as $L_{dn}$ are meaningful. The following analysis of impacts, therefore, concentrates on single launch events.

##### 4.12.1.1.1 Concept A, Cape Canaveral AS

**In-Flight Rocket Noise.** Figure 4.12-1 shows the in-flight maximum A-weighted noise level contours for the HLV-G. Figure 4.12-2 shows in-flight maximum A-weighted noise level contours for the MLV-D. Contours for other medium vehicles are similar to those shown in Figure 4.12-2. Sound levels for the medium vehicle are about 5 dB lower than for the heavy vehicle. Heavy vehicles represent approximately 2 percent of the projected Concept A launches. Conservative estimates of impact can be made by examining levels from the louder heavy vehicle.

The maximum A-weighted levels for the HLV-G in the nearest residential communities would be in the 75-dB range. This is somewhat louder than the noise of a passing automobile (65 to 70 dBA) and less than that of a passing heavy truck (80 to 85 dBA). Occasional sounds of this level will not cause adverse impact. SEL has been computed for this launch and is about 13 dB higher than the AWSPL. This corresponds to an effective duration of about 20 seconds. Launch noise is likely to be audible for a longer period, but the total time involved is not great enough to cause substantial impact.

Figure 4.12-3 shows the OSPL for the HLV-G. The higher-level contours are approximately circular, so launch azimuth is not important. OSPL in excess of 110 dB, which could cause structural damage claims at a rate of one per 1,000 households, is limited to a radius of approximately 3.3 miles from the launch site. This area does not contain residential communities, and most of the land area affected is within Cape Canaveral AS and KSC. The OSPL at the nearest residential communities, 8 to 10 miles away, would be below 100 dB, where structural damage, if any, would occur at a negligible rate.

The majority of missions (98 percent) would utilize medium and small vehicles, for which noise is about 5 dB lower and correspondingly less intrusive.

**Sonic Boom.** Figure 4.12-4 shows the sonic boom footprint for the HLV-G, and Figure 4.12-5 shows the footprint for the MLV-D. These two footprints are drawn to scale, and the highest level contours in the focal zones (6 to 7 psf) are too small to be seen in the figures. The lowest contour value drawn, 0.5 psf, is larger for the heavy vehicle, and its maximum overpressure is slightly higher, but otherwise the footprints are fairly similar.

Both of these footprints are aligned with the launch azimuths (94 degrees and 92 degrees, respectively) and fall in the Atlantic Ocean, well offshore. Most Concept A launches would be at azimuths between 91 and 97 degrees, and would not be substantially different from those shown in Figures 4.12-4 and 4.12-5. Some launches would be at an azimuth of 64 degrees. The footprint would fall farther to the north but would still be entirely over the Atlantic Ocean.

Figure 4.12-1 Maximum A-Weighted Sound Pressure Level, HLV-G, Cape Canaveral AS

Figure 4.12-2 Maximum A-Weighted Sound Pressure Level, MLV-D, Cape Canaveral AS

Figure 4.12-3 Maximum Overall Sound Pressure Level, HLV-G, Cape Canaveral AS

Figure 4.12-4  Sonic Boom Footprint, HLV-G, Cape Canaveral AS

Figure 4.12-5  Sonic Boom Footprint, MLV-D, Cape Canaveral AS

Most of the boom footprints are below 1 psf, a level at which no adverse effects would be expected, even over land, from an occasional sonic boom. The maximum focus overpressures are in the 6- to 8-psf range. This is comparable to the focus boom overpressures routinely generated by military aircraft during supersonic training missions over both land and water (Plotkin et al., 1993), and similar to focus boom overpressures generated by other launch vehicles (Downing et al, 1996). Since the entire boom footprint is over water, the only potential impacts would be to wildlife (see Section 4.14, Biological Resources).

Cumulative program noise impacts would be quantified by $L_{dn}$ which has been computed for the busiest years. Values are about 50 dB lower than the AWSPL values shown in Figures 4.12-4 and 4.12-5. This is well within acceptable criteria for any type of land use. However, $L_{dn}$ is not meaningful for events as infrequent as EELV launches, so the primary impact assessment is the single-event analysis presented above.

#### 4.12.1.1.2 Concept A, Vandenberg AFB

**In-Flight Rocket Noise.** Figures 4.12-6 and 4.12-7 show the in-flight maximum AWSPL for the HLV-L and MLV-D. These contours are very similar to the corresponding contours at Cape Canaveral AS, differing primarily in location and alignment with the launch trajectory. Contours for the MLV-D are approximately 5 dB lower than those for the heavy vehicle.

Considering the HLV-L (less than 1 percent of Vandenberg AFB launches would be heavy vehicles), maximum A-weighted levels in the nearest residential communities would be in the 80- to 85-dB range (see Figure 4.12-6). This is comparable to the noise of a passing heavy truck (80 to 85 dBA). Occasional sounds of this level will not cause adverse impacts. SEL has been computed for this launch, and is about 13 dB higher than the AWSPL. This corresponds to an effective duration of about 20 seconds. Launch noise is likely to be audible for a longer period, but the total time involved is not great enough to cause substantial impact.

Figure 4.12-8 shows OSPL for the HLV-L. OSPL in excess of 110 dB, which could cause structural damage claims at a rate of one per 1,000 households, is limited to a radius of approximately 3.3 miles from the launch site. This area does not contain residential communities, and almost all of the land area affected is within Vandenberg AFB. The OSPL at the nearest residential community, Lompoc, about 8 miles away, would be below 100 dB, where structural damage, if any, would occur at a negligible rate.

The majority of missions (99 percent) would utilize medium and small vehicles, for which noise is about 5 dB lower and correspondingly less intrusive.

Figure 4.12-6 Maximum A-Weighted Sound Pressure Level, HLV-L, Vandenberg AFB

Figure 4.12-7 Maximum A-Weighted Sound Pressure Level, MLV-D, Vandenberg AFB

Figure 4.12-8 Maximum Overall Sound Pressure Level, HLV-L, Vandenberg AFB

**Sonic Boom.** Figures 4.12-9 and 4.12-10 show the sonic boom footprints for the HLV-L and MLV-D, respectively. The boom footprints are offshore, in the Pacific Ocean. The footprints are similar to each other (HLV-L is slightly larger than MLV-D), differing primarily in position and orientation along the launch azimuth. The maximum overpressures, in the narrow focal zones, are in the 6- to 8-psf range. Impacts are expected to be minimal.

The two boom footprints shown intersect the Channel Islands, with this intersection being at or near the focal zone. Potential impacts to wildlife are discussed in Section 4.14, Biological Resources.

The two missions shown are at launch azimuth of 181 degrees. Most Concept A launches from Vandenberg AFB would be at azimuths from 174 to 187 degrees, and sonic boom footprints would occur in similar regions. However, 23 percent of Concept A launches would utilize a 142-degree azimuth which is closer to the coast (Figure 4.12-11). The boom footprint intercepts the California coastline. Booms near the shore would be in the 0.5- to 2.0-psf range; booms farther inland would be smaller. The boom amplitudes are comparable to those associated with space shuttle landings at Edwards AFB, but the area is considerably smaller. Because of the small amplitude of the booms, and their infrequent occurrence (about twice a year during peak years), no adverse effects are expected.

Cumulative program noise impacts would be quantified by $L_{dn}$ which has been computed for the busiest years. Values are about 50 dB lower than the AWSPL values seen in Figures 4.12-6 and 4.12-7. As discussed in Section 4.12.1.1.1, this is well within acceptable criteria for any type of land use.

#### 4.12.1.2 Concept B

Noise analysis was performed for two vehicles (one three-engine heavy and one single-engine medium) at Cape Canaveral AS and Vandenberg AFB, and one medium-plus vehicle at Cape Canaveral AS. The selected missions analyzed include: DIV-H (95-degree azimuth), DIV-M+ (95-degree-azimuth), DIV-S (65-degree azimuth) at Cape Canaveral AS and DIV-H (184-degree azimuth) and DIV-M (170-degree azimuth) at Vandenberg AFB.

Noise and sonic boom footprints for the medium vehicles were similar among the missions analyzed, differing primarily according to launch azimuth and location. The results for the specific missions analyzed can be applied to other missions with the same vehicle sizes.

The peak-year launch rates for Concept B (see Table 2.1-8) are 23 per year from Cape Canaveral and 10 per year from Vandenberg. These are considerably less than one per day, the rate at which cumulative program noise metrics such as $L_{dn}$, are meaningful. The following analysis of impacts, therefore, concentrates on single launch events.

Figure 4.12-9 Sonic Boom Footprint, HLV-L, Vandenberg AFB

Figure 4.12-10  Sonic Boom Footprint, MLV-D, Vandenberg AFB

Figure 4.12-11 Sonic Boom Footprint, MLV-A, Vandenberg AFB

#### 4.12.1.2.1 Concept B, Cape Canaveral AS

**In-Flight Rocket Noise.** Figures 4.12-12, 4.12-13, and 4.12-14 show the in-flight maximum A-weighted noise level contours for the three Cape Canaveral AS missions analyzed: heavy, medium-plus, and medium vehicles, respectively. There is slight distortion in the flight direction, but the contours (especially higher levels) are approximately circular. Sound levels for the medium and medium-plus vehicles are about 3 to 5 dB lower than for the heavy vehicle. Heavy vehicles represent approximately 2 percent of the projected Concept B Cape Canaveral AS launches. Conservative impact estimates can be made by examining levels from the louder heavy vehicles.

Referring to Figure 4.12-12, maximum A-weighted levels in the nearest residential communities would be in the 80-dB range. This is comparable to the noise of a passing heavy truck (80 to 85 dBA). Occasional sounds of this level will not cause adverse impact. SEL has been computed for this launch, and is about 18 dB higher than the AWSPL. This corresponds to an effective duration of about one minute. Launch noise is likely to be audible for a longer period, but the total time involved is not great enough to cause substantial impacts.

Figure 4.12-15 shows the OSPL contours for the DIV-H. OSPL in excess of 110 dB, which could cause structural damage claims at a rate of one per 1,000 households, is limited to a radius of approximately 4 miles from the launch site. This area does not contain residential communities, and most of the land area affected is within Cape Canaveral AS and KSC. The OSPL at the nearest residential communities, 8 to 10 miles away, would be in the 100- to 105-dB range, where structural damage claims would occur at a rate of about one per 10,000 households. Damage potential for the smaller vehicles, which would be used for 98 percent of Cape Canaveral AS launches, would be substantially less.

**Sonic Boom.** Figures 4.12-16, 4.12-17, and 4.12-18 show the sonic boom footprints for the heavy, medium-plus, and medium vehicles, respectively. The footprints have the characteristics described earlier. The maximum focus boom amplitude is 7.2 psf for the heavy vehicle. The carpet boom amplitude diminishes rapidly as the vehicle gains altitude. Sonic boom footprints for the other two missions (medium-plus and medium vehicles) are similar to that for the heavy vehicle mission, with comparable maximum overpressures and comparable or somewhat smaller areas.

Most of the boom footprints are below 1 psf at which level no adverse effects would be expected, even over land, from an occasional sonic boom. The maximum overpressures, in the narrow focal zones, are in the 6- to 8-psf range. Since the entire boom footprint is over water, the only potential impact is to wildlife (see Section 4.14, Biological Resources).

Figure 4.12-12 Maximum A-Weighted Sound Pressure Level, DIV-H, Cape Canaveral AS

Figure 4.12-13 Maximum A-Weighted Sound Pressure Level, DIV-M+, Cape Canaveral AS

Figure 4.12-14 Maximum A-Weighted Sound Pressure Level, DIV-H, Cape Canaveral AS

Figure 4.12-15 Maximum Overall Sound Pressure Level, DIV-H, Cape Canaveral AS

Figure 4.12-16  Sonic Boom Footprint, DIV-H, Cape Canaveral AS

Figure 4.12-17  Sonic-Boom Footprint, DIV-MT, Cape Canaveral AS

Figure 4.12-18  Sonic Boom Footprint, DIV-S, Cape Canaveral AS

Cumulative program noise impacts would be quantified by $L_{dn}$ which has been computed for the busiest years. Values are about 50 dB lower than the AWSPL values seen in Figures 4.12-12 through 4.12-14. As discussed in Section 4.12.1.1.1, this is well within acceptable criteria for any type of land use.

#### 4.12.1.2.2 Concept B, Vandenberg AFB

**In-Flight Rocket Noise.** Figures 4.12-19 and 4.12-20 show the in-flight maximum AWSPL for the DIV-H and DIV-M. These contours are very similar to the corresponding contours at Cape Canaveral AS, differing primarily in location and alignment with the launch trajectory. Contours for the DIV-M are approximately 5 dB lower than those for the heavy vehicle.

Considering the DIV-H (which would comprise 27 percent of Vandenberg AFB launches), maximum A-weighted levels in the nearest residential communities would be in the 80- to 85-dB range (see Figure 4.12-19). This is comparable to the noise of a passing heavy truck (80 to 85 dBA). Occasional sounds at this level would not cause adverse impact. SEL has been computed for this launch, and is about 18 dB higher than the AWSPL. This corresponds to an effective duration of the sound of about a minute. Launch noise is likely to be audible for a longer period, but the total time involved is not great enough to cause substantial impacts.

Figure 4.12-21 shows OSPL for the DIV-H. OSPL in excess of 110 dB, which could cause structural damage claims at a rate of one per 1,000 households, is limited to a radius of approximately 4 miles from the launch site. This area does not contain residential communities, and almost all of the land area affected is within Vandenberg AFB. The OSPL at the nearest residential community, Lompoc, about 8 miles away, would be in the 100- to 105-dB range, where structural damage claims would occur at a rate of about one per 10,000 households. Damage potential for the smaller vehicles, which would be used for 73 percent of launches, would be substantially less.

**Sonic Boom.** Figures 4.12-22 and 4.12-23 show the sonic boom footprints for the DIV-H and DIV-M, respectively. The boom footprints are offshore, in the Pacific Ocean. These footprints are similar to each other, differing primarily in position and orientation along the launch azimuth. The maximum overpressures, in the narrow focal zones, are in the 6- to 8-psf range. Impacts are expected to be minimal

The two boom footprints shown intersect the Channel Islands, with this intersection being at or near the focal zone. Potential impacts to wildlife are discussed in Section 4.14, Biological Resources.

Figure 4.12-19 Maximum A-Weighted Sound Pressure Level, DIV-H, Vandenberg AFB

Figure 4.12-20 Maximum A-Weighted Sound Pressure Level, DIV-M, Vandenberg AFB

Figure 4.12-21 Maximum Overall Sound Pressure Level, DIV-H, Vandenberg AFB

Figure 4.12-22  Sonic Boom Footprint, DIV-H, Vandenberg AFB

Figure 4.12-23 Sonic Boom Footprint, DIV-M, Vandenberg AFB

The two missions shown are at launch azimuths of 184 and 170 degrees. Concept B missions would have launch azimuths from 163 to 192 degrees. The booms would remain over the ocean, and differ in their relation to the Channel Islands.

Cumulative program noise impacts would be quantified by $L_{dn}$ which has been computed for the years with the most launches. Values are about 45 dB lower than the AWSPL values seen in Figures 4.12-22 and 4.12-23. This is well within acceptable criteria for any type of land use. However, $L_{dn}$ is not meaningful for events as infrequent as EELV launches, so the primary impact assessment is the single-event analysis presented above.

#### 4.12.1.3 Concept A/B

Under Concept A/B, both Concept A and Concept B launch vehicle systems would be developed, and launches would be conducted as shown in Table 2.1-11. Noise and sonic boom from a given mission would be the same as for that mission for the corresponding Concept A or Concept B vehicle. Impacts would, therefore, be similar to the combined effects discussed in Sections 4.12.1.1 and 4.12.1.2. The total launch rate would be approximately the same, so cumulative noise impacts would also be the same as described in Sections 4.12.1.1 and 4.12.1.2.

### 4.12.2 No-Action Alternative

If the No-Action Alternative were selected, noise and sonic boom exposure would remain as it is under current operations (see Section 3.12). These levels are comparable to those that would result under the Proposed Action.

## 4.13 ORBITAL DEBRIS

### 4.13.1 Proposed Action

This section analyzes the potential impacts of the launch vehicle only. The environmental consequences of payloads that would utilize the EELV system to reach orbit would be addressed under separate NEPA documentation that would be prepared for each of the satellite programs, as required.

**4.13.1.1 Concept A.** Concept A would contribute to the overall space debris problem from the addition, although of limited duration, of intact upper stages to the orbital debris population through fragmentation if other debris were to collide with the intact upper stages. Because liquid propellants would be used, the typical solid rocket motor aluminum oxide dust emission impacts to the space environment would not occur.

The CUS used for HLV-G missions would remain in orbit after shutdown and separation from the payload. The CUS would be safed to vent residual propellants. Liquid hydrogen and oxygen would be vented through the engine valves without lighting the engine. Hydrazine would be vented through the settling thrusters. If propellants were not vented in a controlled manner, they would boil off, which would eventually cause relief valves to open. The resulting uncontrolled venting could cause the CUS to tumble.

Tumbling motion could cause components to break off and become space debris.

The intact upper stages would remain in orbit. However, at the altitudes at which the upper stages of the MLV-D, HLV-L, and MLV-A missions would separate from their payloads, residence time in orbit would be short, and the debris population at altitudes below about 435 miles is not likely to exceed the critical density necessary for collisional growth in debris. At these altitudes, atmospheric drag will typically remove collision fragments before they collide with another object (National Research Council, 1995). However, the upper stage of the HLV-G missions would remain in orbit after shutdown and separation from the payload for an indeterminate time, due to their much higher altitude of release, leaving a total of 8 upper stages in orbit between 2001 and 2020 (see Table 2.1-3).

EELV launch vehicles would be designed to be litter-free: i.e., separation devices, shrouds, and other expendable hardware would separate at a low enough altitude and velocity to keep them from becoming orbital. In addition, stage-to-stage separation devices and other potential debris would be kept captive to the stage with lanyards or other provisions to minimize debris (Office of Science and Technology Policy, 1995). Where possible, the use of new materials on the EELV launch vehicles would reduce the natural degradation and fragmentation that occurs in the harsh environment of outer space (Office of Technology Assessment, 1990).

Two of the principal mitigation measures that would be employed to minimize creation of orbital debris are the expulsion of all propellants and pressurants, and the addition of electrical protection circuits to batteries to preclude electrical shorts and add protection from explosion (Office of Science and Technology Policy, 1995).

The impacts of this principal source of orbital debris from Concept A would be a small, incremental contribution to the existing orbital debris population impacts already occurring under the existing launch programs and discussed in more detail in Section 3.13.

**Mitigation Measures.** The use of operational practices to limit the orbital lifetime of spent upper stages has the potential to mitigate the growth of orbital debris. Wherever possible, mission designers would select orbital parameters that would minimize the creation of additional orbital debris. Other preventive measures could include designing and building the EELV launch vehicle upper stages so that they would resist environmental degradation from atomic oxygen and solar radiation (Office of Technology Assessment, 1990). Using paint less vulnerable to atomic oxygen, for example, would be one possibility (Johnson & McKnight, 1988).

#### 4.13.1.2 Concept B

Under Concept B, the hypergolic upper stage, Delta cryogenic upper stage, and heavy Delta cryogenic upper stage would re-enter the atmosphere, remain intact and burn up as they re-enter the atmosphere. However, the optional third-stage rocket motor for the DIV-S would go into elliptical orbit. The Star 48B would have an explosive composition and weight of 4,431

pounds and would remain in an elliptical orbit of about 100 miles perigee by 19,323 nautical miles for some unknown period of time (McDonnell Douglas, 1997b).

The contribution to the overall space debris problem from Concept B launches would be similar to that described for Concept A. In addition, solid rocket motor emissions from the DIV-M+ and from the Star 48B for the DIV-S would eject aluminum oxide dust into the orbital environment. Larger chunks of unburned SRM propellant or slag may also be released (ignited propellant will not burn completely outside the pressurized confines of the rocket body). However, as described in Section 3.13.3, solid rocket motor particles decay rapidly, and impacts are anticipated to be temporary and minor.

Although the intact upper stages would remain in orbit, at the altitudes at which the upper stages of the DIV-S, DIV-M, and DIV-H missions would separate from their payloads, residence time in orbit would be short, and the debris population at altitudes below about 435 miles is not likely to exceed the critical density necessary for collisional growth in debris. However, the Star 48B would remain in orbit after shutdown and separation from the payload for an indeterminate time, due to its much higher altitude of release (see Table 2.1-8).

The impacts of these two principal sources of orbital debris from Concept B would be a small, incremental contribution to the existing orbital debris population impacts already occurring under existing launch programs. As described for Concept A, EELV launch vehicles would be designed to minimize creation of orbital debris.

**Mitigation Measures.** Mitigation measures would be similar to those discussed in Section 4.13.1.1.

#### 4.13.1.3 Concept A/B

With an estimated 532 launches under Concepts A and B, and 534 under Concept A/B between 2001 and 2020, for an average of just under 27 per year, and a projected peak annual launch rate of 30 missions in both 2006 and 2014, the contribution of Concept A/B to the orbital debris environment would be similar to that described for Concepts A and B.

### 4.13.2 No-Action Alternative

The No-Action Alternative, like any other launch vehicle program, including EELV, would contribute to the orbital debris population, as described for Concept A. It would also contribute to the problem of pollution in outer space that includes determination of paint and insulation, as well as radio-frequency interference and interference with scientific observations in all parts of the spectrum, as noted in Section 3.13. The continued use of older launch vehicles would not present the same opportunities for implementation of the mitigation measures identified below that use of the newer EELVs would allow.

## 4.14 BIOLOGICAL RESOURCES

### 4.14.1 Proposed Action

EELV launch activities with the potential to affect biological resources include loud noises associated with launches including sonic booms, extreme heat/fire in the vicinity of the launch pad, visual impact from the rocket flight path, and vapor from the deluge system associated with launches; the dropping of the booster, payload fairings, and HLV side boosters containing kerosene fuel into the ocean; and use of security lighting at the SLCs.

#### 4.14.1.1 Concept A

**4.14.1.1.1 Concept A, Cape Canaveral AS.** At Cape Canaveral AS, other potential impacts to biological resources from Concept A could occur from ground-disturbing activities at SLC-41, at the assembly facilities construction site, at road intersections that would be modified, and from launch activities at SLC-41 that would affect the biological resources in the extended vicinity. All other facilities would be used as is, or the modifications would be either internal to the building or on a concrete apron outside of the building. Biological resources impacts would not be expected from use of these facilities. Figure 4.14-1 shows the locations of vegetation and sensitive habitat associated with proposed construction at SLC-41.

**Vegetation.** The impact to vegetation from this concept would be minimal. The vegetation at SLC-41 is a mixture of mowed grasses and forbs. The area is currently affected by deposition of HCl and aluminum oxide associated with SRM launches which has resulted in changes to the vegetation community composition by elimination of species sensitive to this effect. Concept A would use only liquid fuels that would not result in acid deposition. The effect to the surrounding vegetation would be beneficial, allowing sensitive species to reestablish if conditions are otherwise

Figure 4.14-1. SLC-41 Vegetation and Sensitive Habitat, Cape Canaveral AS, Florida

appropriate. Removal of 13 acres of road shoulder (mowed grass and Brazilian pepper or fill), wetland scrub (Brazilian pepper/willow mix), and wetland marsh vegetation (mostly cattail marsh) for the construction of the assembly facilities would cause minimal impact to the native vegetation in the area because the area has been previously disturbed and little native vegetation remains. Of the area to be disturbed, only 1.5 acres is in high-quality maritime hammock community that has not been extensively altered by non-native species. However, this is in four small areas and does not account for any notable contiguous habitat on Cape Canaveral AS. Wetland impacts will be discussed under Sensitive Habitats.

Launch effects on vegetation include burning of areas adjacent to the flame trenches and defoliation due to heat. Near-field deposition of debris from launch could also damage vegetation. Areas affected by the deluge vapor cloud could suffer damage from the hot water, but this should not result in any changes that would affect the composition of the vegetation community.

An anomaly on the launch pad could produce extreme heat and fire that could burn adjacent vegetation.

**Wildlife.** Wildlife would be temporarily displaced during the construction of the assembly facilities and other ground-disturbing activities, but the effect to the wildlife population would be negligible because the foraging and nesting habitat that would be impacted is of poor quality, and because adjacent similar habitat is nearby. The most important wildlife impact would occur during the launch activities.

The visual disturbance from pre-launch patrol aircraft overflight often creates more disturbance than the launch itself. The greatest effect of aircraft overflight on animals is from the visual effect of flying aircraft and the sound of its approach. Pre-launch patrol aircraft could temporarily disrupt nesting or feeding birds along the Banana River if flown below 550-feet above ground level (AGL). The 550-foot AGL zone has been shown to account for most wildlife reaction to visual stimuli (Bowles et al., 1991; Lamp, 1987). A report to Congress in 1992 by the U.S. Forest Service reviewed existing literature assessing wildlife impacts from aircraft overflight effects. The report concluded that, although aircraft overflights are initially startling, animals generally adapt by habituating behaviorally and physiologically to the challenge. The report concluded that overflights generally pose negligible risks to wildlife. Therefore, effects of patrol aircraft activities on wildlife are expected to be negligible.

Direct launch effects on the wildlife in the near-field area include incidental death from heat, loss of hearing to various degrees, and temporary disruption of life patterns such as feeding, roosting, and moving about. Because this launch pad is currently being used for rocket launches, resident species sensitive to these disturbances are not likely to be found in the nearby vicinity. Individuals that wander into the area during a launch could be lost, but the effects to the populations nearby from this loss would be negligible.

Wild animals exposed to sudden intense noise can panic and injure themselves or their young; however, this is usually the result of the noise in association with the appearance of something perceived by the animals as a

pursuit threat, such as a low-flying aircraft. EELV launch noise is not expected to cause more than a temporary startle-response because the "pursuit" would not be present. Any loss or injury as a result of this startle response would be incidental and not a population-wide effect. Noise associated with EELV launches may startle many species within the area including the Indian River habitat, but actual losses are expected to be minimal.

Sonic booms created by the launch would occur over the open Atlantic Ocean. The effects of a sonic boom on whales or other open ocean species are not known. Because these sonic booms are infrequent, the marine species in the ocean's surface waters are present in low densities (although spring and fall migration will see periodic groups of migrating whales that follow the coastline), and the sonic boom footprint lies over 30 miles from Cape Canaveral AS, the sonic booms from EELV launches are not expected to negatively affect the survival of any marine species.

A residual amount of hydraulic fluid would remain in the stages when they fall into the ocean. If released, the fluid would be diluted by the vast amounts of sea water and is not expected to affect marine species. The chances that the stages would strike a marine mammal are unlikely due to the extent of the open ocean and the general scarcity of marine mammals in open ocean areas.

An anomaly on the launch pad would also present potential impacts to biological resources due to the possibility of extreme heat and fire, and from percussive effects of the explosion. The explosion could injure or kill wildlife found adjacent to the launch pad or within debris impact areas. Potential fires started from the anomaly could result in a temporary loss of habitat and mortality of less mobile species. On SLC-41, fire would probably be limited to areas adjacent to the launch pad because of the amount of surrounding water. A mishap downrange would occur over the open ocean and would not likely jeopardize any wildlife, given the relatively low density of species within the surface waters of these open ocean areas.

**Threatened and Endangered Species.** Concept A may potentially affect species protected under the federal Endangered Species Act, the Migratory Bird Treaty Act, and the Bald and Golden Eagle Protection Act. Concept A would require compliance with the federal Endangered Species Act of 1973 (16 U.S.C. Sections 1531-1547, et al.) if a federal agency determines that there may be a potential impact to individuals, populations, or habitat of a species listed under the Endangered Species Act. Section 7 of this act requires the proponent federal agency to conduct endangered species consultation prior to irreversible and irretrievable commitment of resources for all federal actions that pose endangered species concerns. Formal consultation is a process between the USFWS and the proponent federal agency that concludes with the USFWS's issuance of an opinion stating whether or not the action is likely to jeopardize the continued existence of a listed species. Although formal consultation has not been initiated with the USFWS, informal consultation will occur through the agency's review of this EIS and the Air Force's request for mitigation planning. The USFWS will evaluate the need for formal consultation for the EELV program.

Two species state-listed as threatened (the golden polypody found in the 1.5 acres of maritime hammock, and the giant leather fern found in the Brazilian pepper/willow community) are expected to be directly affected by the construction activities associated with Concept A in the assembly facilities construction areas. These species are locally abundant and are not listed as rare on Cape Canaveral AS by the Florida Natural Areas Inventory (FNAI) (Smith Environmental Services, 1997). Therefore, the removal of a few individuals by the assembly facility construction would not threaten the range recovery or survival of these species. The area to be disturbed does not contain suitable scrub jay habitat. The American alligator is present at the assembly facility site but is abundant at Cape Canaveral AS and will move away from construction activities. No negative effect is expected to this species from construction activities. Most of the impacts to threatened and endangered species would occur from launch activities.

Four Titan IVB launches were monitored in 1990 from SLC-40 and 41 for effect on the scrub jay. No mortality was observed. All banded individuals were located four hours after the launches, and none showed signs of distress. Each responded to taped scrub jay calls played by investigators. Fire caused by one of the launches did disrupt the scrub jays in the area, who exhibited unusual intensity and duration of scolding behavior. The burned area was avoided by the birds for approximately one month (Larson et al., 1993). The Titan IVB launch vehicle is larger than the EELV; therefore, effects from EELV launches are anticipated to be less than from Titan launches.

Effects to sensitive birds in the nearby estuaries (wood stork and bald eagle) or shorelines (least tern and piping plover) would be similar to those described for wildlife. The launches are not expected to jeopardize the continued existence of any listed species due to the intermittent nature of the disturbance and the ability of wildlife to habituate to disturbance or to return to normal behavior after a startle response.

Manatees are relatively unresponsive to human-generated noise to the point that they are often suspected of being deaf to oncoming boats (although their hearing is actually similar to that of pinnipeds) (Bullock et al., 1980). Since manatees spend most of their time below the surface, and since they do not startle readily, no effect of aircraft or launch vehicle overflights on manatees would be expected (Bowles et al., 1991).

Sea turtle adults and hatchlings are sensitive to artificial incandescent, metal halide, or high-pressure sodium lighting near their nesting beaches. The hatchlings use moonlight on the ocean water for directional guidance after emerging from the nest. If lighting inland is brighter than the moonlight, sea turtles may become confused and head the wrong way, never reaching the water. A new light management plan will need to be developed for SLC-41 that addresses the new lighting configuration to prevent negative sea turtle impacts. Any changes in this lighting would necessitate development of a new light plan and would require consultation with the USFWS under Section 7 of the Endangered Species Act. Cape Canaveral AS has lighting guidelines requiring low-pressure sodium lighting to minimize impacts to the sea turtle population.

Impacts of an anomaly would be as described for Wildlife, and could affect scrub jay habitat.

**Sensitive Habitats.** Wetlands would be impacted from clearing vegetation and constructing assembly facilities in a 15-acre project site. Up to 8.2 acres of these are jurisdictional wetlands that could be impacted. The wetlands are Brazilian pepper/willow (5.2 acres) and cattail (3 acres) wetland communities that have low species richness and are not quality wetland habitats. The loss of these degraded wetland types would be mitigated as required in the appropriate permits.

Activities affecting federal jurisdictional wetlands would be subject to EO 11990 for the Protection of Wetlands and Section 404 of the CWA. Under the CWA, any action that would directly involve the placement of fill material in wetlands or other Waters of the United States is subject to the permit requirements of Section 404. According to U.S. EPA regulations issued under Section 404(b)(1), the permitting of fill activities will not be approved unless the following conditions are met: no practicable, less environmentally damaging alternative to the action exists; the activity does not cause or contribute to violations of state water quality standards or jeopardize endangered or threatened species; the activity does not contribute to significant degradation of waters of the United States; and all practicable and appropriate steps have been taken to minimize potential adverse impacts to the aquatic ecosystem (Title 40 CFR 230.10). Further, the guidelines establish a presumption, which the applicant has the opportunity to rebut, that for non-water-dependent projects, a practical alternative to the filling of wetlands exists.

The SJRWMD Environmental Resource Permit: Surface Water Management Systems (Chapter 40C-4, F.A.C.) is a joint application with the Section 404 Dredge and Fill Permit. Florida's wetland program regulates dredge and fill activities in both fresh and salt waters under their jurisdiction. Jurisdictional waters include surface waters that are present all year and that are greater than 10 acres at a minimum average depth of 2 feet existing throughout the year, and permanent flowing streams and tributaries. Waters adjoining Florida's coastline are also under the state's jurisdiction.

The Banana River, which is adjacent to SLC-41, is manatee critical habitat. However, monitoring of manatee habitat conducted for the space shuttle program has revealed no lasting effect in these waters after a launch has taken place. Therefore, Concept A launches are not expected to adversely affect manatee habitat. The use of liquid propellants would not result in the production of an acid cloud such as that currently produced by Titan IVB launches, resulting in overall beneficial effects to manatee habitat.

Effects to rookeries in the waters surrounding the SLC from launch overflight would be as discussed for Wildlife.

Effects of noise and sonic booms from EELV launches on sensitive habitats would be as described for Wildlife.

An anomaly on the launch pad would frighten nearby sensitive species utilizing the Indian and Banana Rivers, such as birds in rookeries and

neotropical migrants. Manatees, sea turtles and other aquatic species are not expected to be adversely affected by an anomaly.

**Mitigation Measures.** To mitigate the threat to sea turtle nestling survival caused by artificial light sources, only low-pressure sodium lighting fixtures would be used for exterior lighting applications. A new light management plan will be required for SLC-41 construction. Any exceptions to using low-pressure sodium lighting would be coordinated with 45 CES/CEVP and would require Section 7 consultation with USFWS.

Project planning and facility design have been conducted to minimize potential impacts to wetlands through avoidance of direct or indirect disturbance to quality salt marsh wetland communities. Other mitigation measures could include replacement of any wetlands lost at a ratio determined through consultation with the USFWS, the USACE, and the SJRWMD; protection or restoration wetland habitat away from the site for replacement; and monitoring (until habitat becomes well established) of any replacement wetlands in order to determine the effectiveness of replacement and to identify any necessary remedial measures. Avoidance of disturbance could include controlling runoff from demolition and construction sites into drainages through use of berms, silt curtains, straw bales, and other appropriate techniques. Equipment could be washed in areas where wash water could be contained and treated or evaporated. A FONPA will be prepared by the Air Force, as required by EO 11990, and must be signed by SAF/MIQ before activities that could affect wetlands are initiated.
Proposed mitigation measures for wetlands at SLC-41 (Smith Environmental Services, 1997) include providing a 6 to 1 enhancement of existing wetlands through reconnection of the 58-acre “West Marsh Area” to the Banana River by removing the berm, which has already failed in one place. A biological monitoring program could be included in the final mitigation proposal to determine if impoundment restoration goals are being achieved. The removal of the berm would allow the waters to ebb and flow with the tide and allow an exchange of nutrients and marine species. Cattail density would be expected to decrease with the decrease in water level stability, creating a diverse habitat capable of supporting a greater number of species.

**4.14.1.1.2 Concept A, Vandenberg AFB.** At Vandenberg AFB, potential impacts to biological resources from Concept A could occur from ground-disturbing activities at SLC-3W, at the assembly facilities, power substation, USF construction sites, at road intersections that would be modified, and from the 14 launch activities per year at SLC-3W. All other facilities would be used as is, or the modifications would be internal to the building. Biological resources impacts would not be expected from use of these facilities. Figure 4.14-2 shows the locations of vegetation and sensitive habitat associated with proposed construction at SLC-3W.

**Vegetation.**

Vegetation disturbance would be minimal for this concept. Areas that would be disturbed during facility construction are bladed road shoulders, mowed grasses and forbs, and weedy parking areas. The intersections that would be modified do not contain any sensitive plant communities. Launch effects on

vegetation at SLC-3W would be similar to those described for SLC-41 at Cape Canaveral AS, under Vegetation in Section 4.14.1.1.1.

An anomaly on the launch pad could produce extreme heat and fire that would present potential impacts to vegetation. Vandenberg AFB has a high hazard risk for wildfire, which could result from an anomaly.

**Wildlife.** Wildlife would be temporarily displaced during the construction of the assembly buildings and other ground-disturbing activities, but the effect to the wildlife population would be negligible because sufficient suitable habitat is present nearby. The most important wildlife impact would occur during the launch activities. General sonic boom studies and specific studies for the species on Vandenberg AFB and the Channel Islands have been conducted.

Launch noise at levels as low as 80 dBA caused a short-term (30-minute) abandonment of a pinniped haul-out area at Vandenberg AFB (Tetra Tech, 1997b). EELV launches would create noise levels lower than 80 dBA at

Figure 4.14-2 SLC-3W Vegetation and Sensitive Habitat, Vandenberg AFB, California

Purisima Point, but would create launch noise of 85 dBA at Rocky Point. However, short-term haul-out area abandonment has not caused noticeable impacts on the pinniped populations at these locations. Therefore, EELV effects from launches from SLC-3W will be temporary and minor, and are not expected to negatively affect these populations. The two pinniped haul-out areas along Vandenberg AFB's coast (Purisima Point and Rocky Point) are shown on Figure 3.14-4.

The sonic boom footprint of the HLV could affect San Miguel and Santa Rosa Islands with up to 5 psf. However, most of the launches would be with MLVs that could cross Santa Rosa Island with overpressures of up to 6 psf. The trajectories vary, however, so the sonic boom may occur over San Miguel Island, or may miss the Channel Islands completely. Titan IVB vehicles launched from SLC-4E created focused sonic booms over the northern Channel Islands but showed a lack of significant impact to biota of San Miguel Island (Versar, 1991). The Titan IVB launch effects would be similar to those of the HLV launches from SLC-3W, and would be greater than those of the EELV launches. None of the studies summarized in the Final Programmatic EA for the Marine Mammal Take Permit showed injury or pup abandonment during all noise levels and sonic boom overpressures observed from any launch site, although temporary abandonment of haul-out places were of a longer duration for those areas subject to higher noise levels (Tetra Tech, Inc., 1997b).

Launch noise effects on cetaceans appear to be somewhat attenuated by the air/water interface. The cetacean fauna in the area have been subjected to sonic booms from military aircraft for many years without apparent adverse effects (Tetra Tech, Inc., 1997b).

Launches from Vandenberg AFB require a take permit from the NMFS in order to address the harassment of marine mammals under the Marine Mammal Protection Act. Vandenberg AFB has prepared a 5-year draft programmatic take permit (June 1997) consolidating different launch programs that would allow incidental harassment of marine mammals to occur during their associated launches (Appendix H). The take permit final rule should be published by December 1997 (Lagamorsino, 1997). Depending on the approval timing of the permit with the timing and needs of the EELV program, this programmatic permit may meet the take permit requirements of EELV launches.

An anomaly on the launch pad could present potential impacts to wildlife from fire and from the percussive effect of the explosion and falling debris. The Santa Ynez River and Florida and Bear Creeks present optimal riparian habitat for numerous species that could be killed by a fire. Habitat fires could drive mountain lions known to occur near SLC-3 to less optimal habitat, although they would return with habitat regrowth. Debris from a downrange anomaly could impact in the open ocean, the channel, or on the Channel Islands. Given the large amount of area beneath the flight path, it is unlikely that debris would fall in an area heavily populated by wildlife.

**Threatened and Endangered Species.** Impacts to threatened, endangered, or sensitive species from a launch are not expected to jeopardize the

existence of any species. Impacts from EELV launches would be similar to or less than those of Titan IVB launches from SLC-4.

Helicopter security overflights for EELV launches would be similar to those in support of Titan IVB launches. Disturbance of snowy plovers during any security overflights will be addressed during consultation with the USFWS. Although the overall effects are expected to be minor, monitoring of these responses may be necessary for impact mitigation. The Titan IV helicopter activity flushed sanderlings (not a threatened or endangered species), whose agitated behavior in turn flushed snowy plovers.

Between 1973 and 1993, Atlas E/F launches were conducted at SLC-3W. Data from 1991 to 1993 indicate that up to seven pairs of flycatchers nested in this area in spite of these launches (Holmgren, 1995). Therefore, EELV launches are expected to have only a minimal impact on nesting willow flycatchers along the Santa Ynez River. As with other birds, potential impacts to this species are expected from direct, low-altitude overflight of aircraft during pre-launch security patrols.

Least terns at the Purisima site show a lack of observable impact from Titan IVB launches from SLC-4 (Read, 1996a). Snowy plovers flushed at launch but returned to normal behavior soon after (Read, 1996a,b). EELV launches from SLC-3W would have less impact upon these birds because the launch site is farther from the coastline and most of the EELV launch vehicles are smaller than the Titan IVB. The least tern nesting colony near SLC-2 experienced significant impacts from Delta II launches from SLC-2 in 1997 (Read, 1997). EELV would eliminate launches from SLC-2W and would, therefore, reduce the impacts to this nesting area.

Peregrine falcons nest within areas that could be subjected to high noise levels from launch activities. This exposure could cause lower nesting success of peregrines if launches were to occur during the nesting season, as supported by studies outlined in Appendix F.

Launch noises could disrupt the feeding and roosting activities of brown pelicans off the coast of Vandenberg AFB by causing a startle effect.

Potential impacts from launch noises to the unarmored threespine stickleback and the tidewater goby are expected to be minimal because noise is readily and well attenuated by water. Launch noises may potentially startle the red-legged frog, but the effect is expected to be temporary. Replacement of existing launch vehicles that use solid rocket motors with the EELV would result in a beneficial impact to these aquatic species because EELV launches would not result in acid deposition in aquatic habitats, as launches using solid rocket motors do.

The southern sea otter is found off the coast of Vandenberg AFB in a small breeding colony off Purisma Point near SLC-2. Larger populations are found primarily to the north of the base with an increase in sightings of sea otters along Vandenberg AFB's north shore. Concept A would eliminate launches from SLC-2W, which is situated on North Vandenberg AFB. Launches from South Vandenberg AFB are less likely to adversely affect the sea otter, and could result in overall beneficial effects to the species.

Impacts of an anomaly would be as described for Wildlife. In addition, the endangered beach layia (plant) is 1.3 miles west and could be affected by a fire.

**Sensitive Habitats**. A willow wetland has been identified on SLC-3W. Construction plans of a road may affect the edge of the wetland (approximately 0.03 acre) closest to the fence. If this wetland is affected, consultation under Section 404 and a FONPA, as required by EO 11990 would be conducted, as described for Cape Canaveral AS. The Channel Islands are also a sensitive habitat and have been addressed under Wildlife. Vandenberg AFB is a significant shorebird migration/wintering area, and these birds are disturbed by launches from South Vandenberg AFB to as far north as SLC-2W. However, launches occur from SLC-2W, and the shore birds continue to use the area.

SLC-3W is close to known major overwintering monarch butterfly sites in Spring Canyon. It is 1.25 miles south of and downwind of the launch site, just south of SLC-4. Hazardous byproducts from launch are not expected from the liquid fuels used for this concept. A benefit to the butterflies would occur from eliminating launches using solid rocket motors that emit HCl at SLC-4. Therefore, no impacts to butterflies are anticipated.

White-tailed kite foraging habitat is over the grasslands and coastal sage scrub in the area. Although launches could be disruptive to foraging activities, the launches are expected to cause only a temporary startle effect and would not negatively affect the kite population.

Impacts to seabird nesting and roosting areas are discussed under the preceding Threatened and Endangered Species section.

Impacts from an anomaly would be as described under Vegetation and Wildlife. Burton Mesa Chaparral, a state-sensitive plant community 2 miles inland, supports sensitive bird species, including Bell's sage sparrow and Southern California rufous crowned sparrow. These species could be adversely affected by a wildfire at Vandenberg AFB. Burning of the butterfly trees would make them unsuitable for the overwintering monarchs. Burning of nesting habitat along Bear Creek may lower the reproductive success of the species that use this habitat.

**Mitigation Measures.** Studies conducted before, during, and after Titan IVB launches from SLC-4 in May and December 1996 have resulted in several recommended mitigations for future monitoring of sensitive species. Cumulative effects of multiple launches could cause a particularly sensitive species to abandon the area or have low breeding success. Monitoring could help identify these effects, if they occur.

All space launch effects on marine mammals would be monitored according to the monitoring measures that have been proposed by the take permit application, if adopted.

A Biological Opinion for Titan IVB launches from SLC-4 requires monitoring of sample populations of western snowy plovers, California least terns, peregrine

falcons, and southwestern willow flycatchers before, during, and after launches during the breeding season and monitoring of sample populations of wintering western snowy plovers during the non-breeding season. No impacts to their continued use of habitat areas or nesting success of wintering and nesting snowy plovers has been observed, although they may flush at the sight and sound of a launch. However, impacts to snowy plover from SLC-3 launches have not been studied, and SLC-3 launches would result in more direct overflight of snowy plover habitat than launches from SLC-4. Therefore, monitoring of snowy plovers is warranted (Read, 1997). Pre-launch helicopter security patrols cause the most disruption to snowy plover behavior, so every effort must be made to ensure that these patrols do not unduly disturb this species (Read, 1996a). This would be accomplished through coordination with Environmental Management at Vandenberg AFB in order to apprise the security overflight personnel of the areas sensitive to direct overflight.

Least terns at the Purisima site also show a lack of observable impact from Titan IVB SLC-4 launches. However, monitoring of these least terns would be required because there are no data from launch effects on least terns from SLC-3 launches. If least terns re-establish a nesting site near the Santa Ynez River, terns at this location should be monitored for launch-related effects.

Pre- and post-launch monitoring of peregrine falcons could be conducted during the incubation and fledgling periods to note any breakage of already thin eggshells. Environmental Management would identify nest sites and nesting phases of concern during each year as identified through their ongoing sensitive species status monitoring program.

Possible wetland mitigations would be required if the edge of the SLC-3 wetland is affected by construction.
Impacts of fire caused by an anomaly would be minimized through the fire response practices established through Vandenberg AFB Fire Regulation 92-1. Brush management in the areas around SLC-3 would keep the heat of the fire lower to help preserve root systems and facilitate recovery after a fire.

#### 4.14.1.2 Concept B

Under Concept B, proposed activities that could potentially affect biological resources include ground disturbance during facility construction and modifications; loud noises, including sonic booms, extreme heat/fire in the vicinity of the launch pad, the overflight by prelaunch patrol aircraft and the rocket, and vapor from the deluge system associated with launches; the impact of the common core booster, payload fairings, and HLV side boosters into the ocean; use of security lighting; and maintenance of a clear zone at the SLCs.

**4.14.1.2.1 Concept B, Cape Canaveral AS.** At Cape Canaveral AS, potential impacts to biological resources from Concept B could occur from ground-disturbing activities during the construction of the two launch pads at SLC-37, at the HIF construction site, and along new utility corridors, from dredging activities at the roll on/roll off dock, and from launch activities at SLC-37. All other facilities would be used as is, or the modifications would be

either internal to the building or on a concrete apron outside of the building, and would not entail ground disturbance. Therefore, biological resources impacts would not be expected from use of these facilities. Additional potential impacts to biological resources from commercial activities include adverse effects of acid deposition resulting from use of solid rocket motors (commercial launches only). Figure 4.14-3 shows the locations of vegetation and sensitive habitat associated with proposed construction at SLC-37.

**Vegetation.** The impacts to vegetation would include clearing 60 to 70 percent of the scrub within the SLC-37 perimeter fence. Scrub also may be cleared along the road leading to SLC-37 in order to install a nitrogen gas line. However, this vegetation comprises mostly Brazilian pepper. Removal of this weedy, aggressive species would be beneficial to the ecosystem. Installation of the wastewater and electrical line would require the clearing of undisturbed scrub to create the utility corridor. Although clearing of scrub can provide an opportunity for invasion of weedy species, if weedy species are controlled, clearing dense scrub areas is beneficial to the plant community because it allows new growth to occur. Vegetation impacts associated with clearing scrub for construction of the HIF or utility lines would be compensated for under the habitat compensation plan for scrub jay habitat impacts (see Threatened and Endangered Species in this section).

Effects on vegetation from launches associated with some commercial launches could include burning of areas adjacent to the flame trenches and

Figure 4.14-3  SLC-37 Vegetation and Sensitive Habitat, Cape Canaveral AS, Florida

defoliation caused by heat. Near-field deposition of launch debris could also damage vegetation around the launch pad, including dune scrub and coastal scrub vegetation. The effects to the vegetation communities in the region from EELV launches are expected to be minor because only a very small portion of available habitat would be affected.

The solid rocket propellant associated with some commercial launches produces an acid cloud that can damage vegetation when it settles to the ground. The effects of the acid cloud produced by space shuttle launches from KSC are well documented and are summarized below. The effects of Concept B commercial launches would be less than those from space shuttle launches because the smaller solid rocket motors associated with EELV would produce smaller acid clouds.

Space shuttle launches cause local environmental impacts in the areas surrounding the launch pad. Exhaust from the solid rocket boosters combines with deluge water to create an acidic cloud (American Institute of Aeronautics and Astronautics, 1993). Primary components of this cloud include water, carbon dioxide, aluminum oxide, and hydrochloric acid (National Aeronautics and Space Administration, 1985). The hydrochloric acid and aluminum oxide are the components that affect the biota. A ground cloud that is approximately $1.4 \times 10^6$ $m^3$ in volume forms within the first 10-12 seconds of a launch. The cloud then cools, rises, and begins to move away from the launch site with prevailing winds.

Near-field deposition results in vegetation damage and temporary increases in available metals in water and soils. Effects of repeated near-field deposition include loss of sensitive species, decline in shrub cover, and resultant erosion. Hydrochloric acid and aluminum oxides from space shuttle launches were found to cause acute vegetation damage in an area of about 54 acres near the launch pad; however, effects from EELV launches would be less than described for the space shuttle. The changes include loss of sensitive species, loss of plant community structure, reduction in total cover, and invasion by weedy species (National Aeronautics and Space Administration, 1985). Acute damage to strand and dune vegetation, especially to sensitive species, was noted from the space shuttle at distances of up to 0.75 mile northeast of the launch pad, but the vegetation recovered within 6 months. Although there are increased levels of metals in the water (i.e., lagoon and Banana River system) and soils, cumulative decreases in pH have not occurred because local soils and surface water are well buffered.

Far-field deposition results from the launch cloud rising and moving with the prevailing winds. No cumulative effects of far-field deposition have been identified, although acid spotting on vegetation and other structures has been observed. Far-field acidic and dry aluminum oxide fallout from the launch cloud of the space shuttle was observed at locations of up to 14 miles from the launch pad and caused vegetation spotting over 1 to 5 percent of the leaf surface area, but no plant mortality or community damage resulting from far-field deposition has been identified (National Aeronautics and Space Administration, 1985). Effects of EELV launches would be lower than those of the space shuttle; therefore, no impacts are expected.

Impacts to vegetation from an anomaly would be damage from extreme heat and fire, as described for Concept A. Overgrown scrub would benefit from the clearing of the dense vegetation. Hydric hammock and mangroves would be negatively affected. Additionally, the cloud of airborne HCl released would be larger than under normal launch conditions because it would all be generated at ground level. Because the EELV would emit smaller amounts of HCl, the effects of EELV launches would be expected to be less than those described for space shuttle launches.

**Wildlife.** Wildlife would be temporarily displaced during construction and other ground-disturbing activities, but the effect to the wildlife population would be negligible because sufficient suitable habitat is available nearby. The most important wildlife impact would occur during the launch activities.

The visual disturbance, direct launch effects, intense noise, and general wildlife effects from sonic booms would be as described in Section 4.14.1.1.1.

NASA conducted a thorough evaluation of the effects of rocket systems that impact in seawater. This study considered sounding rockets, which have a solid propellant. It was concluded that the release of missile-related hazardous materials into seawater would not be significant. The study determined that materials would be rapidly diluted and, except in the immediate vicinity of the debris, would not be found at concentrations identified as producing any adverse effects (U.S. Army Space and Strategic Defense Command, 1994; National Aeronautics and Space Administration, 1994). Any area affected by the release of the propellant as the rubber matrix dissolves would be relatively small due to the size of the rocket motor or propellant pieces relative to the quantity of water. Sensitive marine mammals are widely scattered, and the probability that one would encounter or ingest the slowly decaying propellant or a toxic chemical/seawater solution is remote (U.S. Department of the Navy, 1996).

Solid propellant causes an acid cloud during launch. Fish kills have been noted from near-field space shuttle launch effects (Knott et al., 1983, Milligan and Hubbard, 1983, Hawkins et al., 1984). Although the effects from EELV launches are not expected to be as severe as for the space shuttle launches because of the smaller acid cloud that would be produced, temporary increases in acidity in the surface waters surrounding the launch site are expected, and fish kills could occur.

The effects from an anomaly on the launch pad or downrange would be as described for Concept A. Wildlife in any burn areas could be displaced, killed, or otherwise affected by such a fire. Impacts from acid deposition would be similar to those described previously.

**Threatened and Endangered Species**. Concept B may potentially affect species protected under the federal Endangered Species Act, the Migratory Bird Treaty Act, and the Bald and Golden Eagle Protection Act. Compliance with these acts would be required as described in Section 4.14.1.1.1.

SLC-37 is near a sea turtle nesting beach. Security lighting at the SLC should be low-pressure sodium fixtures in accordance with the 45 SW exterior

lighting policy. A Light Management Plan would need to be prepared in accordance with the USFWS requirements for that complex.

SLC-37 is also adjacent to the beach, which is habitat for the southeastern beach mouse, a species federally listed as threatened. The flame duct points directly over 0.25 to 0.5 acre of this habitat and may impact this species during a launch by direct mortality of individuals from fire and heat, especially during night launches, when this species is active.

Gopher tortoises were found on SLC-37 and the HIF site. Their burrows are in areas planned for construction and would be impacted by the action. Those not directly impacted by construction would be impacted when the launches begin. Other listed species that may reside within these burrows include the eastern Indigo snake, the beach mouse, and the gopher frog. These species could also be affected by construction or launch effects.

Clearing the 14-acre HIF site could impact numerous species, including the Florida scrub jay and those mentioned for SLC-37. The numbers of scrub jays are in a regional decline as a result of habitat loss and degradation due to fire suppression (Myers, 1990; Cox, 1987; and Cox, 1984). In a 1997 Florida scrub jay survey that determined the presence, density, and distribution of Florida scrub jays on the HIF site and in the SLC-37 area, only one pair was observed across the road from the HIF, although the HIF area is most likely part of the territory (Earth Tech, 1997). The areas along road shoulders that would be cleared to accommodate utility lines contain mostly Brazilian pepper, an introduced, aggressive, weedy species. Clearing this vegetation would provide openings in the scrub that would support scrub jay foraging.

Unless a scrub jay is directly in line with the flame trench, immediate mortality of scrub jays seldom occurs from current Titan IVB launches at SLCs 40 and 41. Some road mortality has been noted for scrub jays that occupy territories along the highway (Larson et al., 1993). In the 1997 scrub jay survey of SLC-37, four groups of birds were noted around the perimeter of the SLC (Earth Tech, 1997). Given the distribution of habitat and known scrub jay pairs within the area, it is expected that use of the SLC will not greatly impact Florida scrub jay territories. Project-related clearing of the SLC area inside the perimeter road will only serve to increase areas available for acorn caching. Fire and heat from launches would reduce cover in the area immediately surrounding the SLC, which would be favorable for the scrub jay. The direct impacts of the launch noise and flame could cause incidental mortality; however, because scrub jay territories are maintained at SLCs 40 and 41 during launches without an observable adverse effect on the population, no adverse effect on scrub jays at SLC-37 would be expected. No noticeable effects on scrub jays from the acid cloud were observed from these launches.

The effects from an anomaly would be as described for Concept A. The surrounding scrub jays would be temporarily displaced by a fire. Scrub jay nests could be destroyed if fires occur during the nesting season, but the scrub jays would experience a long-term benefit from the opening up of overgrown habitat as the result of fire and the regrowth of the burned habitat.

Other species that could be affected by an anomaly are the beach mouse and gopher tortoise commensal species, such as the eastern indigo snake, which would be affected by the blast or by the fire and smoke. Acid cloud effects on vegetation and wildlife would be less than those described for the space shuttle.

**Sensitive Habitats.** Wetlands would be impacted from construction of facilities within SLC-37 and the HIF (ENSR Corporation, 1997c). At the HIF site, 0.68 acre of jurisdictional wetlands could be filled during construction. This wetland is a swale surrounded by scrub and has been impacted by changes in the natural hydrology.

At SLC-37, wetland delineations have identified a jurisdictional drainage ditch wetlands that surrounds the SLC and empties into the Banana River. New utility corridors to the SLC may cross the ditch, and their installation would constitute a wetland impact. Within the SLC, 7 acres of vegetated drainage ditches connect to the jurisdictional wetland ditch surrounding the SLC. Approximately 2 acres of these surface waters may be impacted as a result of proposed development. Impacts to these waters, as well as to the wetlands, would require the appropriate permits, as described in Section 4.14.1.1.1.

Contact with the acid cloud could be expected to irritate or annoy birds in the rookeries along the Banana River; however, solid rocket motor launches occur in the vicinity, and animals sensitive to these launches would most likely have moved elsewhere. Manatee critical habitat is not expected to be adversely affected by acid deposition because of the diluting effects of the water. An anomaly could cause effects as described under Concept A. Although fire could benefit overgrown coastal scrub or wetlands by clearing duff and recycling nutrients, uncontrolled burns could adversely affect species using these habitats if fire occurs during sensitive seasons, such as Florida scrub jay nesting season. An anomaly could cause an acid cloud in the vicinity of the launch pad; however, effects would be less than those described for space shuttle launches.

**Mitigation Measures.** Mitigation for sea turtle nestling lighting impacts would be as described in Section 4.14.1.1.2.

Impacts to the southeastern beach mouse may be mitigated though a trapping effort to relocate the mice and through habitat restoration (clearing scrub) near the site. The final methods would be determined through formal consultation with the USFWS.

Any construction activities affecting Florida scrub jay habitat would be coordinated with USFWS. Specific mitigations may be developed during Endangered Species Act Section 7 consultation, and could include the following measures. To the extent possible, construction activities would occur between July 1 and February 29 to avoid the nesting season. If the nesting season cannot be avoided, surveys should be conducted one to two days prior to construction to identify any nests present in or around the construction site. If no nests are present in the construction area, or within 50 to 75 feet surrounding the area to be cleared, construction may proceed. Vegetation clearing would be limited to that absolutely necessary for the project (U.S. Air Force, 1993a). Scrub clearance would be followed by habitat

compensation mitigation activities as outlined in the Scrub Jay Habitat Compensation Plan for Cape Canaveral AS, which requires restoration of 3 acres of scrub to compensate for the loss of each acre of scrub jay habitat. Areas that are extremely degraded may also be planted with live oak, myrtle oak, and Chapman's oak seedlings. A 5-year monitoring program, including oak seedling replacement and weed control as required, would accompany any scrub jay habitat restoration activities (U.S. Air Force, 1993a). Removal of abandoned pavement and revegetation of these areas with scrub, and the clearing of densely vegetated areas previously containing scrub jay habitat, are some of the actions considered for compensation. Disturbed road shoulder areas should be replanted with native grasses, not with sod, to allow the scrub jays to utilize small patches of open sand for acorn caches.

The clearing of overgrown scrub jay habitat could also be considered as wetland restoration because it would benefit the swale wetlands in the area. Swale-overgrown vegetation would be cleared to compensate for wetlands impacted by the project at a ratio of 1 to 1. The selected mitigation site is adjacent, south of SLC-37. Use of a hydroaxe for brush clearing, followed by a prescribed burn, is recommended. The proposed parcel contains 5 acres of degraded wetlands and will exceed mitigation requirements set by the USACE. Mitigations compensating for drainage ditch wetland impacts will not be required.

Prior to construction, a biological survey would be conducted to identify existing gopher tortoises on the site. These tortoises would be trapped and removed from the area to the scrub jay mitigation site after all mitigation activities are complete, prior to the clearing of any construction site. Necessary permits for handling tortoises would be obtained from the Florida Game and Freshwater Fish Commission. Additional mitigative actions, if necessary, would be identified by the USFWS through the Section 7 consultation process (U.S. Air Force, 1993). Gopher tortoise burrows create habitat for a number of sensitive species; relocation of the tortoises would facilitate creation of habitat for these species at other locations. Relocation of the species that use the tortoise burrows is not always feasible but could be conducted as appropriate.

Mitigation parameters for wetland impacts would generally be as described in Section 4.14.1.1.2. Enhancement of degraded wetlands may be required as mitigation for wetlands impacts, at a ratio of 1 to 1. The site for wetlands mitigation would be the same as for the scrub jay habitat mitigation (ENSR Corporation, 1997c).

Monitoring of pre- and post-launch effects of acid cloud deposition on the nearby resident plant and animal species could provide information concerning long-term effects and potential protective measures.

**4.14.1.2.2 Concept B, Vandenberg AFB.** At Vandenberg AFB, potential impacts to biological resources from Concept B could occur from ground-disturbing activities at and adjacent to SLC-6, from dredging activities at the boathouse dock, and from launch activities from SLC-6. All other facilities would be used as standing, or the modifications would be either internal to the building or on a concrete apron outside of the building. Biological resources impacts would not be expected from use of these facilities.

Figure 4.14-4 shows the locations of vegetation and sensitive habitat associated with proposed construction at SLC-6.

Some of the launches would utilize solid propellants whose combustion produces an acid cloud at launch.

**Vegetation.** Vegetation disturbance would be minimal for this concept. Areas planned for facility disturbance are either bladed road shoulders, mowed grasses and forbs, or weedy parking areas. Vegetation would be affected by the installation of a fence at SLC-6 and by direct effect of the launches (i.e., burning, defoliation, near-field deposition).

Figure 4.14-4  SLC-6 Vegetation and Sensitive Habitat, Vandenberg AFB, California

A fence would be constructed through native vegetation. For security (visibility) purposes, vegetation would be cleared for 30 feet on either side of the fence, for a length of 200 feet. The vegetation along a portion of this fence is a pristine coastal sage scrub community with former Category 2 plants such as Indian paintbrush and dudlea. The vegetation could be affected by fence construction. Effects to vegetation from launches, acid cloud deposition, and launch anomalies would be the same as those summarized under Concept A for Vandenberg AFB (specific vegetation effects) and under Concept B for Cape Canaveral AS (acid cloud effects).

**Wildlife.** Wildlife would be temporarily displaced during construction and other ground-disturbing activities, but the effect to the wildlife population would be negligible because sufficient suitable habitat is available nearby. The primary effects to wildlife would occur during the launch activities.

The impacts to open-ocean species from direct ocean impacts, and to general wildlife species from pre-launch control aircraft overflights and direct effect of launches, would be similar to those described under Concept A for Vandenberg AFB. In addition, general sonic boom studies and specific studies have been conducted for the species on Vandenberg AFB and the Channel Islands.

Physiological and behavioral response to sonic booms and launch noise on birds and pinnipeds of California would be similar to those described in Section 4.14.1.1.3. SLC-6 is farther from the Point Sal and Purisima Point haul-out and nesting areas than SLC-3, although it is directly adjacent to the Rocky Point site. However, birds and pinnipeds continue to use these areas near SLC-2, even though launches are conducted there, so no long-term adverse effects on these species or their habitats are anticipated from EELV launches from SLC-6.

The permitting requirement for the harassment of marine mammals is described in Section 4.14.1.1.3.

The area by the boathouse designated for dredging was dredged in the mid-1980s. Clearing of this area could remove algae (seaweed) or surfgrass and cause siltation impacts to adjacent invertebrates. Although some individuals may be removed or buried, these invertebrate populations are not expected to be adversely affected by this siltation. Fish species present near Point Arguello would leave the area during dredging activities, as would any seals, sea lions, or sea otters that may be visiting the channel. Long-term effects to these species are not expected.

The deposition of dredged material would cause the greatest impact. When the site is chosen for deposition, it should be inspected for species impacts before disposal is implemented.

Solid propellant causes an acid cloud during launch. Fish kills have been noted from near-field space shuttle launch effects (Knott et al., 1983, Milligan and Hubbard, 1983, Hawkins et al., 1984). Although the effects are not expected to be as severe as those from the space shuttle because of the smaller acid cloud that would be produced by the EELV, temporary increases in acidity in the surface waters surrounding the launch site would be

expected, and fish kills could occur. Acid deposition in the nearby Cañada Honda Creek could have adverse impacts on aquatic species that live there. A beneficial effect of terminating solid rocket motor launches under current programs would be cessation of acid deposition effects on sensitive least tern and snowy plover nesting areas near SLC-2.

An anomaly would cause effects as described for Concept A. Cañada Honda Creek and its associated wildlife is closer to SLC-6 than to SLC-3 and could be adversely affected as well. Acid cloud deposition would be more intense for an anomaly than for a nominal launch, and could affect species in Cañada Honda Creek or Jamala Creek.

**Threatened and Endangered Species.** Helicopter security overflight effects in support of EELV launches would be as described in Section 4.14.1.1.3.

Effects of SLC-3 launches and low-altitude overflight of aircraft during pre-launch security patrols on willow flycatchers along the Santa Ynez River would be minimal, as described in Section 4.14.1.1.3. SLC-6 is located farther from the Santa Ynez River than SLC-3W, and launches from SLC-6 would be expected to have less impact on this species than launches from SLC-3W.

Least terns at the Purisima site show a significant impact from Delta II launches from SLC-2. Effects of EELV launches from SLC-6 would not be as great because the launch site is located much farther from the Purisima site than SLC-2. The EELV program would benefit the Purisima Point least tern population because launches from SLC-2 would be terminated.

General impacts to peregrine falcons from launch activities are described in Section 4.14.1.1.3. Because SLC-6 is much closer to the peregrine's nesting area than SLC-4, the potential for impacts from EELV launches from SLC-6 is greater than for Titan IVB from SLC-4. Launching during the nesting season could cause the nearby nests to fail, due to possible nest abandonment or from a startle response that could injure or kill the young.

Potential general impacts from launch noises to the unarmored threespine stickleback and the tidewater goby are described in Section 4.14.1.1.3.

The negligible impacts on southern sea otter from South Vandenberg AFB launches are described in Section 4.14.1.1.3.

The acidic emissions caused by solid rocket boosters could affect the shallow Cañada Honda Creek. The tidewater goby, the unarmored threespine stickleback, and the red-legged frog inhabit the creek and could be adversely affected by acidification of the water. These impacts would be similar to those experienced under the current launch programs.

Impacts from an anomaly would be as described under Wildlife. Sensitive species residing in the surrounding cliffs could be injured or killed from the explosion.

**Sensitive Habitats.** An arroyo wetland has been identified on SLC-6. Construction of a security fence would disturb this wetland, affecting a wetland area approximately 25 feet long by 60 feet wide (0.03 acre).

Disturbance of the wetland would likely require a Section 404 Fill Permit and a FONPA. HCl and aluminum oxide deposition could harm species living in the wetland as described under Vegetation and Wildlife.

The Channel Islands are also a sensitive habitat; potential impacts to them have been discussed under Wildlife. Shorebird nesting occurs along the coast of Vandenberg AFB and is disturbed by launches from South Vandenberg AFB to as far north as SLC-2W. However, launching occurs out of SLC-2W, and the shore birds continue to use the area; consequently, no long-term adverse impacts from EELV launches would be expected.

The dredging of the boathouse channel would have to be authorized by Section 10 of the Rivers and Harbors Act of 1899, Section 404 of the CWA, and Section 103 of the Marine, Protection, and Sanctuaries Act. These laws require permits authorizing activities in or affecting navigable Waters of the United States, the discharge of dredged or fill material into Waters of the United States, and the transportation of dredged material for the purpose of dumping it into ocean waters. This site was originally dredged in the mid-1980s and was authorized to be maintained at 12.4 feet below MSL through June 1989, although plans as stated on the permit include dredging as needed through 1998. The spoil disposal site in the ocean was a deep canyon with a high degree of instability where land slumped off the canyon walls naturally and fell to the canyon bottom. It was thought that additional sand debris would not greatly impact the canyon's ecology (U.S. Air Force, 1982b). Areas of biological importance, such as spawning grounds, are far from the canyon and are not thought to be affected by the disposal. In the latest permit (1988), the dredged sand was to be trucked to a borrow site located along the coastal bluffs at Point Pedernales. Although it has not yet been determined whether the 20,000 cubic yards of spoils will be disposed on dry land as stipulated in the 1988 permit, or in the ocean as was conducted in the mid-1980s, the amount of dredging and dredged materials is approximately one-third of that originally dredged and is not expected to cause a serious impact.

Butterfly trees are present near SLC-6, and the visiting monarch butterflies could be affected by the acid cloud if a launch occurs when the butterflies are congregating (November through February). Offshore or southerly wind directions during the launch could blow the acid cloud away from the butterfly trees; onshore or northerly winds could blow the cloud directly over the trees.

Impacts from an anomaly would be as described for Concept A, and could affect sensitive species and habitat along Cañada Honda Creek and in the cliffs surrounding SLC-6.

**Mitigation Measures.** Impacts to the native upland vegetation at SLC-6 for the fence installation would require replacement at a ratio of 3 to 1, consistent with the Santa Barbara County policy for impact mitigation (Gillespie, 1997).

Numerous special conditions were added to the original dredge permit for the boat dock. These conditions included pre-, during, and post-surveys of flora and fauna to determine if the dredging caused changes in the rocky inter- and subtidal, and sandy regions; providing a qualified biologist on site to ensure that a minimal amount of physical impacts occur during the dredging

to mammals and birds; notifying appropriate organizations of planned activities; and planting red abalone in rocky habitat adjacent to the boathouse area.

Studies conducted before, during, and after Titan IVB launches from SLC-4 in May and December 1996 resulted in several recommended mitigations for future monitoring of sensitive species. These are discussed in Section 4.14.1.1.3.

Mitigation measures that could be implemented for the wetland that would be disturbed by the SLC-6 fence installation are summarized in Section 4.14.1.2.2. Specific mitigation requirements for wetland impacts on Vandenberg AFB may include creation of new wetlands rather than restoration of existing wetlands. Wetland mitigations required for this fence installation would be determined during the permit application process for the Section 404 CWA wetland fill permit, and a FONPA will be prepared by the Air Force, as required under EO 11990.

Monitoring of water quality in Cañada Honda Creek should be continued to assess effects to sensitive species and habitats.

#### 4.14.1.3 Concept A/B

**4.14.1.3.1 Concept A/B, Cape Canaveral AS.** Impacts from launch effects and anomalies would be as similar to the combined effects described for Concepts A and B because most of the launch effects are measured more by single events than by number of launches, providing the launches are spread apart to allow wildlife to resettle and acid deposition to dissipate. Construction effects would also be the combined effects of both concepts and would be greater than for either concept individually.

Impacts to vegetation and wildlife from this concept's construction requirements would be similar to the combined effects described for Concepts A and B. No regionally sensitive vegetation community or wildlife would be affected in important amounts.

Impacts to threatened or endangered species would include effects described for both Concept A and B to the Florida scrub jay, the Florida beach mouse, the American alligator, and two state-listed plants. However, these effects are not considered significant for any single species. Concept A/B could disturb 0.68 acre associated with the SLC-37 HIF site and 8.2 acres at the assembly facility near SLC-41, resulting in disturbance of a total of 8.88 acres of wetlands under Concept A/B. Mitigations would be the same as those described in Sections 4.14.11.1 and 4.14.1.2 for Concepts A and B.

**4.14.1.3.2 Concept A/B, Vandenberg AFB.** Impacts from construction activities, launch operations, and anomalies would be a combination of the effects described for Concepts A and B. Concept A/B activities could disturb 0.03 acre associated with the SLC-3W site and 0.03 acre near SLC-6, resulting in disturbance of a total of 0.06 acre of wetlands under Concept A/B. Mitigations would be the same as described for Concepts A and B in Sections 4.14.1.1 and 4.14.1.2.

### 4.14.2 No-Action Alternative

#### 4.14.2.1 Cape Canaveral AS

The solid rocket motors used in some existing launch vehicles produce an HCl/aluminum oxide cloud that affects the nearby ecosystem as described for Concept B in Section 4.14.1.2.1. In addition, direct effects from launches on vegetation at these SLCs (e.g., burning of vegetation, defoliation from heat) and impacts to wildlife from launch noises, pre-launch control aircraft and rocket overflights, sonic booms, and impact of rocket debris in the open-ocean area from these launch programs would continue and would be similar to the impacts described for Concepts A and B.

#### 4.14.2.2 Vandenberg AFB

The solid rocket motors used in some existing launch vehicles produce an HCl/aluminum oxide cloud that adversely affects the nearby ecosystem. The northern site would continue to operate launches in a location adjacent to sensitive species, including the endangered California least tern, the brown pelican, the threatened western snowy plover, and the southern sea otter, although this northern location avoids most impacts to the Channel Islands. An anomaly at this location could potentially affect the sensitive adjacent species from heat, fire, and the percussive effects of the explosion and falling debris. In addition, direct effects from launches on vegetation at these SLCs (e.g., burning of vegetation, defoliation from heat), and impacts to wildlife from launch noises, pre-launch control aircraft and rocket overflights, sonic booms, and impact of rocket debris in the open-ocean area from these launch programs would continue and would be similar to the impacts described for Concepts A and B.

## 4.15 CULTURAL RESOURCES

### 4.15.1 Proposed Action

#### 4.15.1.1 Concept A

##### 4.15.1.1.1 Concept A, Cape Canaveral AS

**Prehistoric and Historic Archaeological Resources.** Concept A at Cape Canaveral AS encompasses portions of land around SLC-41 that are under the jurisdiction of either Cape Canaveral AS or the KSC. Both installations have completed archaeological surveys and inventories that satisfy the requirements of Section 110 of the NHPA. Each installation has identified numerous prehistoric and historic sites and established archaeological sensitivity zones for those areas not intensively surveyed (New South Associates, 1996). Cape Canaveral AS cultural resources managers have consulted with the Florida SHPO, and the SHPO has concurred that ground-disturbing activities that take place outside of recorded site boundaries and the sensitivity zones require no additional study (see Appendix I). KSC cultural resources policy directs that additional studies be conducted when direct ground-disturbing activities have the potential to affect archaeologically unevaluated areas.

There are no National Register-listed or -eligible prehistoric or historic archaeological sites or archaeologically sensitive areas within the direct ground disturbance footprints for Concept A (i.e., areas of facility and utility line construction and roadway modification) within the ROI. Recent archaeological studies encompassing the ROI for the two proposed assembly facilities indicate that two previously identified mounds are non-aboriginal and that no other cultural remains are present (Archaeological Consultants, Inc., 1997). As a result, no effects on archaeological resources are expected to occur from construction activities associated with the EELV program under Concept A.

Because of the remote possibility that an on-pad or missile storage mishap could occur, an ROI around SLC-41 and the proposed assembly facility sites has been assumed. Within these areas, one prehistoric site (8BR914) that is potentially eligible for inclusion in the National Register (see Appendix I) and a portion of an archaeologically sensitive area were identified; both are located on land that is under the jurisdiction of the KSC.

**Historic Buildings and Structures.** None of the buildings and structures identified for EELV activities is under the jurisdiction of the KSC.

Facilities at Cape Canaveral AS requiring modification under Concept A include SLC-41 (encompassing numerous individual buildings and structures completed by 1965), Hangar J (Building 1721, constructed in 1956), and Buildings 38804 and 38835 in the CPF complex. Both SLC-41 and Hangar J were recently assessed for their eligibility for inclusion in the National Register. However, because of their age, their lack of association with events or persons significant in history, their unremarkable architecture or design, and their unlikely ability to meet the exceptional criteria required under National Park Service Criteria Consideration G for properties less than 50 years in age, it is unlikely that either facility would meet the required National Register-listing criteria. In addition, the modification of Hangar J is minor and interior only. Of the numerous features within SLC-41, only a few (i.e., the MST, the Umbilical Tower, and the SEB) require substantial modification or removal. Buildings 38804 and 38835 have only recently been constructed and will be modified for EELV activities before final completion and acceptance by the Air Force.

Consultation with the Florida SHPO is in progress; results of the consultation will be presented in the FEIS.

**Native Populations/Traditional Resources.** Two Native American tribes have expressed interest in the cultural resources environment in the ROI: the Seminole Indian Tribe and the Micosukee Indian Tribe. Although no traditional resources sites have been identified within the ROI, these groups will be contacted during the EIS preparation process to ensure that their concerns regarding the EELV program are considered.

**Mitigation Measures, Cape Canaveral AS**

**Prehistoric and Historic Archaeological Resources and Traditional Resources.** Because no National Register-listed or -eligible prehistoric or historic archaeological resources or traditional resources have been identified within the direct ground disturbance ROI for Concept A, no mitigation

measures have been identified. However, if during the course of program activities, cultural materials (particularly human remains) are unexpectedly discovered, work in the immediate vicinity of the cultural materials would cease and the Florida SHPO would be consulted through the Cape Canaveral AS Environmental Offices (see Appendix I). Subsequent actions would follow guidance provided in Title 36 CFR 800.11 and/or in NAGPRA.

Mitigation measures to offset potential effects on archaeological/traditional resources from an on-pad or missile storage mishap are not proposed because the probability of such an occurrence is low and the cost of the mitigation (e.g., data recovery) is high. In the unlikely event that a mishap occurs, post-event recommendations include survey, mapping, photography, and site record revisions to determine and record the extent of damage from impacts or fire.

**Historic Buildings and Structures.** Determination of the historical significance of SLC-41 and Hangar J is pending. Mitigation measures would be developed during consultation with the Florida SHPO.

#### 4.15.1.1.2 Concept A, Vandenberg AFB

**Prehistoric and Historic Archaeological Resources.** Within the direct ground-disturbance footprints for Concept A (i.e., areas of facility and utility line construction and roadway intersection/building entrance modification), no National Register-listed or -eligible prehistoric or historic archaeological sites have been identified. However, in one proposed project location (the corner of Bear Creek and Coast roads), a National Register-eligible site does occur within close proximity to ground-disturbing activities.

The immediate project area at the corner of Bear Creek and Coast roads has been previously surveyed, and no sites have been recorded. This area is also very heavily disturbed from the installation of several communications and light poles and the recent replacement of large underground water pipes. Several archaeological sites are near this area, however, and one is eligible for inclusion in the National Register (Site SBA 534) (see Appendix I). Site SBA 534 is just south of the construction area where a power pole would be raised. Discussions with Vandenberg AFB cultural resources managers indicate that because of the proximity of this site to the ground-disturbing activities, archaeological and Native American monitoring would be required.

In addition, because of the remote possibility that an on-pad mishap could occur, an ROI around SLC-3W has been assumed. Within this area, 11 archaeological sites have been identified; a recent review of archaeological site records indicates that none of the sites is eligible for inclusion in the National Register.

As a result of the lack of National Register-eligible or -listed sites within the direct construction areas and the ROI, and the proposed mitigation monitoring at the intersection of Bear Creek and Coast roads, no adverse effects on archaeological resources are expected to occur from EELV program activities under Concept A. Except as already noted, consultation with Vandenberg AFB cultural resources managers indicates that no archaeological/Native American monitoring would be required at any of the ground-disturbing areas.

**Historic Buildings and Structures.** Facilities at Vandenberg AFB requiring modification under Concept A include SLC-3W, encompassing numerous individual buildings and structures completed between 1956 and 1959. SLC-3 (East and West) and all of its associated support facilities have been evaluated for inclusion in the National Register and determined to be eligible under the Cold War historic context as a "highly technical and scientific" facility. SLC-3W contributing features include the Launch and Service Building (Building 770), the MST, the Umbilical Tower, the retention basin, and the deluge channel. The Launch Operations Facility (Building 763) and the Launch Vehicle Support Facility (Building 766) are also contributing as "shared" facilities with SLC-3E.

The typical mitigation for potential adverse effects on historic buildings and structures (i.e., demolition, modification, damage from on-pad mishap) is recordation using standards developed by the HABS/HAER. HABS/HAER recordation of SLC-3 (East and West) was completed in 1993.

**Native Populations/Traditional Resources.** The only Native American tribe affiliated with the area encompassed by Vandenberg AFB is the Chumash Indian Tribe. No traditional resources sites have been identified within the Concept A ROI; however, the Santa Inez Band of Chumash Indians will be contacted during the EIS preparation process to ensure that their concerns regarding the EELV program are considered.

**Paleontological Resources.** There are no recorded fossils or National Natural Landmarks within the immediate vicinity of SLC-3 or any of the other proposed ground-disturbing areas within the Concept A cultural resources ROI; therefore, no effects are expected.

**Mitigation Measures, Vandenberg AFB**

**Prehistoric and Historic Archaeological Resources and Traditional Resources.** Monitoring by a professional archaeologist and a Native American representative from the Santa Inez Band of Chumash Indians would be required during intersection modifications (road widening and the raising of power poles) proposed for the northeast and southeast corners of Bear Creek and Coast roads. No other cultural resources mitigation measures have been identified under Concept A at Vandenberg AFB. However, if during the course of any EELV program activities, cultural materials (particularly human remains) are unexpectedly discovered, work in the immediate vicinity of the cultural materials would cease and Vandenberg AFB cultural resources managers would be notified immediately.

#### 4.15.1.2 Concept B

##### 4.15.1.2.1 Concept B, Cape Canaveral AS

**Prehistoric and Historic Archaeological Resources.** Numerous prehistoric and historic sites and a large archaeological sensitivity zone (primarily along the Banana River) have been established for the portions of the APE that have not been intensively surveyed (New South Associates, 1996). Cape Canaveral cultural resources managers have consulted with the Florida SHPO who has concurred that ground-disturbing activities that take place outside of recorded site boundaries and the sensitivity zone require no additional study (see Appendix I).

There are no National Register-listed or -eligible prehistoric or historic archaeological sites or archaeologically sensitive areas within the direct ground disturbance footprints for Concept B (i.e., areas of facility and utility line construction and roadway intersection/facility entrance modification). As a result, no effects on archaeological resources are expected to occur from construction activities associated with the EELV program.

Because of the remote possibility that an on-pad mishap could occur, an ROI around SLC-37 has been assumed. Within this area, six archaeological sites have been identified; three of the sites (8BR82A, 8BR83, and 8BR221) are potentially eligible for inclusion in the National Register; the remaining sites are not eligible (see Appendix I).

**Historic Buildings and Structures.** Facilities at Cape Canaveral AS requiring modification under Concept B include SLC-37 (encompassing numerous individual buildings and structures completed by 1962 [including Buildings 38315, 43302, and 43400]); Hangar C (Building 1348, constructed in 1953); the MIS (Building 75251, constructed in 1964); Buildings 38800, 38804, and 38835 within the CPF complex, and the Air Force Roll-on Roll-off Dock (Structure 92050, constructed in 1956) (alternative to use of the Port of Canaveral dock). Under Concept B, launch activities may also require abandonment of Buildings 33001, 33003, 33007, 33009, 38320, 43401, 43403, and 43405, all of which are support structures associated with SLC-37.

SLC-37 and all associated support facilities have been evaluated for inclusion in the National Register and determined to be ineligible (New South Associates, 1996). The MIS and the Air Force Roll-on Roll-off Dock have been recently assessed for possible inclusion in the National Register. However, because of their age, their lack of association with events or persons significant in history, their unremarkable architecture or design, and their unlikely ability to meet the exceptional criteria required under National Park Service Criteria Consideration G for properties less than 50 years in age, it is unlikely that these facilities would meet the required National Register-listing criteria.

Hangar C has also been recently assessed for possible inclusion in the National Register. Historical research indicates that there is some potential for this facility to possess historical significance based on its association with Werner von Braun and its function as a checkout and assembly facility for

several early types of rockets (e.g., Matador, Snark, Bomarc). Proposed exterior modifications to this facility include rust removal around hangar doors, re-hanging of broken personnel doors, and construction of new entrance canopies over the east and west personnel entrances. Interior modifications include asbestos removal; lead-based paint abatement (probably by over-painting); installation of new lighting and power distribution, suspended ceiling, doors, and HVAC; removal of drywall partitions, refurbishment of stairwells, and painting.

The Air Force will consult with the Florida SHPO regarding the eligibility of these facilities and any required mitigation measures.

**Native Populations/Traditional Resources.** Two Native American tribes have expressed interest in the cultural resources environment in the ROI: the Seminole Indian Tribe and the Micosukee Indian Tribe. Although no traditional resources sites have been identified within the ROI at Cape Canaveral AS, these groups will be contacted during the EIS preparation process to ensure that their concerns regarding the EELV program are considered.

#### 4.15.1.2.2 Mitigation Measures, Cape Canaveral AS

**Prehistoric and Historic Archaeological Resources and Traditional Resources.** Because no National Register-listed or -eligible prehistoric or historic archaeological resources or traditional resources have been identified within the direct ground disturbance ROI for Concept B, no mitigation measures have been identified. However, if during the course of program activities, cultural materials (particularly, human remains) are unexpectedly discovered, work in the immediate vicinity of the cultural materials would cease and the Florida SHPO would be consulted through the Cape Canaveral AS Environmental Office (see Appendix I). Subsequent actions would follow guidance provided in Title 36 CFR 800.11 and/or in NAGPRA.

Mitigation measures to offset potential effects on archaeological/traditional resources from an on-pad or missile storage mishap are not proposed because the probability of such an occurrence is low and the cost of the mitigation (e.g., data recovery) is high. In the unlikely event that a mishap occurs, post-mishap recommendations include post-event survey, mapping, photography, and site record revisions to determine and record the extent of damage from impacts or fire.

**Historic Buildings and Structures.** The historical significance of Hangar C, the MIS, and the Air Force Roll-on Roll-off Dock is pending. Mitigation measures would be developed during consultation with the Florida SHPO.

#### 4.15.1.2.3 Concept B, Vandenberg AFB

**Prehistoric and Historic Archaeological Resources.** All of the direct ground disturbance areas under Concept B would take place at SLC-6, which is an archaeologically sensitive area. Numerous sites have been recorded within the fenceline of SLC-6, as well as adjacent to the complex, and 15 sites have been recorded within the cultural resources ROI for the EELV program; 6 of the 15 sites have been recommended as eligible for inclusion in the National Register.

Of the ground disturbance proposed for SLC-6, only construction of the HIF has the potential to directly affect an archaeological site (Site SBA 2032). Results of recent surface and subsurface studies of SBA 2032 (ENSR Corporation, 1997a) indicate that the site is heavily disturbed and deeply buried and not likely to be affected by HIF construction. However, recommendations developed in consultation with Vandenberg AFB cultural resources managers indicate that any earth disturbance in the southeastern quarter of the HIF project area should be monitored by an archaeologist and a representative from the Santa Inez Band of Chumash Indians. In addition, if the HIF construction area changes to include the North Access Road lower parking lot, Vandenberg AFB cultural resources managers are to be notified and a subsurface testing program undertaken to determine the presence or absence of SBA 2032-associated cultural materials.

As proposed, the remaining ground-disturbing activities associated with Concept B (e.g., installation of the security fence) do not threaten known archaeological sites. However, since the entire SLC 6 area is archaeologically sensitive, Vandenberg AFB cultural resources managers have requested that archaeological and Native American monitoring be conducted during all ground-disturbing activities in that area. Any ground disturbance around Building 398, which is immediately adjacent to SLC 6, would also require monitoring (ENSR Corporation, 1997a).

Archaeological surveys of Vandenberg AFB include an underwater study of the South Vandenberg AFB Point Arguello boathouse harbor (U.S. Department of the Interior, National Park Service, 1978). The study did not identify any underwater sites and indicated that no additional studies would be necessary. As such, dredging of the boathouse harbor would have no effect on underwater archaeological resources.

**Historic Buildings and Structures.** Facilities at Vandenberg AFB requiring modification under Concept B include SLC-6 (encompassing numerous individual buildings and structures completed by 1966) and Buildings 330, 375, 396, 520, 636, 1032, and 1670. None of these facilities is eligible or potentially eligible for inclusion in the National Register; therefore, no effects on historic buildings and structures are expected to occur.

**Native Populations/Traditional Resources.** The only Native American tribe affiliated with the area encompassed by Vandenberg AFB is the Chumash Indian Tribe. No specifically designated traditional resources sites have been identified within the Concept B ROI; however, some of the recorded archaeological sites may represent traditional resources sites or contain traditional resources elements as well. The Santa Inez Band of Chumash Indians will be contacted during the EIS preparation process to ensure that their concerns regarding the EELV program are considered.

**Paleontological Resources.** There are no recorded fossils or National Natural Landmarks within the SLC-6 ROI; therefore, no effects are expected to occur.

#### 4.15.1.2.4 Mitigation Measures, Vandenberg AFB

**Prehistoric and Historic Archaeological Resources and Traditional Resources.** Monitoring by a professional archaeologist and a Native American representative from the Santa Inez Band of Chumash Indians will be required during all ground-disturbing activities at SLC-6. No other cultural resources mitigation measures have been identified under Concept B at Vandenberg AFB. However, if during the course of any EELV program activities, cultural materials (particularly, human remains) are unexpectedly discovered, work in the immediate vicinity of the cultural materials would cease and Vandenberg AFB cultural resources managers would be notified immediately.

### 4.15.1.3 Concept A/B

#### 4.15.1.3.1 Concept A/B, Cape Canaveral AS

Because Concept A/B encompasses the facilities described under both Concepts A and B, effects from EELV activities and any proposed mitigation measures would be similar to the combined effects described in Sections 4.15.1.1 and 4.15.1.2.

#### 4.15.1.3.2 Concept A/B, Vandenberg AFB

Because Concept A/B encompasses the facilities described under both Concepts A and B, effects from EELV activities and any proposed mitigation measures would be similar to the combined effects described in Sections 4.15.1.1 and 4.15.1.2.

## 4.15.2 No-Action Alternative

### 4.15.2.1 Cape Canaveral AS

Under the No-Action Alternative at Cape Canaveral AS, SLCs 17, 36, 40, and 41 would continue to support Delta II, Atlas IIA, and Titan IVB launches. SLCs 17 and 36 have been evaluated for inclusion in the National Register and have been determined eligible (see Appendix I). SLC-41 was recently assessed, and a determination of eligibility is pending. SLC-40 has not yet been evaluated. However, because no new construction or facility modifications have been proposed under the No-Action Alternative, no effects on historic properties are expected.

### 4.15.2.2 Vandenberg AFB

Under the No-Action Alternative at Vandenberg AFB, SLCs 2W, 3E, and 4E would continue to support Atlas IIA, Delta II, and Titan IVB launches. All three complexes have been evaluated for inclusion in the National Register and specific features determined to be eligible (see Appendix I); however, no new construction or facility modifications have been proposed under the No-Action Alternative. Therefore, no effects on historic properties are expected.

## 4.16 ENVIRONMENTAL JUSTICE

The analysis conducted for this EIS included a review of influencing factors (local community resources) and a discussion of resulting impacts associated with hazardous materials and hazardous waste management and the natural environment. Local community resources (e.g., employment and population, land use and aesthetics, transportation, utilities) have been identified as influencing factors only and therefore would not have disproportionately high and adverse human health and environmental effects on minority and low-income populations.

Based upon the analysis conducted for this EIS, it was determined that activities associated with the Proposed Action would not have adverse effects on low-income and minority populations for any of the resources analyzed in this EIS: hazardous materials and hazardous waste, health and safety, geology and soils, water resources, noise, biological resources, and cultural resources. Air quality impacts would be basin-wide, and orbital debris impacts would be at a global scale; thus, no disproportionately high and adverse air quality impacts to low-income and minority populations would be expected.

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# 5.0 CONSULTATION AND COORDINATION

The federal, state, local, and private agencies/organizations that were contacted during the preparation of this Environmental Impact Statement are listed below.

**FEDERAL AGENCIES**

Merritt Island National Wildlife Refuge
National Aeronautics and Space Administration
Natural Resources Conservation Service
U.S. Army Corps of Engineers
U.S. Department of Transportation/Federal Aviation Administration
U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service

**STATE AGENCIES**

California Air Resources Board
Florida Department of Environmental Protection
Florida Department of Environmental Protection, Bureau of Air Regulations
Florida Department of Labor and Employment Security, Bureau of Labor Market Information
Florida Department of State, Division of Historical Resources

**LOCAL/REGIONAL AGENCIES**

Brevard County, Viera, Florida
Brevard County Growth and Management Department
Brevard County Housing and Human Services Administration
City of Cape Canaveral
City of Lompoc
County of Santa Barbara, Department of Planning
Port of Canaveral
St. John's River Water Management District
Santa Barbara Air Pollution Control District
Santa Barbara County Association of Governments
Santa Barbara County Department of Social Services
Santa Barbara County Human Services

**PRIVATE AGENCIES AND ORGANIZATIONS**

Aerospace Corporation
Brevard County Chamber of Commerce
C.I.T.A. Rescue Mission
Candelaria American Indian Council, Inc.
Catholic Charities
Catholic Social Services, Inc.
Central Brevard Sharing Center, Inc.
Coalition for the Hungry and Homeless of Brevard
Daily Bread, Inc.
Dynamac
EG&G, Kennedy Space Center

Foodbank of Santa Barbara County
Food Pantry of Lompoc Valley, Inc.
GRCI, Inc.
Good Samaritan Shelter
Guadalupe Community Center
Human Services Association
Johnson Controls World Services, Inc.
La Casa de La Raza
Lompoc Valley Community Kitchen
National Association for the Advancement of Colored People
Operation Lighthouse
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