Environmental Assessment

Draft Final

Vulcan Centaur Program Operations and Launch on Cape Canaveral Air Force Station

Prepared for:

and

45TH Space Wing

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Acronyms and Abbreviations

45 SW	45TH Space Wing
ACOE	Army Core of Engineers
AFB	Air Force Base
AFI	Air Force Instruction
AFSPCMAN	Air Force Space Command Manual
Al2O3	Aluminum Oxide
AIRFA	American Indian Religious Freedom Act
ALTRV	Altitude Reservation
ARPA	Archaeological Resources Protection Act
ASOC	Atlas V Spaceflight Operation Center
ASWS	Acoustic Suppression Water System
BASH	Bird/Wildlife Aircraft Strike Hazard
BLS	Below Land Surface
BMP	Best Management Practices
BO	Biological Opinion
CAA	Clean Air Act
C&D	Construction and Demolition
CAT	Crew Access Tower
CCAFS	Cape Canaveral Air Force Station
CDNL	C-Weighted Day-Night Level
CEMP	Comprehensive Emergency Management Plan
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CH4	Methane
CLOIS	Cape Launch Operations and Infrastructure Support
CO	Carbon Monoxide
CSEL	C-Weighted Sound Exposure Level
CWA	Clean Water Act
CZM	Coastal Zone Management
CZMA	Coastal Zone Management Act
dB	Decibel
dBA	“A-weighted” Logarithmic Scale Decibel
dBC	Decibels Relative to the Carrier Signal
DERP	Defense Environmental Restoration Program
DEX	Duct Exit
DNL	Day-Night Average Noise Level

DoD	Department of Defense
DOT	Department of Transportation
EA	Environmental Assessment
EELV	Evolved Expendable Launch Vehicle
EFH	Essential Fish Habitat
EIAP	Environmental Impact Analysis Process
EIS	Environmental Impact Statement
EISA	Energy Independence and Security Act
EO	Executive Order
EPA	Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
ERP	Environmental Resource Permits
ESA	Endangered Species Act
ETL	Engineering Technical Letter
EWR	Eastern and Western Range
FAA	Federal Aviation Administration
FAAQS	Florida Ambient Air Quality Standards
FAC	Florida Administrative Code
FCMA	Florida Coastal Management Act
FCMP	Florida Coastal Management Program
FDCA	Florida Department of Community Affairs
FDEP	Florida Department of Environmental Protection
FEIS	Final Environmental Impact Statement
FETSA	Florida Endangered and Threatened Species Act
FONPA	Finding of No Practical Alternative
FONSI	Finding of No Significant Impact
FPL	Florida Power and Light
FWCC	Fish and Wildlife Conservation Commission
GHG	Greenhouse Gas
GN2	Gaseous Nitrogen
GTO	Geosynchronous Transfer Orbit
H2O	Water
HAP	Hazardous Air Pollutant
HAZCOM	Hazardous Communication
HCl	Hydrochloric Acid
HMTA	Hazardous Materials Transportation Act
ICBM	Intercontinental Ballistic Missile
ICP	Integrated Contingency Plan
ICRMP	Integrated Cultural Resources Management Plan

IIP	Instantaneous Surface Impact Point
IM	Interim Measure
INRMP	Integrated Natural Resources Management Plan
IPA	Isopropyl Alcohol
IPCC	International Panel on Climate Change
IRP	Installation Restoration Program
ITL	Integrate-Transfer-Launch
KSC	Kennedy Space Center
kV	Kilovolt
kVA	Kilovolt Amperes
LAeq	Long-Term Equivalent A-Weighted Sound Level
LEO	Low Earth Orbit
LH2	Liquid Hydrogen
LMP	Light Management Plan
LN2	Liquid Nitrogen
LNG	Liquified natural gas
LO2	Liquid Oxygen
LTDP	Long Term Development Plans
LTM	Long Term Monitoring
LUC	Land Use Control
LUCIP	Land Use Control Implementation Plan
MBTA	Migratory Bird Treaty Act
MGD	Million Gallons Per Day
MINWR	Merritt Island National Wildlife Refuge
MLP	Mobile Launcher Platform
MMPA	Marine Mammal Protection Act
MSFCMA	Magnuson-Stevens Fishery Conservation and Management Act
MSL	Mean Sea Level
MT	Metric Tons
N2O	Nitrous Oxide
NAAQS	National Ambient Air Quality Standards
NAGPRA	Native American Graves Protection and Repatriation Act
NASA	National Aeronautics and Space Administration
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NOx	Nitrogen Oxides
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System

NRHP	National Register of Historic Places
NSS	NASA Safety Standard
NAVD88	North American Vertical Datum of 1988
NOA	Notice of Availability
NRP	NASA Routine Payloads
ODS	Ozone-Depleting Substances
OFW	Outstanding Florida Water
OSD	Office of the Secretary of Defense
OSHA	Occupational Safety and Health Administration
PAFB	Patrick Air Force Base
PAH	Polynuclear Aromatic Hydrocarbon
PCBs	Polychlorinated Biphenyls
PEB	Pad Equipment Building
PFDP	Preliminary Flight Data Package
PLF	Payload Fairings
PM	Particulate Matter
psf	Pounds Per Square Foot
PSI	Pounds per Square Inch
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
RMP	Risk Management Plan
ROI	Region of Influence
RP-1	Rocket Propellant 1
SAFMC	South Atlantic Fishery Management Council
SARA	Superfund Amendments and Reauthorization Act
SEIS	Supplemental Environmental Impact Statement
SEL	Sound Exposure Level
SHPO	State Historic Preservation Office
SJRWMD	St. Johns River Water Management District
SLC	Space Launch Complex
SLMP	Space Launch Modernization Plan
SMARF	Solid Motor Assembly and Readiness Facility
SO_X	Sulfur Oxide
SO_2	Sulfur Dioxide
SR	State Road
SRM	Solid Rocket Motor
SSA	Space Situational Awareness
SSC	Species of Special Concern
SWI	Space Wing Instruction
SWMU	Solid Waste Management Unit

SWPPP	Stormwater Pollution Prevention Plan
T&E	Threatened and Endangered
THA	Toxic Hazard Assessment
THC	Toxic Hazard Corridors
TNT	Trinitrotoluene
TSCA	Toxic Substance Control Act
ULA	United Launch Alliance
US	United States
USC	United States Code
USACE	United States Army Corps of Engineers
USAF	United States Air Force
USFWS	United States Fish and Wildlife Service
USGODMSP	US Government Orbital Debris Mitigation Standard Practices
VAFB	Vandenberg Air Force Base
VIF	Vertical Integration Facility
VOC	Volatile Organic Compound
WDR	Wet Dress Rehearsal
WWTP	Waste Water Treatment Plant

1 Introduction: Purpose of and Need for Proposed Action

This Environmental Assessment (EA) is prepared to evaluate the impacts associated with United Launch Alliance's (ULA) Vulcan Centaur Space Launch Program. ULA is developing the Vulcan Centaur to provide a more versatile and cost competitive space launch vehicle while maximizing the use of existing space launch infrastructure and reducing reliance on foreign made goods, specifically the current Atlas V Launch Vehicle Russian-supplied RD-180 engines.

ULA announced the Vulcan Centaur Program in 2015 to reduce cost, increase launch capability and provide the opportunity to partner with companies in the United States (US) to develop rocket engines that eliminate reliance on the current Atlas V Russian-supplied RD-180 engines. The Vulcan Centaur Vehicle is designed primarily to meet all current United States Air Force (USAF) Evolved Expendable Launch Vehicle (EELV) requirements and will support National Aeronautics and Space Administration (NASA), Department of Defense (DoD) and commercial payloads. ULA eventually intends to phase out its current Atlas V and Delta IV Programs.

The Vulcan Centaur Launch Vehicle (***Appendix A, Figure 1. Vulcan Centaur Vehicle***) will contain a larger diameter booster tank than the Atlas V. The first stage will use new BE-4 booster engines that consume liquid oxygen (LO2) and liquefied natural gas (LNG). Multiple Solid Rocket Motor (SRM) configuration options (zero, two, four or six Orbital ATK GEM-63XL motors) can be specified depending on payload and performance requirements. The Vulcan first stage will integrate with the Centaur V upper stage, which is similar to but larger than the current Centaur III stage flying on Atlas V.

ULA plans to launch the Vulcan Centaur Vehicle from Space Launch Complex 41 (SLC-41) on Kennedy Space Center (KSC) (leased to the USAF at Cape Canaveral Air Force Station (CCAFS) and SLC-3E on Vandenberg Air Force Base (VAFB). This EA covers the Vulcan Centaur Vehicle and launch operations at CCAFS only. A supplemental EA will be developed for VAFB once ULA decides on specific requirements for VAFB launch operations.

At CCAFS, Vulcan Centaur Program modifications will occur at SLC-41, the Vertical Integration Facility (VIF) (Facility 29410) and the Solid Motor Assembly and Readiness Facility (SMARF) (Facility 69800). These modifications include:

- Constructing a new Mobile Launcher Platform (MLP) in the SMARF, Facility 69800, (estimated completion 2019). The MLP will then be stored in the SMARF between launches.
- Upgrading the existing 60-ton crane in the VIF, Facility 29410, to 65-ton capacity. New VIF mechanical work platforms will be designed, fabricated and installed to support Vulcan Centaur Vehicle preparations.
- Adding a LNG system and modifying existing LO2, liquid hydrogen (LH2) and Acoustic Suppression Water System (ASWS) systems.

SLC-41 currently supports ULA's Atlas V launches. The Atlas Program was evaluated in the Environmental Impact Statement (EIS) completed in April 1998 (*Final Environmental Impact Statement Evolved Expendable Launch Vehicle Program*[1]) and in the *Final Supplemental Environmental Impact Statement (SEIS) for the EELV Program* (March 2000)[2]. The USAF was the lead agency and the Federal Aviation Administration (FAA) was a cooperating agency for the Final Environmental Impact Statement (FEIS) in 1998. The 1998 EIS covered the development

and operations of the Atlas V and Delta IV EELV systems that replaced the Atlas IIA, Delta II and Titan IVB launch systems. The SEIS (2000) listed the USAF as the responsible agency and the FAA and NASA as cooperating agencies. The SEIS covered the addition of up to five strap-on SRM on the Atlas V Launch Vehicle and larger SRM on the Delta IV Launch Vehicle.

The FAA formally adopted the 1998 FEIS and 2000 SEIS and issued a Record of Decision in August 2011 to document final approval for issuing, renewing or modifying Launch Operator Licenses for EELV launch vehicles, which included Atlas V at CCAFS. The FAA independently evaluated the information contained in the 1998 FEIS and 2000 SEIS and verified the continued validity of the analysis contained in both documents. The FAA found the proposed EIS and SEIS actions were consistent with existing national environmental policies and objectives as set forth in Section 101(a) of the National Environmental Policy Act (NEPA) and approved the Proposed Actions identified.

This EA has been prepared in accordance with the requirements of NEPA of 1969 (42 United States Code [USC.] §4321 et seq.); the Council on Environmental Quality (CEQ) Regulations for Implementing the Procedural Provisions of NEPA (40 Code of Federal Regulations [CFR] Parts 1500-1508); USAF Environmental Impact Analysis Process (EIAP) (32 CFR Part 989); DoD Directive 6050, *Environmental Effects Abroad of Major Department of Defense Actions*; *Executive Order 12114 Environmental Effects Abroad of Major Federal Actions*; and FAA Order 1050.1F, *Environmental Impacts: Policies and Procedures*.

Per agreements between the USAF, NASA and FAA, the USAF is the lead agency for the preparation and coordination of the EA (40 C.F.R. § 1501.5) and the FAA and NASA are acting as cooperating agencies (40 C.F.R. § 1501.6). The USAF is the lease and license holder for the real property where the Proposed Action will occur. NASA owns the real property, has an agreement with the USAF for its use through 2021 and will review and provide input on this EA. Both the USAF and NASA use EELV for access to space for their payloads. The FAA's role is licensing commercial space launch operations.

1.1 Background

The Commercial Space Launch Act Amendments of 1988 (Public Law 100-657) amended the Commercial Space Launch Act of 1984 (Public Law 98-575), which "directs the Secretary of Transportation, in facilitating and encouraging private sector acquisition of US surplus launch property, to take into account the availability of comparable property under reasonable terms from domestic non-Government sources."[3] The Amendments of 1988 direct the Administrator of NASA to: "(1) design a program to support research into launch systems component technologies to develop higher performance and lower costs for commercial and Government launches; and (2) report to the Congress outlining the program."[4]

Recognizing that space transportation costs must be significantly reduced to make continued exploration, development and use of space sustainable given budgetary constraints, the US Government developed the National Space Policy of June 28, 2010. A policy principle is a commitment to encourage and facilitate the growth of a US commercial space sector. Key elements of the commercial aspects of the National Space Policy include:

- "The United States is committed to a robust and competitive industrial base. In support of its critical domestic aerospace industry, the US Government will use commercial space

products and services in fulfilling governmental needs, invest in new and advanced technologies and concepts, and use a broad array of partnerships with industry to promote innovation. The US Government will actively promote the purchase and use of US commercial space goods and services within international cooperative agreements."[5]

- "The United States will advance a bold new approach to space exploration. The National Aeronautics and Space Administration will engage in a program of human and robotic exploration of the solar system, develop new and transformative technologies for more affordable human exploration beyond the Earth, seek partnerships with the private sector to enable commercial spaceflight capabilities for the transport of crew and cargo to and from the International Space Station, and begin human missions to new destinations by 2025."[6]

In 1994, Congress passed legislation that was the impetus for a major study accomplished by the DoD. This study became the basis for a clearly defined national course of action undertaken to reduce significantly the cost of space launches. The Fiscal Year 1994, National Defense Authorization Act, P.L. 103-160, Section 213 (a)[7], in part, read:

"The Secretary of Defense shall develop a plan that establishes and clearly defines priorities, goals, and milestones regarding modernization of space launch capabilities for the Department of Defense or, if appropriate, for the government as a whole."

In response to the law, the Air Force was tasked to produce the plan, known as the Space Launch Modernization Plan[8] (SLMP) April 1994. As a result of the SLMP, the Office of the Secretary of Defense (OSD) and the Administration selected two alternatives for further development:

- NASA would oversee the development of a new reusable space launch system in coordination with the DoD.
- USAF, as executive agent for space launch for the DoD, would develop an EELV program.

President Donald Trump defined the America First National Space Strategy (Fact Sheet issued March 23, 2018[9]). Elements of this strategy key to the Vulcan Centaur Program include:

- "The United States will partner with the commercial sector to ensure that American companies remain world leaders in space technology."
- "The new strategy ensures that international agreements put the interests of American people, workers, and businesses first."

The Vulcan Centaur Program was developed to support the US Government and commercial space exploration, development and use with the guidance of the Commercial Space Launch Act and its Amendments. ULA's Vulcan Centaur Launch Vehicle offers a more versatile, cost competitive launch vehicle and reduces reliance on foreign made goods, specifically the current Russian RD-180 engines.

The first planned launch of the Vulcan Centaur is in mid-2020. Existing SLC-41 systems and infrastructure at CCAFS would be modified for Vulcan Centaur but would remain substantially consistent with current launch operations.

CCAFS was established as the first US long range missile proving ground in 1949. Since that time, over 30 missile and SLCs have been developed at CCAFS. Atlas V has been launching from SLC-

41 since 2002. Prior to use for Atlas V launches, SLC-41 was used by the USAF for Titan III and IV launches from 1965 through 1999.

1.2 Project Location

CCAFS, under the command of the USAF Space Command 45TH Space Wing (45 SW), is located on the east coast of Florida on approximately 16,200 acres of land in Brevard County, Florida on the Canaveral Peninsula. SLC-41 is located on the southern portion of KSC at latitude 28° 35' 00" N and longitude 80° 34' 59" W. Jacksonville is approximately 150 miles north, Miami is approximately 210 miles south and Orlando is approximately 50 miles west of SLC-41.

SLC-41 is located on a barrier island approximately 4,000 feet east of the Banana River (designated an Outstanding Florida Waterway) and 2,600 feet west of the Atlantic Ocean, as shown in ***Appendix A, Figure 2. SLC-41 General Site Location.*** The VIF and SMARF, where minor modifications for Vulcan operations will occur, are located south of SLC-41 in the Integrate-Transfer-Launch (ITL) Area, as shown in ***Appendix A, Figure 3. ITL Area VIF, SMARF and SLC-41 Location***. The southern boundary of KSC coastal property on the barrier island is 2,000 feet south of SLC-41. KSC property also borders CCAFS to the west. ULA also leases and operates SLC-37 approximately 6,500 yards south of SLC-41. Port Canaveral borders CCAFS to the south. CCAFS is accessible from the south by US Highway 401 and from the west and north via KSC roads.

1.3 Purpose of and Need for Proposed Action

The purpose of the Proposed Action is to provide a versatile ULA Vulcan Centaur Launch Vehicle that meets all current USAF EELV requirements to provide medium (2,500 to 17,000 pounds) and heavy (13,500 to 41,000 pounds) payload lift capability for Government space launches at lower recurring costs than current ULA expendable systems. The ULA Vulcan maximizes use of existing space launch infrastructure, provides the USAF with additional lift capability and eliminates reliance on the current Atlas V RD-180 Russian-supplied engines. The Vulcan Program will support the Commercial Space Launch Act and its Amendments and both manned and unmanned NASA, DoD and commercial payloads.

The Proposed Action allows continued fulfillment of the National Space Policy to actively promote the purchase and use of US commercial space goods and services and reduce space transportation costs as well as eliminating use of Russian-supplied engines. The Proposed Action is needed to allow ULA to cost-competitively compete with other commercial launch vehicles and ensure US space launch capability is not reduced or limited.

The FAA's action of issuing licenses to ULA for commercial space launches of the Vulcan Centaur at SLC-41 is considered part of the Proposed Action analyzed in this EA. The FAA's purpose of issuing licenses to ULA is to fulfill the FAA's responsibilities as authorized by Chapter 509 of Title 51 of the U.S. Code for oversight of commercial space launch activities, including licensing launch activities. The need for FAA's action results from the statutory direction from Congress under the U.S. Commercial Space Launch Competitiveness Act of 2015 to, in part, "promote commercial space launches and reentries by the private sector; facilitate government, state, and private sector involvement in enhancing U.S. launch sites and facilities; and protect public health and safety, safety of property, national security interests, and foreign policy interests of the United

States." Pub. L. 114-90, § 113(b). Additionally, Congress has determined the Federal Government is to "facilitate the strengthening and expansion of the United States space transportation infrastructure, including the enhancement of United States launch sites and launch-site support facilities, and development of reentry sites, with Government, State, and private sector involvement, to support the full range of United States space-related activities." 51 U.S.C. § 50901(b)(4).

1.4 Scope of the Environmental Assessment

This EA evaluates the potential site-specific environmental consequences associated with Vulcan Centaur Program and operations at CCAFS. The scope includes evaluating the environmental impacts of the Vulcan Program from receipt of vehicle components from the Delta Mariner cargo ship at the CCAFS Wharf, vehicle component transportation and vehicle preparation, launch preparation, payload considerations and final launch from SLC-41. No vehicle component reuse is included; the Vulcan Program is completely expendable. Because all of these operations are similar to current Atlas V operations covered under existing EIS (1998) and SEIS (2000) actions, this EA will focus on the modifications or changes required by the Vulcan Program as described in Section 2.1, Vulcan Centaur Vehicle and Section 2.2, Facility Modifications.

1.4.1 Lead and Cooperating Agency Actions

This ULA Vulcan Centaur Program EA was developed with the USAF as the responsible agency and the FAA and NASA as cooperating agencies.

The USAF is the lead agency, since the Action is directly related to ULA's obligations under the USAF's EELV Program and the USAF is the lease and license holder for the real property where the Action will occur. If, after the public's review of the EA, the USAF determines that the Proposed Action would not individually or cumulatively result in significant impacts on the human or natural environments, the USAF would issue a final Finding of No Significant Impact (FONSI) and real property modifications would proceed.

The FAA is a cooperating agency because of its role in licensing commercial space launch operations in the US. The FAA expects to receive a launch license application(s) from ULA for Vulcan operations at SLC-41. The FAA intends to adopt this EA to support its environmental review when evaluating ULA's launch license application(s). If, after reviewing the launch license application and this EA, the FAA determines that ULA's proposed operations fall within the scope of this EA and that the FAA's action of issuing a launch license to ULA for Vulcan operations at SLC-41 would not individually or cumulatively result in significant impacts on the human or natural environment, the FAA would adopt this EA and issue its own FONSI to support issuing a launch license to ULA for Vulcan. The FAA will draw its own conclusions from the analysis presented in this EA and assume responsibility for its environmental decision and any related mitigation measures. For the FAA to completely rely on this EA to satisfy its NEPA obligations, the EA must meet the requirements of FAA Order 1050.1F, which contains the FAA's policies and procedures for compliance with NEPA.

NASA owns the SLC-41 area, has an agreement with the USAF for its use through 2021 and is also a cooperating agency. The Proposed Action would support the Commercial Space Launch Act and its Amendments and launches of NASA payloads.

1.4.2 EA Structure

Section 1 of this EA contains an introduction to the Vulcan Program and the scope of the proposed action. Section 2 of this EA describes the Proposed Action and the No Action Alternative. Section 3 describes the 16 environmental aspects identified for analysis: Land Use / Visual Resources, Noise, Biological Resources, Historical and Cultural Resources, Air Quality, Climate, Orbital and De-Orbiting Debris, Hazardous Materials and Solid and Hazardous Waste, Water Resources, Geology and Soils, Transportation, Utilities, Health and Safety, Socioeconomics, Environmental Justice and Department of Transportation Act Section 4(f) Properties. Section 4 describes the potential impacts associated with each of the 16 environmental aspects under the Proposed Action and the No Action Alternative. Section 4.17 summarizes the impacts in each of the 16 environmental aspect areas and Section 5 describes cumulative environmental impacts.

This EA was produced using available Vulcan Centaur Program Launch Vehicle and CCAFS launch operations information. All applicable environmental data necessary was collected to describe current environmental conditions.

2 Description of the Proposed Action and Alternatives

This section describes the Proposed Action, location for Vulcan Centaur Program operations and the No Action Alternative. The Vulcan Centaur Program was announced in 2015 and is anticipated to significantly reduce costs while increasing overall capabilities. The first planned launch of the Vulcan Centaur Launch Vehicle is in 2020.

2.1 MLP

A new larger MLP will be required to support the heavier Vulcan Centaur vehicle. The MLP functionality will remain the same.

2.2 Facility Modifications

The Proposed Action to support Vulcan Centaur Program operations requires modifications to existing systems at SLC-41, SMARF and VIF. These modifications include:

- SMARF, Facility 69800 – A new MLP will be constructed in the SMARF over the next two years (2018-2019) and then the MLP will be stored in the SMARF between launches. All work at the SMARF will be inside the building.
- VIF, Facility 29410 – The 60-Ton crane will be upgraded to 65-Ton capacity. New mechanical work platforms will be designed, fabricated and installed.
- SLC-41 - Existing LO2, LH2 and the ASWS will be modified and an LNG system will be added, to include:
    1. Installing a new LNG system with three new 100,000-gallon storage vessels, six vaporizers, one knock-down vessel, one liquid nitrogen (LN2) vessel, three flare stacks, three offload stations and cross-country piping to support the Vulcan first stage.
    2. Replacing the existing 36,000-gallon Duct Exit (DEX) ASWS vessel with a 50,000-gallon ASWS vessel and installing two new 20,000-gallon water tanks and one new 600 cubic foot GN2 accumulator for the lower ASWS spray manifold to accommodate a larger Vulcan vehicle burn time.
    3. Replacing the existing 42,000-gallon LH2 vessel with one 122,000-gallon LH2 vessel and associated piping, three new fill stations and replacing the existing LH2 vehicle and tank flare stacks to support the new Centaur upper stage.
    4. Installing one new 65,000-gallon LO2 vessel and associated piping, three new fill stations, and four new vaporizers to support the new Vulcan Centaur upper stage. The existing 28,000-gallon LO2 vessel that currently supports Atlas V Centaur will be deactivated. The existing 465,000-gallon LO2 vessel that currently supports the Atlas V booster will be used to support Vulcan booster with only minor piping changes required.

These modifications and new program elements will not interfere with existing Atlas V operations or launch manifests.

Appendix A, Figure 4. SLC-41 Current Configuration shows the current SLC-41 Atlas V configuration and ***Appendix A, Figure 5. SLC-41 Conceptual Drawing of Modifications for Vulcan Centaur*** shows a conceptual layout of vehicle operations facilities at SLC-41 for Vulcan Centaur.

2.2.1 LNG Flare Vegetation Clear Zone

Approximately 2.67 acres of cleared, vegetated area outside the SLC-41 perimeter fence is required to allow dissipation of the radiant heat flux produced by the LNG flares. ***Appendix A, Figure 6. SLC-41 LNG Flare Radiant Heat Flux Area Vegetation Clear Zone*** shows the location and area of the clearing action. This area is part of a larger parcel that will be cleared to perform a remedial action under the direction of the USAF Installation Restoration Program (IRP) in 2019. The cleared area required by the Vulcan Program LNG flares will be included under a separate NEPA action that addresses remedial activities to remove all vegetation and soils to depth. The contaminated area would be restored with clean fill and stabilized with herbaceous vegetation (grass). ULA would maintain the area after remediation is complete.

2.2.2 Proposed Changes to SLC-41

2.2.2.1 Liquified Natural Gas (LNG) System

The Vulcan LNG system is a new installation at SLC-41 built to support the Vulcan Centaur Program. All major components are new and all the supporting infrastructure is new except for the Auto Coupler Building, the Fuel Vault and the vent line routing trench.

Three drive-through filling stations will be constructed to offload LNG from tankers to the LNG storage area and accessible from the existing northwest pad perimeter road. All three stations will be designed to safely and adequately vent and purge natural gas.

The LNG Storage Area will consist of three 100,000-gallon vacuum-jacketed LNG storage vessels, LNG recovery vessel (knock-down tank), eight LNG vaporizers (six for the storage vessels and two for the knock-down tank), one LN2 vessel, a system control panel, various piping, valves, and access platforms. All the storage area components will be contained in a concrete catch basin. The catch basin will be constructed and sloped to capture LNG in the event of an accidental leak and direct it to the impoundment basin located away from the storage area along the northwest fence line.

The impoundment basin will be designed to contain 110,000 gallons of LNG (110% of the largest vessel) as required by code in the event of an accidental leak and is connected to the LNG Storage Area through a sloped impoundment trench. The impoundment basin has a 207-foot acceptable separation distance and no equipment or buildings may lie within this area. The impoundment basin will have an explosion proof sump pump with LNG interlock sensor to remove stormwater from the basin when LNG is not present.

Three new natural gas flare stacks will be located along the pad perimeter between the inner and outer fence line. Two elevated utility flare stacks will be used for launch day activity. The third will be an enclosed flare stack used for tank venting and tanker offload operations.

Two vacuum-jacketed cross-country lines (the LNG Transfer and Drain Line) will run from the LNG storage area to the existing pad Fuel Vault. Inside the fuel vault, the LNG transfer and drain line will have flow control, relief and manual valves, and a system control panel. The LNG transfer and drain line will be routed through a new pad deck trench between the Fuel Vault and the Auto Coupler Building. Inside the Auto Coupler Building, the LNG transfer and drain line will be routed

to connect to a new LNG Manual Coupler which will be the interface between the LNG ground systems and the MLP.

One insulated vent line will be constructed to run from the MLP vent pipe to the Flare Stacks. The vent line will interface from a manual connection point to the MLP and run along the top of the auto coupler building before crossing to the Crew Access Tower (CAT) structure for support and down into the CAT commodity trench. From there the vent line will exit the trench and route with the other LNG cross-country lines and head to the LNG storage area. The vent line will pass through the LNG storage area and into the impoundment basin trench where it will be routed under the road and to the flare stack.

2.2.2.2 Acoustic Suppression Water System Modifications

The ASWS continues to support the Atlas V program in addition to meeting the new, extended duration, requirements of the Vulcan Centaur program.

Modifications to the DEX ASWS include replacing the 36,000-gallon water tank with a new 50,000-gallon water tank. ULA will extend the concrete equipment pad and curbing, and modify the existing foundations as required to accommodate the new, longer DEX ASWS Tank. The new DEX ASWS Tank will connect to the existing water and Gaseous Nitrogen (GN2) lines serving the existing DEX Manifold. Two new 20,000-gallon Lower ASWS Tanks will be installed south of the existing flame duct exit. New GN2 piping will be routed from a new 600 cubic feet GN2 accumulator to the ASWS valves for activation.

2.2.2.3 Centaur Liquid Hydrogen System Modifications

A new 122,000-gallon LH2 vessel will be installed west and adjacent to the existing Centaur LH2 vessel in the southwest quadrant of SLC-41. The existing LH2 vessel will be drained and taken off-line before the new vessel is filled. A new equipment pad with curbing and a discharge valve will be provided to enable containment of washdown water or storm water.

The foundation will be designed based on vessel manufacturer's design loads and the geometry of the new tank. A new berm will be added to provide appropriate separation from LO2 stored on the east side of SLC-41. Soil will not be removed from the launch complex (LC) due to Land Use Controls. Three new tanker off-load stations will be provided designed similarly to the existing Centaur LH2 system. A new concrete roadway will be provided for tanker access to the new LH2 fill stations. The stormwater management system will be revised to meet code for the added impervious surface. Foundations and steel supports will be installed as required for the cross-country piping and conduit between the new LH2 vessel and the pad deck/pad equipment building (PEB).

2.2.2.4 Centaur Liquid Oxygen (LO2) System Modifications

The Vulcan Centaur Program will require the addition of a new 65,000-gallon LO2 vessel in addition to the existing Centaur LO2 vessel used to support the Atlas V program. The new LO2 vessel will have four vaporizers and three fill stations. The vessel, vaporizers and fill stations will require the removal of asphalt and a new concrete equipment pad with curbing and a valve that controls discharge to grade. New transfer lines will be added and routed to the existing trench to the Auto Coupler Building with new foundations and supports as required.

2.2.3 Proposed Changes to Support Facilities

2.2.3.1 SMARF

The SMARF will be used to assemble the new Vulcan Centaur MLP. This area will see additional traffic from construction activities for approximately two years. During this period, normal construction hazards would be expected including traffic, material and personnel increases. Once construction is complete, the SMARF will be used to store the mobile launcher (MLP) between launches.

2.2.3.2 Vertical Integration Facility (VIF)

VIF modifications in support of the Vulcan Centaur Program includes upgrading the 60-ton bridge crane to a 65-ton bridge crane to lift the heavier SRMs into the vertical position. Changes to the VIFs internal support platforms are also required to support Vulcan Centaur operations.

2.3 Launch Operations

2.3.1 Launch Vehicle Components

Vulcan vehicle components, manufactured at ULA's Facility in Decatur, AL and shipped aboard the Delta Mariner cargo ship, will be received at the CCAFS Wharf. Components are transferred via truck over CCAFS roads to the Atlas Spaceflight Operations Center (ASOC), Facility 75251, in the CCAFS ITL area. The transportation routes used for Vulcan vehicle components are identical to the current Atlas V routes from the wharf. The weight of Vulcan components is proposed to increase compared to Atlas V, but still meet standard Department of Transportation (DOT) requirements for axle loading.

Atlas V vehicle components can also be transferred via air on an Antonov cargo plane that lands at the CCAFS Skid Strip and is transported by truck to the ASOC. This operation will cease after Atlas V flyout, as Vulcan components are too large for transport on the Antonov aircraft.

No vehicle components will be reused; the Vulcan Program vehicles are completely expendable.

2.3.2 Manpower

Vulcan Centaur Program operations personnel levels will not change significantly from the existing Atlas V operations, which is approximately 200 people.

2.3.3 Safety Systems

The 45 SW Atlas V Operations Safety Plan contains the Safety Operating Plan and the Emergency Instructions. This document will be updated for the Vulcan Centaur Program and specifically address LNG hazard mitigation. The Eastern and Western Range (EWR), Air Force Space Command Manual (AFSPCMAN) 91-710 Range Safety Requirements (tailored for Vulcan Centaur) outlines the process for reviewing and approving launch facility design and construction at SLC-41.

2.4 Vulcan Centaur Vehicle

The Vulcan Centaur Launch Vehicle will have a gross lift-off mass of approximately 450 to 780 tons and produce approximately 1.1-3.5 million pounds of thrust. The vehicle's overall liftoff height is 199.8 feet with a diameter of 17.7 feet. The Vulcan first stage will integrate with the Centaur V upper stage which is similar to but larger than the current Centaur III stage flying on Atlas V.

The Vulcan Centaur Launch Vehicle will contain a larger diameter booster tank than the Atlas V. The first stage will use new BE-4 booster engines. A single BE-4 engine consumes approximately 150,000 pounds (68,038 kilograms) of LNG and 500,000 pounds (226,796 kilograms) of LO2. Multiple SRM configuration options in zero, two, four or six Orbital ATK GEM-63XL engines can be specified depending on payload and performance requirements. The Centaur second stage will have two RL10 LO2/LH2 engines.

2.4.1 Ground Support Operations

Vulcan Centaur ground support operations and vehicle processing flow will be nearly identical to current Atlas V operations. Vulcan Centaur component receipt, inspection and horizontal testing will be completed in the ASOC and then the components will be transferred to the VIF for vertical assembly of the launch vehicle, payload and SRMs. Launch vehicle subsystem checks and system verifications, final installations and vehicle closeouts will be conducted in the VIF. The Payload Van provides electrical, gas, and communication interfaces to the payload at the VIF for prelaunch testing, during transit to the pad and then at the pad during launch.

The Vulcan Centaur vehicle is transported on the MLP from the VIF to SLC-41 where the first stage booster LNG and LO2 transfers and checkouts and Centaur upper stage LH2 and LO2 transfers and checkouts are completed to support Wet Dress Rehearsal (WDR) and terminal launch countdown sequences.

2.5 Launch Trajectories

Vulcan Centaur Program launch vehicle trajectories will be specific to each particular mission and are similar to Atlas V trajectories as described in ULA's FAA Commercial Space Transportation License application (License # LLO 18-113). Flight trajectories vary based on mission specifics such as payload, desired orbit (height, eccentricity) and engine configuration. Vulcan launches from CCAFS will be geosynchronous transfer orbit (GTO) missions, as are Atlas V missions. Nominal Vulcan trajectories will be eastward over the Atlantic Ocean and will be similar to the launch azimuths permitted for Atlas V, respectively inclusive between:

- 93.5 to 95.9 degrees for Atlas V 401
- 84.8 to 94.4 degrees for Atlas V 411
- 92.5 to 104.0 degrees for Atlas V 421
- 93.5 to 97.0 degrees for Atlas V 431
- 81.0 to 86.5 degrees for Atlas V 521
- 90.1 to 97.0 degrees for Atlas V 531.

2.6 Payloads

Vulcan Centaur Program payloads will be similar to current and planned payloads launched on Atlas V.

In November 2011, NASA prepared an EA for *Launch of NASA Routine Payloads on Expendable Launch Vehicles*[10]. The abstract from this document verifies that no new or substantial environmental impacts or hazards were identified:

> "This Final Environmental Assessment updates the Final Environmental Assessment for Launch of NASA Routine Payloads on Expendable Launch Vehicles from Cape Canaveral Air Force Station, Florida and VAFB, California (June 2002) and addresses NASA's proposed action to launch a variety of spacecraft missions. The spacecraft used in these missions are considered routine payloads; the same threshold quantities and characteristics describe them all, and they would present no new or substantial environmental impacts or hazards as compared to previously analyzed and documented impacts. These scientific and technology demonstration missions are needed for US space and Earth exploration. All spacecraft (referred to as NASA routine payloads (NRP)) examined in this environmental assessment would meet rigorously defined criteria to ensure that the spacecraft and their launch and operation would not present any new or substantial environmental or safety concerns. The NRPs would launch from existing launch facilities (or those currently under construction) at CCAFS, Florida; VAFB, California; the Ronald Reagan Ballistic Missile Defense Test Site at US Army Kwajalein Atoll in the Republic of the Marshall Islands; NASA Wallops Flight Facility, Virginia; and Kodiak LC, Alaska. National Environmental Policy Act documentation exists that analyze the potential environmental impacts at each of these launch sites for the evaluated launch vehicles."

Future Vulcan Centaur operations were evaluated and determined to be within the scope of the NASA Routine Payload EA.

2.7 Projected Launch Schedule

The first Vulcan Centaur Program launch from SLC-41 is anticipated in mid-2020, with anticipated maximum annual launch rates of 20 per year (see ***Table 2-1: Planned and Projected ULA Vehicle Launches at CCAFS, SLC-41***). As shown in ***Table 2-1***, Atlas V launches would continue until 2024. After 2024, the Atlas V Program would be phased out completely and only Vulcan Centaur launches would occur from SLC-41. ***Table 2-1*** shows the very preliminary proposed Vulcan Centaur annual launch forecast. For purposes of environmental analysis, a maximum launch rate of 20 Vulcan Centaur launches per year from CCAFS is used.

Table 2-1: Planned and Projected ULA Vehicle Launches at CCAFS, SLC-41

Year	ULA Project Launches		
	Delta IV (SLC-37)	Vulcan Centaur (SLC-41)	Atlas V (SLC-41)
2018	2		6
2019	1		6
2020	1	2	6

Year	ULA Project Launches		
	Delta IV (SLC-37)	Vulcan Centaur (SLC-41)	Atlas V (SLC-41)
2021		8	2
2022		10	2
2023		12	2
2024		14	2
2025		16	
2026		18	
2027		20	
Note: Launch projections greater than two years out are very subjective.			

2.8 No Action Alternative

Under the No Action alternative, ULA would retain its current Atlas V and Delta IV capabilities to launch payloads into space. ULA would be at a competitive cost disadvantage to other commercial launch vehicles. Under the No Action Alternative, ULA would not apply to the FAA for a commercial space launch license for the Vulcan Centaur for operations at SLC-41.

Atlas V launches would still rely on Russian-made RD-180 engines, which could become increasingly difficult to procure, endangering Atlas V's longevity and potentially reducing or limiting US space launch capability and assured access to space.

SLC-41 would continue to be used to launch Atlas V 400 and 500 variants, with a standard common core booster powered by the LO2-kerosene (Rocket Propellant-1(RP1)) RD-180 engines, up to five strap-on Aerojet SRMs, a Centaur upper stage in a single- or dual-engine configuration, and one four (4) or five (5) meter diameter payload fairing. SRMs would continue to be shipped ready-to-fly by truck to the VIF where they would be installed on the Atlas V Vehicle with no launch site processing. The Centaur would be powered by the existing Aerojet Rocketdyne RL10C-1 engines.

Atlas V launches would continue to use the VIF, Payload Van, MLP, SLC-41 and ASOC for Atlas V processing and launch operations. VIF processing includes stacking booster(s) and Centaur, performing launch vehicle subsystem checks and system verification, installing the encapsulated payload, performing integrated system verification, final installations, and vehicle closeouts. The Payload Van provides electrical, gas, and communication interfaces between the payload ground support equipment and the payload, first at the VIF for prelaunch testing, during transit to the pad and then at the pad during launch.

The structural steel MLP supports the Atlas V launch vehicle. Operations that would continue to be supported include integration of the booster(s), mating of the Centaur and payload in the VIF, transport to the launch pad, launch vehicle fueling, final preparation for launch, thrust hold-down and release of the vehicle at launch. The MLP is moved between the VIF and launch pad by two track-mobiles that push the train. The MLP includes an umbilical mast for electrical, fluids, and gas servicing during final countdown, eliminating the need for an on-pad umbilical tower.

The Atlas V vehicle is fully integrated off-pad on the MLP in the VIF. SLC-41 is used only for launch day propellant loads and launch countdown. All payloads are fueled off-site before encapsulation and no payload processing occurs at the VIF or SLC-41. SLC-41 contains LO2 and RP-1 storage areas for core booster loading, LO2 and LH2 storage areas for Centaur upper stage loading, ASWS deluge water systems, flame trench, high pressure gas storage and support and equipment buildings.

The ASOC is a multifunctional facility supporting Atlas V vehicle hardware receipt and inspection, horizontal testing and the Launch Control Center.

2.9 Alternatives Considered but Eliminated from Further Study

After ULA determined the need to field a new launch system to replace the current capabilities of Atlas V and Delta IV, ULA considered many alternatives for launch vehicle design and launch sites. In accordance with Title 32 CFR 989.8, alternatives were evaluated for reasonableness using the following selection criteria:

1. Fully support the purpose and proposed need (specifically to provide medium and heavy lift capability, maximize use of existing space launch infrastructure and eliminate reliance on the current RD-180 Russian-supplied engines).
2. Ensure safe launch trajectories that minimize risk to the public.
3. Reduce recurring costs with respect to current ULA expendable systems.
4. Minimize capital expense.
5. Support a development and construction schedule to meet a mid-2020 first Vulcan Centaur launch.
6. Engage an available, high quality workforce.

From a launch vehicle perspective, a broad survey of available and in-development booster engines was considered. These engines used either LNG or RP-1 for fuel. The LNG BE-4 engine was selected as it was the only engine identified that that could provide medium and heavy lift capability, eliminate reliance on the current RD-180 Russian-supplied engines and support a development schedule to meet a mid-2020 first Vulcan Centaur launch.

LNG drives the size of the booster due to fuel density and performance required. With the booster generally sized, launch sites could be considered. Current ULA facilities (SLC-41 and SLC-37) were considered as well as existing, no-longer operational launch sites at CCAFS. Sites outside the continental US were also considered. Sites outside the continental US were eliminated because they did not maximize use of existing space launch infrastructure, ensure reduction in recurring costs, minimize capital expense, support a mid-2020 launch construction schedule and ensure an available, high quality workforce.

Existing, no-longer operational launch sites at CCAFS were evaluated, but no such sites that can support medium and heavy launch vehicles are actually available for development. SLC-11 and SLC-36 are currently being developed by Blue Origin. SLC-20 and SLC-17 (former Delta II launch complex) are too close to critical CCAFS infrastructure to support the Quantity-Distance and set-back requirements of heavy vehicle launches. In addition, SLC-17 is under development by Moon Express. This alternative was eliminated from consideration.

SLC-37, the current Delta IV launch complex, was evaluated for Vulcan Centaur accommodation. The Delta IV vehicle is integrated horizontally, transported to the launch pad and erected vertically. SRMs and the payload are then integrated vertically. Recurring costs were evaluated to integrate Vulcan horizontally, erect vertically at the pad and integrate SRMs and the payload horizontally. Recurring costs for horizontal integration and on-pad vertical integration were determined to be greater than vertical integration off-pad. Capital costs for retrofitting the Mobile Service Tower, Launch Table and Fixed Umbilical Tower at SLC-37 to support Vulcan launches was estimated to be greater than building a new MLP and modifying the VIF at SLC-41. In addition, the schedule for modifying SLC-37 to support Vulcan Centaur launches could not be adjusted to meet a mid-2020 launch. This alternative was eliminated from consideration.

2.10 Preferred Alternative

The BE-4 engine was selected as the Preferred Alternative because it was the only engine identified that that could provide medium and heavy lift capability, eliminate reliance on the current RD-180 Russian-supplied engines and support a development schedule to meet a mid-2020 first Vulcan Centaur launch.

Modifying SLC-41, constructing a new MLP and modifying the VIF to accommodate Vulcan Centaur, while maintaining Atlas V capability, was determined to be ULA's Preferred Alternative for the launch site because:

1. SLC-41 supports medium and heavy lift capability and maximizes use of existing space launch infrastructure, requiring minor modifications to pad systems. New LNG capability would be required at all launch site alternatives.
2. Vertical integration off-pad reduces recurring costs compared to horizontal integration with on-pad vertical integration.
3. SLC-41 and VIF modifications minimize capital expense.
4. The SLC-41 construction schedule is able to meet a mid-2020 first Vulcan Centaur launch.
5. Vulcan Centaur operations are very similar to current Atlas V operations and take advantage of the Atlas V high quality, available workforce.

The Proposed Action is then the Preferred Alternative.

3 Affected Environment

In compliance with NEPA and CEQ guidelines, this Section describes the existing environment for the Proposed Action and No Action Alternative.

Sixteen (16) environmental aspects are identified for analysis: Land Use / Visual Resources, Noise, Biological Resources, Historical and Cultural Resources, Air Quality, Climate, Orbital and De-Orbiting Debris, Hazardous Materials and Solid and Hazardous Waste, Water Resources, Geology and Soils, Transportation, Utilities, Health and Safety, Socioeconomics, Environmental Justice and Department of Transportation Act Section 4(f) Properties. For each resource area, a region of influence (ROI) is established that defines an area where the federal action, program or activity may cause an impact. In general, the ROI for this assessment is SLC-41, the surrounding area between SLC-41 and the SMARF and wider CCAFS and KSC areas.

As stated in Section 1, this EA complies with FAA Order 1050.1F (the FAA's NEPA-implementing policies and procedures) so the FAA can easily adopt this EA and issue its own FONSI, if applicable. FAA Order 1050.1F, Paragraph 4-1, lists environmental impact categories (i.e., resource areas) for which the FAA considers in its NEPA documents. This EA analyzes all of the FAA's environmental impact categories except children's environmental health and safety risks and natural resources.[11] Given the location of SLC-41 and the activities proposed, the Proposed Action would not disproportionately affect children. The Proposed Action would not have a measurable effect on natural resources, such as water, asphalt, aggregate, or wood. Therefore, these two impact categories are dismissed from detailed analysis because the Proposed Action would not affect them.

The Affected Environment Section 3.0 in the April 1998 EIS and the March 2000 SEIS establish the baseline conditions used to evaluate the environmental changes resulting from implementation of the Vulcan Centaur Program.

3.1 Land Use / Visual Resources

Land use is defined as the human usage of land resources for uses such as economic production, natural resources protection, residential or commercial uses. Compatible land use is achieved when the Proposed Action fits within the land use patterns (such as vehicle launches, residential, commercial, industrial, recreational), land ownership (federal, state, private), and land use management plans. Zoning, management plans and policies regulate how land is used. Land uses described are regional land use and zoning, on-station/base land use and zoning and coastal zone management (CZM). Visual resources are any naturally occurring or manmade feature that contributes to the aesthetic value of an area. The term coastal zone is defined as the coastal waters (including the lands therein and thereunder) and the adjacent shorelands (including the waters therein and thereunder) strongly influenced by each other and in proximity to the shorelines of the several coastal states, and includes islands, transitional and intertidal areas, salt marshes, wetlands, and beaches (16 U.S.C. 1453).

The Land Use ROI includes the ITL Area north of the SMARF to SLC-41, SLC-41 and surrounding areas as applicable on CCAFS and KSC.

SLC-41 is located within Fire Management Unit 7.4 managed by the Merritt Island National Wildlife Refuge (MINWR).

3.1.1 Regional Land Use and Zoning

Brevard County and the City of Cape Canaveral are the local planning authorities for incorporated and unincorporated areas near CCAFS and designate compatible land uses and zoning around CCAFS. CCAFS and KSC designate their own land use and zoning regulations since they are federal-owned and are not included under the land use or zoning authority of Brevard County or the City of Cape Canaveral. Port Canaveral planned uses include continued commercial and industrial uses and expansion. The federal-owned section of Port Canaveral is used by NASA, the US Navy, USAF, the US Coast Guard and ULA to support space launches, shipping, vessel maintenance and other related activities.

KSC, which is north and west of CCAFS, includes predominantly industrial uses associated with NASA launch programs and recent commercial aerospace ventures and open space associated with the MINWR. Uses of the river and ocean water areas surrounding CCAFS include commercial fishing, marine recreation and marine transportation. The Canaveral National Seashore is located directly north of CCAFS and is operated by the National Park Service.

3.1.2 Land Use and Zoning

CCAFS encompasses approximately 16,200 acres (25 square miles), representing approximately two percent Brevard County's total land area. Land uses at CCAFS include an airfield, port operations, launch operations, launch and range support, commercial aerospace ventures, station support and maintenance areas and open space. The launch operations land use category along the Atlantic Ocean shoreline includes both inactive and active launch sites and support facilities. The launch and range support area lie west of the launch operations land use area and is divided into two sections by the Skid Strip (airfield). The port operations area is in southern CCAFS and includes facilities for government, commercial and industrial shipping activities. The Industrial Area is centrally located in the western portion of CCAFS, near the Banana River and is identified as a CCAFS support area category. Land use at CCAFS also includes administrative, recreational, historic lighthouse, monuments and museum and range support functions. Open space is dispersed throughout the station. CCAFS has no public beaches.

The southern boundary of KSC coastal property on the barrier island is 2,000 feet south of SLC-41. KSC property also borders CCAFS to the west. Land and open water resources of KSC comprise 142,000 acres in Brevard County and Volusia County. The majority of the KSC land areas are located on the northern part of Merritt Island, which forms a barrier island complex adjacent to CCAFS. Undeveloped areas (uplands, wetlands, mosquito control impoundments and open water) comprise approximately 95% of KSC.

MINWR manages habitat surrounding SLC-41 as part of Fire Management Unit 7.4 allowing prescribed burning operations and impoundment management.

Areas of SLC-41 are designated as Solid Waste Management Units (SWMU). Land Use Controls (LUC) were implemented as a result of a Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) conducted at SLC-41. The property is prohibited from residential or other non-industrial development. Additional information on SWMU is included in Section 3.8.4.

The ITL Area, where the VIF and the SMARF are located, was constructed beginning in 1961. Three (3) connected man-made islands were constructed northwest of the CCAFS Industrial Area

using 6.5 million cubic yards of fill dredged from the Banana River. Titan III Road and railroad tracks run north-south through the ITL Area. Wetland and vegetated scrub areas are located on or near both sides of the road.

3.1.3 Coastal Zone Management

The Coastal Zone Management Act (CZMA), enacted in 1972, encourages states to preserve, protect, develop, and, where possible, restore or enhance valuable natural coastal resources such as wetlands, floodplains, estuaries, beaches, dunes, barrier islands, and coral reefs, as well as the fish and wildlife using those habitats. Federal activity in, or affecting, a coastal zone requires preparation of a Coastal Zone Consistency Determination, in accordance with the federal CZMA of 1972, as amended (P.L. 92-583), and implemented by the National Oceanic and Atmospheric Administration (NOAA). CZM Program administration has been delegated to states that develop state specific guidelines and requirements. The Office of Ocean and Coastal Resource Management administers individual state programs. Federal property is exempt from the definition of states coastal zones, but activities occurring on federal property that directly affect state coastal zones must comply with the CZMA. Section 307(c)(1)(A), Coordination and Cooperation, mandates that each federal agency activity within or outside the coastal zone that affects any land or water use or natural resource of the coastal zone would be carried out in a manner which is consistent, to the maximum extent practicable, with the enforceable policies of approved state management programs.

Applicable federal actions must be consistent with NOAA's federal consistency regulations at 15 CFR Part 930. Federal consistency is required for federal actions that are defined as federal activities, including any development projects (15 CFR Part 930, Subpart C). Subpart C regulations require that all federal activities and development projects be consistent to the maximum extent practicable with federal-approved state CZM programs as indicated in ***Table 3-1: Summary of Land Use and Zoning Requirements***.

Table 3-1: Summary of Land Use and Zoning Requirements

Law or Rule	Permit/Action(s)	Requirement	Agency or Organization
Coastal Zone Management Act	Development projects must be consistent to the maximum extent practicable with Florida's CZM Program	Preserve, protect, develop, and, where possible, restore or enhance valuable natural coastal resources such as floodplains, and dunes	Federal Department of Environmental Protection (FDEP), USAF
Florida Statutes, Section 373.428	Federal Consistency	When an activity regulated under this part is subject to federal consistency review under Section 380.23, the final agency action on a permit application submitted under this part shall constitute the state's determination as to whether the activity is consistent with the federal-approved Florida Coastal Management Program. Agencies with authority to review and comment on such activity pursuant to the Florida Coastal Management Program shall review such activity for consistency with only those statutes and rules incorporated into the Florida Coastal Management Program and implemented by that agency.	NOAA

Law or Rule	Permit/Action(s)	Requirement	Agency or Organization
Florida Statutes, Section 380.23	Federal Consistency	(1) When a federal-licensed or permitted activity subject to federal consistency review requires a state license, the issuance or renewal of a state license shall automatically constitute the state's concurrence that the licensed activity or use, as licensed, is consistent with the federal-approved program.	NOAA
Florida Administrative Code 62B-33.004 (2) (b)	Exemptions from Permit Requirements	(3) In addition to the exemptions provided in Section 161.053(11), F.S., the following are exempt from the provisions of Section 161.053, F.S., and this rule chapter: (b) Construction, excavation, and damage or destruction of vegetation conducted by the United States Government on lands owned and maintained by the United States Government.	FDEP

In Brevard County, the Florida Coastal Management Program (FCMP), 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 and extends from the mean high-water level inland 75 feet.

CCAFS has additional siting and facility design standards for construction that require new facilities to be set back at least 150 feet from the coast. (SLC-41 is approximately 2600 feet west of the Atlantic coast.) Land uses are addressed by the CCAFS General Plan[12], which contains existing land use maps, future land use maps, and siting standards to guide development. The Florida Department of Environmental Protection (FDEP) is the state's lead coastal management agency. The FDEP along with FCMP member agencies review the coastal zone consistency determination. The USAF is responsible for making the final coastal zone consistency determinations for its activities within the state, and the FDEP along with FCMP member agencies will review the Florida CZMA plan to ensure the proposed action is consistent with the coastal zone consistency determination through submittal of this EA to the Florida Clearinghouse.

3.1.4 Visual Effects

3.1.4.1 Light Emissions

The ROI for light emission effects includes people, wildlife and land uses in the SLC-41 area. Light emissions from the proposed Vulcan Program are expected to be nearly identical to the emissions from the current Atlas V Program. Light emissions from the SLC-41 and ITL Area facilities are not visible from existing populated areas outside CCAFS and KSC except during nighttime launch events, where additional mobile search lights are used to illuminate the launch pad.

The ROI for light emissions includes most of CCAFS and KSC/MINWR Atlantic coastline due to sensitivity of nesting adult and emerging hatchling sea turtles to artificial lighting. Section 3.3.5.2, Marine Turtles, provides additional details on compliance with Section 7 of the Endangered Species Act (ESA). The USAF developed 45TH Space Wing Instruction (SWI) 32-7001, Exterior Lighting Management, for various areas and facilities on CCAFS to protect sea turtles.

3.1.4.2 Visual Resources and Visual Character

Visual resources include buildings, sites, traditional cultural properties, and other natural or manmade landscape features that are visually important or have unique characteristics. Historical and Cultural Resources are detailed in Section 3.4. Natural landscape features include the Atlantic Ocean coastline and the Banana River and surrounding wetlands. Visual character refers to the overall visual makeup of the existing environment where the proposed action would be located. The visual character of the area surrounding SLC-41 and ITL Area facilities is described in Section 3.3.1.5, Vegetation and also includes the Atlantic Ocean coastline and the Banana River and surrounding wetlands.

3.2 Noise

Noise is usually defined as unwanted sound. The decibel (dB) is the accepted standard unit for the measurement of sound and is a logarithmic unit that accounts for the large variation in sound pressure amplitudes. Environmental noise is often expressed in terms of A-weighted (dBA) noise levels. A-weighting simulates the frequency response of the human hearing mechanism. The Environmental Protection Agency (EPA) administers the Noise Control Act of 1972 and has identified 65 dB Day Night Average Noise Level (DNL) as an acceptable noise level for compatible land uses. The DNL is essentially a 24-hour average of noise levels with 10 dB added to nighttime noise levels (10 pm to 7 am). The 10 dB correction accounts for increased sensitivity to nighttime noise. ***Table 3-2: A-weighted Sound Levels of Common Sounds*** contains common sound examples.

Table 3-2: A-weighted Sound Levels of Common Sounds

Common Sounds	Sound Level Range (dB)	Region of Comfort
Threshold of Hearing	0-10	Just Audible
Recording Studio	10-20	
Bedroom at Night	20-30	
Quiet Urban Nighttime	30-40	Quiet
Average Office	40-50	
Air Conditioner at 100 ft (30.5m)	50-60	
Conversational speech Normal Piano Practice	60-70	Moderate
Heavy Truck at 50 ft (15.2m)	70-80	
Riding Mower	80-90	
Light-duty Bulldozer	90-100	Very Loud
Textile Mill or Discotheque	100-110	
Oxygen Torch	110-120	Uncomfortable
Chain Saw	120-130	
Jet Aircraft at takeoff	140	
Primary Source[13]		

Descriptors are used to assess and correlate the various effects of noise on humans, including land use compatibility, sleep and speech interference, annoyance, hearing loss, and startle effects. Although derived for humans, these descriptors can also be used to qualitatively assess the effects of noise on wildlife. These descriptors are shown in ***Table 3-3: Sound Level Descriptors***.

Table 3-3: Sound Level Descriptors

Descriptor	Description
A-Weighted Sound Level	The momentary magnitude of sound weighted to approximate the human ear's frequency sensitivity. A-weighted sound levels are typically measured between 20 hertz and 20 kilohertz.
Level Equivalent A-Weighted Sound Level (LAeq)	An A-weighted sound level that is "equivalent" to an actual time-varying sound level
Day-Night Average Noise Level (DNL)	An A-weighted equivalent sound level averaged over a 24-hour period with a 10-dB "penalty" added to nighttime sounds (10:00 p.m. to 7:00 a.m.). The DNL has been adopted by federal agencies as the standard for measuring environmental noise.
C-Weighted Sound Level	Measures sound levels in dB, with no adjustment to the noise level over most of the audible frequency range except for a slight de-emphasis of the signal below 100 hertz and above 3,000 hertz. It is used as a descriptor of low-frequency noise sources, such as blast noise and sonic booms.
C-Weighted Day-Night Level (CDNL)	The C-weighted sound level averaged over a 24-hour period; with a 10-dB penalty added for noise occurring between 10:00 p.m. and 7:00 a.m. CDNL is similar to DNL, except that C-weighting is used rather than A-weighting.
Sound Exposure Level (SEL)	A-weighted SEL. The total sound energy in a sound event if that event could be compressed into one second. SEL converts the total sound energy in a given noise event with a given duration into a 1-second equivalent, and, therefore, allows direct comparison between sounds with varying magnitudes and durations.
C-Weighted Sound Exposure Level (CSEL)	C-weighted SEL. The same as SEL except the measurement is in C-weighting rather than A-weighting.
Peak Overpressure	A measure of changes in air pressure and is often measured in units of pounds per square foot (psf). Peak overpressure is often used to measure the magnitude of sonic booms, particularly with respect to evaluating the potential for structural damage.

The ROI for noise includes the area around SLC-41, CCAFS and KSC and the closest populated areas, which are Cape Canaveral and Cocoa Beach to the south and Merritt Island to the east southeast. Three noise areas associated with the Proposed Action are evaluated, Construction Noise, Launch Operations Noise and Launch and Ascent Noise.

Noise levels around industrial facilities at CCAFS and KSC approximate those of any urban industrial area, reaching levels of 60 to 80 dBA. Additional on-site sources of noise are the aircraft landing facilities at the CCAFS Skid Strip. Other less frequent but more intense sources of noise in the region are launches from CCAFS and KSC. The closest residential areas to CCAFS are in Merritt Island and Cape Canaveral, both over 10 miles from SLC-41. The distance from these communities reduces the effect of potential noise generated from the Proposed Action. Expected sound levels in these areas are normally low, with higher levels occurring in industrial areas such as 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 fly-overs and rocket launches from CCAFS and KSC would be expected to increase noise levels for short periods of time.

The largest portion of the total acoustic energy produced by a launch vehicle is usually contained in the low-frequency end of the spectrum (1 to 100 Hertz). Launch vehicles also 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.

3.2.1 Launch Operations Noise

Operation-related noise refers to noise generated from activities such as actual launches and also temporary noise during construction, maintenance or refurbishment activities and ongoing noise generated from worker traffic to and from the selected site. The highest recorded levels were produced by Space Shuttle launches, which could exceed 160 dBA.

Launch is the major source of all operational noise. Three distinct noise events are associated with launch and ascent of a launch vehicle: on-pad engine noise, in-flight engine noise, and sonic booms. Operations-related noise from the actual launches are summarized below.

3.2.1.1 On-pad Noise

On-pad engine noise occurs when engines are firing, but the vehicle is still on the pad. The engine exhaust is deflected horizontally by an exhaust tunnel or flame duct. Noise is highly directional, with maximum levels in lobes that are about 45 degrees from the main direction of the deflected exhaust. Noise levels at the vehicle and within the LC are high. Because the sound source is at or near ground level, propagation from the launch vehicle to off-site locations is along the ground, with 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.

3.2.1.2 In-flight Noise

In-flight 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, 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. The in-flight sound source is also well above the ground and therefore there is less attenuation of the sound as it propagates to large distances.

The major source of in-flight 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 to 100 hertz).

3.2.1.3 Sonic Booms

Sonic booms occur when vehicles reach supersonic speeds. A sonic boom is the shock wave resulting from the displacement of air in supersonic flight. It differs from other sounds in that it is impulsive and very brief. In many cases an ascending launch vehicle’s orientation at the Mach 1 (speed of sound) is nearly vertical and therefore the sonic boom ray cone would not impinge on the earth’s surface and would not be heard. Conversely, a descending launch vehicle’s orientation often would cause a sonic boom to impinge on the earth’s surface and be heard.

3.2.2 Construction Noise

Temporary noise impacts from the operation of construction equipment (e.g., earth moving machinery, dump trucks, power tools) are usually limited to a distance of 1,000 feet or less. Vehicles associated with construction typically generate between 65 and 100 dBA at a distance of 50 feet.[14] In addition, noise diminishes at a rate about 6 dBA for each doubling of distance from the source. CCAFS has no sensitive receptors (e.g., schools, hospitals) in its vicinity. All construction work would be conducted as normal activities on CCAFS.

3.3 Biological Resources

Much of the detailed Biological Resource information included was extracted from the *45 SW Integrated Natural Resources Management Plan* (INRMP)[15]. Biological resources covered in this section include native and nonnative vegetation communities, upland or wetland habitats, threatened and endangered (T&E) species and species of special concern (SSC) that occur or could potentially occur in the ROI, which is considered to be the areas surrounding SLC-41 and the ITL area, and could be affected by construction activities and the effects of launch operations. Sensitive and protected biological resources include plant and animal species listed as threatened or endangered by the United States Fish and Wildlife Service (USFWS) and the Florida Fish and Wildlife Conservation Commission (FWCC). Natural areas around SLC-41 are managed by MINWR.

In this section, all descriptions attributed to CCAFS also include the coastal area on KSC that includes SLC-41.

3.3.1 Regulatory Framework

3.3.1.1 Federal Regulations

Endangered Species Act (ESA). The ESA provides for the conservation of ecosystems upon which T&E species of fish, wildlife, and plants depend, both through federal action and by encouraging the establishment of state programs. Section 7 of the ESA requires federal agencies to ensure that any action authorized, funded or carried out by them is not likely to jeopardize the continued existence of listed species or modify their critical habitat.

Marine Mammal Protection Act. This Act protects mammals including cetaceans (whales, dolphins, and porpoises) and other marine mammals in US waters.

Migratory Bird Treaty Act (MBTA). Under this Act, taking, killing or possessing migratory birds is unlawful.

Bald and Golden Eagle Protection Act. This Act prohibits the taking or possession of, and commerce in, bald and golden eagles.

3.3.1.2 State Regulatory Requirements

Florida Endangered and Threatened Species Act (FETSA). This Act includes no specific prohibitions or penalties but does establish the conservation and wise management of endangered and threatened species as state policy.

Endangered Species Act. This Act prohibits the intentional wounding or killing of any fish or wildlife species designated by the FWCC as "endangered", "threatened" or of "special concern". This prohibition also extends to the intentional destruction of the nests of any such species.

In addition, Florida has an Imperiled Species Management Plan, implemented in 2016, that provides a comprehensive, integrated approach for the conservation of state-listed species.[16]

3.3.2 CCAFS INRMP

Directed under the INRMP, AFI 32-7064, the USAF is committed to the long-term management of all natural areas on the installation. Long-term management objectives are identified in the 45 SW's INRMP, with specific land management objectives identified in the Scrub-jay and Sea Turtle Management Plans located in the Appendices of the INRMP. Section 3.3.4 provides details of the threatened, endangered and special concern species at CCAFS that may be found near the area surrounding the SLC-41 and ITL areas.

3.3.3 Vegetation

3.3.3.1 Native Species

Native vegetation communities on CCAFS are somewhat fragmented by construction and clearing activities. CCAFS contains a series of ridges and swales parallel to the coastline to support the communities. At least 10 high-quality natural communities of vegetation exist on CCAFS, including the oak scrub, rosemary scrub, maritime hammock, coastal strand, coastal dunes, grasslands, sea grasses, and three wetland communities (hydric hammock, interdunal swales, and estuarine tidal swamps and marshes). Vegetation on CCAFS, including areas surrounding the perimeter fence of SLC-41, consists mainly of the indigenous Florida coastal scrub (including oak and rosemary scrub) and xeric and maritime hammocks. Native vegetation communities have been invaded by the Brazilian pepper, which is a nonnative aggressive plant that invades communities along disturbed areas and subsequently out-competes native species.

No federal-listed threatened or endangered plant species occur at CCAFS. ***Table 3-4: Florida Threatened and Endangered Vegetation Species Found on CCAFS*** contains the State of Florida T&E species for plants that have been documented as present on CCAFS.

Table 3-4: Florida Threatened and Endangered Vegetation Species Found on CCAFS

Common Name	Scientific Name	State	
		Threatened	Endangered
Sea-Lavender	*Argusia gnaphalodes*		E
Curtiss's Milkweed	*Asclepias curtissii*		E
Sand Dune Spurge	*Chamaesyce cumulicola*		E
Satin-Leaf	*Chyrsophyllum oliviforme*	T	
Coastal Vervain	*Glandularia maritima*		E
Pineland Florida Lantana	*Lantana depressa var. floridana*		E
Simpson's Stopper	*Myrcianthes fragrans*	T	
Shell Mound Prickly-Pear Cactus	*Opuntia stricta*	T	

Common Name	Scientific Name	State	
		Threatened	Endangered
Beach-Star	*Remirea maritima*		E
Inkberry	*Scaevola plumieri*	T	
Common Wild-Pine	*Tillandsia fasciculata*		E

3.3.3.2 Invasive Species

Most disturbed areas of CCAFS and SLC-41, including roads and utility corridors, contain invasive species including Brazilian pepper (*Schinus terebinthifolius*), Australian pine (*Casuarina equisetifolia*), cogon grass (*Imperata cylindrical*), and melaleuca (*Melaleuca quinquenervia*). ***Table 3-5: 45TH Space Wing Priority Invasive Plant Species Managed*** contains a comprehensive list of 45 SW priority invasive plant species requiring management.[17]. Brazilian pepper is the dominant invasive flora at CCAFS and outside the fenced area of SLC-41 and the surrounding ITL area, followed by Australian pine trees growing singly or as small, dense groves scattered across the base. Within the fenced area of SLC-41, the vegetation is characterized as mowed and maintained.

Table 3-5: 45TH Space Wing Priority Invasive Plant Species Managed

Common Name	Scientific Name
Brazilian pepper	*Schinus terebinthifolius*
Australian pine	*Casuarina equisetifolia*
Cogon grass	*Imperata cylindrica*
Torpedo Grass	*Panicum repens*
Melaleuca	*Melaleuca quinquenervia*
Mimosa	*Albizia julibrissin*
Hydrilla	*Hydrilla verticillata*
Earleaf acacia	*Acacia auriculiformis*
Chaste tree	*Vitex trifolia*
Common guava	*Psidium guajava*
Old World climbing fern	*Lygodium microphyllum*
Schefflera	*Schefflera actinophylla*
Wedelia	*Schagneticola trilobata*

3.3.4 Species of Special Concern (SSC)

In Florida, only six SSC exist and none have been seen on CCAFS/KSC/MINWR property.

3.3.5 Wildlife

Brevard County, Florida is home to a vast network of native and non-native wildlife due to its varying ecosystems including beaches, salt marshes, fresh waters streams and lakes, brackish water lagoons, and coastal and inland scrub. Typical wildlife in the area include the American Alligator (*Alligator mississippiensis*), numerous species of fish, common birds such as seagulls, crows, mockingbirds, and various types of wading birds and herons, land mammals including the wild

pig (*Sus scrofa*), white-tailed deer (*Odocoileus virginianus*), various rodents and other small mammals. The gopher frog (*Lithobates capito*) is part of the Imperiled Species Management Plan in Florida and may reside within gopher tortoise burrows.

Cape Canaveral is situated along a major flyway route for neo-tropical migratory birds that breed in eastern North America. The habitat on CCAFS that is suitable for migrant birds is of conservation concern and is home to numerous birds listed on the USFWS migratory bird list, all of which are protected at the federal level by the MBTA. All but a few bird species (e.g. pigeons, European starlings (*Sturnus vulgaris*) found on CCAFS are on this list. The Air Force is not required to have a state permit to remove migratory birds, however, in the event a nest/bird/eggs needs to be removed, a federal depredation permit from USFWS would be required. The USAF natural resources office would decide on a case-by-case basis if/when a nest would require removal. The Air Force currently has a depredation permit that covers Bird Aircraft Strike Hazard (BASH) issues and removal of birds/nests that if left in place could result in harm to human life.

3.3.6 Threatened and Endangered (T&E) Species

CCAFS and KSC/MINWR contains habitat used by many federal and state-listed species. It is located on a barrier island ecosystem that is an important natural area that supports many plants and animals. Barrier islands along the Atlantic coast are especially important for nesting sea turtles, populations of small mammals and foraging and loafing habitat for a variety of resident and migratory shorebirds, wading birds and songbirds. This section presents the federal and state regulatory requirements for vegetation and wildlife and identifies the federal and state-listed species that may be present on CCAFS.

3.3.6.1 Birds

The **Florida Scrub-jay** (*Aphelocoma coerulescens*) is a federal-protected ESA threatened species. Distribution of the Florida Scrub-jay is restricted to scrub communities associated with relic dunal deposits on peninsular Florida. The scrub-jay shows an obligatory reliance on oak species, especially those growing in low dense thickets interspersed with open sandy areas.

The **Piping Plover** (*Charadrius melodus*) is a small pale federal-threatened shorebird that has the potential to exist on Brevard beaches during the non-breeding season (July-March). The main threat to this species in Florida is disturbance by humans on their primary habitat, the open beaches.

The rufa **Red Knot** (*Calidris canutus rufa*) is a medium-sized federal-threatened shorebird that winters at the tip of South America in Tierra del Fuego and breeds in the tundra of the central Canadian Arctic Circle. During the spring and fall migrations, red knots habitually travel in nonstop segments of 1,500 miles or more along the Atlantic coast using the same stopover sites year and after year to rest and refuel. These birds have been seen north of SLC-37 at CCAFS.

The **Bald Eagle** (*Haliaeetus leucocephalus*) was removed from federal-threatened species list in 2007. They are regularly seen using CCAFS as a foraging area. The nests are usually built in tall pine trees near lakes, marshes or coastlines. Bald eagles are regularly observed on CCAFS between September and April.

Wood Storks (*Mycteria americana*) are a federal-listed threatened species. Wood storks have been observed feeding in the CCAFS drainage canal system, foraging along the beach shoreline and in

other bodies of water on CCAFS. In addition, these birds rest along the canal banks and in adjacent fields.

Wilson's Plovers (*Charadrius wilsonia*) are included on the 2014 State of the Birds Watch List and have been recommended to be federal-listed under ESA. They are coastal waders that frequent beaches, lagoons, and salt flats. Their diet consists of crustaceans, insects, and worms located along shorelines. It is a migratory bird in all areas of the eastern seaboard except Florida, where it remains year-round.

Table 3-6: ROI Federal and State Listed Birds contains a complete list of federal and state listed birds in the ROI.

Table 3-6: ROI Federal and State Listed Birds

Common Name	Scientific Name	Federal	State
American Oystercatcher	*Haematopus palliatus*		T
Black Skimmer	*Rynchops niger*		T
Crested Caracara	*Caracara cheriway*	T	
Florida Scrub-Jay	*Aphelocoma coerulescens*	T	
Least Tern	*Sternula antillarum*		T
Little Blue Heron	*Egretta caerulea*		T
Piping Plover	*Charadrius melodus*	T	
Red Knot	*Calidris canutus rufa*	T	
Reddish Egret	*Egretta rufescens*		T
Roseate Spoonbill	*Platalea ajaja*		T
Roseate Tern	*Sterna dougallii*	T	
Snowy Plover	*Charadrius nivosus*		T
Southeastern-American Kestrel	*Falco sparverius paulus*		T
Tricolored Heron	*Egretta tricolor*		T
Wood Stork	*Mycteria americana*	T	

3.3.6.2 Marine Turtles

Four species of federal-protected sea turtles have been documented as nesting on CCAFS: loggerhead turtle (*Caretta caretta*), green sea turtle (*Chelonia mydas*), Kemp's Ridley Sea Turtle (*Lepidochelys kempii*) and leatherback turtle (*Dermocheyls coriacea*). Based on nest surveys as of 2018, CCAFS has a total of 1,767 loggerhead turtle nests, 31 green sea turtle nests and two leatherback sea turtle nests.[18].

While sea turtles spend much of their lives in the ocean, females come ashore each year to nest. Research has shown that females will avoid highly illuminated beaches and postpone nesting. Artificial lights have also resulted in hatchling mortality as disoriented hatchlings move toward these light sources rather than the ocean. In 1988, in compliance with Section 7 of the ESA, the USAF developed 45 SWI 32-7001, Exterior Lighting Management for various areas and facilities on CCAFS to protect sea turtles. A Biological Opinion (BO) issued by the USFWS requires development of Light Management Plans (LMPs) for all new facilities that are in close proximity to the beach, are not compliant with 45 SW lighting policies, have lighting directly visible from the beach, and/or may cause significant sky glow. In addition, USAF biologists conduct nighttime

inspections to ensure all exterior lighting is operated in accordance with policies. The BO authorizes no more than 2% incidental take of turtles as the result of disorientation.

In 2015, the **Kemp's Ridley Sea Turtle** was found nesting on CCAFS for the first time. This resulted in more than 170 hatchlings.[19]Although the endangered **Atlantic Hawksbill Sea Turtles** (*Eretmochelys imbricata*) are not known to nest on CCAFS beaches, they have been known to occur in the waters off the Florida coast and near shore areas.

Loggerhead Sea Turtles are listed as an ESA threatened species. Approximately 90 percent of loggerhead nesting in the southeastern US occurs in Florida. Each year, between May and August, an average of 2,218 Atlantic loggerhead turtle nests are deposited annually on the CCAFS beaches.

The **Green Sea Turtle** was federal-listed as a threatened species in Florida and along the Pacific Coast of Mexico. Each summer an average of 90 green turtle nests are deposited on the CCAFS beach.

The USFWS listed the **Leatherback Sea Turtle** as an endangered species in 1970. Leatherback nests can be found along the shores of the Atlantic, Pacific, and Indian Oceans. Nesting on CCAFS was first documented in 1986 when a single leatherback nest was recorded by CCAFS biologists. In 2018 there were two leatherback nests at CCAFS.

3.3.6.3 Other Reptiles and Amphibians

The **Eastern Indigo Snake** (*Drymarchon couperi*) is federal-listed as a threatened species. It is a large non-venomous snake that is widely distributed throughout Central and South Florida. Gopher tortoise and other animal burrows have been found throughout CCAFS, including in and around LCs and the ITL area. Indigo snakes have been known to use these burrows as shelter from cold and intense heat in other areas, however snakes have not been observed in the burrows found on CCAFS. Eastern indigo snakes have been identified on CCAFS from road kills and field observations. The major threats to the indigo snake on CCAFS are habitat loss and vehicle traffic. Eastern indigo snakes frequent pine flatwoods, high pine, dry prairie, tropical hardwood hammocks, edges of freshwater marshes and coastal dunes.

The **Florida Pine Snake** (*Pituophis melanoleucus*) is a state-listed threatened species. This is one of the largest eastern snakes in North America reaching up to 84 inches. The Florida Pine Snake has been found on CCAFS.

The **Gopher Tortoise** (*Gopherus Polyphemus*) is a state-listed threatened species, as well as a candidate for federal-listing. Gopher tortoises are common on CCAFS. Burrows can be quite deep and long with average depth at 6.5 feet and average length at 15 feet and can be used by more than 350 other commensal species such as frogs, mice, snakes and insects. The Gopher Tortoise can live from 40 to 60 years, and is commonly found in habitats such as sandhill, pine flatwoods, scrub, scrubby flatwoods, dry prairies, xeric hammock, pine-mixed hardwoods and coastal dunes. Active gopher tortoise burrows exist in the SLC-41 and ITL areas.

3.3.6.4 Fish

Smalltooth Sawfish (*Pristis pectinate*) is a federally-listed endangered fish reportedly living in Atlantic Ocean. The US population is found along the east coast of Florida from about Charlotte Harbor through the Everglades region. The Smalltooth Sawfish inhabits shallow coastal waters of tropical seas and estuaries. They are usually found in shallow waters very close to shore over

muddy and sandy bottoms. It is very rare in this area and is unlikely to occur in the ocean off CCAFS[20].

In March 2018, the **Oceanic Whitetip Shark** (*Carcharhinus longimanus*) was listed as a threatened species under the ESA and is found in tropical and subtropical oceans. This species has been seen off the Atlantic Coast of Florida and lives near the surface in warm waters.

The **Giant Manta Ray** (*Manta birostris*) is federally-listed as a threatened species under the ESA in January 2017. In Florida, the Giant Manta Ray is also listed as protected in Florida state waters. The habitat is found near shore waters and coral or rocky reefs.

3.3.6.5 Mammals

The **North Atlantic Right Whale** (*Eubalaena glacialis*) is federally-listed as endangered under the ESA throughout its range. It is rarest of all large whale species and is among the rarest of all marine mammal species. They primarily occur in the northwest Atlantic and in coastal or shelf waters during the winter in both hemispheres. Calving takes place in the lower latitudes and coastal waters. Part of the critical habitat includes coastal Florida and Georgia, from Sebastian Inlet in Florida to the Altamaha River in Georgia.

The **Humpback Whale** (*Megaptera novaeangliae*) is federally-listed as an endangered species under the ESA throughout its range which includes the North Atlantic Ocean. They live at the surface of the ocean, specifically in shallow coastal waters. Their breeding grounds are in warm, tropical waters and occur mostly in the winter through early spring and they have been known to transit north and south in the Atlantic off the coast of Florida.

The **Florida Manatee** (*Trichechus*) (a subspecies of the West Indian Manatee) is one of the few marine mammals known to inhabit the local salt-water lagoon system that is found in marine, estuarine and freshwater habitats. Manatees are generally restricted to the southeastern US habitat areas including foraging, freshwater drinking and resting sites as well as travel corridors. Manatees are herbivores that feed opportunistically on a wide variety of plants including submerged, floating and emergent vegetation. Manatees have been found to transit along near-shore waters where submerged aquatic vegetation may grow or where channels provide immediate deep water or freshwater access. In June 2004, the FWCC approved new boat speed zones to protect manatees in Brevard County. They are federally-listed as endangered due to the low population level (at least 6,300) within the continental US. The USFWS has designated the Indian and Banana Rivers as critical manatee habitat.

The **Southeastern Beach Mouse** (*Peromyscus polionotus niveiventris*) was listed by the USFWS as a threatened species in 1989. The beach mouse is a subspecies of the numerous, widely distributed field mouse. Beach mice populations are typically found in the coastal dune and coastal strand communities along Florida's east coast, however they have been found as far inland as the CCAFS industrial area. Beach mice have been found at launch sites on CCAFS.[21]

3.3.7 Marine Wildlife and Essential Fish Habitat (EFH)

Section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act, as amended, requires interagency coordination to further the conservation of federally-managed fisheries and each federal agency that may adversely affect EFH to consult with the National Marine Fisheries Service (NMFS) and identify EFH. The Act defines EFH as "those waters and

substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." Regional Fishery Management Councils under the NMFS are responsible for designating EFH in their management plans. The South Atlantic Fishery Management Council (SAFMC) currently manages several species in the vicinity of CCAFS including the South Atlantic Snapper-Grouper complex, South Atlantic shrimps, Coastal Migratory Pelagic species, Highly Migratory species, Red Drum (*Sciaenops ocellatus*), Spiny Lobsters, Golden Crab (*Chaceon fenneri*), Calico Scallop (*Argopecten gibbus*) and Sargassum (*Histrio histrio*).

EFH for coastal migratory pelagic species includes sandy shoals and offshore bars, all coastal inlets, designated nursery habitats, and high-profile rocky bottom and barrier island ocean-side waters. This extends from the surf to 200 miles offshore along the coastline.

Areas inshore of the 100-foot contour, estuarine emergent vegetated wetlands, tidal creeks, estuarine scrub/shrub, oyster reefs and shell banks, unconsolidated bottom (soft sediments), artificial reefs, coral reefs, and live/hard bottom habitats are EFH for specific life stages of estuarine-dependent and near shore snapper-grouper species.

3.4 Historical and Cultural Resources

Cultural resources include prehistoric-archaeological, historic, architectural, Native American resources, and any physical evidence of human presence considered important to a culture, subculture, or community for scientific, traditional, religious or any other reasons. Areas potentially impacted include properties, structures, landscapes, or traditional cultural sites that qualify for listing in the National Register of Historic Places (NRHP).

3.4.1 Regulatory Framework

Section 106 of the National Historic Preservation Act (NHPA) of 1966 (as amended) requires federal agencies to consider the effects of their actions on historic properties. AFI 32-7065, *Cultural Resources Management*, provides guidelines for the protection and management of cultural resources on USAF-managed lands.

Federal cultural resource preservation statutes (including the Native American Graves Protection and Repatriation Act [(NAGPRA) (1990)] mandate that should prehistoric or historic artifacts be unexpectedly discovered during construction or excavation, such materials would be identified and evaluated by an archaeologist. Should human remains or cultural artifacts be encountered, federal statutes specify that work would cease immediately and the proper authorities be notified. The 45 SW Cultural Resource manager and archaeologist works with the State Historic Preservation Office (SHPO) should unexpected discoveries be identified, and project re-commencement would only be authorized once the SHPO clears the site.

In addition to the NEPA, the primary laws that pertain to the treatment of cultural resources during environmental analysis are the NHPA (1996) (especially Sections 106 and 110), the Archaeological Resources Protection Act (ARPA) (1979), the American Indian Religious Freedom Act (AIRFA) (1978) and the NAGPRA (1990).

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 NRHP. 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. Sites not yet evaluated, and at least 50 years old, may be considered potentially eligible for inclusion in the National Register and are afforded the same regulatory consideration as nominated properties. Whether prehistoric, historic, or traditional, significant cultural resources are referred to as historic properties.

3.4.2 Prehistoric and Historic Archaeological Resources

Archaeological investigations at CCAFS reflect that human inhabitance first occurred approximately 4,000 years ago. Early settlement was established within the Banana River salt marsh environment. Over time, site dispensation and size fluctuated, and archaeological evidence indicates that the entire peninsula was used for a wide variety of marine, estuarine, and terrestrial resources. Occupation of the peninsula 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 (A.D. 1450-1650) or Seminole Period.

3.4.3 Historic Buildings and Structures

The Cape Canaveral Long-Range Proving Ground was formally established in 1949 under the direction of the USAF. Construction began on the first missile launch pads, support facilities, and down-range tracking stations in 1950, and during this decade military facilities and activities developed at a rapid pace. During these years, various cruise-type missiles were tested and the installation began to support the Intermediate Range and Intercontinental Ballistic Missile (ICBM) programs. CCAFS LCs were also used to support manned Mercury and Gemini Program launches. In 1966 during the peak installation period, more than 30 operational LCs were completed.

CCAFS conducted two recent historic building and structure surveys, New South Associates completed an Architectural Survey and Evaluation of NASA-owned facilities on CCAFS, in 2014[22] and USACE completed Inventory and Evaluation of Buildings in the Industrial Area, in 2015.[23] Neither of these surveys included areas impacted by the proposed action.

3.4.4 Native Populations/Traditional Resources

The Cape Canaveral and Banana River areas were populated by the Ais Native American tribe at the time of European contact[24]. The Ais were one of the most influential and powerful tribes in Florida during the time of the Spaniards. Description of settlements were located from Cape Canaveral to St. Lucie River and extended perhaps as many as 30 miles inland. The Ais settlements closest to CCAFS were the Ulumay villages along the Banana River. These Ais settlements were numerous, changed with the seasons and reflected fishing and gathering subsistence; agriculture was not practiced. Tools and utensils were typically fashioned of conch shells or gourds. Dwellings were temporary[25]. There are no remaining Ais Indians, but they are represented by the Seminole Tribe of Florida, the Seminole Nation of Oklahoma and the Miccosukee Tribe.

Traditional sites are subject to the same regulations and are afforded the same protection as all historical properties. Traditional resources related to 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 the Ais for religious or heritage reasons. Traditional resources sites often overlap with (or are components of) archaeological sites. The National Register listed or eligible sites (as well as any archaeologically sensitive areas) could also be considered traditional sites or could contain traditional resource elements.

3.4.5 Cultural Resources Associated with SLC-41

SLC-41 is not considered a historic complex, no historic properties are located in the immediate vicinity and no known archaeological sites are located either within the complex boundary or close to SLC-41. Section 4.4 contains additional historical and cultural resource information.

There are no Traditional Cultural Properties on CCAFS inclusive of the project area according to the Seminole Tribe of Florida, the Seminole Nation of Oklahoma, and the Miccosukee Tribe[26](2011 CCAFS site visit and 2015 45 SW ICRMP review)

3.5 Air Quality

This section describes air quality resources at CCAFS for the atmosphere at altitudes below 3,000 feet, which contains the atmospheric boundary layer for CCAFS. Rapid mixing within the atmospheric boundary layer ensures that chemicals released within the atmospheric boundary layer quickly mix throughout the atmospheric boundary layer. Atmospheric monitoring for chemicals at CCAFS is within the atmospheric boundary layer where people live and work, which is defined as the ROI.

National Ambient Air Quality Standards (NAAQS) 40 CFR Part 50-51, Title V of the Clean Air Act (CAA) Part 70, Title 40 CFR 61 and 63 (National Emission Standards for Hazardous Air Pollutants [NESHAPs]), Title 40 CFR 70 (Operating Permits), and Florida Administrative Code (FAC) Chapter 62 set standards for pollutants to attempt to control levels that may affect public health and the environment.

Section 112(r) of the CAA and 40 CFR Part 68 require preparation of a Risk Management Plan (RMP) if reportable quantities of regulated and extremely hazardous chemicals are used. ULA's Atlas V Program uses no listed chemicals at or above reportable thresholds and thus is not required to prepare an RMP.

Specific regulations that may be applicable to LC activation and operation activities include

- Rule 62- 210, FAC *Stationary Source General Requirements* - 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
- Rule 62 -212, FAC *Stationary Source Preconstruction Permitting*
- Rule 62 -213, FAC *Operating Permits*
- Rule 62- 242, FAC *Mobile Sources*.

The Atlas V Program is currently exempt from federal and state air permitting requirements.

In Florida, regional air quality is assessed at the county level. CCAFS is located within Brevard County which has been designated by both EPA and FDEP to be in attainment for all CAA Criteria Pollutants (carbon monoxide (CO), lead, nitrogen dioxide, ozone, particulate matter (PM), and sulfur dioxide (SO_2)). Ambient air monitoring records from monitoring stations maintained by the

appropriate state or local agency for the affected environment are examined to characterize the existing air quality. In Brevard County there are two monitoring stations, Melbourne and Cocoa Beach. For the past three years, the only monitoring at these stations was for ozone and PM as shown in ***Table 3-7: Measured Ambient Air Concentrations of Criteria Pollutants Brevard County.*** Criteria Pollutants and Hazardous Air Pollutant (HAP) Emissions for CCAFS are reflected in ***Table 3-8: Measured Ambient Air Concentrations of Criteria Pollutants and HAP Emissions at CCAFS*** and ULA's most recent Atlas V criteria pollutant and HAP emissions data are shown in ***Table 3-9: Summary of Atlas V CCAFS Criteria Pollutant and HAP Emissions***, (ppm, except PM in µm/m3)**.**

Table 3-7: Measured Ambient Air Concentrations of Criteria Pollutants Brevard County

Pollutant	Average Time	Nearest Monitoring Station	Maximum Measured Concentration (ppm, except PM in µm/m^3)		
			2015	2016	2017
O_3	1 Hour	Cocoa Beach	71	66	75
O_3	8 Hour	Cocoa Beach	67	87	69
O_3	1 Hour	Melbourne	70	65	69
O_3	8 Hour	Melbourne	64	61	66
$PM_{2.5}$	24 Hour	Melbourne	22.2	21.2	26.8
PM_{10}	24 Hour	Melbourne	47.7	41.4	53.9

Table 3-8: Measured Ambient Air Concentrations of Criteria Pollutants and HAP Emissions at CCAFS

Pollutant	Maximum Measured Concentration (ppm, except PM in µm/m^3)	
	2014	2015
CO	5.329	5.916
Nitrogen Oxides (NO_X)	6.8	8.284
Sulfur Oxides (SO_X)	0.081	0.318
VOC	3.805	5.23
$PM_{2.5}$	0.657	0.662
PM_{10}	0.723	0.692
HAP (Tons/Year)	0.719	0.171

Table 3-9: Summary of Atlas V CCAFS Criteria Pollutant and HAP Emissions, (ppm, except PM in µm/m3)

Pollutant	2005	2006	2007	2008
Diesel Fuel	7099	10749	7454	6602
VOC	0.46	0.46	0.46	0.64
PM	1.2	1.2	1.2	0.86
NO_X	2.16R-03	0.00216	2.16E-03	1.08E-03
SO_X	1.48E-05	1.48E-05	1.48E-05	7.50E-06
CO	2.85E-04	2.85E-04	2.85E-04	1.43E-04
HAP	8.00E-07	8.00E-07	8.00E-07	2.20E-07

Use of Class I ozone depleting chemicals (ODC) is prohibited at CCAFS. The Atlas V program does not use any Class II ODCs. As referenced in the 2000 EELV Program SEIS, the SRMs would create a temporary local ozone loss which will occur at each launch using SRMs.

Vehicles will emit exhaust CO, NO_x, and SO_2 during project construction and launch operation activities. Dust particles (PM) are generated during construction activities. Equipment used to grade, dig, and perform other construction related activities emit exhaust and dust particulates. The two main pollutants of concern in diesel exhaust that affect human health are NO_x and PM.

3.6 Climate

Brevard County has one of the most diverse ecosystems in North America due to the rare combination of climates. Brevard County is exposed to a temperate climate to the north and a warm subtropical climate to the south, combining the habitat and environmental needs for a wide variety of animal life.

Summers are hot and humid with temperatures in the mid- to- upper 90s (degrees Fahrenheit). Winters are mild with average day-time temperatures in the 60-70 degrees Fahrenheit range, with January being the coldest month on average. Hurricane season runs from June through November and is normally most active between August and October. Central Florida is a transition zone between a tropical climate to the south and a humid subtropical climate to the north. The Florida Peninsula is surrounded by oceanic currents of the Gulf Stream that influences the state's weather, which is punctuated by thunderstorms, lightning and hurricanes.

The principal meteorological conditions that control dispersion are atmospheric winds and turbulence (or mixing ability). The wind direction determines which locations would be affected by a given source. The wind speed, along with the degree of turbulence, controls the volume of air available for pollutant dilution. Atmospheric stability is a measure of the mixing ability of the atmosphere and, therefore, its ability to disperse pollutants. Greater turbulence and mixing are possible as the atmosphere becomes less stable, and thus pollutant dispersion increases. In general, stable conditions occur most frequently during the nighttime and early morning hours.

Localized meteorological effects are measured on a meso-scale basis pre-launch and post launch to document weather conditions both at lower atmosphere and upper atmosphere currently. Various computer models are used by the USAF 45^{TH} Weather Squadron (45 WS). The 45 WS provides weather support to the space program at CCAFS and KSC. They provide technical and climatological consultations to 45 SW customers. Range safety requirements are followed prior to and post launch with regard to determining and measuring required meteorological conditions such as temperature, barometric pressure and wind speeds and various computer modeling is conducted to predict conditions in the event of a launch failure or accident on surrounding populations. NOAA in cooperation with several related federal agencies develops and improves stratospheric and tropospheric wind profiler models that help to access upper-air short -period wind changes to continually improve pre-launch risk assessments. NOAA Environmental Technology Laboratory developed wind profilers (such as the KSC 50 megahertz and 915 megahertz profilers) for characterization of wind and temperature fields for toxic hazard assessments (THA) that support risk assessment forecasts for low level winds on all Eastern Range CCAFS launch vehicles. Extensive forecasting is conducted to minimize possible negative short-term effects in air quality in the event of a launch failure or accident.

Greenhouse Gases (GHGs) are gas emissions that trap heat in the atmosphere. Natural processes and human activities create emissions. Climate is presumed to be impacted by increases in GHG. Aviation or Commercial space launch GHG emissions have no significance thresholds. The FAA has not identified specific factors which should be considered in making a significance determination for GHG emissions. Currently no accepted methods to determine significance applicable to aviation or commercial projects for space launches exists. ***Table 3-10: Summary of Greenhouse Gases Emissions for CCAFS (Years 2011 through 2013)*** summarizes Greenhouse Gases Emissions for CCAFS. CCAFS emissions are small compared to global emissions, so the cumulative impact should not be significant.

Table 3-10: Summary of Greenhouse Gases Emissions for CCAFS (Years 2011 through 2013)

GHG	**2011 GHG Emissions**		
	Ton (Short)	**Ton (Metric)**	**$MTCO_2e$**
Carbon Dioxide (CO_2)	3,160.034	2,866.735	2,866.735
N_2O	0.052	0.047	14.624
CH_4	122.215	110.872	2,328.303
Total Reportable GHG for 2011			**5,209.662**
GHG	**2012 GHG Emissions**		
	Ton (Short)	**Ton (Metric)**	**$MTCO_2e$**
CO_2	2,827.9	2,565.43	2,565.42
N_2O	0.05	0.04	13.21
CH_4	211.41	191.79	4,027.65
Total Reportable GHG for 2012			**6,606.28**
GHG	**2013 GHG Emissions for 2013**		
	Ton (Short)	**Ton (Metric)**	**$MtCO_2e$**
CO_2	6,148.266	5,577.651	5,577.651
N_2O	227.900	206.500	61,153.000
CH_4	241.542	219.085	5,433.214
R-22	0.085	0.077	0.004
R-123	0.076	0.069	0.002
Total Reportable GHG for 2013			**72,547.870**

Source: Environmental Assessment Blue Origin Orbital Launch Site at CCAFS, 2016

Note: $MTCO_2e$: Metric Ton Carbon Dioxide Equivalent

R-22: Chlorodifluoromethane or difluoromonochloromethane is a hydrochlorofluorocarbon (HCFC-22) refrigerant being phased out.

R-123: 2,2-Dichloro-1,1,1-trifluoroethane or HCFC-123 is replacement refrigerant being phased in.

Because SLC-41 is near the Atlantic Ocean (2,600 feet to the east) and Banana River (4,000 feet to the west), sea and estuary level increases are of concern. An eustatic sea level change is that which is caused by an alteration to the volume of water in the world oceans. According to the International Panel on Climate Change (IPCC), global MSL continues to rise due to thermal expansion of the oceans and the loss of mass from glaciers, ice caps and the Greenland and Antarctic ice sheets.[27]

At KSC and CCAFS, mean sea level is approximately -0.8 feet North American Vertical Datum of 1988 (NAVD88). Mean water level of the Indian River Lagoon (includes the Banana River) is estimated at -0.7 feet NAVD88, based on analyses of data from historic and current NOAA tide gauges. Water levels at CCAFS and KSC fluctuate cyclically, with maximum heights generally in October and minimal elevations in February and March.[28]

3.7 Orbital and De-Orbiting Debris

This section addresses the potential hazards and environmental impacts associated with manmade orbital and de-orbiting debris. Orbital and de-orbiting debris is a concern as a potential collision hazard to spacecraft including ULA Vulcan Centaur Vehicle. Large pieces of debris are of concern with respect to re-entry and eventual Earth impact. Space debris can be classified as either natural or manmade objects. The measured amount of manmade debris equals or exceeds that of natural meteoroids at most low earth orbit (LEO) altitudes (i.e., below 2,000 kilometers (1,243 miles). Manmade 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 800 to 1000 kilometers (500 to 625 miles)[29]. Orbital and de-orbiting debris moves in many different orbits and directions, at velocities ranging from three to over 75 kilometers per second (1.9 to over 47 miles per second) relative to Earth[30]. Although space debris is not explicitly mentioned in any US legislation, an Executive Branch policy directive, National Space Policy[31], identifies the following guidance to support major US space policy objectives:

"…the United States shall:

- Lead the continued development and adoption of international and industry standards and policies to minimize debris, such as the United Nations Space Debris Mitigation Guidelines;
- Develop, maintain, and use space situational awareness (SSA) information from commercial, civil, and national security sources to detect, identify, and attribute actions in space that are contrary to responsible use and the long-term sustainability of the space environment;
- Continue to follow the United States Government Orbital Debris Mitigation Standard Practices, consistent with mission requirements and cost effectiveness, in the procurement and operation of spacecraft, launch services, and the conduct of tests and experiments in space;
- Pursue research and development of technologies and techniques, through the Administrator of the National Aeronautics and Space Administration (NASA) and the Secretary of Defense, to mitigate and remove on-orbit debris, reduce hazards, and increase understanding of the current and future debris environment; and
- Require the head of the sponsoring department or agency to approve exceptions to the United States Government Orbital Debris Mitigation Standard Practices and notify the Secretary of State."

3.7.1 Characteristics of Orbital and 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. Once the object enters the measurable atmosphere, atmospheric drag slows it down rapidly and causes it either to burn up or de-orbit and fall to Earth. Satellites with circular orbital altitudes of less than 400 kilometers (248 miles) may re-enter the atmosphere within a few months, whereas satellites with orbital altitudes greater than 900 kilometers (559 miles) may have lifetimes of 500 years or more[32].

It is estimated that more than 10,000 objects greater than 4 inches in size, tens of millions of objects between 0.039 and 4 inches in size, and trillions of objects less than 0.039 inch in size are in orbit[33]. Most cataloged orbital debris occurs in LEO because most space activity has occurred at those altitudes. LEO occurs at altitudes less than 2,000 kilometers (1,243 miles). The quantity of orbital debris has been growing at a roughly linear rate and growth is projected to continue into the future[34].

3.7.2 Hazards to Space Operation from Debris

The effects of launch vehicle generated orbital debris impacts on other spacecraft including the Vulcan Centaur Vehicle 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. 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. Debris between 0.004 and 0.4 inch in diameter would produce impact damage that can be serious. Objects larger than 0.4 inch in diameter can produce catastrophic damage[35].

3.8 Hazardous Materials and Solid and Hazardous Waste

This section addresses the existence or use of hazardous materials or the existence or production of solid or hazardous waste at the Proposed Action locations (SLC-41, VIF and SMARF). The section also includes use of, and the proper, or improper disposal methods of those materials.

3.8.1 Hazardous Materials Management

Hazardous materials include all chemicals identified and regulated under the Emergency Planning and Community Right-to-Know Act (EPCRA), Occupational Safety and Health Administration (OSHA) Hazardous Communication (HAZCOM) Standard, Hazardous Materials Transportation Act (HMTA), Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Toxic Substance Control Act (TSCA) and the CAA. ULA currently purchases and manages all hazardous materials proposed for the Vulcan Centaur Program Vehicle Program on the Atlas V program with the exception of LNG, which is proposed for use in the first stage Vulcan BE-4 engine. ULA uses its internal supply system to purchase hazardous materials. LO2, LN2 and LH2 purchases are managed through the Atlas purchasing organization.

In the event of a spill of hazardous materials, ULA would determine if the situation is an emergency. If it is an emergency, ULA would notify the USAF. The USAF 45 SW has the primary responsibility for Emergency Response at CCAFS. They would provide emergency spill response and situation stabilization. Once stabilized, corrective and cleanup actions would be the responsibility of ULA. Response to an emergency situation will be conducted in accordance with the 45 SW Comprehensive Emergency Management Plan (CEMP) 10-2 Vol. I. The CEMP provides details, policies, procedures, responsibilities, and required actions that govern the

emergency response of USAF, DoD, government contractor employees and commercial operations, to the actual or potential accidental release or spill of hazardous materials/chemicals. Response to major aerospace vehicle incidents is as directed in the CEMP. ULA is responsible for providing personnel who have specialized knowledge of launch processing systems to support the 45 SW HAZMAT Response Team. The CEMP contains the required organizational chart; job descriptions, detailed description of information flow; and description of the formation of a unified command within the response management system. ULA is responsible for the coordination of all environmental emergency response actions on its leased premises.

ULA maintains its own Integrated Contingency Plan (ICP). This plan will be expanded to cover Vulcan Centaur operations. This plan covers response to non-emergency spills and leaks and clean-up of all spill or leak incidents. ULA would also be responsible for completing all state and EPA notifications if the spill/release exceeds reporting thresholds.

3.8.2 Solid Waste Management

Solid Waste from LC operations is managed by the Cape Launch Operations and Infrastructure Support (CLOIS) contractor and disposed of at the Brevard County Land Fill.

3.8.3 Hazardous Waste Management

Hazardous waste is defined in RCRA as any solid, liquid, contained gaseous or semi-solid waste, or any combination of wastes that could or do pose a substantial hazard to human health or the environment. Waste may be classified as hazardous because of its toxicity, reactivity, ignitability or corrosivity. In addition, certain types of waste are “listed” or identified as hazardous in 40 CFR 263. In regulatory terms, a RCRA hazardous waste is a waste that appears on one of the four hazardous waste lists (F-list, K-list, P-list, or U-list) or exhibits at least one of four characteristics: ignitability, corrosivity, reactivity, or toxicity.

Hazardous waste management at CCAFS is regulated under RCRA (40 CFR 260-280) and FDEP (Rule 62-730, FAC). ULA has an EPA hazardous waste generator ID number from the EPA for the current Atlas V and Delta IV operations and is responsible for managing and disposing of all hazardous waste generated. ULA currently manages all Atlas V Program hazardous waste generated from its operations in accordance with all local, state, and federal regulations and its Hazardous Waste Management Plan. The Atlas V Program maintains a 180-day hazardous waste storage site located at Facility 29118 in the SLC-41 area, the ITL Warehouse, Facility 70510 and Barrel Storage Building, Facility 70512. All individuals or organizations generating hazardous waste at CCAFS are responsible for administering all applicable regulations and plans regarding hazardous waste.

3.8.4 Installation Restoration Program (IRP)

The IRP is an USAF program that identifies, characterizes and remediates past environmental contamination on USAF 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 the CERCLA and requirements of Section 211 of the Superfund Amendments and Reauthorization Act (SARA), DoD established the Defense Environmental Restoration Program (DERP) to facilitate cleanup 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 EPA. AFI 32-7020, Environmental Restoration Program, implements the DERP as outlined in DoD Manual 500.52-M, Environmental Restoration Program Manual. The DoD established the IRP to identify, characterize, and evaluate past disposal sites and remediate associated contamination as needed to protect human health and the environment. The IRP was initiated at CCAFS in 1984[36].

Appendix A; Figure 7. Solid Waste Management Unit (SWMU) C047 Map shows that all of SLC-41 is contained within SWMU 047. A Land Use Control Implementation Plan (LUCIP) is in place due to polychlorinated biphenyls (PCBs), arsenic, and a polynuclear aromatic hydrocarbon (PAH) soil contamination. In 1999, an Interim Measure (IM) was conducted to remove contaminated soil to below Industrial levels which posed a risk to human health or environment. The LUC remain in effect until the soil contamination is removed or is naturally attenuated to acceptable regulatory levels.[37] Soils will not be disturbed or moved during property development, maintenance or construction without meeting the following conditions of the Installation Restoration Program (IRP)-negotiated LUC:

- USAF review, coordination, and approval of the proposed construction/development plans via AF Form 103 (Base Civil Engineer Work Clearance Request), 332 (Base Civil Engineering Work Request), 813 (Request for Environmental Impact Analysis) or similar process.
- Ensure proper engineering controls are in place so that unauthorized release or disposal of the affected media does not occur. This includes conducting appropriate testing and developing a disposal plan prior to off-site disposal.
- Use of proper personal protection equipment by site workers, as determined by the project proponent's occupational health and safety advisor.

SWMU 115, also shown in ***Figure 7***, is located within SLC-41. It was the site of the former sewage treatment plant for SLC-41 before lift stations were constructed and tied into the CCAFS Regional Waste Water Treatment Plant. SWMU 115 was granted No Further Action status in 2005.

Table 3-11: SWMU within 0.5 Miles of SLC-41 contains details on other SWMUs within 0.5 miles of SLC-41.

Table 3-11: SWMU within 0.5 Miles of SLC-41

SWMU #	SWMU Information	Date	Action
C135	Pump Station #7 Area Diesel UST Location, Facility 21955 Groundwater and soil contamination	12/13/2012	Groundwater injections were performed at C135 in 2016 to mitigate petroleum contamination. The 2017 Annual Long-Term Monitoring (LTM) Report for C135 was submitted on 4/20/18. Site was recommended for No Further Action in April 2018. The IRP is awaiting FDEP issuance of the Site Rehabilitation Completion Order (SRCO), which will allow the site to have future unconditional use.
C187	Pump Station #7 Area Transformer PCB soil contamination	2005	PCB soil contamination was identified. Soil was removed and No Further Action was approved by FDEP.

SWMU #	SWMU Information	Date	Action
C218	Pump Station #7 Area Water Tank PCB soil contamination	9/2012	PCB soil contamination was identified. Soil was removed and No Further Action was approved by FDEP.
C248	Southeast corner of SLC-41 outside perimeter fence Camera Tower, Facility 29166 Soil and potential groundwater contamination.	03/26/2013	The C249 PCBs delineation was completed in 2016. The CSR and IMWP, revision 0, was submitted on 7/26/18. The tower was shown to be a recurring source of PCBs so the IMWP included a task for the demolition of the existing structure. Once approved and implemented, the IM will remove PCB/PCDD/PCDF affected soil from the site to meet residential criteria. This should prepare the site for administrative closure with no additional future controls.
C249	Northwest corner of SLC-41 outside perimeter fence Camera Tower, Facility 29167 Soil and potential groundwater contamination.	03/26/2013	The C249 PCBs delineation was completed in 2016. The CSR and IMWP, revision 0, was submitted on 7/26/18. The tower was shown to be a recurring source of PCBs so the IMWP included a task for the demolition of the existing structure. Once approved and implemented, the IM will remove PCB/PCDD/PCDF affected soil from the site to meet residential criteria. This should prepare the site for administrative closure with no additional future controls. Note: Remediation at this site encompasses the vegetation clear zone required by the Vulcan LNG flares. This area will be covered by a separate NEPA action initiated by the IRP.

3.8.5 Pollution Prevention

Pollution prevention is reducing or eliminating waste at the at the source by promoting the use of non-toxic or less toxic substances, modifying production processes, reusing materials to reduce waste and implementing conservation techniques. The Federal Compliance with Pollution Control Standard (EO 12088) and the USAF Pollution Prevention Management Action Plan (AFI 32-7080) give guidance on measures for pollution. ULA's policy is to reduce hazardous material use and minimize waste generation. ULA launch programs consider pollution prevention in the design of both the launch system and vehicle. Environmental aspects of design decisions are considered during all design phases.

3.9 Water Resources

This section addresses the water resources located at CCAFS, SLC-41 and the ITL area including the groundwater and surface waters. Physical, chemical, and biological characteristics and factors that determine water quality and runoff are addressed. The ROI for groundwater includes the local aquifers that are directly or indirectly used by CCAFS. The ROI for surface water is the drainage system/watershed in which the station is located. Groundwater contamination is discussed in Section 3.8.4.

The federal CWA provides the basic structure for regulating the discharge of pollutants from point sources to waters of the US as implemented by the EPA through pollution control programs such as the National Pollutant Discharge Elimination System (NPDES) and industry standards set for wastewater. Permitting through the USACE is required where waters are regulated under Section 404 of the CWA (33 USC. 1344). The USACE has jurisdiction over Section 10 of the Rivers and Harbor Act for navigable waters and interstate commerce. The CWA sets the requirements for water quality standards in all surface water and regulates the discharge of pollutants through NPDES permitting, including stormwater permits, stormwater construction permits and wastewater construction and operation permits. St. Johns River Water Management District (SJRWMD) regulates CWA stormwater construction and operation permits. The FDEP regulates NPDES stormwater construction permits for land disturbing activities greater than one acre. The FDEP also has authority to regulate wastewater discharges, both surface water and groundwater discharges, related to state water quality.

3.9.1 Surface Water

SLC-41 and the ITL area are located on a barrier island within the Florida Middle East Coast Basin approximately 4,000 feet east of the Banana River and 2,600 feet west of the Atlantic Ocean. The Basin contains three major bodies of water; the Banana River to the immediate west, Mosquito Lagoon to the north, and the Indian River to the west. Many man-made canals and ditches facilitate surface water runoff of the developed areas on CCAFS. All three water bodies are estuarine lagoons, with circulation provided mainly by wind-induced currents[38]. CCAFS/KSC/MINWR areas designated as Outstanding Florida Waters (OFW) per FAC 62-3 include most of Mosquito Lagoon of the Banana River, Indian River Aquatic Preserve, Banana River State Aquatic Preserve, and Canaveral National Seashore. These water bodies are afforded the highest level of protection and any compromise of ambient water is prohibited.

The Indian River Lagoon System has also been designated an Estuary of National Significance by the 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. No wild and scenic rivers are located on or near CCAFS.

On SLC-41, surface water drains by overland flow to the manmade low-lying percolation areas, drainage swales and one wet detention pond in the northwest quadrant. The percolation areas and swales consist primarily of mowed and maintained grass and surface water typically recharges the groundwater system through infiltration. During severe storm events, runoff from SLC-41 discharges to the surrounding undeveloped vegetated scrub and wetland areas outside the perimeter fence. To the west of SLC-41, ponds and mosquito control impoundments may receive runoff from severe storm events. These ponds and impoundments are managed by MINWR.

The route between the SLC-41, the VIF and the SMARF is a paved road and railroad bed. Runoff discharges to the surrounding undeveloped vegetated scrub and wetland areas that are connected to the Banana River. Surface water in the VIF area flows to wet detention stormwater ponds, one north of the VIF and one south of the GSE Storage Building (Facility 29410). A permitted stormwater treatment detention pond serves the parking lot directly east of the VIF. During severe

storm events, the wet ponds overflow to surrounding undeveloped vegetated scrub and wetland areas.

3.9.2 Groundwater

Groundwater at CCAFS occurs under unconfined (water table), semi-confined and confined (artesian) conditions. The unconfined aquifer, composed of Holocene and Pleistocene age surficial deposits of marine sand, shell fragments, and sand conglomerate of the Anastasia Formation, is approximately 70 feet thick and is recharged by direct infiltration or rainfall. The generalized direction of groundwater flow in the surficial aquifer is westward, toward the Banana River. Localized flow in the surficial aquifer is from topographic highs (mounds, swells, dune ridges) toward surface water bodies (creeks, ponds, drainage canals). The surficial aquifer at SLC-41 consists of groundwater that occurs at depths ranging from approximately 3 to 18 feet below land surface (BLS).

A confining unit composed of clays, sands and limestone separates the surficial aquifer from the underlying Floridan aquifer. The confining unit is generally 18 to 120 feet thick. The relatively low hydraulic conductivity of the confining unit restricts the vertical exchange of water between the surficial aquifer and the 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. The Floridan aquifer is used for water in Cocoa Beach, the water is extracted from the Floridan Aquifer on the mainland and there are no public supplies wells on or near CCAFS or Cocoa Beach.

3.9.3 Wetlands and Floodplains

Wetland and floodplains require compliance with the following regulations:

- Clean Water Act (CWA), Section 404. Section 404 regulates applicable waterways such that no discharge of dredged or fill material can be permitted if a practicable alternative exists which is less damaging to the aquatic environment or if the nation's waters would be significantly degraded.
- EO 11990, Protection of Wetlands. This EO requires avoidance, to the extent possible, the long and short-term adverse impacts associated with the destruction or modification of wetlands and to avoid direct or indirect support of new construction in wetlands wherever a practicable alternative exists.
- EO 11988, Floodplain Management. This EO requires consideration of alternatives to avoid adverse impacts associated with occupancy, modifications and incompatible development in Floodplains whenever there is a practical alternative.

3.9.3.1 Wetlands

Wetlands are the transition zones between dry upland ecosystems and deeper aquatic habitats. Each wetland area is unique according to its surrounding geologic, hydrologic, and climatic conditions. Wetlands are defined in Air Force Instruction (AFI) 32-1067, Water and Fuel Systems[39], as those areas that are inundated by surface or groundwaters that support plants and animals that need saturated or seasonally saturated soil to grow and reproduce. Wetlands provide

flood control, aquifer recharge, coastal protection and act to help filter pollutants from the ecosystem. Section 1 of Executive Order (EO) 11990 *Protection of Wetlands*, directs each federal agency to provide leadership and take action and include all practical measures to minimize destruction, loss, degradation or harm to wetlands. Per EO 11990, the Proposed Action's effect on wetlands should consider factors such as public health, safety, water supply, pollution, long term productivity of existing flora and fauna, habitat diversity and recreational use. Wetlands are located within 300 feet of the SLC-41 perimeter and on or near both sides of Titan III Road. The National Wetlands inventory map is shown in ***Appendix A, Figure 8. SLC-41 Area Wetlands.***

3.9.3.2 Floodplains

Floodplains are lowland and relatively flat areas adjoining inland and coastal waters that are subject to flooding. Since CCAFS does not have a significant change in topography, the floodplains include the coastal dunes, wetlands and all areas of CCAFS. The 100-year floodplain extends to seven (7) feet above mean sea level (MSL) on the ocean side and four (4) feet above MSL on the Banana River side. The 500-year floodplain elevations are ten (10) feet above MSL on the ocean side of CCAFS and six (6) feet above MSL along the Banana River[40].

The 100-year floodplain is not present within the boundary of SLC-41, VIF or SMARF. The floodplain boundary is presented in ***Appendix A, Figure 9. SLC-41 Floodplains Map***.

3.10 Geology and Soils

3.10.1 Geology

The geology underlying CCAFS 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. 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. Beneath the Hawthorn Formation lie the limestone formations of the Floridan aquifer, which extend several thousand feet below the surface at CCAFS[41].

Bedrock at CCAFS ranges from a hard to dense limestone that is a principal part of one of the major Florida Artesian Aquifers, located 75 to 300 feet below the surface. It is overlain by sandy limestone, calcareous clay with fragments of shells, coquinoid limestone and unconsolidated, well-graded quartz sand[42].

3.10.2 Topography and Soils

CCAFS topography consists of a series of relic dune ridges formed by gradual beach deposits that occurred throughout time. The higher naturally occurring elevations occur along the eastern portion of CCAFS, with a gentle slope to lower elevations toward the marshlands along the Banana River. Land surfaces are level to gently sloping along the SLCs with elevations that range from sea level to approximately 20 feet above MSL[43].

CCAFS has 11 different soil types based on the soil survey of Brevard County, Florida, 1974, the most prevalent type being Canaveral Peninsula. It is comprised of about 37% Canaveral soils on moderately low ridges and consist of a mixture of light-colored quartz sand grains and multicolored shell fragments, 17% Palm Beach soils characterized as moderately well drained to excessively drained, and sandy throughout, 9% Welaka soils, characterized as well- drained sandy soils and have a light-colored subsurface layer and yellowish subsoil, and 37% soils of minor extent. The three most prominent soil types comprise the Canaveral-Palm Beach-Welaka association, which is generally characterized as nearly level and gently sloping ridges interspersed with narrow wet sloughs that generally parallel the ridges and extends the entire length of the county along the coast near the Atlantic Ocean.

Soils at SLC-41 are excessively drained and are primarily of the Palm Beach and Canaveral soils. They occur on higher ridges and have a lower water table. The subsoil extends to a depth of 40 to 60 inches. Below this is a mixture of quartz sand and shell fragments. Minor soils in this association are the Myakka, Pomello and Parkwood soils, Coastal beaches and poorly drained soils in sloughs. Other soil classifications found at the SLC-41 area are Urban Land and Coastal beaches. The complex is considered a developed area.

3.11 Transportation

A transportation network provides access to CCAFS, SLC-41 and the ITL Area facilities. The ROI focuses on the roadways and railroads on CCAFS reaching SLC-41 and the ITL Area facilities and the regional area immediately surrounding CCAFS.

3.11.1 Roadways

3.11.1.1 Regional Access

The CCAFS area can be accessed from Daytona Beach to the north via US Highway 1 or Interstate 95; from Orlando approximately 50 miles to the west via State Road (SR) 528; and from Miami approximately 187 miles to the south via US 1 or Interstate 95.

3.11.1.2 Local Access

The majority of the employees and other related support services providers for CCAFS reside within the unincorporated areas of north and central Brevard County and in the cities of Cape Canaveral, Cocoa, Cocoa Beach and Rockledge, which are all within 20 miles of the CCAFS south Gate 1. The key roads providing access to CCAFS from the local communities include SR A1A, SR 520, SR 528, SR 401, SR 3 and SR 405. The NASA Causeway (SR 405), Beach Road, and SR 528 connect CCAFS with KSC, the inner barrier islands and the mainland. Access roads include:

- Northern access into CCAFS through Gate 4 and Gate 6 at KSC from SR 3.
- Beach Road provides access to Gate 4 and Gate 6 from the west. Beach Road becomes SR 401 as it approaches CCAFS and subsequently turns into Samuel C. Phillips Parkway.
- Southern access into CCAFS occurs through Gate 1. Gate 1 is accessed by SR 401 via SR A1A, SR 520, and SR 528.
- SR 401 becomes Samuel C. Phillips Parkway as it approaches Gate 1 and is a 5-lane road that narrows to a 4-lane divided road.

- SR A1A is a north-south, 4- lane divided highway to the south of CCAFS that connects SR 401 and Gate 1 with the cities of Cape Canaveral, Cocoa Beach, and Patrick Air Force Base (PAFB) to the south.
- Western access onto CCAFS is provided by SR 3 and SR 405.
- SR 3 is a north-south highway located on the south side of KSC that provides access to Gate 2. It becomes Kennedy Parkway once on KSC property.
- SR 405 is a 4-lane road providing access to CCAFS from the west. It turns into the NASA Causeway after entering KSC at Gate 3, just before crossing the Indian River Lagoon. After continuing through KSC, SR 405 crosses the Banana River, entering CCAFS and intersecting SR 401 (Samuel Phillips Parkway).

SR 520 is a 4-lane/6-lane, east-west urban roadway that crosses the Banana River and the Indian River Lagoon and connects SR A1A, US 1 and Interstate 95 as well as the city of Cocoa to Merritt Island.

SR 528 is a 4-lane, limited-access toll road that connects the Orlando urban area to the coast. It intersects the southern portion of CCAFS 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 CCAFS.

3.11.1.3 On-Site Roadways

The major on-site roadway on CCAFS 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. East-west roadways provide additional internal access. To the north and south of CCAFS, Samuel C. Phillips Parkway becomes SR 401. The general work force using these roadways is increasing because of new commercial development of LCs such as SLC-36 and 40.

SLC-41 is primarily accessible off of Samuel C Phillips Parkway; however, it is also accessible via Titan III Road from the south through the CCAFS ITL area. The SMARF and the VIF are located on Titan III Road.

Discussions with 45 SW personnel indicate that the roads and supporting structures (culverts, and pavement) were constructed to meet Florida DOT standards. Condition of CCAFS roadways were assessed in the 2013 AMEC Environmental & Infrastructure, Inc. Report.[44] Most road pavement conditions were indexed as either good or fair. Phillips Parkway Section ID 01A from SLC-41 north to the KSC SLC-39A turn-off was assigned an index condition of poor. The transportation study indicated that some older culverts may require replacement.

3.11.2 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 CCAFS was accessible through KSC and Titusville. That rail line used to connect through the ITL Area and to SLC-40 and 41 to service the Titan Program. After the close of the Titan Program, the tracks in the ITL Area were abandoned and some sections were removed or covered. The tracks from the SMARF to the VIF along Titan III Road will be refurbished or replaced and are covered under a separate NEPA action.

3.11.3 Port Canaveral

ULA currently uses the Mariner Wharf located within the CCAFS Wharf for receipt of Atlas and Delta launch vehicle components from the Delta Mariner cargo ship. The Proposed Action includes continued use of the Delta Mariner Ship and Wharf for transporting Vulcan launch vehicle components. ***Appendix A, Figure 10. Transportation Route Map*** indicates the location of the Mariner Wharf within the CCAFS Wharf.

The CCAFS Wharf is also used by the US Navy, the US Coast Guard and other commercial space launch recovery vessels. The CCAFS Wharf is part of Port Canaveral. A significant amount of ocean-going transportation goes through Port Canaveral, including commercial shipping and cruise lines and commercial and private fishing and pleasure boats.

3.12 Utilities

3.12.1 Water Supply

The City of Cocoa's municipal potable water distribution system supplies water under a single long-term contract with the US Government to CCAFS, KSC and PAFB. CCAFS recovers a portion of the costs through its contracts with commercial contractors operating on-site. A total of 6.5 million gallons per day (MGD), 17.5% of the City's capacity, is allocated for all three sites. Total water consumption for all three sites averages 3.7 MGD historically.

Water is used at CCAFS for both potable and non-potable purposes. Non-potable use includes fire protection, limited irrigation and launch-related consumption. Launch pad use of non-potable water includes noise abatement, cooling and shock wave attenuation associated with the deluge system and pre and post launch testing. Pump House Number 7 supplies non-potable deluge water to SLC-40 and SLC-41. The design capacity of supply water to both launch complexes is up to 24,000-gallons of water per minute at 180 psi (pounds per square inch) pressure. Currently, a launch or test uses between 70,000 and 250,000 gallons of water from Pump House #7 for either SLC-40 or SLC-41.

3.12.2 Wastewater

The Regional Waste Water Treatment Plant (WWTP), Facility 54730 located on CCAFS, services all of CCAFS and KSC. Lift stations across CCAFS and KSC pump sewage through underground sewers from facilities to the WWTP.

Deluge water from Atlas V launches collected in the flame basin is currently sampled, pumped to a lift station and treated at the CCAFS WWTP.

Other wastewater generated includes washdown of SLC-41 facilities and equipment after Atlas V launches that use SRMs. Washdown of launch pad facilities and equipment drains to the flame basin, where it is collected, sampled, pumped to a lift station and treated at the CCAFS WWTP.

Washdown of other SLC-41 facilities and equipment is determined based on Atlas V launch conditions (wind direction and speed) and visual inspections. If the decision is made to washdown, the water is collected, sampled and pumped out to a tanker and treated at the CCAFS WWTP. No washdown water is discharged to grade.

3.12.3 Electric Power

CCAFS receives 115 kilovolt (kV) power from the Florida Power and Light (FPL) transmission system at the North, South and Titan substations. The substations convert the 115 kV power to 13.2 kV for the feeders, load break switches, and vacuum fault interrupters that make up the CCAFS-owned distribution system. Individual unit substations convert the 13.2 kV distribution system to user level 480 or 208 volt power.

SLC-41 is provided power from the North and Titan Substations through the CCAFS medium voltage distribution system to a double-ended 1000 Kilovolt Amperes (kVA) substation at the PEB and a double-ended 2500 kVA substation at the Pad AC Shelter. Power is supplied to the support building through a 225 kVA pad mounted transformer and the guard shack through a 112.5 kVA transformer. The Titan Substation supplies one of the PEB and PAC transformers from the south. Supply from the North Substation comes in by the Ready Building and supplies the other transformers, providing redundancy to the medium voltage distribution system.

3.12.4 Stormwater

SJRWMD regulates stormwater discharges through SJRWMD Rule 40C-4, FAC. SJRWMD issues Environmental Resource Permits (ERP) for all proposed work in, on or over wetlands or other surface waters. The Vulcan Program will require a SJRWMD ERP. The FDEP grants NPDES construction stormwater permits for sites that disturb one or more acres. The Vulcan Program will require an NPDES construction stormwater permit.

Stormwater that collects in secondary containment areas is managed in accordance with the ULA ICP. Stormwater may be discharged to grade in compliance with the *ICP Rainwater Disposal from Containment Areas*.[45]

3.13 Health and Safety

Range safety organizations review, approve, monitor and impose safety holds, when necessary, on all pre-launch and launch operations in accordance with AFSPCMAN 91 -710. 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 pre-launch and launch operations adhere to public laws.

3.13.1 Operations Safety

ULA complies with OSHA Standards 29 CFR 1910, *Occupational, Safety, and Health Standards* requirements for the protection of health and safety and 29 CFR 1926, *Safety and Health Regulations for Construction* during project construction. ULA maintains fire protection systems that comply with NFPA requirements as applied by the CCAFS Authority Having Jurisdiction, Unified Facilities Criteria and DoD Engineering Technical Letter (ETL) guidance and direction. Fire protection alarms are monitored by the CCAFS Fire Department. Hazardous materials such as propellants, ordnance, chemicals and other payload components must be transported to CCAFS in accordance with DOT regulations for interstate shipment of hazardous substances (Title 49 CFR 100-199). Hazardous materials such as LH2, LO2, LN2 and LNG must be 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 at CCAFS have occurred.

3.13.2 CCAFS Safety Requirements

Launches are not allowed to proceed if an undue hazard exists for persons and property due to potential dispersion of hazardous materials or propagation of blast overpressure. The 45 SW has prepared detailed procedures to be used to control toxic gas hazards. Atmospheric dispersion computer models are run to predict toxic hazard corridors (THCs) for both nominal and aborted launches, as well as spills or releases of toxic materials from storage tanks or that occur during loading or unloading of tanks. Range Safety uses the THCs to reduce the risk of exposure of CCAFS personnel and the general public to toxic materials, including toxic gases.

Emergency response to major aerospace vehicle and hazardous material incidents is provided by the CCAFS Emergency Response Team as directed in the Air Force Emergency Management Program, AFI 10-2501.

3.13.2.1 Range Safety Procedures

AFSPCMAN 91-710 Range Safety Requirements directs overall safety regulations for CCAFS and VAFB. It outlines the process for reviews, approves and operation safety including monitors, safety holds on all launch operations.

Impact debris corridors would be established for the Vulcan Centaur Vehicle on a mission (launch) basis as part of the program's safety review using the results of a debris analysis. Impact debris corridors would be established off the Brevard County, Florida coast over the Atlantic Ocean 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 within the Preliminary Flight Data Package (PFDP) document.

The 45 SW Flight Analysis notifies the 1st 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 1st Range Squadron notifies the FAA so that the appropriate Altitude Reservation (ALTRV) or Notice to Airmen can be disseminated. Restricted and Warning Areas would be active and controlled according to AFSPCMAN 91- 710, Range Safety Requirements.

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. Adherence to specific standards for mission/vehicle reliability are contained in AFSPCMAN 91- 710, Range Safety Requirements is required.

3.13.2.2 45 SW Regulations and FAA Directives and Regulations

Control of air traffic in FAA-designated areas around the launch head is maintained and coordinated between the Military Radar Unit and FAA to ensure that non-participating aircraft are not endangered by launches. The Military Radar Unit restricts aircraft movement in Restricted Airspace and Warning Areas beginning 15 minutes prior to the scheduled launch time and until the launch is complete.

Zone closures are announced daily over various radio frequencies and posted in harbors along the coast. The 45 SW Flight Analysis notifies the 1st Range Squadron of areas that are hazardous to shipping for all normally jettisoned and impacting stages by 30 working days prior to launch. This information is published weekly in the US Coast Guard Broadcast to Mariners. Broadcasts by US Coast Guard Cape Canaveral provide the latest available hazard information to offshore surface vessels. CCAFS in conjunction with PAFB would assume control and could set up a national defense area if protected material were involved in any launch vehicle accident. In the event of a launch vehicle impacting areas outside CCAFS, the on-scene emergency response team from CCAFS would respond to the accident upon request of the county. County agencies would be requested 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.

3.13.2.3 Quantity Distance Criteria Requirements

Explosive safety quantity-distance criteria are used to establish safe distances from LCs and associated support facilities to non-related facilities and roadways. DoD and Air Force Explosive Safety Standards establish these regulations. The criteria use the trinitrotoluene (TNT) explosive equivalent of propellant to determine safe distances from space launch operations or processing and holding areas. As specified in AFSPCMAN 91-710, all facilities would be properly sited and approved in accordance with DoD quantity distance criteria and explosives safety standards.

3.13.2.4 Security Requirements

Access to CCAFS is secured by manned guard stations and fencing. All employees and visitors must have access badges to gain entrance to CCAFS. CCAFS is responsible for ensuring USAF security requirements are maintained, including addressing terrorist threats. SLC-41 adheres to ULA's site security requirements, including ULA access badging, LC fencing, security lighting and intrusion detection cameras.

Further Antiterrorism procedures would be established by ULA as required, in concert with USAF guidance, to improve the safe transport of any vehicle, payload or other item entering CCAFS.

3.14 Socioeconomics

The influence of launch programs at CCAFS on population and employment varies widely within several counties. CCAFS generally influences eastern Brevard County, which includes the cities of Melbourne, Cocoa Beach, Titusville, Rockledge and Cocoa and unincorporated areas in Brevard County including Merritt Island, Port St. John and Viera. CCAFS also draws commuters from Orange County (Orlando) and Volusia County (Daytona Beach). Based on the 2010 Census of Population and Housing, Brevard County had a population of 543,376 persons[46].

Statewide, the Aerospace Industry employs over 130,000 workers as of 2017[47]. Most of the employees are based out of Brevard County, making KSC and CCAFS Brevard County's major employer with a combined CCAFS/KSC work force of military, civil service, other governmental and contract employees. The presence of these employers causes a chain of economic reactions throughout the local region and nearby counties. It is estimated that for each job in the Space Industry, another two are created within the region. This economic force generates over $2.2 billion in household income, $1.8 billion in wages and commodity purchases within the state of Florida, as well as $4.1 billion in total output in the Florida economy annually.[48]

Encouraging commercial space launch companies such as ULA to expand existing launch capabilities ensures continuation of positive impacts on the economics of Brevard County by maintaining launch sites at CCAFS.

3.15 Environmental Justice

Environmental justice is defined by the EPA as "The fair treatment and meaningful involvement of all people regardless of race, color, national origin or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies."

Title 32 CFR 989.33, Environmental Justice and AFI 32-7061, Environmental Impact Analysis Process require that a project proponent comply with EO 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*. The EO requires federal agencies to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority and low-income populations and to ensure that these types of impacts are considered in EAs and other environmental documents. DOT Order 5610.2(a), *Final DOT Environmental Justice Order*, requires FAA to analyze impacts on low-income and minority populations.

The 2010 Census of Population and Housing reports numbers of minority residents. Minority populations included in the census are identified as Black or African American, American Indian and Alaskan Native, Asian, Native Hawaiian/Other Pacific Islander, Hispanic or Other. Based upon the 2010 Census of Population and Housing, Brevard County had a population of 543,376 persons. Of this total, 122,022 persons, or 22.5 %, were minority. Orange County had a population of 1,145,956 persons, of this total, 686,080 persons or 59.9% were minority. The largest segment of the minority population is Hispanic at 26.9%.[49]

3.16 Department of Transportation Act Section 4(f) Properties

Section 4(f) of the U.S. Department of Transportation Act of 1966 (now codified at 49 U.S.C. § 303) protects significant publicly owned parks, recreational areas, wildlife and waterfowl refuges, and public and private historic sites listed or eligible for listing on the National Register of Historic Places. As FAA is a cooperating agency, this section is included in this EA to document FAA compliance with Section 4(f) requirements.

Section 4(f) provides that the Secretary of Transportation may approve a transportation program or project requiring the use of publicly owned land of a public park, recreation area, or wildlife and waterfowl refuge of national, state, or local significance, or land of an historic site of national, state, or local significance, only if there is no feasible and prudent alternative to the use of such land and the program or project includes all possible planning to minimize harm resulting from the use.

No designated Section 4(f) properties exist within the boundaries of CCAFS. Public parks and recreation areas adjacent to KSC and CCAFS include the MINWR that overlaps KSC boundaries and the Canaveral National Seashore adjacent to KSC north of CCAFS. The nearest public park, Jetty Park, is located about 12 miles south of SLC-41 in the City of Cape Canaveral. Other public parks within an approximate 15 mile (24.1 km) radius of SLC-41 include Kelly Park, KARS Park, Kings Park and Manatee Cove Park. St. John’s National Wildlife Refuge and Tosohatchee State

Game Preserve are located west of Interstate 95 in Orange County is approximately 25 miles from SLC-41.

4 Environmental Consequences

This section describes the potential environmental impacts associated with the Proposed Action and No Action Alternative. Components of the affected environment that are of greater concern are described in greater detail.

Guidelines established by the CEQ (40 CFR 1508.27) specify that significance should be determined in relationship to both context and intensity (severity). The assessment of potential impacts and the determination of their significance are based on the requirements in 40 CFR 1508.27. The three levels of impact are:

- No Impact - No impact is predicted
- No Significant Impact - An impact is predicted, but the impact does not meet the intensity/context significance criteria for the specific resource
- Significant Impact - An impact is predicted that meets the intensity/context significance criteria for the specific resource

Factors contributing to the intensity or severity of the impact include the following:

- The degree to which the action affects public health or safety;
- Unique characteristics of the geographic area such as proximity to cultural resources, park lands, prime farmlands, wetlands, wild and scenic rivers or ecologically critical areas;
- The degree to which effects of the action on the quality of the human environment are likely to be highly uncertain or controversial;
- The degree to which the action may establish a precedent for future actions with significant effects or represents a decision in principle about a future consideration;
- Whether the action is related to other actions with individually insignificant, but cumulatively significant impacts;
- The degree to which the action may adversely affect an endangered or threatened species or its habitat that has been determined to be critical under the ESA.

Sixteen (16) environmental aspects are analyzed to assess potential impacts of the Proposed Action and No Action Alternative: Land Use / Visual Resources, Noise, Biological Resources, Historical and Cultural Resources, Air Quality, Climate, Orbital and De-Orbiting Debris, Hazardous Materials and Solid and Hazardous Waste, Water Resources, Geology and Soils, Transportation, Utilities, Health and Safety, Socioeconomics, Environmental Justice and Department of Transportation Act Section 4(f) Properties. Thresholds for determining impact significance are based on the applicable compliance standard, federal or state recommended guidance or professional standards/best professional judgment. In addition, the FAA uses thresholds that serve as specific indicators of significant impact for some impact categories. FAA actions that would result in impacts at or above these thresholds require the preparation of an EIS, unless impacts can be reduced below threshold levels. Quantitative significance thresholds do not exist for all impact categories; however, consistent with the CEQ Regulations, the FAA has identified factors that should be considered in evaluating the context and intensity of potential environmental impacts (FAA Order 1050.1F, Paragraph 4-3.3). Because the FAA plans to adopt this EA to support its environmental review of ULA's license application(s), the FAA's significance thresholds are considered in the assessment of potential environmental consequences in this EA.

4.1 Land Use / Visual Resources

Applicable topics include land use, coastal resources, light emissions, and visual resources/visual character. The FAA has not established a significance threshold for these topics.

4.1.1 Proposed Action

The Proposed Action would occur primarily at SLC-41, which is designated for space launch activities, and the VIF and SMARF. Operations would be consistent with both the Base General Plan and the Air Force mission at CCAFS. The Proposed Action would not convert prime agricultural land to other uses; result in a decrease in the land's productivity; or conflict with existing uses or values of the project area or other base properties. The Proposed Action would generate no significant impacts on CCAFS/MINWR land use.

Activities at SLC-41, VIF and SMARF would be in conformance with the designated use for space launch activities.

The existing ULA facilities are not visible by the public except from the ocean or from the viewing structure built by the KSC Visitor Complex operators specifically for tourists. Facilities built for Vulcan will be within the existing Atlas footprint and are all shorter than existing facilities. Therefore, the Proposed Action would generate no significant impacts on visual resources within the flight range of the Vulcan Centaur Vehicle.

The proposed Vulcan Centaur Program construction and refurbishment activities are within the existing Atlas V footprint. Outside the SLC-41 perimeter fence, approximately 2.67 acres of vegetation will require clearing for flare stack operation, but this area will be encompassed by an IRP remediation action that requires clearing and soil removal and will be covered under a separate NEPA action. Vulcan Centaur Program operations and launch activities are similar to current Atlas V activities and would not change MINWR oversight and operation of Burn Unit 7.4. All Vulcan construction, refurbishment, operations and launch activities would be coordinated with CCAFS. Coordination with KSC, FAA, MINWR, FDEP and FCMP member agencies will be conducted as required to ensure the Proposed Action is consistent with meeting the Florida CZMA plan objectives. Issuance of a federal license or permit for an activity in or affecting a coastal zone must be consistent with the CZMA, which is managed by the Florida Department of Community Affairs (FDCA). No soil will be removed outside the SLC-41 fenceline per the LUCs in place for SWMU C047. Thus, the Proposed Action would have no significant impacts to land use, zoning, natural shoreline processes and coastal resources.

4.1.2 No Action Alternative

Under the No Action Alternative, the Vulcan Program would not be implemented; thus, no change to visual resources, land use, zoning, natural shoreline processes and coastal resources impacts would occur.

4.2 Noise

The EPA administers the Noise Control Act of 1972, 40 CFR part 209 and has identified 65 DNL (dBA) or a CDNL of 61 decibels relative to the carrier (dBC) for sonic booms or rocket noise as

an acceptable noise level for compatible land uses. This level is not regarded as a noise standard, but as a basis to set appropriate standards that should also factor in local considerations and issues. For project-related overpressures at one (1) psf, the probability of a window breaking ranges from one in a billion to one in a million. In general, the threshold for building damage due to sonic booms is 2 psf[50] , below which damage is unlikely.

Per FAA Order 1050.1F, impacts are considered significant if the action would increase noise by DNL 1.5 dB or more for a noise sensitive area that is exposed to noise at or above the DNL 65 dB noise exposure level, or that will be exposed at or above the DNL 65 dB level due to a DNL 1.5 dB or greater increase, when compared to the no action alternative for the same timeframe. For example, an increase from DNL 65.5 dB to 67 dB is considered a significant impact, as is an increase from DNL 63.5 dB to 65 dB.

Noise impacts from the operation of construction equipment are usually limited to a distance of 1,000 feet or less. Vehicles associated with the Proposed Action typically have noise levels between 65 dBA and 100 dBA at a distance of 50 feet.[51]

Temporary noise sources such as refurbishment and demolition would be considered significant if they resulted in noise levels 10 dB or more above the 85 dB, a noise threshold limit value for construction workers in an eight-hour day.

In accordance with 29 CFR 1910, protection against the effects of noise exposure would be provided. When employees are subjected to elevated sound levels from construction activities, feasible administrative or engineering controls would be used. If such controls do not reduce sound levels to the levels presented in ***Table 3-3: Sound Level Descriptors***, hearing protection would be provided and used to reduce exposure.

Noise impact criteria are based on land use compatibility guidelines and on factors related to the duration and magnitude of noise level changes. Annoyance effects are the primary consideration for most noise impact assessments on humans. Noise impacts on wildlife are discussed in Section 4.3.1.1, Vulcan Centaur Program Vehicle Launch Impacts on Vegetation and Wildlife, and 4.3.1.5, Construction.

4.2.1 Proposed Action

Noise generated during Proposed Action launch and construction operations includes launch (engine), sonic boom and construction noise.

4.2.1.1 Launch Noise and Sonic Booms

ULA contracted with Blue Ridge Research and Consulting, LLC (BRRC) to develop the technical report *Noise Study for United Launch Alliance's Vulcan Centaur Launch Vehicle Operations at CCAFS*,[52] to address launch and sonic boom noise. FAA reviewed and commented on this report. The revised report is contained in ***Appendix B*** and the results are summarized in the following sections. BRRC developed and used their Launch Vehicle Acoustic Simulation Model (RUMBLE) noise model to predict the noise associated with the proposed Vulcan launch operations. Based on BRRC's analysis, noise due to launch and sonic booms was not considered to be a significant impact.

4.2.1.1.1 Launch Noise

A single Vulcan launch event may generate levels at or above a maximum A-weighted sound level (LA,max) of 115 dBA within 0.7 miles of the launch pad, as shown by the orange contour in ***Appendix A, Figure 11. Vulcan Maximum A-Weighted Sound Level (LA,max) Contours - Launch of the most powerful configuration (single Vulcan core and six GEM-63XL strap-on SRBs)***[5]. The 115 dBA contour is entirely within the boundaries of CCAFS and KSC.[53]

Structural damage claims were assessed by analyzing the 111 dB and 120 dB Lmax contours generated by a Vulcan launch event and shown in ***Appendix A, Figure 12. Vulcan Lmax Contours - Launch of the most powerful configuration (single Vulcan core and six GEM-63XL strap-on SRBs)***[5]. The potential for structural damage claims is approximately one damage claim per 100 households exposed at 120 dB and one in 1,000 households at 111 dB. For launch events, Lmax in excess of 120 dB and 111 dB would be limited to a radius of 4.4 miles and 11.1 miles from the launch pad, respectively. The 120 dB contour is entirely within the boundaries of CCAFS and NASA KSC. The 111 dB contour includes area outside the CCAFS/KSC boundaries to the west and southwest on the Indian River and Merritt Island.[54]

As shown in BRRC's noise report, the DNL 65 and 60 dBA contours extend approximately 1.2 and 1.8 miles from the launch pad, respectively. This area does not encompass land outside the boundaries of CCAFS and KSC, and thus no residences are impacted. Therefore, Vulcan launches would not result in significant noise impacts.

4.2.1.1.2 Sonic Boom

Sonic booms resulting from the Vulcan nominal launch trajectory would be directed easterly out over the Atlantic Ocean in the direction of the launch azimuth, making them inaudible on the mainland. With respect to human annoyance, health and safety, or structural damage; noise impacts due to sonic booms for the launch trajectory are not expected. Thus, BRRC did not perform a quantitative analysis. To provide more perspective, modeled and measured sonic boom levels of similar vehicles are discussed. Modeled sonic boom levels for a liquid-fueled medium class launch vehicle and liquid-fueled heavy class launch vehicle at other launch sites ranged from 3.0 and 5.25 psf, respectively. A sonic boom due to the overflight of a Titan IV from Vandenberg AFB was measured at a number of locations in the Channel Islands, 30 to 40 miles from the launch pad. The over pressures recorded at these locations were less than 2.4 psf, with the exception of one site which recorded an 8.4 psf focused sonic boom. Heavy-class vehicles such as the Space Shuttle and Saturn V have been launched from CCAFS and KSC, so the community is familiar with the sonic boom impacts.[55]

Sonic boom contours for Vulcan VC62 (six solid rocket motors, two BE-4 first stage engines) were estimated using data from the EELV Program Atlas V Heavy vehicle. This original data was computed by the USAF using the Plotkin methodology[56], deemed acceptable during the 2000 SEIS and adopted by FAA in 2011. The EELV data evaluated the largest and most powerful version of Atlas V, anticipated as a triple-core Heavy Vehicle with extended length 5m payload fairing. While the Atlas V Heavy never launched, the Vulcan Centaur vehicle is built on similar architecture and shares identical launch location, flight profiles and 5m payload fairing configuration. This results in a similar sonic boom footprint for the 5m fairing shape shown in ***Appendix A, Figure 13. Sonic Boom Footprint, Vulcan VC62, CCAFS.*** The footprints are aligned with the launch azimuth and

fall in the Atlantic Ocean, well offshore. Most launches would be at azimuths between 91 and 97 degrees and would not be substantially different from those shown in ***Figure 13***. 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.

Most of the boom footprints are below one (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[57], and similar to focus boom overpressures generated by other launch vehicles. Since the entire boom footprint is over water, the only potential impacts would be to wildlife, refer to Section 4.3 Biological Resources. However, no current or past launch programs on CCAFS, including Atlas, Titan, or Delta launches, have been documented as causing any animal mortality or significant impact to wildlife habitat on CCAFS.

Underwater penetration of the sonic boom was analyzed in the 2000 SEIS. The Proposed Action would fit within the bounds of that analysis and its conclusion that no significant impacts are expected to occur from the underwater penetration of sonic booms.[58]

4.2.1.2 Construction and Refurbishment Impacts

A temporary increase in ambient noise levels would occur at SLC-41 and the surrounding area during the construction of the LNG System (including one LN2 vessel) and modification to the ASWS System, addition of the new LH2 vessel and the new LO2 vessel due to the operation of any heavy equipment (e.g., earth moving machinery, dump trucks). Noise impacts from the operation of construction equipment are usually limited to a distance of 1,000 feet or less. No residential areas or other sensitive receptors occur at, or near, SLC-41; therefore, refurbishment noise would not impact the public or sensitive receptors.

When employees are subject to sound exceeding those listed, engineering or administrative controls would be used and/or personal protective equipment such as approved ear plugs would be provided. Therefore, noise effects on construction workers would have no significant impact under the Proposed Action. Noise level impact on workers would be regulated by complying with OSHA requirements to limit noise impacts on workers and OSHA standards would be followed to protect worker safety related to noise levels. Monitoring of worker exposure to noise would be conducted as required by OSHA.

4.2.2 No Action Alternative

Under the No Action Alternative, no construction or refurbishment noise would occur. Operational noise and sonic booms would remain the same as the current Atlas Program.

4.3 Biological Resources

Per FAA Order 1050.1F, impacts would be significant if the U.S. Fish and Wildlife Service or the NMFS determines that the action would be likely to jeopardize the continued existence of a federally-listed threatened or endangered species, or would result in the destruction or adverse modification of federally-designated critical habitat.

The USAF is committed to the long-term management of all-natural areas on its installations, as directed by the Sikes Act and AFI 32-7064, *Integrated Natural Resources Management*. Long-term management objectives are identified in the 45 SW's INRMP with specific land-management objectives such as wetland protection, conservation of T&E species and habitat restoration.

Any operation that may affect federally-listed species or their critical habitats involves consultation with the USFWS under Section 7 of the ESA of 1973 (as amended). The Marine Mammal Protection Act of 1972 also prohibits the taking of marine mammals, including tormenting them, and may require consultation with the NMFS. The NMFS is also responsible for evaluating potential impacts to EFH and enforcing the provisions of the 1996 amendments to the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA). In February 2019, the 45 SW Chief, Environmental Conservation, submitted a memorandum for an *Informal Section 7 Consultation for United Launch Alliance Vulcan Centaur Operations and Launch Program, Cape Canaveral Air Force Station, Florida*. The memorandum determined that the Proposed Action may effect, but is not likely to adversely effect, federally listed species occurring in the area that could be impacted by launch operations. USFWS concurred in April 2019, as documented in ***Appendix C***.

Specific requirements are identified in ***Table 4-1: Summary of Requirements to Protect Biological Resources*** would be used to minimize impacts to biological resources.

Table 4-1: Summary of Requirements to Protect Biological Resources

Law or Rule	Permit/Action(s)	Requirement	Agency or Organization
Endangered Species Act (ESA)	Consultation with USFWS and NMFS to determine no effect or not likely to adversely affect some T&E species. Determine if species under USFWS jurisdiction are impacted.	Conserve ecosystems that support T&E species. Section 7 requires federal agencies to ensure that any action authorized, funded or carried out by them is not likely to jeopardize the continued existence of listed species or modify critical habitat.	USFWS
Magnuson-Stevens Act	Consultation with NMFS to determine no impact or no significant adverse impact	Conserve/protect EFH. federal agencies must ensure that any action authorized, funded or carried out by them will not adversely impact EFH otherwise mitigation will be required	NMFS
EO 11988	SLC-41 is not located within the 100-year floodplain. No construction is proposed within the 100-year floodplain.	Reduce the risk of flood loss, minimize the impact of floods on human safety, health and welfare, and restore and preserve the natural and beneficial values served by floodplains. Consider alternatives to avoid adverse effects in the floodplains. Prepare Finding of No Practicable Alternative (USAF)	DoD
EO 11990	Directs each federal agency to provide leadership and take action to minimize destruction, loss or degradation of wetlands	Minimize loss, destruction or degradation of wetlands and restore and preserve the natural and beneficial values served by wetlands. Consider alternatives to avoid adverse effects to wetlands.	DoD

Law or Rule	Permit/Action(s)	Requirement	Agency or Organization
		Prepare a Finding of No Practicable Alternative (USAF)	
EO 13112	Remove and control invasive species	Prevent the introduction of invasive species and provide for their control and minimize the economic, ecological, and human health impacts that invasive species cause.	DoD
Migratory Bird Treaty Act (MBTA)	Consult with USFWS as necessary and comply with applicable permits	Prohibits harassment or harm to migratory birds, and destruction of the eggs or nests without a permit.	USFWS
AFI 32-7064	Long-term management of all-natural areas on the Installation	Protect listed species, biodiversity, wetlands.	USFWS
45 SWI 32-7001	Use full cut off, well shielded, low wattage, or amber Light Emitting Diode (LED) lights or prevent use of lighting from 1 May to 31 October	Reduce the amount of exterior lighting visible from the beach during the sea turtle nesting season (1 May – 31 October) from 2100 to 0600 to reduce sea turtle hatchling mortality caused by disorientation (in accordance with the ESA).	45 SW

4.3.1 Proposed Action

Potential impacts to Biological Resources due to the Proposed Action include construction, launch operations and launch impacts. No state or federally-listed T&E plant species have been documented in the Proposed Action area. Gopher tortoises, southeastern beach mice and scrub-jays have historically been on or in the vicinity of SLC-41. Four species of endangered sea turtles nest on the beaches in the SLC-41 vicinity.

4.3.1.1 Construction Impacts

Potential impacts to biological resources during the construction would be minor. Exterior construction occurs within the SLC-41 previously disturbed perimeter boundary. Other than the common “startle response”, no impacts to wildlife (including federally and state-listed wildlife species) due to construction noise are anticipated.

Under the Proposed Action, construction of LNG supply facilities will include an LNG vent flare stack system that will require clearing approximately 2.67 acres of vegetation adjacent to the LNG Flare Stack. ***Appendix A, Figure 6. SLC-41 LNG Flare Radiant Heat Flux Area Vegetation Clear Zone*** shows the location and area of the clearing action. This area will be encompassed by an IRP remediation action that requires clearing and soil removal and will be covered under a separate NEPA action.

A survey for gopher tortoises and indigo snakes would be conducted prior to any Proposed Action construction activity. If gopher tortoises are within 25 feet of any construction, they would be relocated to another area that is sufficiently out of the impact zone in accordance with the Air Force and NASA requirements.

Vulcan construction activities will have no significant impact on Biological Resources.

4.3.1.2 Operations Impacts

Potential impacts to biological resources during launch preparations would be minor. Other than the common "startle response", no impacts to wildlife (including federally and state-listed wildlife species) due to the noise of daily operations are anticipated.

Night lighting at the launch pads has been a concern at CCAFS because of the potential for sea turtle hatchlings at the beach to be drawn toward the lights instead of toward the surf. Sea turtles like dark beaches to lay their eggs. Potential negative impacts by lighting are reduced and managed by 45 SWI 32-7001, Exterior Lighting Management which addresses exterior light management implemented by a series of management plans specific to all active LCs as well as the CCAFS Industrial Area.

These plans require the use of amber LED, shielding and special light management steps where lights are visible from the beach areas. All construction and operational activities must have an LMP approved by the USFWS. Exterior lighting at all facilities used for spacecraft processing at CCAFS, including SLC-41, would comply with established lighting policy for minimizing disorienting effects on sea turtle hatchlings.

Currently, ULA has an approved LMP for SLC-41 and all changes or additions to exterior lighting at SLC-41 for the Vulcan Program require an amendment to the LMP and approval by the Air Force and USFWS.

Vulcan launch preparation and operation activities will have minimal impact on Biological Resources due to the implementation of the LMP, biological surveys and tortoise relocation efforts. There will be no significant impacts.

4.3.1.3 Launch Impacts

4.3.1.3.1 Vegetation

Vulcan launches will have some impacts near the launch pad associated with fire and acid deposition similar to previous actions at CCAFS. NASA has mapped the effects on local vegetation of 14 Delta II/III, 20 Atlas V and 8 Titan launches from CCAFS[59]. Vegetation scorching was limited to small areas (less than 2.67 acres) within 492 feet of the launch pad. ULA performed a Delta IV Heavy and Medium Vehicle Launch Exhaust Temperature Study at CCAFS SLC-37 in 2004. Results indicated that damaging temperatures and scorched vegetation were confined to an approximately 2.7 acre area directly opposite the flame trench. At SLC-41, a berm inside the perimeter fence protects the roadway and vegetation outside the fence from launch exhaust exiting the flame trench. No reports of scorched vegetation outside the fence due to Atlas V launches were found. Since the Vulcan is a larger vehicle than Atlas V, the Proposed Action would impact the vegetation in an area no larger than the areas impacted by a Delta IV Heavy or Titan, both as large or larger than the Vulcan, of approximately 2.7 acres. Past vegetation scorching has not permanently affected the vegetation near the LCs and this is expected to apply to Vulcan launches.

Acid deposition is primarily associated with SRMs. Vulcan Vehicle configurations will include zero, two, four or six Orbital ATK GEM-63XL SRMs. Atlas V Vehicles can be configured with up to five Rocketdyne's AJ-60A SRMs. Delta IV Vehicles can be configured with up to four Orbital ATK GEM-60 SRMs. The GEM-60 SRMs are in the same family as the proposed Vulcan GEM-63XL SRMs.

Acid and particulate deposition for Delta launches has extended less than 0.6 miles from the launch pad and affected relatively small areas (up to 114 acres). Continuous acid deposition did not exceed 0.6 miles from the launch pad for Titan launches. However, isolated acid deposition has occurred up to 5.8 miles from the launch pad under certain meteorological conditions. Titan launches used approximately twice the solid propellant compared to the six SRM Vulcan variant.

The 2000 SEIS analyzed potential impacts to the environment from the five Atlas V SRMs and the GEM-60 Delta IV SRMs, including deposition to wetlands, and determined no significant environmental impacts are expected to occur. The SEIS noted that increased use of SRMs would result in larger and more frequent hydrochloric acid (HCl) ground clouds from the increased use of SRMs, temporarily affecting flora and fauna. The SEIS concluded that the effects of HCl and aluminum oxide (Al2O3) deposition from SRMs would be minimal and that plant species are expected to recover from short-term launch impacts. Acid and particulate deposition for the Proposed Action would be slightly greater than current Atlas V deposition due to anticipated use of greater quantities of solid propellants. However, Vulcan use of solid propellants is less than past Titan use. Acid and particulate impacts of the Proposed Action on vegetation is expected to be minimal with recovery of short-term launch impacts expected.

An anomaly on the launch pad would present potential impacts to biological resources from the possibility of extreme heat and fire, percussive effects of the explosion and debris that might impact land or surface waters. The 2000 SEIS concluded that damaged vegetation resulting from a launch anomaly would be expected to regrow within the same growing season because no lingering effects would be present. Similar results are expected for Vulcan Program launch anomalies.

Vulcan launches will have no significant impact on vegetation resources.

4.3.1.3.2 Wildlife and Marine Life

No animal mortality has been observed at CCAFS that could be attributed to Delta, Atlas or Titan launches.[60] Similar results are expected for Vulcan Centaur Program launches. Scrub-jays, gopher tortoise, southeastern beach mice, indigo snakes and sea turtle nesting occur in the vicinity SLC-41. Post launch monitoring conducted on previous launches, and previous environmental analyses concluded that launch impacts to these species are minimal. The behavior of scrub-jays observed after Delta, Atlas and Titan launches has been normal, indicating no noise-related effects.

An anomaly on the launch pad would present potential impacts to biological resources from the possibility of extreme heat and fire, percussive effects of the explosion and debris that might impact land or surface waters. 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.[61]

During a nominal launch, the launch vehicle and spacecraft would be carried over the coastal waters of the Atlantic Ocean and through the Earth's atmosphere. When expended, the SRMs and booster disengage and fall into the Atlantic Ocean. The payload fairings separate, re-enter the Earth's atmosphere and fall into the Atlantic Ocean. The Centaur upper stage delivers the payload into orbit. The Vulcan Program plans no recovery of any segments.

With more than 75 Atlas V launches (as of March 2018) with no complete failures, Atlas V is among the most reliable launch vehicles in the world. Although no reliability data for the Vulcan

Centaur Program exists, similar EELVs typically have a reliability of approximately 95 percent. Thus, it is unlikely that a launch vehicle or payload would impact land surface or the ocean.

An improbable mishap downrange would occur over the open ocean and would not likely jeopardize any marine life, given the relatively low density of species within the surface waters of these open ocean areas. Debris from launch failures has a small potential to adversely affect managed fish species and their habitats in the vicinity of the project area. However, after 1998 EIS EELV consultation with the NMFS, the Air Force found "no greater than minimal adverse effects" to EFH under NMFS regulations[62].

In August 2016, NASA and the FAA conducted an ESA consultation with NMFS on waterborne landings of spacecraft that included landings in the Atlantic Ocean and addressed marine turtles, mammals and fish included in Section 3.3 of this EA. NMFS concluded potential project effects to listed species and critical habitat were found to be discountable, insignificant, or beneficial, and that the proposed action is not likely to adversely affect listed species and critical habitat under NMFS's purview.[63]

In the event of an early launch abort or failure, spacecraft and launch vehicle debris would fall onto land surface or into the ocean and cause potential impacts. Launch vehicle debris from a liquid propellant vehicle is considered a negligible hazard because virtually all hazardous materials are consumed in the destruct action or dispersed in the air and only structural debris would strike the water. In a destruct action, the Vulcan Centaur vehicle may survive to impact the water essentially intact, presenting some potential for habitat impact if the spacecraft contains hypergolic propellants or other chemicals that are toxic to marine organisms. Hazards of each payload are addressed in separate NEPA actions specific to the payload customer and are covered in general in NASA's 2011 Routine Payload Environmental Assessment.[64] Vulcan payloads are expected to be covered by NASA's EA.

Sonic booms created by launches from CCAFS LCs 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 would see periodic groups of migrating whales that follow the coastline), and the sonic boom footprint lies over 30 miles from CCAFS, the sonic booms from launches are not expected to negatively affect the survival of any marine species.[65]

Vulcan launches will have no significant impact on wildlife and marine life resources.

4.3.2 No Action Alternative

Under the No Action Alternative, the Vulcan Centaur Program would not be implemented. Impacts to Biological Resources, T&E species, or wildlife and marine habitat would remain the same as currently imposed by the Atlas V program. The 1998 EELV EIS and 2000 SEIS concluded that impacts to vegetation and wildlife would be minimal.

4.3.3 No Action Alternative

Under the No Action Alternative, the Vulcan Centaur Program would not be implemented and would revert to the Atlas V Program, which has no impacts on Historical and Cultural Resources.

4.4 Historical and Cultural Resources

In the 1990s, the USAF 45 SW Cultural Resources Office determined that SLC-41 was not eligible for listing on the NRHP. In 2018, SLC-41, VIF and SMARF were re-evaluated and no changes to the previous determination were made.[66]

4.4.1 Proposed Action

The 45 SW Cultural Resources Manager evaluated the areas impacted by Proposed Action and no historical or cultural resource issues were found within the boundaries of SLC-41, SMARF, VIF and the surrounding area. In October 2018, the Florida Department of State Division of Historic Resources Deputy State Historic Preservation Officer determined that a Section 106 consultation was required as part of this NEPA process as shown in ***Appendix D***. The Florida Department of State Division of Historic Resources and State Historic Preservation Officer performed a Sections 106 and 110 National Historic Preservation Act of 1966 review of the Proposed Action. Their conclusion that the Proposed Action will have no effect on historic properties is contained in ***Appendix D***.

There are no Traditional Cultural Properties on CCAFS inclusive of the project area according to the Seminole Tribe of Florida, the Seminole Nation of Oklahoma, and the Miccosukee Tribe.[67] These three consulting Tribes notified CCAFS that they will not consult on projects unless the project could potentially affect Native American archaeological sites as documented in the 45 SW Integrated Cultural Resources Management Plan (ICRMP). The Proposed Action will have no effect on traditional cultural resources.

4.4.2 No Action Alternative

Under the No Action Alternative, no impact to Historical or Cultural resources would occur.

4.5 Air Quality

The ROI for air quality includes all of CCAFS and Brevard County, including both lower and upper atmospheres. Per FAA Order 1050.1F, impacts would be significant if the action would cause pollutant concentrations to exceed one or more of the National Ambient Air Quality Standards (NAAQS), as established by the Environmental Protection Agency under the Clean Air Act, for any of the time periods analyzed, or to increase the frequency or severity of any such existing violations.

4.5.1 Proposed Action

Air emissions from the Proposed Action include construction emissions, operations emissions and launch emissions. The Vulcan Program introduces no listed chemicals at or above CAA RMP reportable thresholds and will not require preparation of an RMP.

4.5.1.1 Construction

Air emissions from construction activities (described in Section 2.1) would cause a minor increase in PM emissions due to demolition, excavations, minor clearing, construction vehicles and diesel

generators. Carbon dioxide would be released by fossil fuel powered equipment and vehicles. Diesel-powered equipment would emit CO, hydrocarbons, NOx and CO_2. Emissions are expected to be minor from these sources over the expected 18 months of construction. Construction activities are not expected to significantly change regional (Brevard County) or local (CCAFS) air emissions. No NAAQS exceedances are expected during construction.

4.5.1.2 Operations

Proposed Action air emissions from Vulcan launch preparations and daily operations include PM, VOC, NOx, SOx, HAPs and CO_2/CO from sources such as:

- Fugitive emissions due to road dust or modification of existing facilities
- Vehicle, mobile equipment emissions
- Battery charging emissions
- Surface coating launch structures, ground support equipment, other equipment and structures
- Sandblasting, hand-sanding of launch structures, ground support equipment, other equipment and structures
- Engine-driven electrical emergency generators
- Diesel fuel storage tanks for emergency generators
- Diesel powered mobile search lights for launches
- Hydrogen flare stack
- LNG, LN2, LO2, LH2 storage and supply fugitive emissions
- Minor coating, painting
- Isopropyl Alcohol (IPA) flush carts
- Fugitive emissions from hand-wipe cleaning, application of adhesives, and other maintenance activities.

All emissions described for this Proposed Action are exempt from FDEP air permitting pursuant to FAC Rule 62-210.300(3)(a), Categorical Exemptions or because the emission amounts are small quantities (Rule 62.040). ULA uses no ozone-depleting substances (ODS) in launch operations support. Vulcan launch preparation and operations support emissions are expected to be similar to the Atlas V Criteria Pollutant and HAP Emissions detailed in ***Table 3-8*** (latest data available). Thus, Proposed Action operations, even at a higher launch rate, emissions are not expected to significantly change the existing air emissions on CCAFS. No NAAQS exceedances during operations are expected.

The potential for an accidental release of fuels or other hazardous liquids would be minimized by adherence to ULA safety and operating procedures. All spills would be managed in accordance with the existing CCAFS spill response plan and the ULA ICP.

4.5.1.3 Launch

The Vulcan Centaur launch vehicle is considered a mobile source and is not subject to federal, state or local air permitting. The Vulcan Centaur vehicle uses the BE-4 LNG LO_2 engine. Primary BE-4 engine combustion products are carbon dioxide, CO and water vapor; minor combustion products are NOx, methane (CH4), nitrous oxide (N2O), volatile organic compounds (VOCs); and

trace amounts of SOx and PM are produced. Most of the CO is oxidized to carbon dioxide during afterburning in the exhaust plume.

SRMs also produce air emission during launch. ***Table 4-2: Launch Emissions from Vehicles using SRMs*** contains the criteria pollutants and HCl (HAP) emissions for Atlas V and Delta IV SRM launches. Aluminum oxide emissions are included in PM10 emissions.

Table 4-2: Launch Emissions from Vehicles using SRMs

Vehicle	First Stage Propellants	Air Emissions, Tons per Launch, into Lowest 3000 feet of Atmosphere					
		VOC	NOx	CO	SO2	PM10	HCl
Atlas V (551/552	RP-1 / LO_2	0	1.1	0.01	0	15	7.8
Delta IV Medium +	LH2 ./ LO_2	0	0.71	0.0054	0	10	5.1
Source[68]							

Air emissions from Vulcan launches with SRMs are expected to be similar to Atlas V or Delta IV launches with SRMs. LNG is a cleaner burning fuel than RP-1, with anticipated reductions in PM, but overall Vulcan launch per launch emissions are expected to be similar to the current Atlas V launch emissions.

BE-4 engine combustion product gases and particles, such as N_2O, NO_x, water vapor (H_2O), and hydrogen oxides, reduce stratospheric ozone concentrations locally and globally. N_2O is now the largest anthropogenic ozone-depleting emission since the prohibitions on chlorofluorocarbons. H_2O is not highly reactive but participates in chemical reactions creating radicals that destroy ozone. SRM emissions contain aluminum oxide, NOx, chlorine compounds and small amounts of highly reactive radical compounds that deplete ozone in the plume wake immediately following launch. Particulate emissions may also enable reactions creating radicals that deplete ozone concentrations. The 2000 SEIS noted that a conservative estimate of the yearly EELV contribution to the total annual global ozone decrease, based on the maximum expected launches of vehicles with SRMs, is less than 0.1 percent of existing conditions. This constitutes an insignificant decrease in global ozone. Neither the BE-4 engine or SRM emissions contribute significantly to stratospheric ozone depletion.

4.5.2 No Action Alternative

Under the No Action Alternative, the Vulcan Centaur Program would not be implemented; therefore, air emissions from the Atlas V Program would remain the same and no potential reduction in PM emissions would be realized.

4.6 Climate

The effects on climate of the Proposed Action or the No-Action Alternative covers the potential effects of currently understood climate change issues. The CEQ specifically asked agencies in 2016 to consider:

- The potential effects of a proposed action on climate change as indicated by its GHG emissions
- The implications of climate change for the environmental effects of a Proposed Action.

GHG trap heat in the atmosphere. Increasing global temperatures trending over the past century have been scientifically correlated to increasing GHG emissions due to human activities. Climate change induced by global warming may result in rising sea levels, more severe weather events, loss of habitat and economic and socio-political effects such as reduced food security.

4.6.1 Proposed Action

Generation of GHG emissions from construction and launch preparation and daily operations include CO2 generation from vehicles and fugitive methane emissions. These emissions are insignificant compared to total US GHG emissions (see ***Table 3-10***).

Vulcan launches emit GHGs CO_2, water vapor, NOx, CH4 and N_2O. Annual GHG emission associated with the Proposed Action operations are compared to US 2011 GHG emissions (EPA, 2013) and the 2011 global CO_2 emissions in ***Table 4-3: Estimated CO2 Emissions***. Emissions of GHGs from the Proposed Action alone would not cause any appreciable global warming that may lead to climate change. However, these emissions would increase the atmospheric concentration of GHGs. At present, no methodology exists that would enable estimating the specific impacts that this increment of warming would produce locally or globally. The impact to the climate would still not be significant.

Table 4-3: Estimated CO_2 Emissions

Annual Emissions Source	Metric Tons CO_2 per Year
Global Total CO_2 Emissions	$3{,}400 \times 10^7$
US 2010 Total GHG Emissions	$6{,}821.8 \times 10^6$
2013 CCAFS GHG Emissions (Total)	72,547

Source[69]

The Proposed Action cause by climate change would no significant impact. Compared to CCAFS totals, Proposed Action GHG emissions would be essentially unmeasurable and not have a climate change impact.

Conservative climate models project that the seas off KSC and CCAFS will rise five (5) to eight (8) inches by the 2050s and nine (9) to 15 inches by the 2080s. If ice sheets in Greenland and Antarctica continue to melt as quickly as current measurements indicate, those numbers could become 21 to 24 inches by the 2050s and 43 to 49 inches by the 2080s.[70] Launch Complex 41 – CCAFS: This launch site is protected from sea level rise inundation due to its high elevation. However, sea level rise is expected to intrude within the outer boundary (but not the circular boundary) of the launch site by year 2100 when using the ACOE high curve.[71]

4.6.2 No Action Alternative

Under the No Action Alternative, GHG emissions would revert to the existing Atlas V GHG emissions, which would essentially be unmeasurable and not have a climate change impact.

4.7 Orbital and De-Orbiting Debris

Because orbital debris may re-enter the Earth's atmosphere, NASA's policy is to employ design and operations practices that limit the generation of orbital debris, consistent with mission

requirements and cost-effectiveness. NASA Safety Standard (NSS) 1740.14 "Guidelines and Assessment Procedures for Limiting Orbital Debris" requires conducting a formal assessment of the potential to generate orbital debris.

Vulcan Centaur Program payloads would comply with all requirements of NPD 8710.3, NASA *Policy for Limiting Orbital Debris Generation*, US Government Orbital Debris Mitigation Standard Practices (USGODMSP), DoDI 3100.12, *Space Policy* and NASA-STD 8719.14A, *Process for Limiting Orbital Debris*. Preparing debris assessments as required by this policy is the responsibility of the payload customers and not ULA.

Environmental and safety impacts resulting from the normal and errant burnout of launch vehicle stages would be controlled at CCAFS in accordance with AFSPCMAN 91-710V2. That document requires that a trajectory analysis predict the instantaneous surface impact point (IIP) at any moment during launch for either normal flight or debris from a flight terminated by range safety action. This IIP would be overlaid on range maps indicating populated or environmentally sensitive areas, and a launch corridor would be developed. This package of data, called the PFDP is developed for each mission (launch) well in advance of the launch activity. During the actual launch of the Vulcan Centaur Vehicle, tracking data and IIP plots would be monitored to assure the launch trajectory stays within the corridor. If a flight approaches corridor limits, it would be destroyed by Range Safety. This assures that spent stages or debris would only impact broad ocean areas cleared of shipping or air traffic.

4.7.1 Proposed Action

The environmental consequences of orbiting and deorbiting debris from additional payloads potentially launched on Vulcan Program vehicles would be addressed under separate NEPA documentation for each of the payload programs, as required.

For all Vulcan Centaur Program missions, the Centaur upper stage would be placed in a disposal orbit. Disposal orbits are orbits that, as a result of current and projected missions and technologies, are effectively useless except as regions of the space environment where spent hardware can be disposed of without impacting current or projected space systems. The Vulcan Centaur upper stage would also be vented to preclude debris creation resulting from explosive overpressure. These techniques are in accordance with the EELV program System Performance Document and international agreements on space debris minimization.[72]

Although the Vulcan Centaur upper stage is larger than the current Atlas V Centaur upper stage, the environmental impact of orbiting and de-orbiting debris is similar. Implementation of the Proposed Action would not likely change the total number of worldwide space launches. Thus, no significant global effect on orbital/deorbiting debris would be incurred from the implementation of the Proposed Action.

4.7.2 No Action Alternative

Under the No Action Alternative, the Vulcan Centaur Program would not be implemented; thus, orbital debris impacts would not change from the existing Atlas V Program.

4.8 Hazardous Materials and Solid and Hazardous Waste

This section covers hazardous materials and solid and hazardous waste related to Proposed Action construction and operations and the no action alternative.

4.8.1 Proposed Action

4.8.1.1 Hazardous Materials, Solid and Hazardous Waste

Construction activities require the use of hazardous materials. Hazardous materials expected to be used include diesel fuel, gasoline and propane to fuel the construction equipment; hydraulic fluids, oils, and lubricants; welding gases; paints and solvents; adhesives and batteries. Hazardous materials associated with construction activities would be delivered and stored to prevent leaking, spilling and potentially polluting soils, groundwater, and surface waters, and in accordance with applicable federal, state, and local environmental and public and occupational health and safety regulations. Public transportation routes would be used for the conveyance of hazardous materials during construction. Transportation of all materials would be conducted in compliance with DOT regulations.

Construction activities will also generate construction and demolition (C&D) debris and solid wastes. The construction contractor is required to properly manage and dispose of C&D debris and solid waste in accordance with state and federal regulations. In accordance with the LUCIP, no soil may be removed from SLC-41.

Launch operations, routine maintenance and flight support activities would require the use and storage of hazardous materials. Hazardous materials used on the Vulcan Program would be the same as currently used on the Atlas V Program, with the exception that LNG would be used instead of RP-1. In addition to propellants (LNG, LH2 and LO2) and flight batteries, typical operations and maintenance activities would require use of products containing hazardous materials, including paints, solvents, oils, lubricants, acids, batteries, surface coating, and cleaning compounds. These materials would be handled, stored, and disposed of in accordance with the Safety Data Sheet recommendations and storage in accordance with applicable federal and state regulations would minimize the potential for impacts to the launch pad and surrounding areas. Hazardous materials such as propellants, chemicals and other hazardous material payload components would be transported in accordance with DOT regulations (e.g., 49 CFR 100-199) governing interstate and intrastate shipment of hazardous materials, as applicable.

As is current practice, hazardous materials used for maintenance or in-flight preparation would be stored in their original containers with their original product labels and stored on pallets under cover and with secondary containment or in appropriate hazardous material cabinets. Incompatible materials would not be stored together and sufficient space would be provided between stored containers to allow for spill cleanup and emergency response access. Storage units would meet building and fire code requirements and would be located away from vehicle traffic. Storage instructions would be posted and construction employees would be trained in proper receiving, handling and storage procedures. Safety Data Sheets for all materials stored on the site would be provided and available to all site personnel.

With the implementation of appropriate storage, handling and management procedures, hazardous materials used during the Proposed Action construction, operation and maintenance would have no significant impacts on the environment.

4.8.1.2 Hazardous Waste and Hazardous Waste Management

Hazardous waste would be generated during Proposed Action construction activities would be expected to include empty containers, spent solvents, paints, sealants, adhesives, waste oil, spill cleanup materials (if used), lead acid batteries and various universal wastes. Other hazardous materials such as welding gases are expected to be consumed in their entirety and the empty gas cylinders returned to the suppliers. Construction contractors would be responsible for safely removing these construction-generated wastes and for arranging for recycling or disposal in accordance with applicable regulations.

The total monthly generation of hazardous waste during construction is anticipated to be less than 100 kilograms during a calendar month. The construction contractor would be (contractually) responsible for determining their regulatory status regarding hazardous waste generation (during construction and obtaining and maintaining compliance) in accordance with federal and state laws and complying with the applicable regulations.

Small quantities of hazardous waste would be generated during routine operations and maintenance. Most of the hazardous materials would be consumed, so no substantial volumes of hazardous waste would require disposal. Launch vehicle maintenance, propellant and fuel storage and dispensing, and facility and grounds maintenance are among those activities that may generate very small quantities of hazardous wastes. The sources of hazardous waste include waste fuel, waste oils, spent solvents, paint waste, spill response materials, and used batteries.

With the implementation of appropriate handling and management procedures, hazardous wastes generated during the Proposed Action construction, operation and maintenance would have no significant impacts on the environment.

4.8.1.3 Spills

The storage and transport of hazardous materials or waste would have the potential to result in accidental spills that could adversely impact soil, surface water, and groundwater adjacent to transportation routes or down-gradient from the construction or operations areas. Potential impacts to water resources with regards to spills are discussed in Section 4.9, Water Resources. Soils adversely affected by spills would be treated on site or would be removed and disposed of in accordance with applicable federal and state regulations. Hazardous wastes associated with construction and operations activities would be stored in a manner (per applicable regulations) that would prevent these materials from polluting soils, groundwater and surface waters and in accordance with applicable federal, state, and local environmental and public and occupational health and safety regulations. During construction, individual contractors would be responsible for the safe and compliant collection, management, and transport of their hazardous wastes to offsite permitted waste disposal facilities.

To minimize the potential for surface water or groundwater contamination, ULA has implemented an existing emergency and spill/release plan, the ICP, to ensure that adequate and appropriate guidance, policies and protocols regarding hazardous material incidents and associated emergency

response are available to and followed by all personnel. Emergency response and cleanup procedures contained in the plan would reduce the magnitude and duration of any impacts both on and off site and would be revised to include LNG and address its hazards.

4.8.1.4 Installation Restoration Program

Vulcan Centaur Program operations would not impact ongoing IRP investigations or activities at CCAFS and would be unchanged from current Atlas V impacts on IRP activities.

Contamination exists at several locations covered in Section 3.8.4 Installation Restoration Program. Coordination with the IRP office must be completed for any planned construction that would involve contact or digging into groundwater.

As previously described, approximately 2.67 acres of cleared, vegetated area outside the SLC-41 perimeter fence is required to allow dissipation of the radiant heat flux produced by the LNG flares. This area is part of a larger parcel that will be cleared to perform a remedial action under the direction of the USAF IRP. This area will be included under a separate NEPA action. ULA would maintain the area after remediation is complete.

No significant impacts to IRP sites or activities by the Proposed Action are anticipated.

4.8.1.5 Pollution Prevention

Best Management Practices (BMPs) for pollution prevention would be implemented in accordance with the Pollution Prevention Act of 1990. ULA prevents pollution via source reduction whenever feasible. Polluting substances whose use cannot be avoided would be recycled and/or treated in accordance with applicable laws. Disposal of all polluting substances would be conducted in accordance with applicable laws. All accidental releases of polluting substance would be responded to quickly and appropriate clean up measures would be implemented in accordance with applicable laws to minimize impacts to the environment.

4.8.1.6 Solid Waste Management

The Proposed Action construction and launch operations would generate solid waste, such as construction and demolition debris, office waste, break room waste, packaging from supplies and launch operations waste that is not hazardous.

Construction and demolition solid waste, including concrete and some scrap metal, would be generated during construction. Management of construction and demolition debris is the responsibility of the construction contractor. Contract documents would require solid waste to be recycled if feasible; or disposed of at an existing, permitted off-site landfill. Construction actions are anticipated to generate minimal amounts of solid waste compared with the capacity of local construction and demolition debris landfills.

The EPA estimates that one person generates 4.40 pounds of waste per day.[73] Based on an average of 120 fulltime Vulcan Program employees, it is expected that approximately 532 pounds of solid waste would be generated per day, resulting in approximately 69 tons of solid waste generated per year (assuming 260 work days). Solid waste generation based on the number of employees is the same for both the Proposed Action (Vulcan Program) and No Action (Atlas V Program) alternative.

Solid waste generated from Vulcan launch support activities is expected to be the same as the current Atlas V Program.

4.8.2 No Action Alternative

Under the No Action Alternative, the Vulcan Centaur Program would not be implemented, thus hazardous materials and hazardous and solid waste impacts would not change from the existing Atlas V Program.

4.9 Water Resources

This section describes the potential effects to surface water and groundwater, including hydrology, water quality, wetlands and floodplains, resulting from either implementation of the Proposed Action or the No Action Alternative. The FAA has established the following significance thresholds for water resources.

- **Surface Waters** – The action would:
  - Exceed water quality standards established by federal, state, local, and tribal regulatory agencies; or
  - Contaminate public drinking water supply such that public health may be adversely affected.
- **Groundwater** – The action would:
  - Exceed groundwater quality standards established by federal, state, local, and tribal regulatory agencies; or
  - Contaminate an aquifer used for public water supply such that public health may be adversely affected.
- **Wetlands** – The action would:
  - Adversely affect a wetland's function to protect the quality or quantity of municipal water supplies, including surface waters and sole source and other aquifers;
  - Substantially alter the hydrology needed to sustain the affected wetland system's values and functions or those of a wetland to which it is connected;
  - Substantially reduce the affected wetland's ability to retain floodwaters or storm runoff, thereby threatening public health, safety or welfare (the term welfare includes cultural, recreational, and scientific resources or property important to the public);
  - Adversely affect the maintenance of natural systems supporting wildlife and fish habitat or economically important timber, food, or fiber resources of the affected or surrounding wetlands;
  - Promote development of secondary activities or services that would cause the circumstances listed above to occur; or
  - Be inconsistent with applicable state wetland strategies.
- **Floodplains** – The action would cause notable adverse impacts on natural and beneficial floodplain values. Natural and beneficial floodplain values are defined in Paragraph 4.k of DOT Order 5650.2, *Floodplain Management and Protection*.

4.9.1 Proposed Action

4.9.1.1 Surface Water

Under the Proposed Action, launch deluge water would be contained in the impermeable concrete flame trench, sampled, pumped to the sanitary sewer and treated at the CCAFS WWTP. Inadvertent discharge of industrial wastewater (deluge water) into jurisdictional waters of the US due to flame trench proximity to the retention basin was reviewed. The flame trench capacity is approximately 400,000-gallons Vulcan's combined deluge, sound suppression and washdown water is calculated to be approximately 225,000-gallons, thus it is highly unlikely that the wastewater would be inadvertently discharged from the basin to surface waters or ground surface. The Atlas V Program has never inadvertently discharged wastewater to surface waters or ground surface. No impacts on surface water are expected to occur from the Proposed Action launch industrial wastewater.

In the event of an early launch abort or failure, spacecraft and launch vehicle debris could fall into the ocean and cause potential impacts. Launch vehicle debris from a liquid propellant vehicle is considered a negligible hazard because virtually all hazardous materials are consumed in the destruct action or dispersed in the air and only structural debris would strike the water. In a destruct action, the Vulcan Centaur vehicle may survive to impact the water essentially intact, presenting some potential for localized surface water impact if the spacecraft contains hypergolic propellants that were released into the water. Any resulting pH changes would be very temporary and very localized.

The drainage from SLC-41 could be affected by the exhaust cloud that would form near the launch pad at liftoff as a result of the exhaust plume and evaporation and subsequent condensation of deluge water. Because the Vulcan Centaur booster uses LO2 and LNG propellants, the exhaust cloud would consist of primarily of steam and would not consist of any significant amounts of hazardous materials. Using larger and more SRMs would result in larger and more frequent HCl ground clouds. Effects on pH of the deluge water from SRM use is known to be small. Any pH changes to surrounding SLC-41 surface waters from the HCl ground cloud is expected to be small and temporary. As the volume of water condensing from the exhaust cloud is expected to be minimal and temporary, the exhaust cloud would generate no significant impacts on surface water quality at SLC-41.

No significant impacts to surface waters are expected as a result of the Proposed Action.

4.9.1.2 Groundwater

Groundwater at SLC-41 generally flows to the surrounding wetlands and eventually to the Banana River. Neither the Proposed Action or the No Action Alternative use groundwater for any purpose. Groundwater contamination could occur if fuels or other hazardous liquids are spilled in significant enough quantities. The potential for an accidental release or spills would be minimized by adherence to ULA safety and operating procedures. All spills would be managed in accordance with the existing CCAFS spill response plan and the ULA ICP and would address groundwater contamination. During construction, if dewatering is required, authorization through the CCAFS IRP would be required to ensure groundwater quality and flow is not impacted. No significant impacts to groundwater are expected as a result of the Proposed Action.

4.9.1.3 Wetlands and Floodplains

Vulcan Centaur Program modifications to SLC-41 are not expected to disturb wetlands or affect any floodplains within the SLC-41 perimeter. ***Appendix A, Figure 8. SLC-41 Area Wetlands*** and ***Figure 9. SLC-41 Floodplains Map*** identify the location of wetlands and 100-Year floodplain in and around SLC-41. No wetlands or 100-Year floodplains occur within the current boundary of SLC-41 but do occur within approximately 300 feet of the boundary. Minor vegetation and soil disturbance inside the SLC-41 perimeter will be accomplished to eliminate permanent impacts to surrounding wetlands and/or surface waters.

The 2.67 acre cleared area outside the SLC-41 perimeter required by the LNG flares will be included under a separate NEPA action since that area is scheduled for remediation under the direction of the USAF IRP in 2019. Any impacts to surrounding wetlands from clearing outside the SLC-41 perimeter will be addressed in that NEPA action.

SJRWMD representatives Karen Garrett-Kraus, Regulatory Scientist, and Perry Jennings, Permit Engineer, visited the proposed cleared area site with ULA representatives in October 2018. SJRWMD determined that the majority of the proposed cleared area meets the definition of an altered wetland of poor quality. SJRWMD determined that the best approach for wetland permitting will be to use the equipment necessary to clear the Brazilian pepper and Australian pine trees from the area, perform earth work to grade the area from ridges and swales to an even landscape at an elevation that would support low growing wetland vegetation. This would result in a self-mitigating action and provide the easily maintained vegetative state. This plan, and any required permitting, will be implemented by the CCAFS IRP as part of a remedial action outside of this Vulcan Program EA.

The Proposed Action will not have a significant impact on floodplains or wetlands.

4.9.2 No Action Alternative

Under the No Action Alternative, the Vulcan Centaur Program would not be implemented. Impacts on water resources would be unchanged from current Atlas V Program insignificant impacts.

4.10 Geology and Soils

This section addresses any potential geologic impact of the Proposed Action to foundation instability, land subsidence or other geologic aspects.

4.10.1 Proposed Action

No unique geologic features of exceptional interest or mineral resources occur in the project area; thus, no impacts would occur to these resources. Proposed Action construction would impact soils at or near SLC-41, VIF or SMARF. No soil will be removed from SLC-41 in accordance with the LUCIP. The development and implementation of a SWPPP in accordance with the NPDES Construction Stormwater permit would specify methods to control erosion. Thus, no significant impacts to geology or soils would occur.

4.10.2 No Action Alternative

Under the No Action Alternative, the Vulcan Centaur Program would not be implemented; thus, no impacts to geology or soils would occur.

4.11 Transportation

This analysis covers the projected transportation and traffic conditions along roadways affected by the construction, operation and launch Proposed Action activities.

4.11.1 Proposed Action

4.11.1.1 Construction Impacts

During the Proposed Action construction activities, 200 people, on average, would be working at Vulcan Program facilities including SLC-41. Eighty of the 200 people would be directly involved in the project construction. Construction of Vulcan facilities would be conducted in parallel with Atlas V launch preparations. During Atlas V launch windows, construction efforts would be suspended until success launch and post launch safing of SLC-41 is complete. The current construction schedule is approximately 18 months. Assuming the worst-case scenario, an addition of 80 people (or 80 daily vehicle trips) traveling on key roadways within CCAFS would not constitute a significant increase in the traffic volume. Construction vehicles would generally be stored and maintained on-site during construction activities. Dump trucks, cranes and large transportation vehicles would occasionally travel to and from the SLC-41 and the ITL area via the CCAFS roadways, however, the increase in construction vehicle traffic would not significantly accelerate the normal wear and tear of the roadways on CCAFS. Proposed Action construction would not have a significant impact on transportation assets.

4.11.1.2 Operations

Vulcan vehicle components are manufactured at ULA's facility in Decatur, AL, including installation and safing of 1.1 and 1.4 ordnance. Vulcan vehicle components would be shipped aboard the Delta Mariner cargo ship and received at the CCAFS Wharf. The boosters would be transferred from the CCAFS Wharf onto trucks that travel over CCAFS roads to the ASOC in the ITL area. The transportation routes used for Vulcan vehicle components are identical to the current Atlas V routes from the wharf. The weight of Vulcan components is increased compared to Atlas V, but still meet standard DOT requirements for axle loading. Proposed Action vehicle component transportation would not have a significant impact on transportation assets.

Transportation of payload fairing (PLF) from Astrotech in Titusville, would use the same roads as Atlas V payloads currently use. These routes are illustrated in ***Appendix A, Figure 10. Transportation Route Map.***

Approximately 120 people are currently supporting Atlas V launches and this number will not be increased to support the Vulcan Program. Vulcan Program operation would have no impact on CCAFS and local or regional traffic patterns or transportation assets.

4.11.1.3 Launch Viewing Related Traffic Impacts

Traffic volume increases for a Vulcan Centaur Program launch is expected to be similar to recent Atlas, Delta or SpaceX launches. Thus, impacts from increase visitor or public observers would cause no significant impacts on CCAFS and local traffic patterns.

4.11.2 No Action Alternative

Under the No Action Alternative, the Vulcan Centaur Program would not be implemented; therefore, no impacts to roadways or transportation routes would occur.

4.12 Utilities

This section describes the potential impacts on the potable water supply, wastewater (industrial and sanitary sewer) and electrical supply by implementing the Proposed Action or No Action Alternatives. The FAA has not established a significance threshold for energy supply.

4.12.1 Proposed Action

4.12.1.1 Water Supply

Current potable and non-potable water supply to SLC-41 was designed to support the Titan IV launch vehicle program and is more than adequate to support the Vulcan Program. Vulcan Program non-potable water needs are greater than the current Atlas V needs because the larger vehicle requires approximately 24,000 gallons of additional sound suppression and washdown water per launch. ***Table 4-4: Water Requirement Estimates per Launch*** contains the water requirements for both Atlas V and Vulcan launches. Washdowns of equipment and facilities occur only when SRM are used on launch vehicle configurations.

Table 4-4: Water Requirement Estimates per Launch

Operation	Atlas V (gal)	Vulcan (gal)
Deluge/Sound Suppression	155,000	179,000
Washdown (SRM configurations only)	46,000	46,000
Total per Launch (assuming SRM configuration)	**201,000**	**225,000**

Table 2-1: Planned and Projected ULA Vehicle Launches at CCAFS, SLC-41 contains the proposed launch rates for Vulcan launches. As noted in the table, launch projections greater than two years out are very subjective. The peak yearly rate of 20 Vulcan launches would require approximately 4.5 million gallons of water.

The Proposed Action water requirements are well within the design availability and capacity would generate no significant impacts on water supply.

4.12.1.2 Wastewater

The Vulcan Program does not anticipate adding personnel, so domestic wastewater generation is anticipated to remain the same as the Atlas V Program's generation. Construction personnel do

not add appreciably to the sanitary sewer load as the contractor is required to provide on-site sanitary facilities.

Deluge and sound suppression industrial wastewater generation will increase by less than 24,000-gallons per launch due to vaporization during launch. Assuming approximately half of the deluge and sound suppression water is vaporized at launch, at the peak yearly rate of 20 launches per year, the Vulcan Program will generate approximately 2.5 million gallons of industrial wastewater including washdown water when SRMs are used. This wastewater is pumped to the CCAFS sanitary sewer and treated at the CCAFS WWTP. No wastewater is discharged to grade. The CCAFS sanitary sewer system and WWTP have adequate capacity for this increase. In addition, the flow to the sanitary sewer is controlled by ULA and coordinated with WWTP operators.

As a pollution prevention effort, ULA would study the feasibility of recycling deluge and sound suppression water to reduce the load on the WWTP before 2022 as the launch rate increases to approximately 10 to 12 per year.

The Proposed Action would have no significant impacts on the CCAFS sanitary sewer or WWTP capacity.

4.12.1.3 Electric Power

The Vulcan Centaur Program power requirements are similar to the Atlas V Program and no additional electrical power supply needs have been defined. The Proposed Action would have no significant impact on available electrical power supply.

4.12.1.4 Stormwater

SLC-41 is permitted under SJRWMD Permit ERP 4-009-16843-2 which established the master stormwater system. The permit subdivided the SLC-41 area into eight basins; Basin 1, 2, 2A, 2B, 2C, 3A, 3B, 3C; refer to ***Appendix A, Figure 14. SLC-41 Stormwater Basin Map***. Basins 1 and 2 are currently not permitted due to the areas not exceeding the SJRWMD impervious area permitting threshold, however due to the proposed site improvement the two basins would be permitted as part of Proposed Action compliance activities. SLC-41 consists of wet and dry detention ponds, swales, culverts, inlet structures, flumes and conveyance piping for stormwater treatment and attenuation. The Proposed Action would require construction of on-site dry detention areas, modification of the wet detention pond, and addition of new control structures to transport and retain the stormwater and release at a rate less than the pre-development 25-year, 24-hour rainfall event flow rate. Since SLC-41 discharges into the Banana River, an OFW, the stormwater system would provide an additional fifty percent of the applicable treatment volume. ERP 16843-19, LC-41 Infrastructure Upgrades, was issued for this Proposed Action by SJRWMD on December 18, 2018.

All construction and stormwater management would comply with Section 438 of the Energy Independence and Security Act (EISA) (2007), which requires all federal development that exceeds 5,000 square feet to maintain or restore pre-development hydrology.

Because the SLC-41 disturbed area is greater than one acre, a NPDES Stormwater Construction Permit would be required by FDEP and a Stormwater Pollution Prevention Plan (SWPPP) would be implemented. SWPPP execution mitigates impacts from erosion and implements specific measures to control both wind and water erosion of soils during and after construction.

Compliance with SJRWMD and NPDES stormwater regulations ensure that the Proposed Action will not have a significant impact on storm or surface water resources.

4.12.2 No Action Alternative

Under the No Action Alternative, the Vulcan Centaur Program would not be implemented, with no impact to current utility services.

4.13 Health and Safety

This section addresses the health and safety effects on people in the impacted area as a result of the Proposed Action or the No Action Alternative.

4.13.1 Proposed Action

4.13.1.1 On-site Safety and Health

The Vulcan Program would adhere to OSHA regulation 29 CFR 1910, *Occupational Safety and Health Standards,* for the protection of personnel health and safety. The Proposed Action entails common safety hazards associated with potential exposure to hazardous materials, heavy equipment operation and construction activities, requiring precautions for workers. All appropriate regulations, including OSHA regulation 29 CFR 1926, *Safety and Health Regulations for Construction*, would be followed during project activities to minimize potential impacts. No significant adverse impacts are anticipated to human safety and health.

As described in Section 3.13.2, CCAFS Range Safety regulations ensure that the general public, launch area personnel and foreign land masses are provided an acceptable level of safety, and that all aspects of pre-launch and launch operations adhere to public laws. Range Safety organizations review, approve, monitor, and impose safety holds, when necessary, on all pre-launch and launch operations.

Launch facilities used to store, handle, or process ordnance items or propellants must have an Explosive Quantity-Distance Site Plan. A THA must also be prepared for each facility that uses toxic propellants. The THA identifies the safety areas to be controlled during the storage, handling and transfer of the toxic propellants.

Hazardous materials such as propellants, ordnance, chemicals, and booster/payload components are transported in accordance with DOT regulations for interstate shipment of hazardous substances (Title 49 CFR 100- 199). Hazardous materials such as liquid rocket propellant is transported in specially designed containers to reduce the potential of a mishap should an accident occur.

The Vulcan Program will adhere to all ULA, USAF, CCAFS, state and federal safety and health regulations and requirements. The Vulcan Program construction and launch operations will have no significant impacts on on-site personnel health and safety.

4.13.1.2 Launch Vehicle Impacts

CCAFS Range Safety models predict launch hazards to the public and on-site personnel prior to every launch. These models calculate the risk of injury resulting from toxic gases, debris, and blast

overpressure both from nominal launches and launch failures. Launches are postponed if predicted risk of injury exceeds acceptable limits. The CCAFS allowable collective public risk limit is less than or equal to $30x10^{-6}$ with an individual risk of $1x10^{-6}$ over the varying population densities, accounting for concentration, location, dwell time, and emergency preparedness procedures.

Although unlikely, a launch could fail. A launch failure could occur on the launch pad or after the launch vehicle has traveled several miles into the atmosphere. Other scenarios could occur including the entire launch vehicle, with onboard propellants, being consumed in a destruct action during flight. In this case, the launch vehicle is largely consumed in the destruct action, but residual propellant escapes and vaporizes into an airborne cloud. The 1998 EIS and 2000 SEIS document modeling and analysis of the effects of launch failures, including modeling the maximum downwind concentrations of pollutants for launch failures. Failure of the Vulcan Vehicle generally fits within these analyses that concluded all predicted launch failure emissions concentrations are less than the regulatory air emission standards or permissible exposure limit (PEL) for exposure of an employee to a chemical substance.

Catastrophic failure of a payload and the release of hazardous substances due to a launch failure is covered under a separate NEPA action specific to the payload customer. However, the safety and health impacts of on-site failure of a payload that releases hazardous substances are addressed in ULA's Process Safety Management program and documented in the Fuel Payload Process Hazard Analysis[74].

USAF has existing a rigorous launch safety certification process which would require a launch license from the FAA prior to the start of launch operations. This will ensure that the public will not be exposed to greater risk than the launches currently at approved at CCAFS. Thus, the Proposed Action would not have a significant impact to the health and safety of the public.

4.13.2 No Action Alternative

Under the No Action Alternative, the Vulcan Centaur Program would not be implemented, with no change to current impacts on Health and Safety.

4.14 Socioeconomics

Socioeconomics impacts would be considered significant if they substantially alter the location and distribution of the local population, economic growth rates, the local housing market and the need for new social services and support facilities. The FAA has not established a significance threshold for socioeconomics.

4.14.1 Proposed Action

Preparations for Atlas V launches and launch day activities last from two to eight weeks. For approximately one week during this time, a peak of 200 people, not including payload support personnel, support the launch at SLC-41 and other Atlas V support facilities. Between launch campaigns, fifty to sixty employees are present at the site. The Vulcan launch preparation timeframe and personnel requirements are anticipated to be similar to Atlas V requirements. Thus, the Vulcan Program will not impact population or growth rate of the region. The Proposed Action

would not affect the local housing market or the need for new social services or support facilities. The Proposed Action would generate no negative socioeconomic impacts on the region.

Construction and refurbishment activities for the Proposed Action would result in a temporary and minor increase in the number of personnel on CCAFS. This increase would not represent a significant increase in the population or growth rate of the region, since most construction personnel already live and work in the area. The local housing market would not be substantially affected and no new social services or support facilities would be required. Construction and refurbishment activities of the Proposed Action would generate no negative socioeconomic impacts on the region.

4.14.2 No Action Alternative

Under the No Action Alternative, the Vulcan Centaur Program would not be implemented, with no impacts on socioeconomics.

4.15 Environmental Justice

A significant impact to environmental justice would occur if:

- A significant adverse impact occurs to the natural or physical environment or to health that affected a minority or low -income population;
- A significant adverse environmental impact occurs on minority or low-income populations that appreciably exceeded those on the general population or other comparison group;
- The risk or rate of environmental hazard exposure by a minority or low-income population was significant and exceeded those by the general population or other comparison group; or
- A health or environmental effect occurred in a minority or low-income population affected by cumulative or multiple adverse exposures from environmental hazards.

The FAA has not established a significance threshold for environmental justice.

4.15.1 Proposed Action

The construction of Vulcan facilities, operation and launch of Vulcan Centaur will occur in the same area as the existing Atlas V Program. The area is not located adjacent to or near minority populations or low-income population centers. The City of Cape Canaveral is the closest populated area at approximately eight miles south of Proposed Action activities. The proposed construction activities would not produce excessive pollution or create a hazardous situation that would impact the surrounding community, regardless of economic background. The Proposed Action would not substantially affect human health or the environment and would not disproportionately affect any population group, including minority or low-income populations. The proposed action would not have significant impacts on Environmental Justice.

4.15.2 No Action Alternative

Under the No Action Alternative, the Vulcan Centaur Program would not be implemented, thus, no change to Environmental Justice would occur.

4.16 Department of Transportation Act Section 4(f) Properties

Impacts to Section 4(f) properties can include physical use (e.g., an actual physical taking of Section 4(f) property through purchase of land or a permanent easement, physical occupation of a portion or all of the property, or alteration of structures or facilities on the property) or constructive use. Constructive use occurs when the impacts of a project on a Section 4(f) property (e.g., noise) are so severe that the activities, features, or attributes that qualify the property for protection under Section 4(f) are substantially impaired (see FAA Order 1050.1F, Appendix B-2). Impacts would be significant if the action involves more than a minimal physical use of a Section 4(f) resource or constitutes a constructive use based on an FAA determination that the project would substantially impair the Section 4(f) resource.

4.16.1 Proposed Action

Due to the proximity of the potential Section 4(f) properties mentioned in Section 3.16 to SLC-41, these properties would experience noise from proposed Vulcan Centaur launches. Noise levels at these properties would increase temporarily during launches. The increased noise level would only last a few minutes. For decades, these properties have been experiencing increased noise levels during launches taking place at KSC and CCAFS. Due to the long history of these properties experiencing noise from launches at CCAFS and KSC, the FAA has determined the Proposed Action would not substantially diminish the protected activities, features, or attributes of any of the properties identified, and thus would not result in substantial impairment of the properties. Therefore, the Proposed Action would not be considered a constructive use of these properties and would not invoke Section 4(f) of the Department of Transportation Act. The Proposed Action would not result in significant impacts on Section 4(f) properties.

4.16.2 No Action Alternative

Under the No Action Alternative, the Vulcan Centaur Program would not be implemented, thus, no change to Section 4(f) properties would occur.

4.17 Summary of Potential Environmental Effects

Table 4-5: Summary of Potential Environmental Impacts from the Proposed Action and the No Action Alternative summarizes the potential environmental effects in the 16 categories for the Proposed Action and No Action Alternative.

Table 4-5: Summary of Potential Environmental Impacts from the Proposed Action and the No Action Alternative

Aspect Area	Proposed Action Environmental Impacts	No Action Alternative
1. Land Use Zoning/ Visual Resources	Launches would not result in significant impacts to land use compatibility at CCAFS. SLC-41 is designated for space launch activities consistent with the CCAFS General Plan. The Proposed Action would not impact or require changes to land use. Facilities built for Vulcan will be within the existing Atlas V footprint and are all shorter than existing facilities. The Proposed Action has no change to coastal zone impacts and will be consistent in meeting Florida CZMA plan objectives. The Proposed Action would generate no significant impacts on visual resources.	No change to existing Atlas V land use or visual resource impacts.
2. Noise	Construction: Noise impacts from the operation of construction equipment are usually limited to a distance of 1,000 feet or less. No residential areas or other sensitive receptors occur at or near SLC-41; refurbishment noise would not impact the public or sensitive receptors. When employees are subject to sound exceeding those listed, engineering or administrative controls would be used and/or personal protective equipment such as approved ear plugs would be provided. Noise impacts on construction workers would have no significant effect under the Proposed Action. Operations and Launch: Based on modeled launch noise levels, noise impacts would not be significant based on the DNL 65 dB noise contour for the Proposed Action. Operations and launch noise would not exceed the 85 dBA noise threshold limit value recommended for workers in an 8-hour day. The sonic booms modeled for Vulcan Centaur would intercept the surface more than 40 miles off the coast over Atlantic Ocean with a maximum sonic boom overpressure of 5.25 psf and would not be heard on land. No significant impacts from launch effect noise including sonic booms is anticipated.	No change to existing Atlas V noise impacts.

Aspect Area	Proposed Action Environmental Impacts	No Action Alternative
3. Biological Resources	To comply with the requirements of the Endangered Species Act and the Marine Mammal Protection Act and avoid significant adverse impacts to species, ULA would be required to continue to adhere to all requirements of the past, current and ongoing consultations with the USFWS and NMFS. With these measures, the Proposed Action would not be expected to have a significant impact on biological resources. No significant impacts to vegetation are anticipated as a result of the Proposed Action based on similarity to current Atlas V launches. Exterior construction occurs within the SLC-41 previously disturbed perimeter boundary. Other than the common “startle response”, no impacts to wildlife due to construction noise are anticipated. Potential negative impacts of lighting on sea turtle survivability are reduced and managed by a 45 SWI 32-7001 which addresses exterior Lighting Management. The existing Atlas V Light Management Plan would be revised to include Vulcan Centaur Program lighting and implemented on new facilities constructed for the program. An anomaly (explosion) on the launch pad 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. Debris from launch failures has a very small potential to adversely affect managed fish species and their habitats in the vicinity of the project area. Sonic booms from launches are not expected to negatively affect the survival of any marine species. Post launch monitoring conducted on previous launches and previous environmental analyses concluded that launch impacts to T&E species are minimal and insignificant. Overall impacts on Biological Resources are anticipated to be insignificant and comparable to the current Atlas V Program.	No change to existing Atlas V biological resource impacts.
4. Historical and Cultural Resources	The 45 SW Cultural Resources Manager evaluated the Proposed Action affected areas and no historical or cultural resource issues were found within the boundaries of SLC-41, SMARF, VIF and the surrounding area. The Proposed Action would have no effect on Historical or Cultural Resources.	No impacts on cultural resources would occur.

Aspect Area	Proposed Action Environmental Impacts	No Action Alternative
5. Air Quality	Construction: Air emissions from construction activities) would cause a minor increase in PM emissions due to demolition, excavations, minor clearing, construction vehicles and diesel generators. Carbon dioxide would be released by fossil fuel powered equipment and vehicles. Diesel-powered equipment would emit CO, hydrocarbons, NOx and CO_2. Emissions are expected to be minor from these sources over the expected 18 months of construction. Construction activities are not expected to significantly change regional (Brevard County) or local (CCAFS) air emissions. Operations and Launch**:** ULA operations at SLC-41 are not a major source of air pollutants and do not currently require a Title V or non-Title V air operating permit. Based on current knowledge of expected Vulcan Centaur Program Vehicle operations, the additional emissions would not require obtaining a Title V or non-Title V air operating permit. As documented in previous EAs and EISs performed for the launch vehicles at CCAFS, emissions from nominal launches, catastrophic launch failures, or spills of liquid propellants would not substantially impact ambient air quality. Proposed Action air emissions from include PM, VOC, NOx, SOx, HAPs and CO_2/CO. Air emissions from Vulcan launches with SRMs are expected to be similar to Atlas V or Delta IV launches with SRMs. LNG is a cleaner burning fuel than RP-1, with anticipated reductions in PM, but overall Vulcan launch emissions are expected to be similar to the current Atlas V launch emissions. Vulcan Centaur operations at CCAFS would not be expected to have a significant impact on air quality.	No change to existing Atlas V air quality impacts would occur.
6. Climate	Emissions of GHGs from the construction, operations and launch of the Proposed Action alone would not cause any appreciable global warming that may lead to climate change. At present, no methodology exists that would enable estimating the specific impacts that this increment of warning would produce locally or globally. The impact to the climate would still not be significant. The Proposed Action would not be significantly impacted by sea level rise due to climate change in the next 30 years because of its elevation. The Proposed Action GHG emissions would be essentially unmeasurable and not have a climate change impact.	No change to Atlas V climate impacts would occur.
7. Orbital and De-Orbiting Debris	The environmental consequences of orbiting and deorbiting debris from additional payloads potentially launched on Vulcan Program vehicles would be addressed under separate NEPA documentation for each of the satellite programs, as required. Although the Vulcan Centaur upper stage is larger than the current Atlas V Centaur upper stage, the environmental impact of orbiting and deorbiting debris is similar. Implementation of the Proposed Action would not likely change the total number of worldwide space launches. Thus, no significant global effect on orbital/deorbiting debris would be incurred from the implementation of the Proposed Action.	No change to Atlas V orbital debris impacts would occur.
8. Hazardous Materials/Solid and Hazardous Waste	Construction: The construction of the pad and VIF areas would result in a small increase in overall hazardous material use and solid waste and hazardous wastes generated, but would have no significant impacts on the environment. Operations and Launch: Launch operations, routine maintenance and flight support activities would require the use and storage of hazardous materials and generation of solid and hazardous waste similar in nature and quantities used and generated by the Atlas V Program. No significant impact on hazardous material use or solid or hazardous waste generated is anticipated.	No change to Atlas V hazardous material or solid/hazardous waste impacts would occur.

Aspect Area	Proposed Action Environmental Impacts	No Action Alternative
9. Water Resources	The Proposed Action would have no significant impact on surface water, groundwater and floodplains and wetlands. The Proposed Action slightly increases deluge and sound suppression water quantities, but since the flame trench has sufficient capacity and ULA has never inadvertently discharged wastewater, no impacts on surface water are expected. In the event of a launch abort or failure, debris could land in the ocean or other surface waters. Impacts to surface waters from a launch anomaly are similar to current Atlas V launches. Increased SRM use could decrease exhaust cloud pH slightly but it is not expected to significantly impact surface water. ULA's safety and operating procedures minimize the risk of groundwater contamination by fuels or other hazardous liquids. No impacts to floodplains or wetlands are anticipated. Impacts to water resources would be similar to the current Atlas V and no significant water resource impacts are expected to result from the Proposed Action.	No change to Atlas V impacts on water resources would occur.
10. Geology and Soils	No unique geologic features of exceptional interest or mineral resources occur in the project area; therefore, no impacts would occur to these resources. The Proposed action would have no direct impacts on geology or soils.	No geology or soil impacts would occur.
11. Transportation	A slight increase in the traffic during the approximate 18-month period of construction is anticipated but it would not significantly impact CCAFS roadways. Transportation of Vulcan components to assembly areas is on a route identical to Atlas V and is not expected to have a significant impact to CCAFS transportation routes. During launches, the increase in traffic should be similar to existing launches and would not be significant. No significant transportation impacts are expected to result from the Proposed Action.	No change to Atlas V transportation impacts.
12. Utilities	Construction and /or refurbishment personnel do not add appreciably to utility loads. Proposed Action impacts on potable water, wastewater and electrical power needs have no significant impacts compared to existing availability and capacity. Stormwater permitting at SLC-41 will occur due to the Proposed Action. Since the construction area exceeds one acre, a NPDES Stormwater Construction Permit would be required by FDEP and a SWPPP would be implemented.	No change to Atlas V utility impacts.
13. Health and Safety	ULA requires all contractors to follow all USAF and Occupational Safety and Health Administration (OSHA) regulations during construction activities with no significant impacts to health and safety of workers. The Vulcan Program will adhere to all ULA, USAF, CCAFS, state and federal safety and health regulations and requirements, as does Atlas V currently. The Vulcan Program construction and launch operations will have no significant impacts on on-site personnel health and safety.	No change to Atlas V health and safety impacts.

Aspect Area	Proposed Action Environmental Impacts	No Action Alternative
14. Socioeconomics	The Vulcan launch preparation timeframe and personnel requirements are anticipated to be similar to Atlas V requirements and will not impact population or growth rate of the region. Construction and refurbishment activities for the Proposed Action would result in a temporary and minor increase in the number of personnel on CCAFS. This increase would not represent a significant increase in the population or growth rate of the region, since most construction personnel already live and work in the area. The Proposed Action would generate no negative socioeconomic impacts on the region.	No changes to Atlas V socioeconomic impacts would occur.
15. Environmental Justice	Environmental impacts generated by construction, refurbishment, operations or launch activities for the Proposed Action would have no significant impacts and would not affect minority or low-income populations or children and would not cause any environmental justice impacts. Use of the SLC-41 site would also not have an impact on any Environmental Justice subject groups.	No impacts to minority or low-income populations would occur.
16. Section 4(f) Properties	Construction: Proposed Action would not substantially diminish the protected activities, features or attributes of any of the Section 4(f) properties identified. No designated 4(f) properties, including public parks, recreation areas, or wildlife refuges, exist within the boundaries of CCAFS. Operations and Launch: Section 4(f) properties are impacted by noise levels from existing Atlas V and other launches from both CCAFS and KSC. The Proposed Action would generate no negative Section 4(f) publicly-owned land impacts on the region.	No changes to Atlas V impacts would occur to publicly-owned land.

5 Cumulative Impacts

According to 40 CFR § 1508.7, cumulative impacts are defined as "…the incremental impact of the actions when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (federal or non- federal) or person undertakes such other actions." Cumulative impacts include impacts from construction and operation of the Vulcan Centaur vehicle that will be launched from SLC-41, CCAFS and other past, present and reasonably foreseeable future activities that could affect the resources impacted by the Proposed Action. Due to the nature of the Proposed Action and its location on the coast within CCAFS, only launch-related actions occurring at CCAFS would meaningfully interact in time and space with the Proposed Action such that potential cumulative impacts could result.

5.1 Reasonably Foreseeable Future Actions

The new CCAFS General Plan states that future development would be guided by sustainability. To accomplish this, 50-year Long Term Development Plans (LTDP) were created for each installation. The LTDP are the 45 SW's vision for future development. The 45 SW strategic plans illustrate how increases in launch tempo and associated support activities can occur sustainably and compatibly with the efficient use of land and energy, the conservation of natural resources and the safe operation of launch vehicles and processing facilities.

NASA's 2012 Future Development Concept envisions the transition of KSC to a multi-user spaceport managed by an independent spaceport authority. Development of the former Shuttle Landing Facility at KSC could also attract new launch capabilities.

The past, present, and reasonably foreseeable launch actions at CCAFS and KSC are listed in ***Table 5-1 and Table 5-2*** and are assumed to still be accurate and applicable to the Cumulative Impacts analysis in this EA. The launch rate since 2010 is shown below in ***Table 5-1: Past Vehicle Launches at KSC and CCAFS***.

Table 5-1: Past Vehicle Launches at KSC and CCAFS

Year	Launch Vehicles (Number of Launches)				Total
	Shuttle	Delta IV	Atlas V	Falcon 9 (LC 40) and Falcon Heavy (LC 39A)	
2010	3	3	3	2	11
2011	3	3*	4	0	10
2012	-	3	5	2	10
2013	-	2	6	2	10
2014		4	6	6	16
2015		2	8	7	17
2016		3	7	7	17
2017		1	4	13	18
Total Launches	6	21	43	39	109
Note: * One Delta Launch in 2011 was a Delta II 7000					

The forecast for CCAFS launches during the next several years is presented in ***Table 5-2: Future Planned and Projected Vehicle Launches CCAFS.***

Table 5-2: Future Planned and Projected Vehicle Launches CCAFS

Year	Launch Vehicles (Number of Launches)					Total
	Delta IV	Vulcan Centaur	Atlas V	Falcon 9 (LC 40) and Falcon Heavy (LC 39A)	Blue Origin	
2018	2		6	16	-	24
2019	1		6	16	-	23
2020	1	2	6	16	1	25
2021		8	2	16	4	30
2022		10	2	16	8	36
2023		12	2	16	10	40
Total Launches	4	32	24	96	23	178
Notes: Launch rates are approximate only. SpaceX future mission launch manifest shows 30 planned Falcon 9 or Falcon Heavy flights but does not provide timing. Vulcan Centaur first launch in scheduled for mid-2020. Blue Origin's New Glenn manifest shows New Glenn Flight 1 in 2020, followed by four launches in 2021.						

Documents reviewed for reasonable foreseen actions include:

- CCAFS Master Plan, 2015
- EIS EELV Program, April 1998
- Supplemental EIS for the EELV Program, March 2000
- EA Blue Origin Orbital Launch Site at CCAFS Florida, November 2016
- FAA Record of Decision Launch Operator Licenses, EELV Program Atlas V and Delta IV, August 2011
- FAA FONSI, Finding of No Practicable Alternative (FONPA) EA for the Blue Origin Orbital Launch Site Construction at LC 11 and 36, December 2016
- 45 SW Integrated Natural Resources Management Plan (INRMP), March 2015
- FAA, The Annual Compendium of Commercial Space Transportation: 2014, February 2015
- USAF 813 EELV Atlas V RP-1 Rollback, CCAFS, September 2001.

5.2 Cumulative Impact Analysis on Resource Areas

The launch actions listed in ***Table 5-1 and Table 5-2***, as well as the projects described above, are considered in conjunction with the Proposed Action and form the basis for the cumulative impacts analysis. This section analyzes the incremental interaction that the Proposed Action may have with the actions described in Section 5.1.1 Reasonably Foreseeable Future Actions and evaluates the potential cumulative impacts resulting from these interactions. With the exception of air quality and noise, the ROI for each resource area discussed below is limited to CCAFS. The ROIs for air quality and noise extend beyond CCAFS boundaries. As described in the Section 4, no direct impacts were identified on Historical and Cultural Resources, Geology and Soils, Health and Safety, Environmental Justice and Section 4(f) Properties. When considered with other past, present, and foreseeable future actions, the Proposed Action would not contribute to any cumulative impacts associated with these resource categories and they are not considered further in this analysis.

5.2.1 Land Use/Visual Resources

The proposed action would not result in any additional impacts to land use compatibility since CCAFS and SLC-41 current use includes launching space vehicles. The Proposed Action would not generate additional impacts on visual resources within the flight range of the Vulcan Centaur Vehicle that significantly differ from Atlas V launches.

The Proposed Action is consistent with existing land use within the ROI as well as with the Base General Plan and the Air Force mission at CCAFS. The visual presence of the proposed infrastructure is within the existing Atlas V footprint.

When considered with other past, present, and foreseeable future actions, the Proposed Action would not change the overall, cumulative negligible and less than significant effect on land use and visual resources.

5.2.2 Noise

Day-Night Average Sound Level (DNL) is used to estimate the potential long-term community annoyance to the proposed Vulcan launch operations. The DNL 60 dBA contour is used to conservatively identify the potential for significant noise impacts, as 60 dBA is the smallest level that could increase noise by DNL 1.5 dB[A] or more for a noise sensitive area that is exposed to noise at or above the DNL 65 dB[A] noise exposure level, or that will be exposed at or above this level due to the increase. The DNL contours from 60 dBA to 75 dBA are presented in ***Appendix A, Figure 15. DNL Contours - Launch of the most powerful configuration (single Vulcan core and six GEM-63XL strap-on SRBs)***[5]. The DNL 65 and 60 dBA contours extend approximately 1.2 and 1.8 miles from the launch pad, respectively. This area does not encompass land outside of the boundaries of CCAFS and NASA KSC and no residences are impacted.[75]

The BRRC report concluded that noise impacts would not be significant based on the DNL 65 dB noise contour for the Proposed Action and the FAA reviewed the report and concurred with its conclusions.[76]

Sonic booms generated by these launch events would impact over the ocean surface beyond 30 miles off the coast and would not be audible on land; therefore, sonic booms would not produce any significant impacts in the surrounding areas.

Construction and refurbishment impacts would increase noise levels temporarily and would not be a significant impact.

The proposed Vulcan launches are not expected to generate significant propulsion noise or sonic boom impacts in the community. Community noise exposure will be less than that from previous CCAFS and KSC launches, including the Space Shuttle and Saturn V. Given the overall cumulative effect of past, present, and foreseeable future actions, the Proposed Action would not have a significant impact from noise.[77]

5.2.3 Biological Resources

The Proposed Action would not be expected to have a significant impact on terrestrial vegetation and wildlife, marine species or protected species. Vulcan construction activities will have minimal

impact on Biological Resources since construction activities will be within the developed Atlas V perimeter fence.[78]

Acid and particulate deposition for the Proposed Action would be slightly greater than current Atlas V deposition due to anticipated use of greater quantities of solid propellants. However, Vulcan use of solid propellants is less than past Titan use. Acid and particulate impacts of the Proposed Action on vegetation is expected to be minimal with recovery of short-term launch impacts expected.

An anomaly on the launch pad would present potential impacts to biological resources from the possibility of extreme heat and fire, percussive effects of the explosion and debris that might impact land or surface waters. 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.

An improbable 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. Debris from launch failures has a small potential to adversely affect managed fish species and their habitats in the vicinity of the project area. During the 1998 EELV EIS, a consultation with NMFS determined that "no greater than minimal adverse effects" to EFH would occur under NMFS regulations.

As a result, the overall cumulative effect of other past, present, and reasonably foreseeable future actions on Biological Resources are considered minor, not significant and similar to the current Atlas V Program. When considered with other past, present, and foreseeable future actions, it is not anticipated that the Proposed Action would contribute a noticeable incremental impact to the overall less than significant effect on Biological Resources.

5.2.4 Air Quality

CCAFS and Brevard County are in an "Attainment" area and the operational emissions for the proposed Vulcan Centaur Program vehicle launch represent an extremely small percentage of the Brevard County regional emissions and would not cause an exceedance of any NAAQS or GHG. The air quality ROI covers all of CCAFS and Brevard County. This includes both lower and upper atmospheres. The Proposed Action includes air emissions for construction, operations and launch.

During construction a slight increase due to construction activities or equipment. However, there will not be a significant change in air emissions for Brevard County or CCAFS.

Vulcan Centaur launch operations emissions are expected to be exempt from FDEP air permitting, similar to the Atlas V Program. Emissions are expected to be similar to Atlas V. These operation emissions are not expected to be significantly change existing air emissions at CCAFS.

Launch emissions for the Vulcan Centaur are expected to be similar to Atlas V or Delta IV launches with SRMs. Since LNG is a cleaner burning fuel than RP-1, PM may be reduced, but overall the emissions would be similar to current launches.

The overall cumulative effect when combined with other past, present and reasonably foreseeable future actions for air quality is considered to be similar to the current Atlas V Program. It is not anticipated that the Proposed Action would contribute significantly to overall cumulative impacts on air quality.

5.2.5 Climate

The Proposed Action construction, launch preparation and daily operations GHG emissions are insignificant compared to the total US GHG emissions. CCAFS GHG emission totals would be unmeasurable and would not have a climate change impact. The impact of sea level rise is mitigated because SLC-41 is at a relatively high elevation. Regional and global impacts of the Proposed Action are not significant.

The overall, cumulative effect when combined with other past, present, and reasonably foreseeable future actions on Climate is considered not significant and it is not anticipated that the Proposed Action would noticeably impact Climate.

5.2.6 Orbital and De-orbiting Debris

Although the Vulcan Centaur upper stage is larger than the current Atlas V Centaur upper stage, the environmental impact of orbiting and de-orbiting debris is similar. Implementation of the Proposed Action would not likely change the total number of worldwide space launches. Thus, no significant global effect on orbital/deorbiting debris would be incurred from the implementation of the Proposed Action. NEPA documentation for each payload would address environmental consequences for orbital and de-orbiting debris.

As a result, the overall cumulative effect of other past, present, and reasonably foreseeable future actions from Orbital and de-orbiting debris are considered to be similar to Atlas V. When considered with other past, present, and foreseeable future actions, it is not anticipated that the Proposed Action would contribute a noticeable incremental impact on Orbital and De-orbiting Debris globally.

5.2.7 Hazardous Materials and Solid and Hazardous Waste

Hazardous materials proposed for use in launch operations and construction supporting the Vulcan Centaur Program are used in support of the Atlas V operations, with the exception of LNG and LN2. These materials would be handled, stored and disposed of with manufacturer and federal and state regulations. Existing Atlas V handling and management procedures for hazardous materials, hazardous wastes and solid wastes will be applied during to the Vulcan Centaur Program, limiting the potential for impacts.

When considered with other past, present, and foreseeable future actions, the Proposed Action would a negligible contribution to impacts from hazardous materials and solid and hazardous waste.

5.2.8 Water Resources

The Proposed Action would have no significant impact on surface water, groundwater, floodplains and wetlands.

The Proposed Action is not expected to have a significant impact on surface water resources. Water usage quantities are increased by 25,00-gallons per launch. ULA has never inadvertently discharged wastewater, so no impacts on surface water are expected. In the event of a launch abort or failure, debris could land in the ocean or other surface waters. Impacts to surface waters from a

launch anomaly are similar to current Atlas V launches. Increased SRM use could decrease exhaust cloud pH slightly but its deposition is not expected to significantly impact surface water.

ULA's safety and operating procedures minimize the risk of groundwater contamination by fuels or other hazardous liquids. No significant impact is expected to groundwater from the Proposed Action.

No impact to wetlands and floodplains is anticipated.

The overall cumulative effect of other past, present, and reasonably foreseeable future actions on water resources are not significant and would be similar to the current Atlas V. When considered with other past, present, and foreseeable future actions, it is not anticipated that the Proposed Action would not contribute a noticeable incremental impact on water resources.

5.2.9 Transportation

Transportation consists of construction, operations and launch impacts. A slight increase in the traffic during the approximate 18-month period of construction is anticipated but it would not significantly impact CCAFS roadways. The Vulcan Centaur boosters and PLF will be manufactured in Decatur, AL, brought to the Mariner Wharf and travel through CCAFS roadways. The boosters will be transported to the ASOC. The PLF will be transported from the Mariner Wharf over CCAFS roadways to Route 405 to Astrotech in Titusville. Refer to ***Appendix A, Figure 10. Transportation Route Map*** for details. Since this transportation route is identical to Atlas V, it is not expected to have a significant impact to CCAFS transportation routes given only a small increase in the number of future Vulcan Program anticipated launches. During launches, the increase in traffic should be similar to existing launches and would not be significant.

The cumulative effect of other past, present, and reasonably foreseeable future actions would not be significant to CCAFS roadways. When considered with other past, present, and foreseeable future actions, it is anticipated that the Proposed Action would not contribute a noticeable incremental impact to regional or local transportation assets.

5.2.10 Utilities

The Proposed Action water requirements are well within the design availability and capacity would generate no significant impacts on water supply. The Vulcan Program does not anticipate adding personnel, so domestic wastewater generation is anticipated to remain the same as the Atlas V Program's generation. Construction personnel do not add appreciably to the sanitary sewer load as the contractor is required to provide on-site sanitary facilities.

Sound suppression, deluge and washdown water associated with SRM launches industrial wastewater generation will increase by approximately 24,000 gallons per launch. This wastewater is pumped to the CCAFS sanitary sewer and treated at the CCAFS WWTP. Water requirements are well within the design availability and capacity would generate no significant impacts on water supply. The CCAFS sanitary sewer system and WWTP have adequate capacity for this increase. The Proposed Action would have no significant impacts on the CCAFS sanitary sewer or WWTP capacity. Future studies will evaluate recycle of deluge and sound suppression water as needed.

The Vulcan Centaur Program power requirements are similar to the Atlas V Program and no additional electrical power supply needs have been defined. The Proposed Action would have no significant impact on available electrical power supply.

Stormwater permitting at SLC-41 will occur due to the Proposed Action. Since the construction area exceeds one acre, a NPDES Stormwater Construction Permit would be required by FDEP and a SWPPP would be implemented. The Proposed Action is not expected to have a significant impact on stormwater.

As a result, the overall cumulative effect of other past, present, and reasonably foreseeable future actions on utilities are considered negligible and not significant in the context of supply. When considered with other past, present, and foreseeable future actions, it is not anticipated that the Proposed Action would contribute a noticeable incremental impact on utilities.

5.2.11 Socioeconomics

The Vulcan launch preparation timeframe and personnel requirements are anticipated to be similar to Atlas V requirements and will not impact population or growth rate of the region. Construction and refurbishment activities for the Proposed Action would result in a temporary and minor increase in the number of personnel on CCAFS. This increase would not represent a significant increase in the population or growth rate of the region, since most construction personnel already live and work in the area. The Proposed Action would generate no negative socioeconomic impacts on the region.

The Proposed Action will have a slightly positive influence on socioeconomics, through contributions to the local economy. As a result, the overall cumulative effect of other past, present, and reasonably foreseeable future actions on socioeconomics is considered beneficial and not significant. When considered with other past, present, and foreseeable future actions, it is anticipated that the Proposed Action would contribute a noticeable incremental beneficial minor and less than significant impact on socioeconomics.

6 Applicable Environmental Requirements

6.1 Federal Regulations Regarding Environmental Quality

The NEPA (42 USC. 4321-4347 as amended) requires federal agencies to analyze the potential environmental impacts of major federal actions and alternatives and to use these analyses as a decision-making tool on whether and how to proceed with the Proposed Action or Alternatives.

6.2 Federal Regulations Regarding Biological Resources

Public Law 93-205 requires military installations to protect and conserve federally-listed, endangered, and threatened plants and wildlife.

The ESA of 1973 declares the intention of the Congress to conserve T&E species and the ecosystems on which those species depend. The Act requires that federal agencies, in consultation with the USFWS and NOAA Fisheries, use their authorities in furtherance of its purposes by carrying out programs for the conservation of T&E species. Section 7 of the ESA (16 USC. 1536) contains provisions that require federal agencies to consult with the Secretary of Interior and to take necessary actions to ensure that actions authorized, funded, or carried out by them do not jeopardize the continued existence of endangered species and threatened species. Federal agencies must ensure that actions taken will not result in the destruction or modification of the habitat of endangered species.

Marine Mammal Protection Act (16 USC. 1361 et seq.), Section 101(a)(5)(A) directs the Secretary of Commerce to allow, upon request, the incidental, but not intentional, taking of marine mammals by US citizens who engage in a specified activity (other than commercial fishing) within a specified geographical region if certain findings are made and regulations are issued. Permission may be granted for periods of 5 years or less if the NMFS finds that the taking will have a negligible impact on the species or stock(s); will not have an unmitigable adverse impact on the availability of the species or stock(s) for subsistence uses; and the permissible methods of taking and requirements pertaining to the monitoring and reporting of such taking are set forth.

The FETSA establishes the conservation and wise management of T&E species as state policy. Agencies are required to consider impacts to T&E species when planning and implementing projects, as mandated by the FWCC.

The Magnuson-Stevens Fishery Conservation and Management Act (Sustainable Fisheries Act) identifies EFH and threats to EFH. This Act requires consultation with NMFS to ameliorate any threats to EFH from non-fishing activities.

The Marine Mammal Protection Act prohibits the harassing or killing of any marine mammal. Harassment is any act of pursuit, torment, or annoyance which has the potential to injure a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but observation of distance requirements from marine mammals as imposed by the NMFS.

6.3 Federal Regulations Regarding Cultural Resources

The NHPA of 1966 (Public Law 89-665), as amended; EO 11593 of 1971 (36 CFR 154); the AIRFA of 1978 (Public Law 95-341); the ARPA of 1979 (Public Law 96-95); the NAGPRA of 1990 (Public Law 101-601); and the AFI for cultural resource management of 1994 (AFI 32-7065). On a day-to-day basis, cultural resource management CCAFS is guided primarily by the NHPA and its implementing regulations, 36 CFR 800. Briefly, Section 106 requires federal agencies to consider the effect of any undertaking on any district, site, building, structure, or object that is on or eligible for the National Register. An undertaking is defined as "a project, activity, or program funded in whole or part under the direct or indirect jurisdiction of a federal agency, including those carried out by or on behalf of a Federal Agency; those carried out with federal financial assistance; those requiring a federal permit, license, or approval; and those subject to state or local regulation administered pursuant to a delegation or approval by a federal agency" (36 CFR 800.16[y]). For any undertaking, the Section 106 process requires identification of historic properties (i.e., those on or eligible for the National Register), assessment of potential adverse project effects on any historic properties, and resolution of adverse effects in consultation with the SHPO and/or, if necessary, the Advisory Council on Historic Preservation.

The Archaeological Resource Protection Act was passed in 1979 to protect archaeological resources and sites on public lands and requires a permit for any excavation or removal of archaeological resources from public lands.

The NAGPRA and its implementing regulations, 43 CFR 10, provides ownership or control of Native American human remains and selected cultural items excavated or discovered on federal lands with designated Native American tribes, organizations, or groups. If human remains or selected cultural items are discovered on federal lands, the appropriate Native American group must be notified. AFI 32-7065 provides detailed guidance for compliance with relevant extant authorities.

6.4 Federal Regulations Regarding Air Quality

The Proposed Action is regulated by the following federal CFR Titles listed and discussed below:

Title 40 CFR 50 National Ambient Air Quality Standards (NAAQS): The CAA required the EPA to establish ambient ceilings for certain criteria pollutants. Subsequently, the EPA promulgated regulations that set NAAQS. Two classes of standards were established: primary and secondary. Primary standards prescribe the maximum permissible concentration in the ambient air required to protect public health. Secondary standards specify levels of air quality required to protect public welfare, including materials, soils, vegetation, and wildlife, from any known or anticipated adverse effects. The criteria pollutants for which the NAAQS have been established include CO, nitrogen dioxide, ozone, PM10, PM2.5, and SO_2.

The EPA classifies air quality within each Air Quality Control Region with regard to its attainment of federal primary and secondary NAAQS. According to EPA guidelines, an area with air quality better than the NAAQS for a specific pollutant is designated as in attainment for that pollutant. Any area not meeting ambient air quality standards is classified as nonattainment. When there is a lack of data for the EPA to define an area, the area is designated as unclassified and treated as an attainment area until proven otherwise.

Title 40 CFR 51 Subpart W (General Conformity): General conformity rule applies to federal actions that are not covered by transportation conformity rule, with several listed exceptions. Other than the listed exemptions and presumptions of conformity, general conformity applies to actions in which projected emissions exceed applicable conformity de minimis thresholds. However, if the emissions from a federal action do not equal or exceed de minimis thresholds but do represent 10 percent or more of a nonattainment or maintenance area's total emissions of any criteria pollutant, the action is considered "regionally significant" and the requirements of conformity determination apply.

Title 40 CFR 61 (NESHAP): The National Emissions Standards for Hazardous Air Pollutants regulates stationary sources with a prescribed standard under Title 40 CFR 61. Such stationary sources may be required to obtain an operating permit issued by an authorized Air Pollution Control agency or by EPA in accordance with Title V of the CAA. The NESHAP identifies and list a variety of HAPs that are regulated.

Title 50 CFR 63 Subpart GG for manufacturers of commercial, civil, or military aerospace vehicles or components and that are major sources of hazardous air emissions. Such emissions would result from cleaning operations, surface coating with primers and topcoats, paint removal, and waste storage.

Hazardous wastes that are subject to RCRA requirements would be exempt from the subpart. Those wastes would include specialty coatings, adhesives, primers, and sealant materials at aerospace facilities. Other exemptions would include HAPs or VOC contents less than 0.1 percent for carcinogens or 1.0 percent for non-carcinogens and low volume coatings.

Title 40 CFR 70 (State Operating Permit Programs): In accordance with Title V of the CAA large facilities that are capable of producing large amounts of air pollution are required to obtain an operating permit. Permits are issued by the District. Typical activities that require the CAA Title V permit include any major source (source that emits more than 100 tons per year of criteria pollutant in a nonattainment area for that pollutant or is otherwise defined in Title I as a major source); affected sources as defined in Title IV; sources subject to Section 111 regarding New Source Performance Standards; sources of air toxics regulated under Section 112 of the CAA; sources required to have new source or modification permits under Parts C or D of Title I of the CAA; and any other source such as hazardous waste pollutants designated by EPA regulations.

Part 70 Federal Operating Permits are issued to specific emission sources. Sources requiring permits are determined based on the source's potential to emit certain threshold levels of pollution given their equipment and processes. Facilities requiring Part 70 Federal Operating Permits include sources with the potential to emit the following:

HAP amounts equal to or greater than: 100 tons/year of any regulated air pollutant; 10 tons/year of any individual HAP or 25 tons/year of a combination of HAPs; or lesser quantity thresholds for any HAP established by the EPA rulemaking. Any stationary source defined by the EPA as major for the District under Title I, Part D (Plans for Nonattainment Areas) of the CAA and its implementing regulations including:

For ozone nonattainment areas, sources with the potential to emit 100 tons per year or more of volatile organic compounds or oxides of nitrogen in areas classified as "marginal" or "moderate," 50 tons per year or more in areas classified as "serious," 25 tons per year or more in areas classified as "severe," and 10 tons per year or more in areas classified as "extreme";

- Acid rain sources included under the provisions of Title IV of the CAA and its implementing regulations.
- Any source required to have a pre-construction review permit pursuant to the requirements of the New Source Review/Prevention of Significant Deterioration program under Title I, Parts C and D of the CAA and its implementing regulations;
- Any solid waste incineration unit required to obtain a Part 70 permit pursuant to Section 129(e) of the CAA and its implementing regulations; and
- Any stationary source in a source category required to obtain a Part 70 permit pursuant to regulations promulgated by the EPA Administrator.

Title 49 CFR Parts 100-199: Liquid propellant for the Vulcan Vehicle must be shipped and handled in accordance with Title 49 CFR Parts 100-199. The liquid propellants would be shipped directly from the manufacturing location to the launch site.

6.5 Federal Regulations Regarding Hazardous Waste/Hazardous Materials

The CERCLA of 1980 responds to the immediate cleanup of hazardous waste contamination from accidental spills or from waste disposal sites that may result in long-term environmental damage.

The RCRA of 1974 (42 USC. 6901 et seq.) was designed to control the handling and disposal of hazardous substances by responsible parties. Hazardous waste, as defined by RCRA, is a "waste that may cause or significantly contribute to serious illness or death, or that poses a substantial threat to human health or the environment when improperly disposed." The treatment, storage, and disposal of solid waste (both hazardous and nonhazardous) is regulated under the Solid Waste Disposal Act as amended by RCRA and the Hazardous and Solid Waste Amendments of 1984.

The SARA of 1986, Title III: EPCRA establishes standards for community right-to-know programs and requires the reporting of releases of certain toxic chemicals. Local planning committees, comprising government, news media, industry, environmental, organizations, and medical representatives, receive right-to-know information from facilities. Facilities with Standard Industrial Classification codes between 20 and 39 that manufacture, process, or otherwise use listed toxic chemicals, must report a release of these toxic chemicals to the environment, in greater than reportable quantities, on a Form R.

Under 49 CFR Section 170 are DOT requirements for the shipment of hazardous materials. This section specifies the proper container type, shipping name, and labeling requirements for the transportation of hazardous materials.

The Toxic Substances Control Act of 1976 regulates chemical substances and mixtures that present an unreasonable risk of injury to health, or the environment, and acts with respect to chemical substances and mixtures which are imminent hazards.

6.6 Federal Regulations Regarding Water Resources

The CWA (33 USC. 1251 et seq.) prohibits the discharge of pollutants from a point source into navigable waters of the US, except in compliance with a NPDES (40 CFR Part 122) permit. The navigable waters of the US are considered to encompass any body of water whose use, degradation, or destruction will affect interstate or foreign commerce.

Section 402 of the CWA requires that the EPA establish regulations for issuing permits for stormwater discharges associated with industrial activity. A NPDES permit is required if activities involve the disturbance of one to five acres of land. A Notice of Intent must be submitted to the SJRWMD by ULA and a SWPPP must be developed.

Section 404 establishes a program to regulate the discharge of dredged and fill materials into waters of the US, including wetlands. Activities in waters of the US that are regulated under this program include fills for development, water resource projects (such as dams and levees), infrastructure development (such as highways and airports), and conversion of wetlands to uplands for farming and forestry. EPA and the USACE jointly administer the program. In addition, the USFWS, NOAA Fisheries, and state resource agencies have important advisory roles.

6.7 Federal Regulations Regarding Environmental Justice

EO 12898 (Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations) requires that all federal agencies develop environmental justice strategies and make environmental justice a part of their mission by identifying and addressing, as appropriate, any disproportionate and adverse human health or environmental effects of their activities on minority or low-income populations.

The CZMA of 1972 (16 USC 2452-24645) FDCA plays a significant role in water quality management. Under the CZMA, a federal action that may affect the coastal zone must be carried out in a manner that is consistent with state CZM Programs.

6.8 State of Florida Regulations

State regulations are contained generally in the FACs. Pertinent requirements include obtaining NPDES permits for construction, Title V Air construction and operation permits, and Stormwater Management requirements. The latter is managed within the SJRWMD as part of the ERP program. Requirements that apply to the biological impact aspects of construction and operations, including listed T&E species and SSC are managed by the FWCC.

7 Persons and Agencies Contacted

Table 7-1: Persons and Agencies Contacted

Name / Title	Company / Agency	Address
Chambers, Angy / Natural Resources Program Manager	45 CES/CEIE	1224 Jupiter Street Patrick AFB, FL 32925-2231
Dabu, Tamy / Air Quality and Storage Tanks Program Manager	45 CES/CEIE	1224 Jupiter Street Patrick AFB, FL 32925-2231
Wallace, Brian / Project Manager	45 CES/CEMP	1224 Jupiter Street Patrick AFB, FL 32925-2231
Langett, John / Installation Restoration Program	45 CES/CEIE	1224 Jupiter Street Patrick AFB, FL 32925-2231
Long, Eva / NEPA Specialist, Environmental Planning and Conservation	45 CES/CEIE	1224 Jupiter Street Patrick AFB, FL 32925-2231
Penders, Thomas / Cultural Resources Program Manager	45 CES/CEIE	1224 Jupiter Street Patrick AFB, FL 32925-2231
Tillman, Bobby / Site Manager, Pump Station	Space Coast Launch Services, Launch Operations Support Contract	1613 SAB Road, Room 11A Patrick AFB, FL 32925
Czelusniak, Daniel / Environmental Specialist	FAA	800 Independence Ave. SW Suite 325 Washington, DC 20591
Dankert, Donald / Technical Lead	NASA / KSC Environmental Management Branch	John F. Kennedy Space Center, NASA Kennedy Space Center, FL 32899
Brooks, James / Biological Scientist	NASA / KSC Environmental Management Branch	John F. Kennedy Space Center, NASA Kennedy Space Center, FL 32899
Anderson, Kathleen / CLOIS CCAFS Water and Wastewater Lead	USAF AFSPC / CLOIS, ASRC Federal	CCAFS

The Florida State Clearinghouse reviews EAs for projects planned in Florida pursuant to Gubernatorial Executive Order 95-359; the Coastal Zone Management Act; 16 U.S.C. SS 1451-1464 as amended; and NEPA, 42 U.S.C. §4321, §§4331–4335, and §§4341–4347. The State of Florida Clearinghouse sends copies of the draft EA to applicable state regulatory agencies for review and submits any comments to be addressed in the final EA. Therefore, this EA will be submitted for Clearinghouse review. Other federal and state agency coordination, approval and permits will include as necessary:

- Consultation with the USFWS pursuant to the federal ESA and the MBTA.
- Informal Consultation with the NMFS pursuant to the federal MSFCMA, the Marine Mammal Protection Act (MMPA), and ESA
- Coordination with DOT to renew and/or maintain transportation permits
- Consultation with SHPO

- SJRWMD ERP
- FDEP Pre-Construction Permit
- USACE CWA Section 404 permit and tribal consolations.

The USAF invites public participation in decision-making on new proposals through the NEPA process. Public participation with respect to decision-making on the Proposed Action is guided by 32 CFR Part 989.

Consideration of the views and information of all interested persons promotes open communication and enables better decision-making. Copies of the draft EA will be made available to the public in local public libraries and the 45 SW Public Affairs Office at Patrick Air Force Base. A Notice of Availability (NOA) will be published in the local newspaper announcing the availability of the documents for a 30-day review period. The Florida State Clearinghouse will provide responses to the draft EA.

8 List of Preparers

Table 8-1: Preparer Details

Name / Company	Title / Responsibility	Education	Years of Experience
Burns, Imogene Nelson Engineering Co.	Environmental Specialist	B.B.A.	15
Longshore, Jeff, PE Nelson Engineering Co.	Director, Civil, Environment, Safety and Health	B.S. Civil Engineering	11
Seringer, Carolyn, PE Nelson Engineering Co.	Vice President	B.S. Chemical Engineering	38
Glancy, Scott, EI Nelson Engineering Co.	Civil Engineer	B.S. Civil Engineering	4
Menzies, Jason, PE Nelson Engineering Co.	Senior Mechanical Design Engineer	B.S. Mechanical Engineering	11
Gadarowski, John ULA	Vulcan SLC-41 Project Manager	B. S. International Business M.B.A. Management	20
Holt, Tim ULA	Vulcan Launch Operations Manager	BSME, PE	34
Seidl, Brian ULA	Safety, Health and Environmental Affairs	B.S. Chemical Engineering	30

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APPENDIX A

Figures

Figure 1. Vulcan Centaur Vehicle

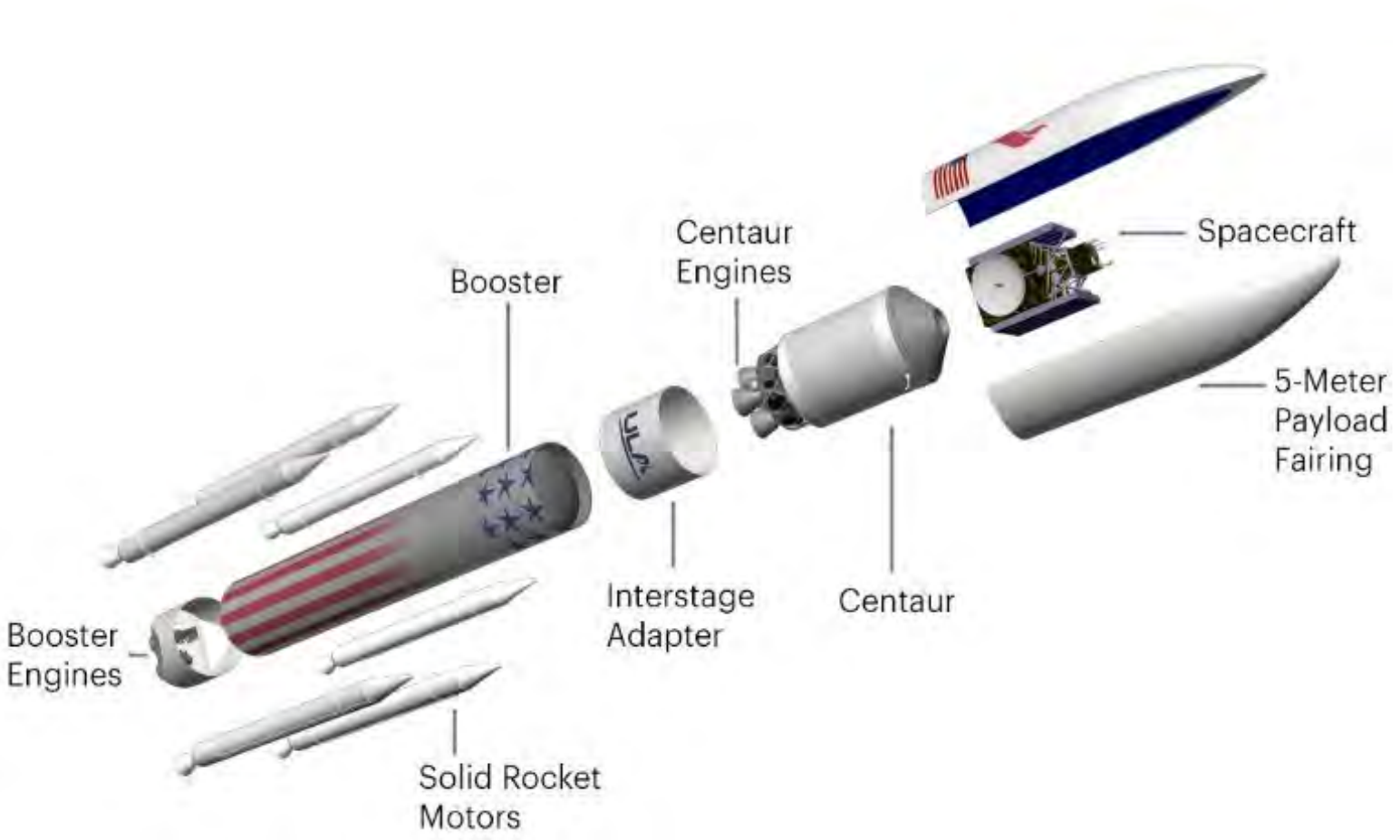


Figure 2. SLC-41 General Site Location

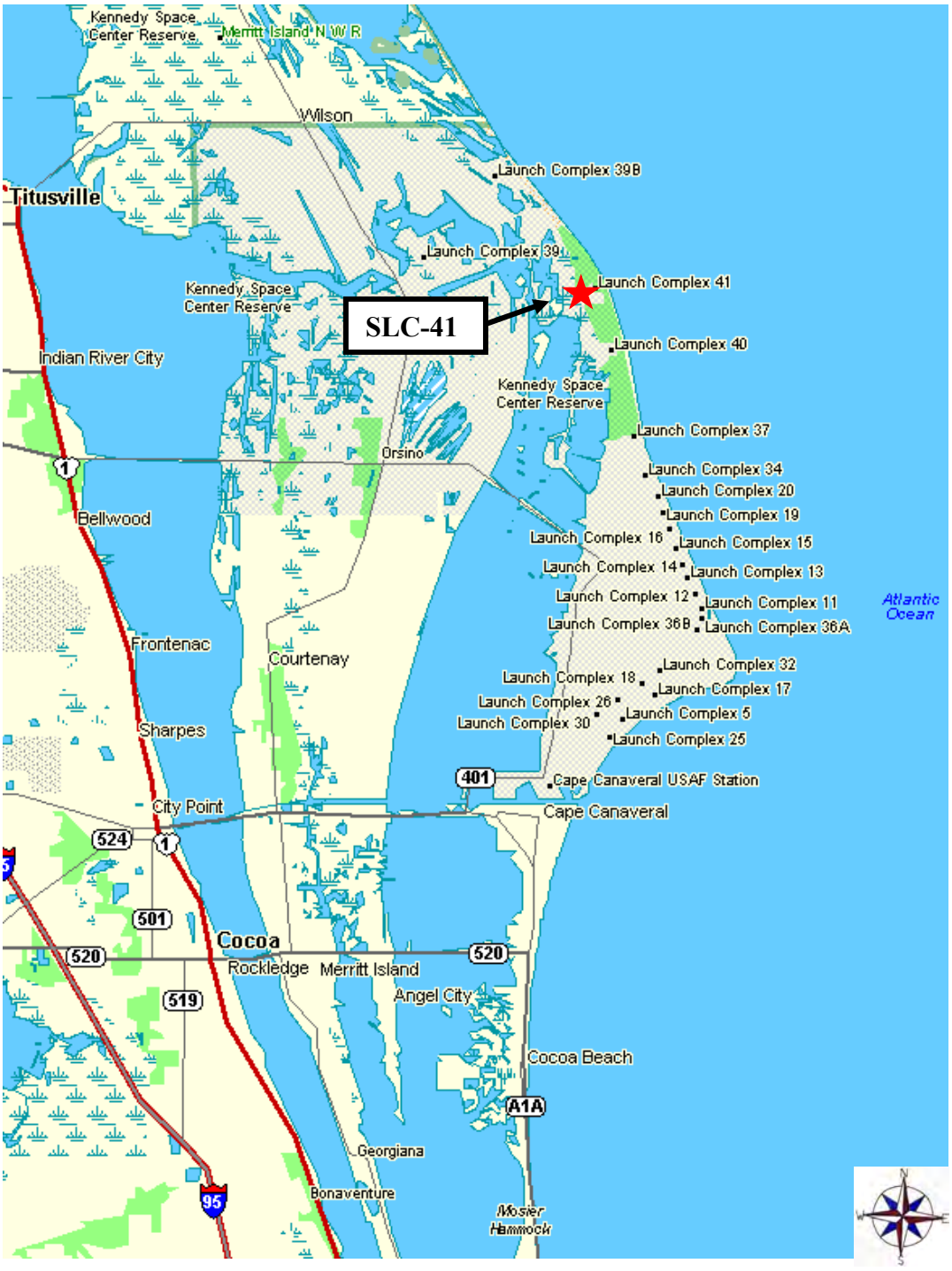
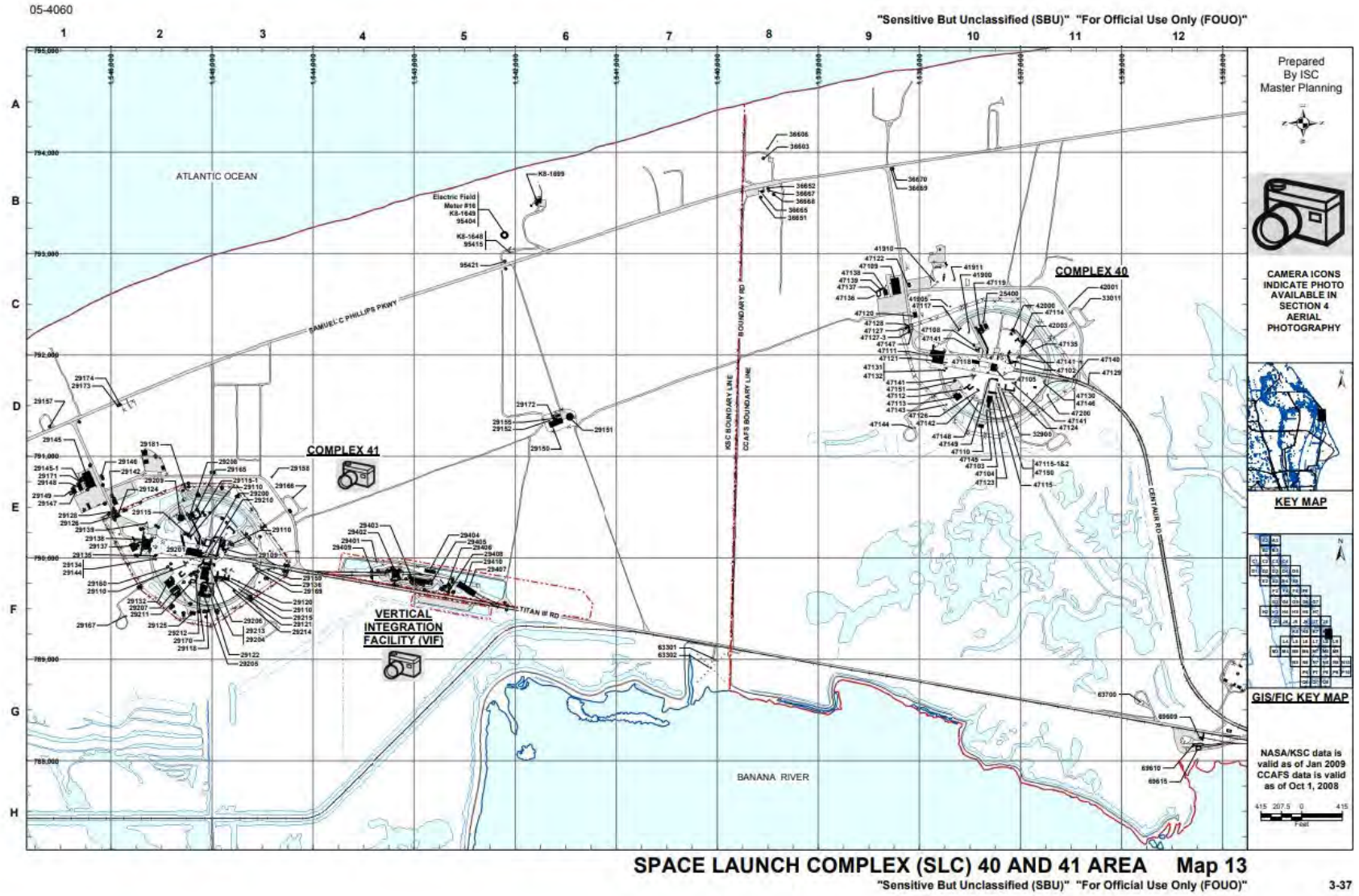
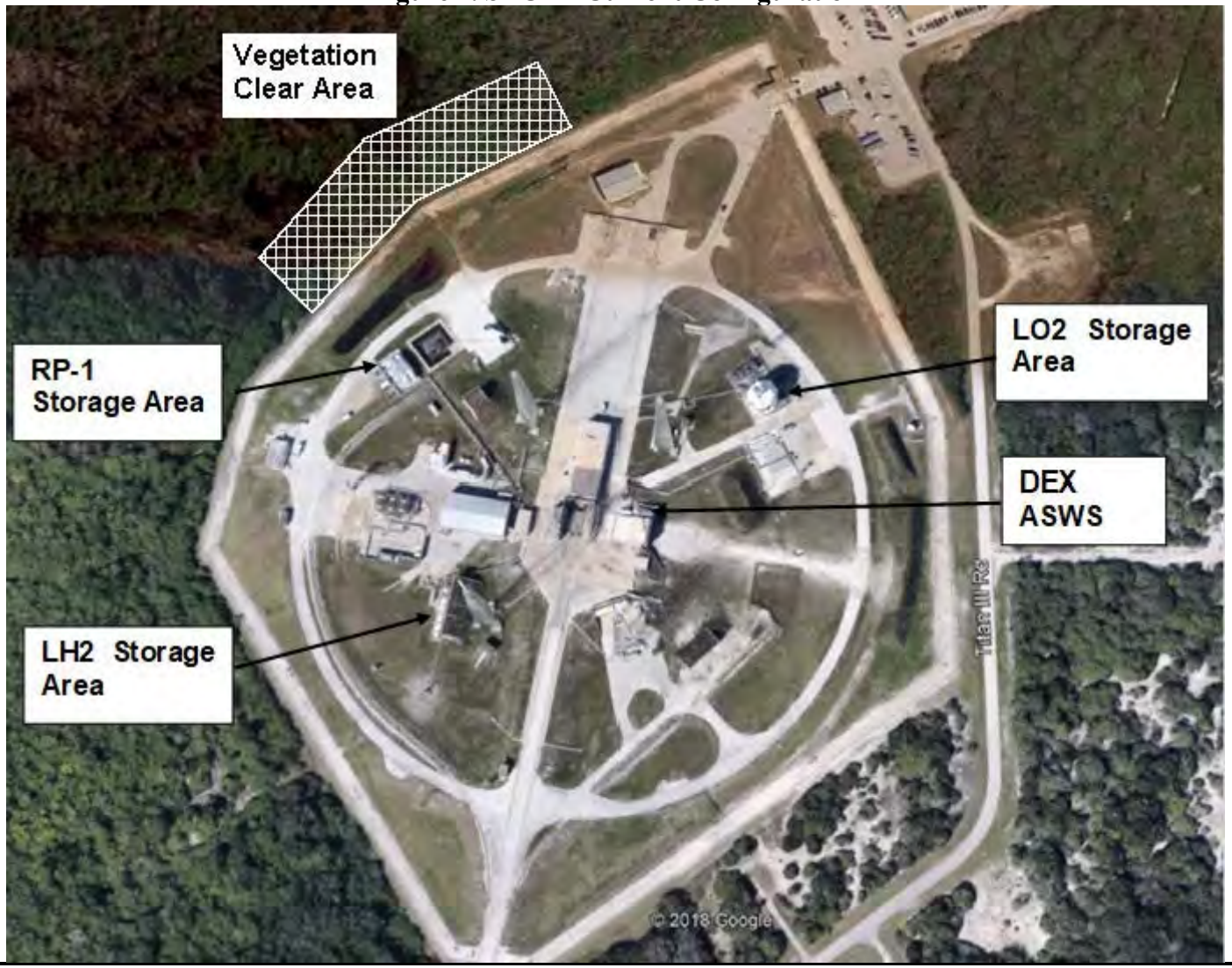


Figure 3. ITL Area VIF, SMARF and SLC-41 Location including Boundaries



KSC-CCAFS-6747, Rev. E, Facility Utilization Maps, KSC Basic Information Guide, 2009

Figure 4. SLC-41 Current Configuration



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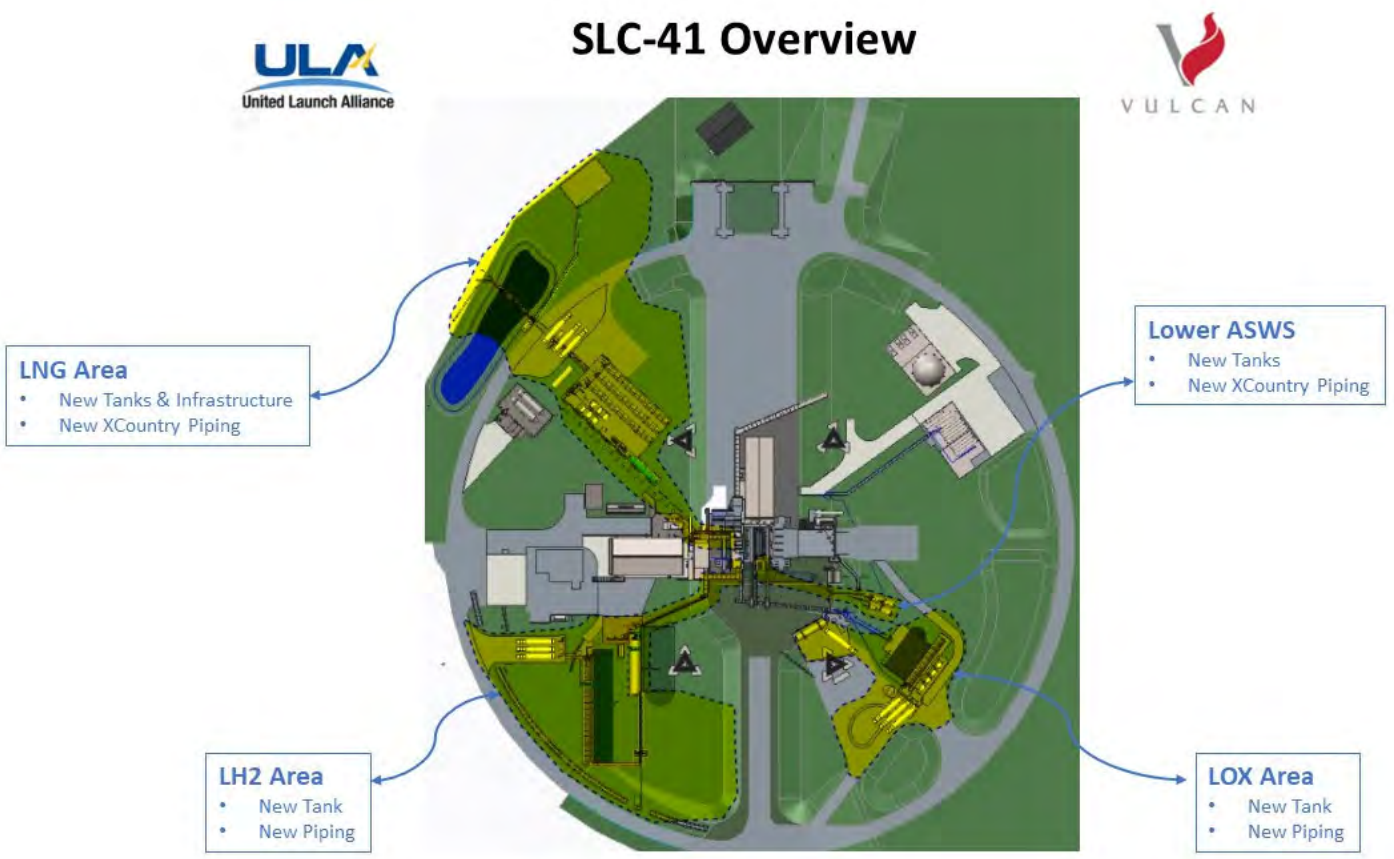

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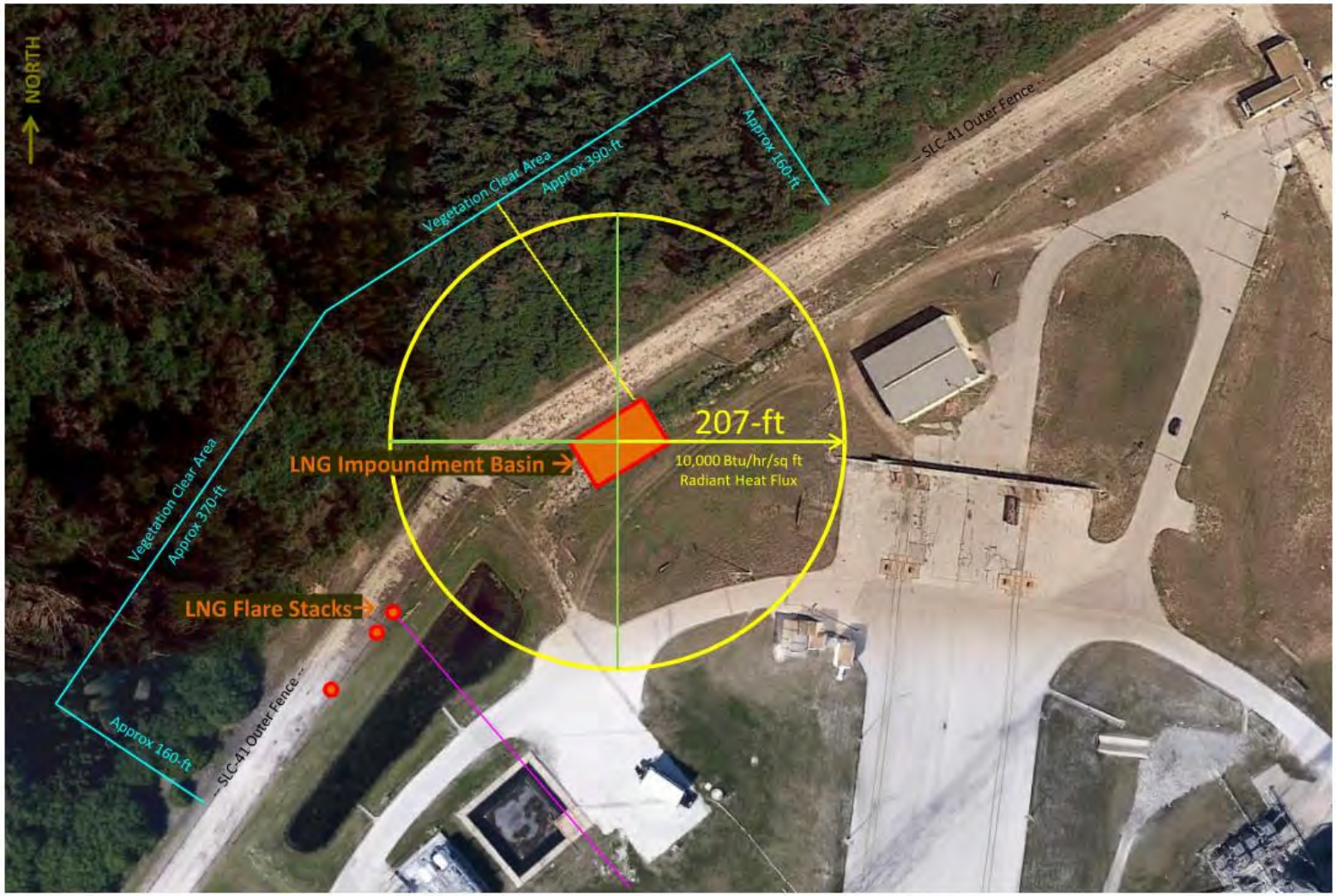
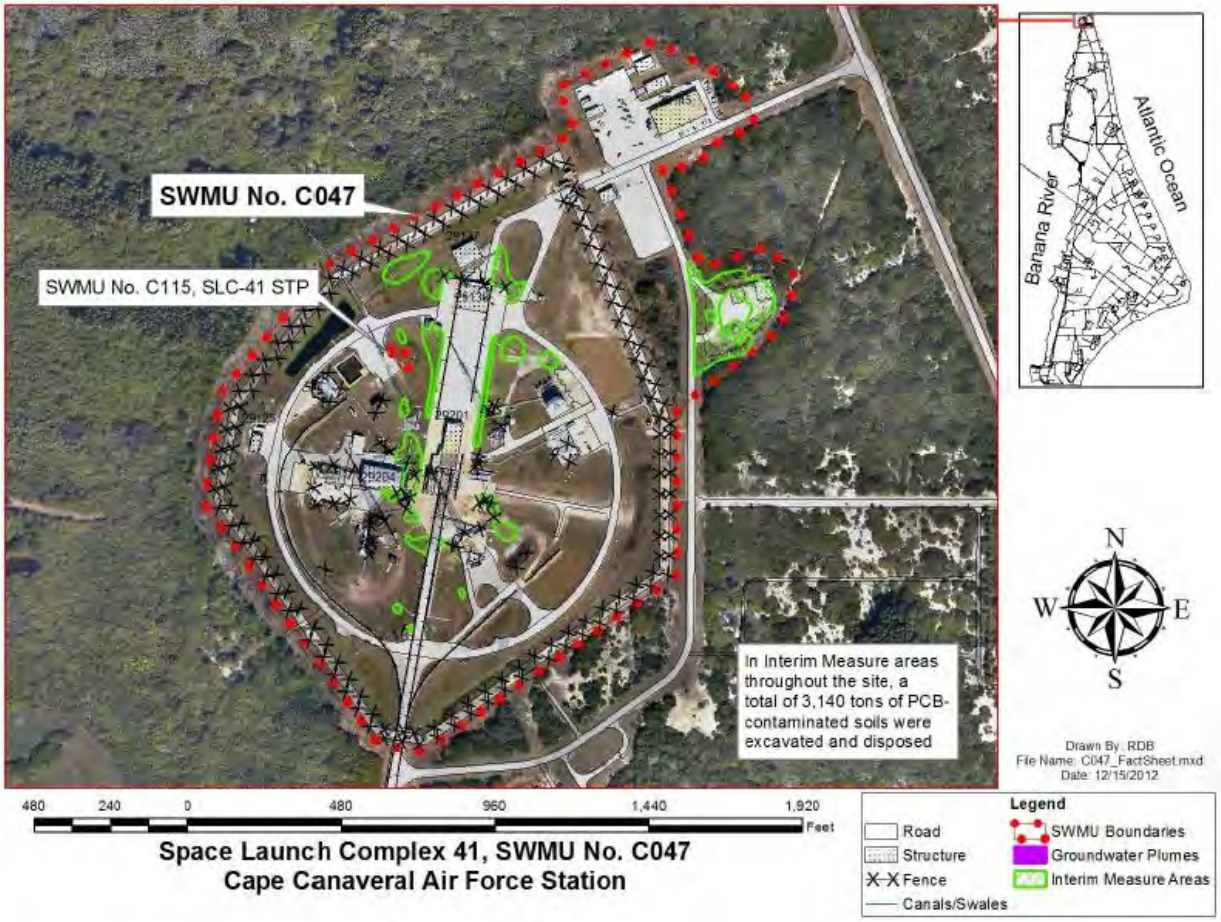


Note: Vegetation clear zone required by LNG flares is contained within the IRP's SWMU 249 remediation area and covered under a separate NEPA action.

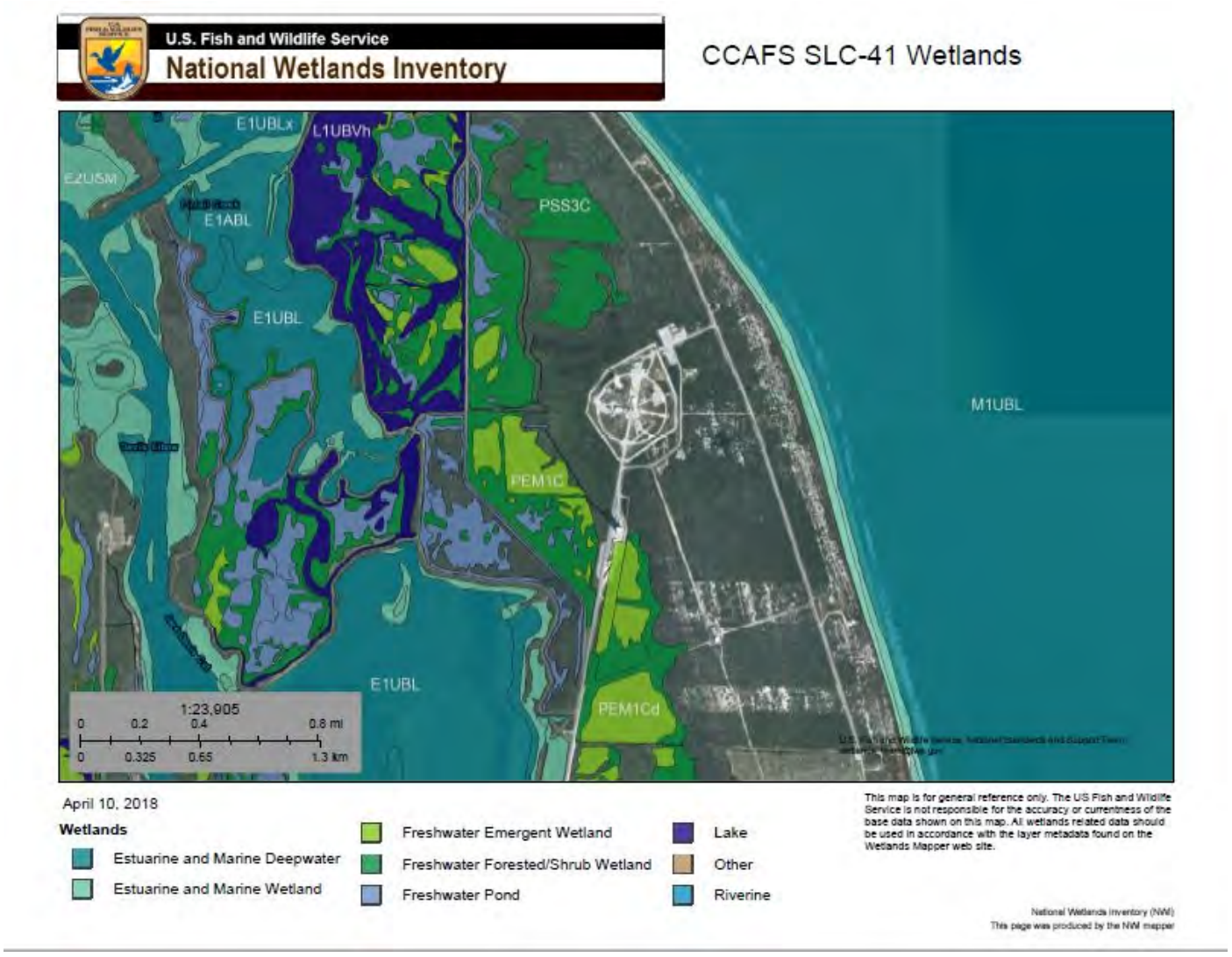
Figure 7. Solid Waste Management Unit (SWMU) C047 Map



Space Launch Complex 41, SWMU No. C047
Cape Canaveral Air Force Station

For further information regarding this site please contact the 45th SW IRP Office at 321-476-2927.

Figure 8. SLC-41 Area Wetlands



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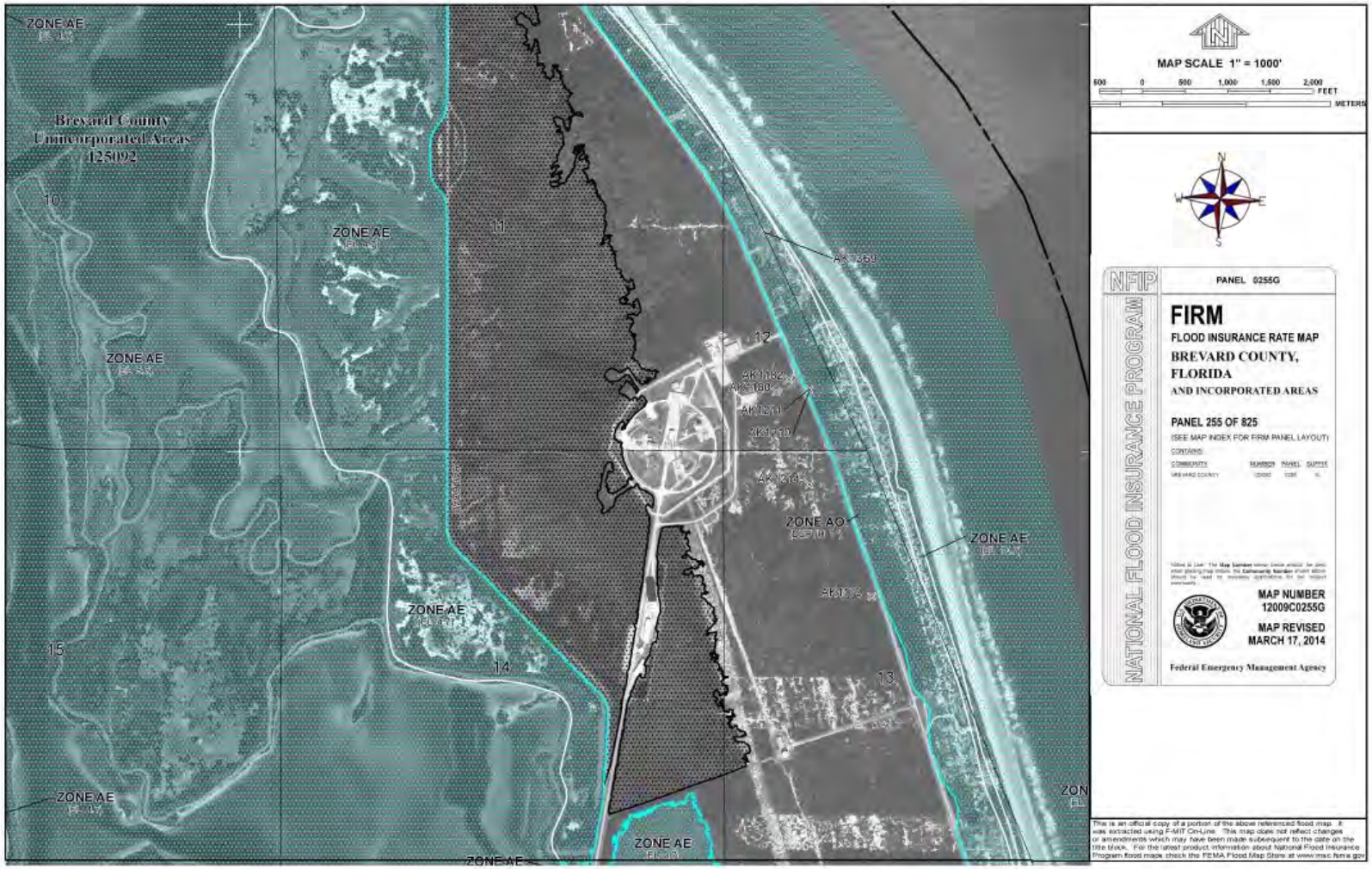

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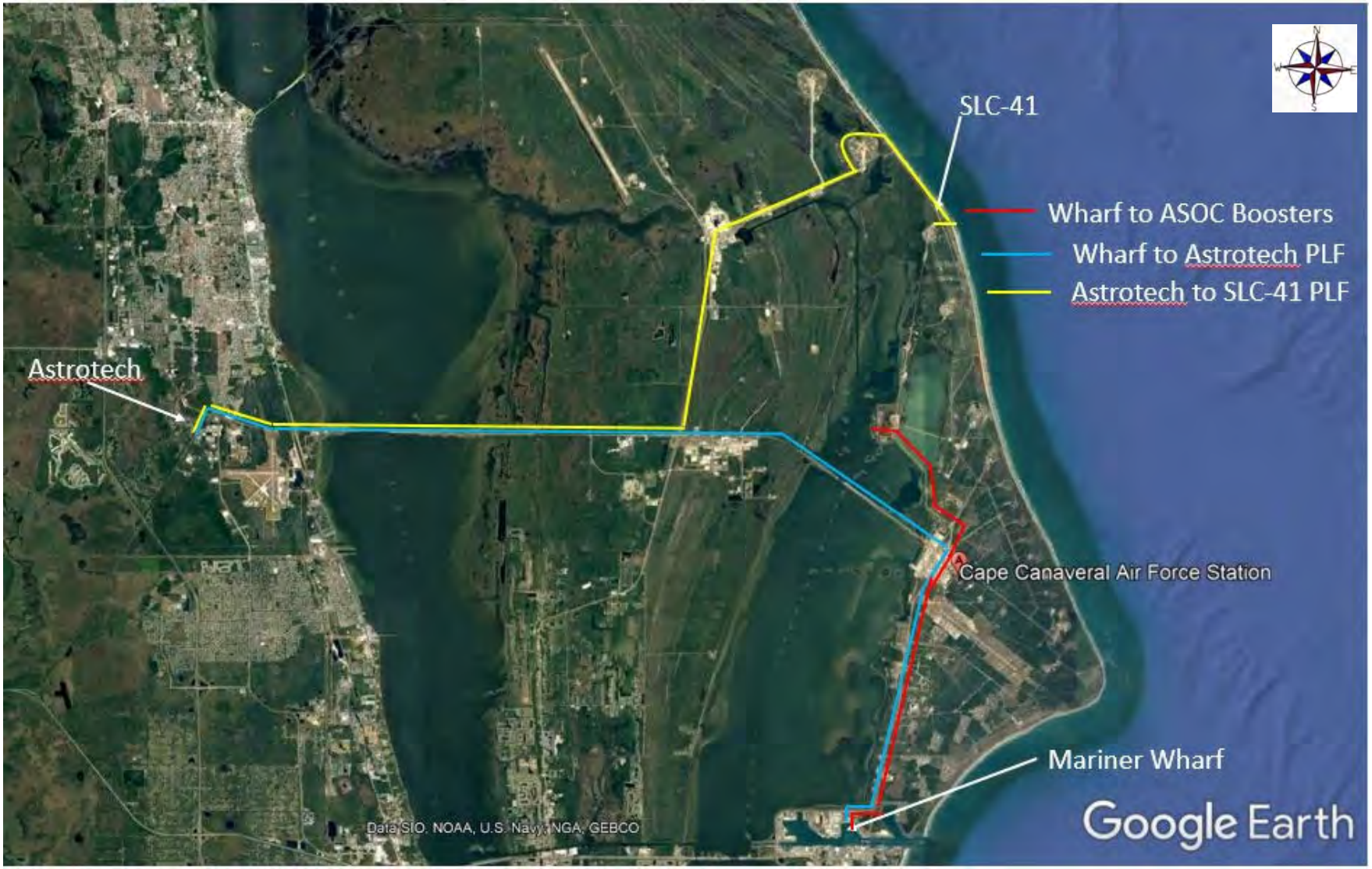

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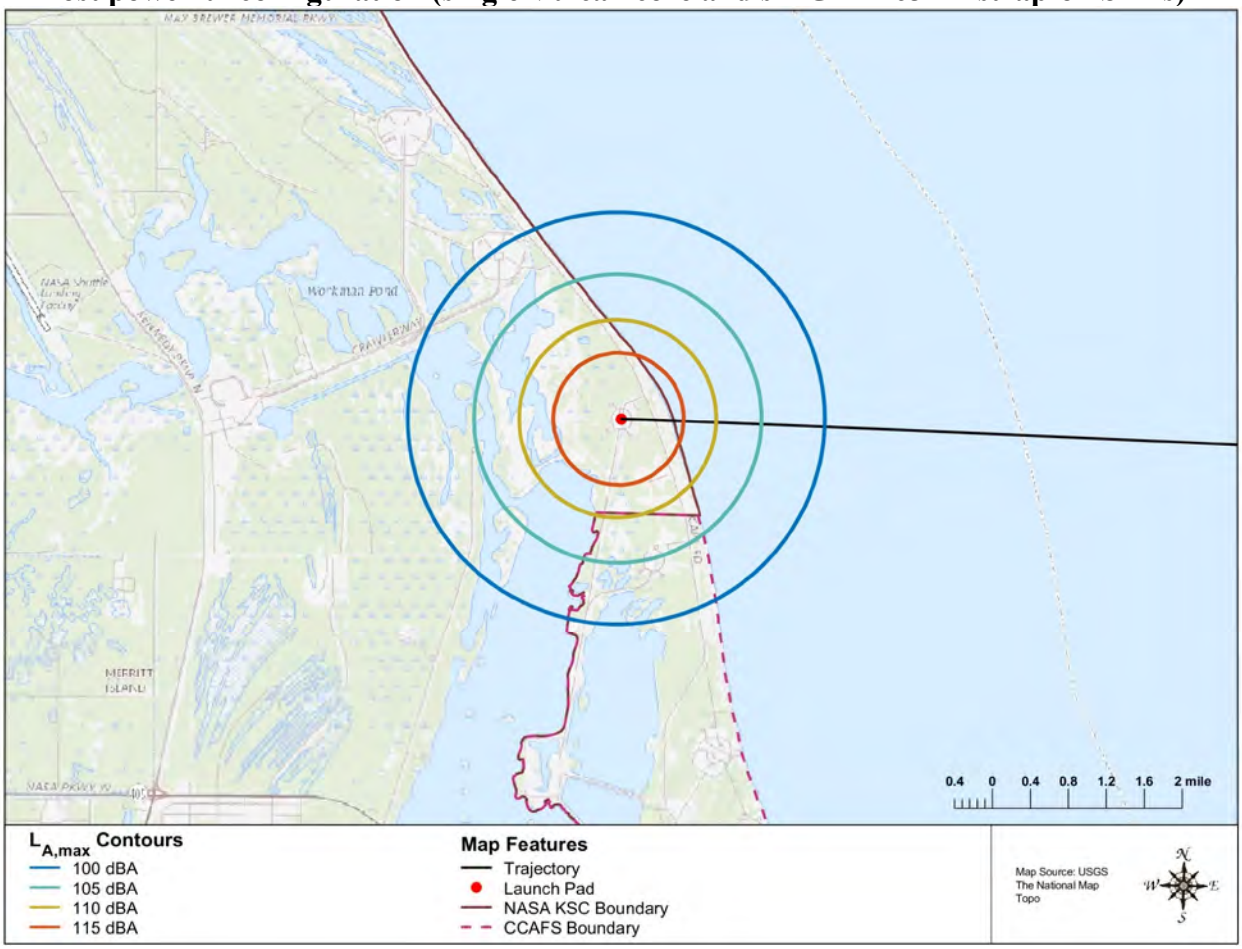

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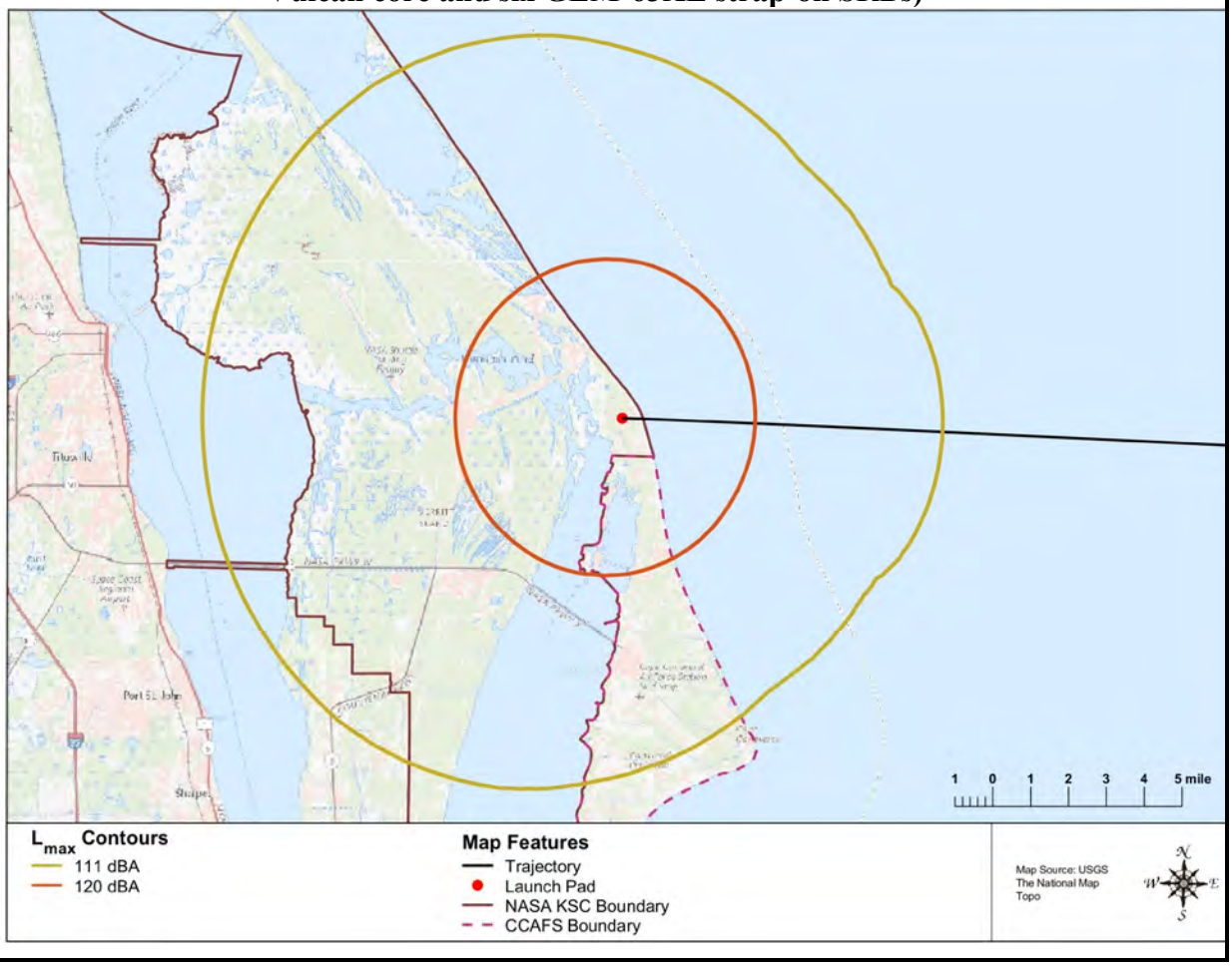

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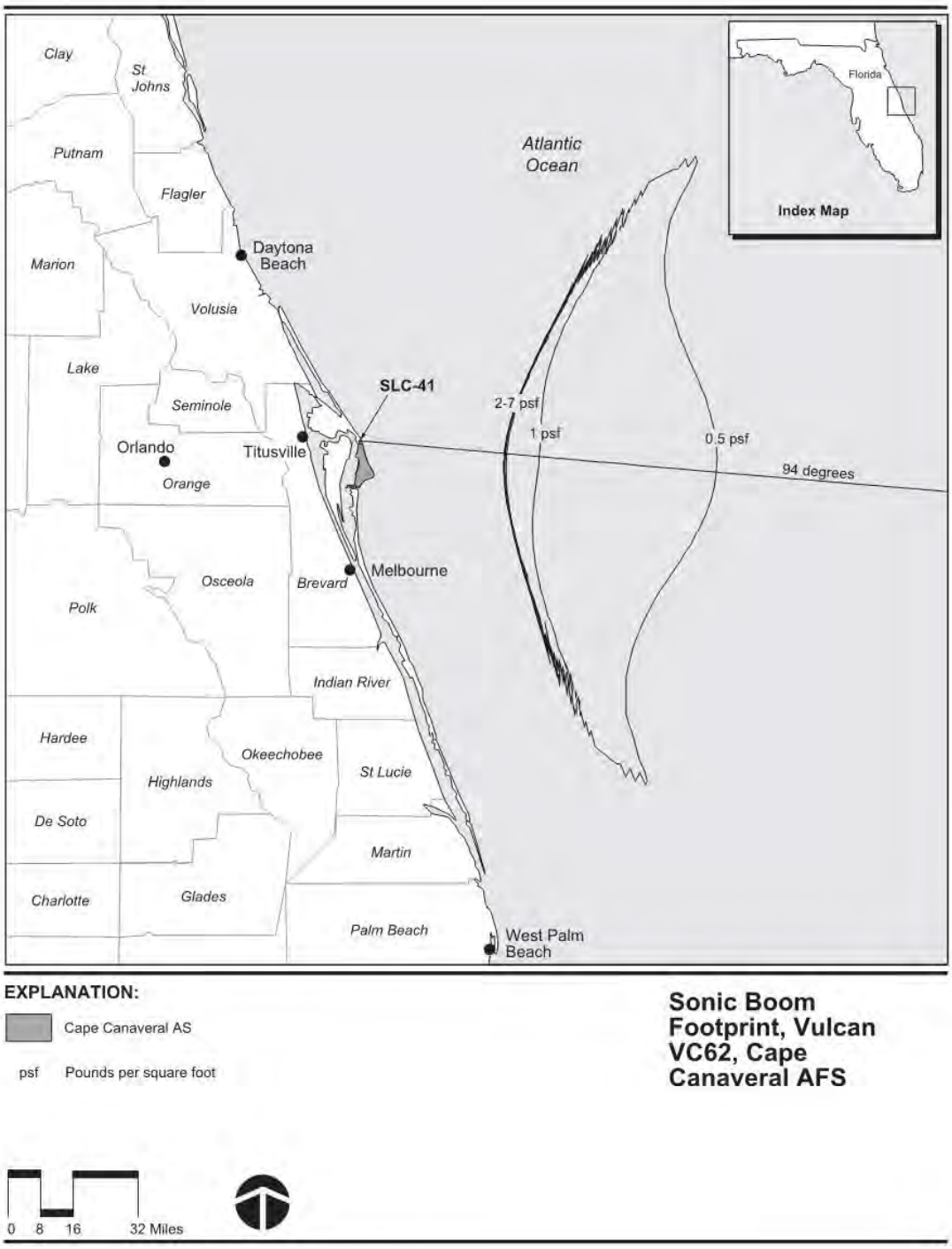

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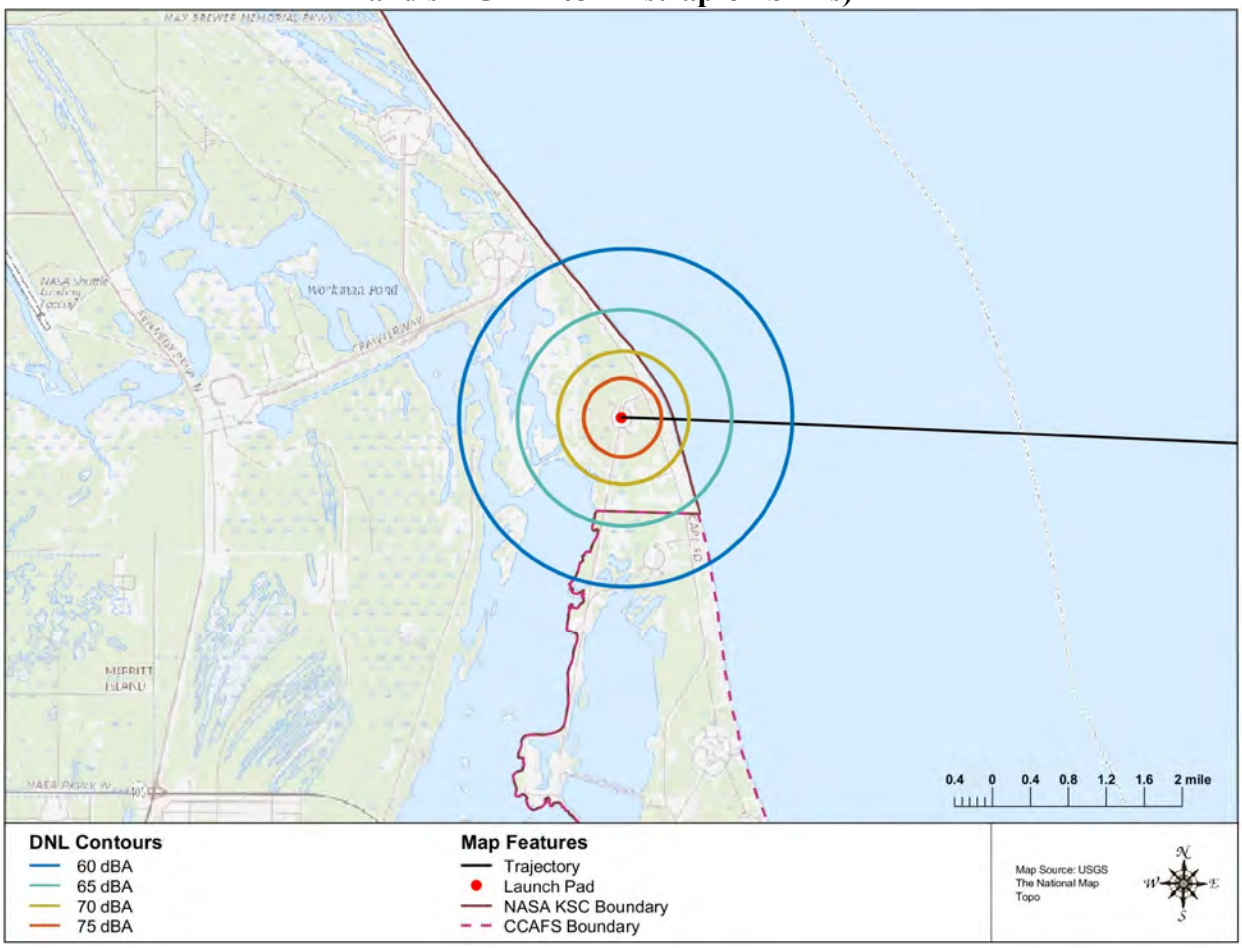

APPENDIX B

Noise Study for United Launch Alliance's Vulcan Centaur Launch Vehicle Operations at CCAFS, Blue Ridge Research and Consulting, LLC, Revision A

Blue Ridge Research and Consulting, LLC

Technical Report

Noise Study for United Launch Alliance's Vulcan Centaur Launch Vehicle Operations at CCAFS

March 4, 2019(Rev. A)

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Acronyms and Abbreviations

The following acronyms and abbreviations are used in the report:

BRRC	Blue Ridge Research and Consulting, LLC
CCAFS	Cape Canaveral Air Force Station
dB	Decibel
dBA	A-weighted Decibel Level
DI	Directivity Indices
DNL	Day-Night Average Sound Level
DoD	Department of Defense
DSM-1	Distributed Source Method 1
FAA	Federal Aviation Administration
ft	Foot/Feet
KSC	Kenned Space Center
lbf	Pound Force
$L_{A,max}$	Maximum A-weighted OASPL in Decibels
L_{max}	Maximum Unweighted OASPL in Decibels
L_{pk}	Peak Sound Pressure Level in Decibels
NASA	National Aeronautics and Space Administration
NIHL	Noise-Induced Hearing Loss
NIOSH	National Institute for Occupational Safety and Health
OASPL	Overall Sound Pressure Level in Decibels
OSHA	Occupational Safety and Health Administration
EA	Environmental Assessment
P_k	Peak Pressure
psf	Pounds per Square Foot
RUMBLE	The Launch Vehicle Acoustic Simulation Model
SRB	Solid Rocket Booster
ULA	United Launch Alliance

1 Introduction

This report documents the noise study performed as part of United Launch Alliance's (ULA's) efforts on the Environmental Assessment (EA) for the proposed Vulcan Centaur (Vulcan) launch operations at Cape Canaveral Air Force Station (CCAFS). ULA plans to conduct launch operations of multiple Vulcan configurations from CCAFS Space Launch Complex 41 (SLC-41). The most powerful configuration, a single Vulcan core and six GEM-63XL strap-on solid rocket boosters (SRB's) as shown in Figure 1, will be modeled to determine the envelope of the potential noise impacts. Noise impacts will be evaluated for a nominal launch trajectory for up to twenty annual launches per year. The potential impacts from propulsion noise and sonic boom are evaluated on a single-event and cumulative basis in relation to human annoyance, hearing conservation, and structural damage.

This noise study describes the environmental noise associated with the proposed Vulcan operations. Section 2 describes the proposed Vulcan operations; Section 3 summarizes the basics of sound and describes the noise metrics and impact criteria discussed throughout this report; Section 4 describes the general methodology of the propulsion noise and sonic boom modeling; and Section 5 presents the propulsion noise modeling results and sonic boom discussion. A summary is provided in Section 6 to document the notable findings of this noise study.

Figure 1. United Launch Alliance's Vulcan Centaur vehicle (image credit: © 2011 ULA)

2 Vulcan Operations

ULA plans to conduct Vulcan launch operations from CCAFS SLC-41 (28.583440° N, 80.582812° W). The proposed action includes a total of twenty annual launch operations, thirteen of which are planned to occur during acoustic daytime hours (0700 - 2200), and seven during acoustic nighttime hours (2200 – 0700). Vulcan launch trajectories departing from SLC-41 will be unique to the vehicle configuration, mission, and environmental conditions. For the purposes of this study, the noise model utilizes a nominal launch trajectory, provided by ULA personnel (T. Holt, personal communication, 6 February 2019), to model noise emissions from Vulcan operations. The nominal launch trajectory follows an azimuth of approximately 92°.

Multiple Vulcan configurations will launch from SLC-41. Each configuration will utilize the Vulcan Core with two Blue Origin BE-4 engines and be supplemented by up to six GEM 63XL SRBs to increase the rockets lift capacity as needed. The most powerful configuration will be modeled to determine the potential extent of noise impacts. The vehicle parameters for the most powerful Vulcan configuration are presented in Table 1. Although the engine/motor thrusts are provided in Table 1, the model uses the time varying thrust profile provided in the nominal Vulcan launch trajectory, reaching a first stage combined maximum of 3,634,361 lbf.

Table 1. Vehicle modeling parameters

Modeling Parameters	Values
Manufacturer	United Launch Alliance
Name	Vulcan
Length	221 ft
Diameter	17.7 ft
Gross Vehicle Weight	2,007,894 lbs
Vulcan Core	Blue Origin BE-4 Engines (x2) 550,000 lbf Thrust/Engine
Solid Rocket Boosters	Northrop Grumman Innovation System GEM 63XL Motors (x6) 460,000 lbf Thrust/Motor

3 Acoustics Overview

An overview of sound-related terms, metrics, and effects, which are pertinent to this study, is provided to assist the reader in understanding the terminology used in this noise study.

3.1 Fundamentals of Sound

Any unwanted sound that interferes with normal activities or the natural environment is defined as noise. Three principal physical characteristics are involved in the measurement and human perception of sound: intensity, frequency, and duration [1].

- **Intensity** is a measure of a sound's acoustic energy and is related to sound pressure. The greater the sound pressure, the more energy is carried by the sound and the louder the perception of that sound.
- **Frequency** determines how the pitch of the sound is perceived. Low-frequency sounds are characterized as rumbles or roars, while high-frequency sounds are typified by sirens or screeches.
- **Duration** is the length of time the sound can be detected.

The loudest sounds that can be comfortably detected by the human ear have intensities a trillion times higher than those of sounds barely audible. Because of this vast range, using a linear scale to represent the intensity of sound can become cumbersome. As a result, a logarithmic unit known as the decibel (abbreviated dB) is used to represent sound levels. A sound level of 0 dB approximates the threshold of human hearing and is barely audible under extremely quiet listening conditions. Normal speech has a sound level around 60 dB. Sound levels above 120 dB begin to be felt inside the human ear as discomfort. Sound levels between 130 and 140 dB are experienced as pain [2].

Because of the logarithmic nature of the decibel unit, sound levels cannot be simply added or subtracted and are somewhat cumbersome to handle mathematically. However, some useful rules help when dealing with sound levels. First, if a sound's intensity is doubled, the sound level increases by 3 dB, regardless of the initial sound level. For example:

$$50\ dB\ +\ 50\ dB\ =\ 53\ dB, \text{ and } 70\ dB\ +\ 70\ dB\ =\ 73\ dB.$$

Second, the total sound level produced by two sounds with different levels is usually only slightly more than the higher of the two. For example:

$$50.0\ dB\ +\ 60.0\ dB\ =\ 60.4\ dB.$$

In the community, "it is unlikely that the average listener would be able to correctly identify at a better than chance level the louder of two otherwise similar events which differed in maximum sound level by < 3 dB" [3]. On average, a person perceives a change in sound level of about 10 dB as a doubling (or halving) of a sound's loudness. This relation holds true for both loud and quiet sounds. A decrease in sound level of 10 dB represents a 90% decrease in sound intensity but only a 50% decrease in perceived loudness because the human ear does not respond linearly [1].

Sound frequency is measured in terms of cycles per second or hertz (Hz). Human hearing ranges in frequency from 20 Hz to 20,000 Hz, although perception of these frequencies is not equivalent across this range. Human hearing is most sensitive to frequencies in the 1,000 to 4,000 Hz range. Most sounds are

not simple pure tones, but contain a mix, or spectrum, of many frequencies. Sounds with different spectra are perceived differently even if the sound levels are the same. Weighting curves have been developed to correspond to the sensitivity and perception of different types of sound. A-weighting and C-weighting are the two most common weightings. These two curves, shown in Figure 2, are adequate to quantify most environmental noises. A-weighting puts emphasis on the 1,000 to 4,000 Hz range to match the reduced sensitivity of human hearing for moderate sound levels. For this reason, the A-weighted decibel level (dBA) is commonly used to assess community sound.

Very loud or impulsive sounds, such as explosions or sonic booms, can sometimes be felt, and they can cause secondary effects, such as shaking of a structure or rattling of windows. These types of sounds can add to annoyance and are best measured by C-weighted sound levels, denoted dBC. C-weighting is nearly flat throughout the audible frequency range and includes low frequencies that may not be heard but cause shaking or rattling. C-weighting approximates the human ear's sensitivity to higher intensity sounds.

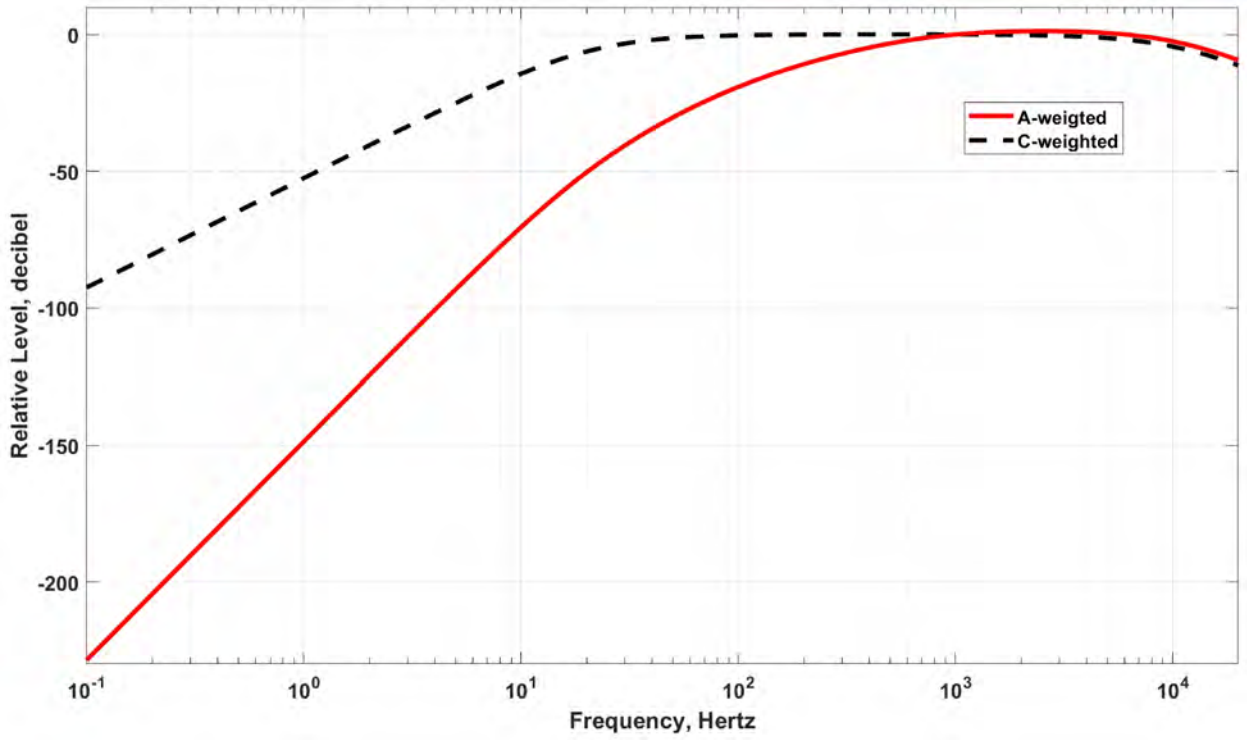

Figure 2. Frequency adjustments for A-weighting and C-weighting [4]

Sound sources can contain a wide range of frequency (pitch) content as well as variations in extent from short-durations to continuous, such as back-up alarms and ventilation systems, respectively. Figure 3 is a chart of A-weighted sound levels from typical sounds [5]. Some sound sources (air conditioners, generators, lawn mowers) are continuous with levels that are constant for a given duration; others (vehicles passing by) are the maximum sound during an event, and some (urban day and nighttime) are averages over extended periods [6]. Per the US Environmental Protection Agency, "Ambient noise in urban areas typically varies from 60 to 70 dB but can be as high as 80 dB in the center of a large city. Quiet suburban neighborhoods experience ambient noise levels around 45-50 dB" [7].

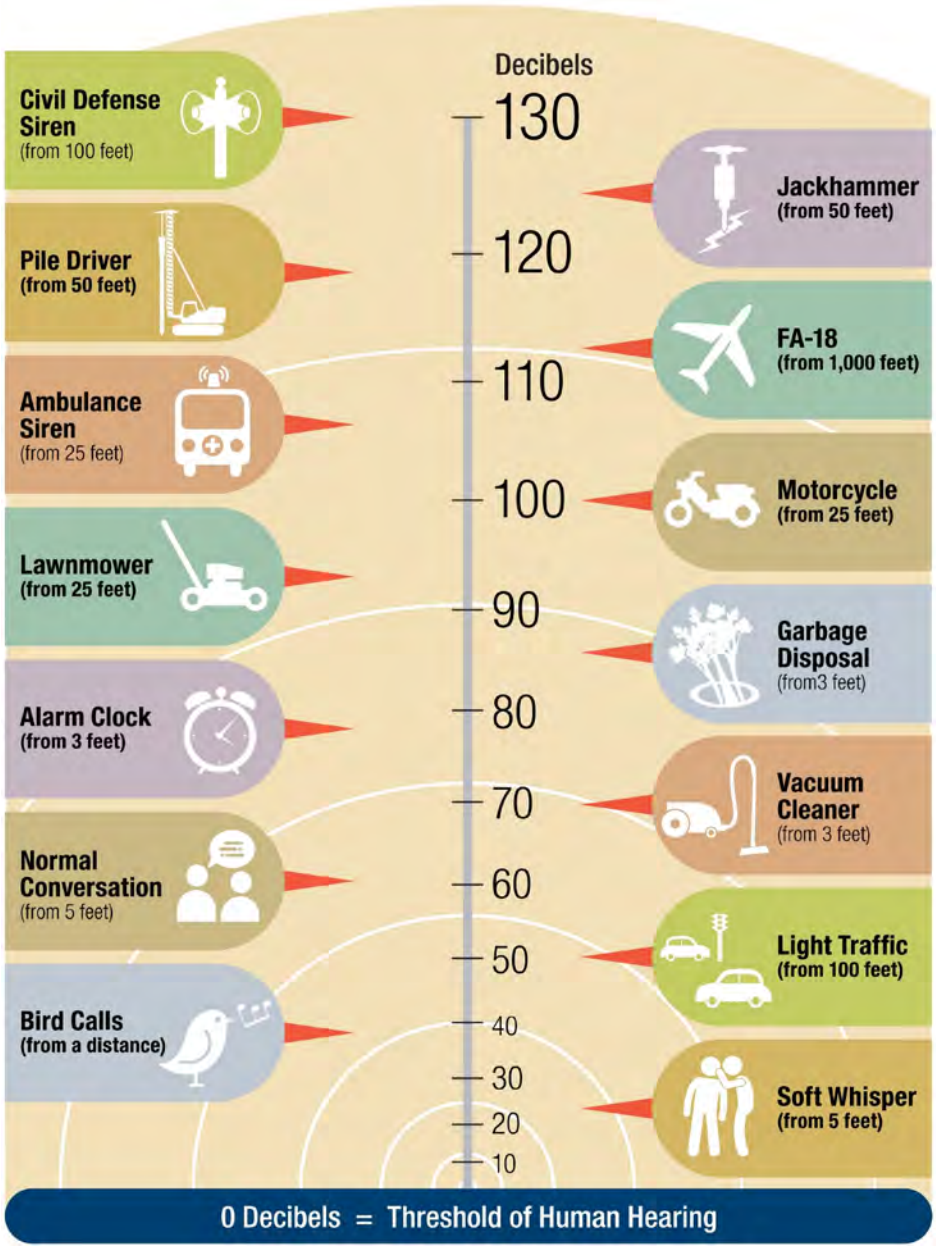

Figure 3. Typical A-weighted sound levels of common sounds [8]

The intensity of sonic booms is quantified with physical pressure units rather than levels. Intensities of sonic booms are traditionally described by the amplitude of the front shock wave, referred to as the peak overpressure. The peak overpressure is normally described in units of pounds per square foot (psf), where 1 psf = 47.88 Pascals (Pa). The amplitude is particularly relevant when assessing structural effects as opposed to loudness or cumulative community response. In this study, sonic booms are quantified by either dB or psf, as appropriate for the particular impact being assessed [9]. A chart of typical impulsive events along with their corresponding peak overpressures in terms of psf and peak dB values are shown in Figure 4.

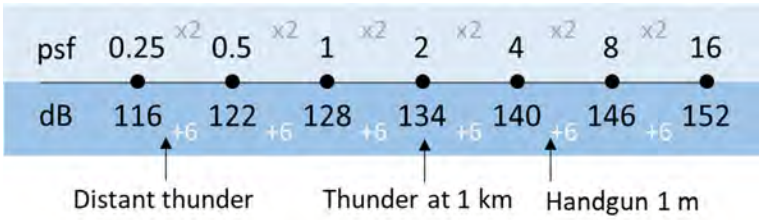

Figure 4. Typical impulsive event levels

3.2 Noise Metrics

A variety of acoustical metrics have been developed to describe sound events and to identify any potential impacts to receptors within the environment. These metrics are based on the nature of the event and who or what is affected by the sound. A brief description of the noise metrics used in this noise study are provided below.

Maximum Sound Level (L_{max})

The highest sound level measured during a single event, in which the sound changes with time, is called the Maximum Sound Level (abbreviated as L_{max}). The highest A-weighted sound level measured during a single event is called the Maximum A-weighted Sound Level (abbreviated as $L_{A,max}$). Although it provides some measure of the event, L_{max} (or $L_{A,max}$) does not fully describe the sound because it does not account for how long the sound is heard.

Peak Sound Level (L_{pk})

For impulsive sounds, the true instantaneous peak sound pressure level, which lasts for only a fraction of a second, is important in determining impacts. The peak pressure of the front shock wave is used to describe sonic booms, and it is usually presented in psf. Peak sound levels are not frequency weighted.

Day-Night Average Sound Level (DNL)

Day-Night Average Sound Level is a cumulative metric that accounts for all noise events in a 24-hour period. To account for our increased sensitivity to noise at night, DNL applies an additional 10 dB adjustment to events during the acoustical nighttime period, defined as 10:00 PM to 7:00 AM. The notations DNL and L_{dn} are both used for Day-Night Average Sound Level and are equivalent. DNL represents the average sound level exposure for annual average daily events. DNL does not represent a level heard at any given time but represents long term exposure to noise.

3.3 Noise Effects

Noise criteria have been developed to protect the public health and welfare of the surrounding communities. The impacts of launch vehicle noise and sonic booms are evaluated on a cumulative basis in terms of human annoyance. In addition, the launch vehicle noise and sonic boom impacts are evaluated on a single-event basis in relation to hearing conservation and potential structural damage. Although FAA Order 1050.1F does not have guidance on hearing conservation or structural damage criteria, it recognizes the use of supplemental noise analysis to describe the noise impact and assist the public's understanding of the potential noise impact.

3.3.1 Human Annoyance

A significant noise impact would occur if the "action would increase noise by DNL 1.5 dB[A] or more for a noise sensitive area that is exposed to noise at or above the DNL 65 dB[A] noise exposure level, or that will be exposed at or above this level due to the increase, when compared to the No Action Alternative for the same timeframe" [10]. DNL is based on long-term cumulative noise exposure and has been found to correlate well with long-term community annoyance for regularly occurring events including aircraft, rail, and road noise [11, 12]. Noise studies used in the development of the DNL metric did not include rocket noise, which are historically irregularly occurring events. Thus, it is acknowledged that the suitability of DNL for infrequent rocket noise events is uncertain. Additionally, it has been noted that the "DNL 65 dB threshold does not adequately address the effects of noise on visitors to areas within a national park or national wildlife refuge where other noise is very low and a quiet setting is a generally recognized purpose and attribute" [10]. DNL contours are provided as the most widely accepted metric to estimate the potential long-term community annoyance.

3.3.2 Hearing Conservation

Launch Vehicle Noise

U.S. government agencies have provided guidelines on permissible noise exposure limits. These documented guidelines are in place to protect human hearing from long-term continuous daily exposures to high noise levels and aid in the prevention of noise-induced hearing loss (NIHL). A number of federal agencies have set exposure limits on non-impulsive noise levels including the Occupational Safety and Health Administration (OSHA) [13], National Institute for Occupational Safety and Health (NIOSH) [14], and the Department of Defense (DoD) Occupational Hearing Conservation Program [15]. The most conservative of these upper noise level limits has been set by OSHA at 115 dBA.[1] At 115 dBA, the allowable exposure duration is 15 minutes for OSHA and 28 seconds for NIOSH and DoD. $L_{A,max}$ contours are used to identify potential locations where hearing protection should be considered for rocket operations.

[1] The OSHA standard specifies exposure to continuous steady-state noise is limited to a maximum of 115 dBA. Note, in addition to implementing Federal OSHA regulations, KSC's Hearing Loss Prevention Program states that hearing protection is required for exposures above 103 dBA [16].

Sonic Booms

A sonic boom is the sound associated with the shock waves created by a vehicle traveling through the air faster than the speed of sound. Multiple federal government agencies have provided guidelines on permissible noise exposure limits on impulsive noise such as a sonic boom. These documented guidelines are in place to protect one's hearing from exposures to high noise levels and aid in the prevention of NIHL. In terms of upper limits on impulsive or impact noise levels, NIOSH [14] and OSHA [13] have stated that levels should not exceed 140 dB peak sound pressure level, which equates to a sonic boom level of approximately 4 psf.

3.3.3 Structural Damage

Launch Vehicle Noise

Typically, the most sensitive components of a structure to launch vehicle noise are windows, and infrequently, the plastered walls and ceilings. The potential for damage to a structure is unique interaction among the incident sound, the condition of the structure, and the material of each element and its respective boundary conditions. A report from the National Research Council on the "Guidelines for Preparing Environmental Impact Statements on Noise" [16] states that one may conservatively consider all sound lasting more than one second with levels exceeding 130 dB (unweighted) as potentially damaging to structures.

A NASA technical memo found a relationship between structural damage claims and overall sound pressure level, where "the probability of structural damage [was] proportional to the intensity of the low frequency sound" [17]. This relationship estimated that one damage claim in 100 households exposed is expected at an average continuous sound level of 120 dB, and one in 1,000 households at 111 dB. The study was based on community responses to 45 ground tests of the first and second stages of the Saturn V rocket system conducted in Southern Mississippi over a period of five years. The sound levels used to develop the criteria were mean, modeled sound levels.

It is important to highlight the difference between the static ground tests on which the rate of structural damage claims is based on, and the dynamic events modeled in this noise study. During ground tests, the engine/motor remains in one position, which results in a longer exposure duration to continuous levels as opposed to the transient noise occurring from the moving vehicle during a launch event. Regardless of this difference, Guest and Slone's (1972) damage claim criteria represents the best available dataset regarding the potential for structural damage resulting from rocket noise. Thus, L_{max} values of 120 dB and 111 dB are used in this report as conservative thresholds for potential risk of structural damage claims.

Sonic Booms

Sonic booms are also commonly associated with structural damage. Most damage claims are for brittle objects, such as glass and plaster. Table 2 summarizes the threshold of damage that may be expected at various overpressures [18]. A large degree of variability exists in damage experience, and much of the damage depends on the pre-existing condition of a structure. Breakage data for glass, for example, spans a range of two to three orders of magnitude at a given overpressure. The probability of a window breaking at 1 psf ranges from one in a billion [19] to one in a million [20]. These damage rates are associated with

a combination of boom load and window pane condition. At 10 psf, the probability of breakage is between one in 100 and one in 1,000. Laboratory tests involving glass [21] have shown that properly installed window glass will not break at overpressures below 10 psf even when subjected to repeated booms. However, in the real world, installed window glass is not always in pristine condition.

Damage to plaster occurs at similar ranges to glass damage. Plaster has a compounding issue in that it will often crack due to shrinkage while curing or from stresses as a structure settles, even in the absence of outside loads. Sonic boom damage to plaster often occurs when internal stresses are high as a result of these factors. In general, for well-maintained structures, the threshold for damage from sonic booms is 2 psf [18]; below 2 psf, damage is unlikely.

Table 2. Possible damage to structures from sonic booms [18]

***Nominal* Level and *Comparative* Events**	**Damage Type**	**Item Affected**
0.5 – 2 psf *Compares to piledriver at construction site*	Plaster	Fine cracks; extension of existing cracks; more in ceilings; over doorframes; between some plasterboards.
	Glass	Rarely shattered; either partial or extension of existing.
	Roof	Slippage of existing loose tiles/slates; sometimes new cracking of old slates at nail hole.
	Damage to outside walls	Existing cracks in stucco extended.
	Bric-a-brac	Those carefully balanced or on edges can fall; fine glass, such as large goblets, can fall and break.
	Other	Dust falls in chimneys.
2 – 4 psf *Compares to cap gun or firecracker near ear*	Glass, plaster, roofs, ceilings	Failures show that would have been difficult to forecast in terms of their existing localized condition. Nominally in good condition.
4 – 10 psf *Compares to handgun at shooter's ear*	Glass	Regular failures within a population of well-installed glass; industrial as well as domestic greenhouses.
	Plaster	Partial ceiling collapse of good plaster; complete collapse of very new, incompletely cured, or very old plaster.
	Roofs	High probability rate of failure in nominally good state, slurry-wash; some chance of failures in tiles on modern roofs; light roofs (bungalow) or large area can move bodily.
	Walls (out)	Old, free standing, in fairly good condition can collapse.
	Walls (in)	Inside ("party") walls known to move at 10 psf.
> 10 psf *Compares to fireworks display from viewing stand*	Glass	Some good glass will fail regularly to sonic booms from the same direction. Glass with existing faults could shatter and fly. Large window frames move.
	Plaster	Most plaster affected.
	Ceilings	Plasterboards displaced by nail popping.
	Roofs	Most slate/slurry roofs affected, some badly; large roofs having good tile can be affected; some roofs bodily displaced causing gale-end and will-plate cracks; domestic chimneys dislodged if not in good condition.
	Walls	Internal party walls can move even if carrying fittings such as hand basins or taps; secondary damage due to water leakage.
	Bric-a-brac	Some nominally secure items can fall; e.g., large pictures, especially if fixed to party walls.

4 Noise Modeling

Launch vehicle propulsion systems, such as solid rocket motors and liquid-propellant rocket engines, generate high amplitude, broadband noise. Most of the noise is created by the rocket plume interacting with the atmosphere, and the combustion noise of the propellants. Although rocket noise radiates in all directions, it is highly directive, meaning that a significant portion of the source's acoustic power is concentrated in specific directions.

In addition to the rocket noise, a launch vehicle creates sonic booms during its supersonic flight. The potential for the boom to intercept the ground depends on the trajectory and speed of the vehicle as well as the atmospheric profile. The sonic boom is shaped by the physical characteristics of the vehicle and the atmospheric conditions through which it propagates. These factors affect the perception of a sonic boom. The noise is perceived as a deep boom, with most of its energy concentrated in the low frequency range. Although sonic booms generally last less than one second, their potential for impact may be considerable.

4.1 Launch Vehicle Noise

The Launch Vehicle Acoustic Simulation Model (RUMBLE), developed by Blue Ridge Research and Consulting, LLC (BRRC), is the noise model used to predict the noise associated with the proposed operations. The core components of the model are visualized in Figure 5 and are described in the following sub sections.

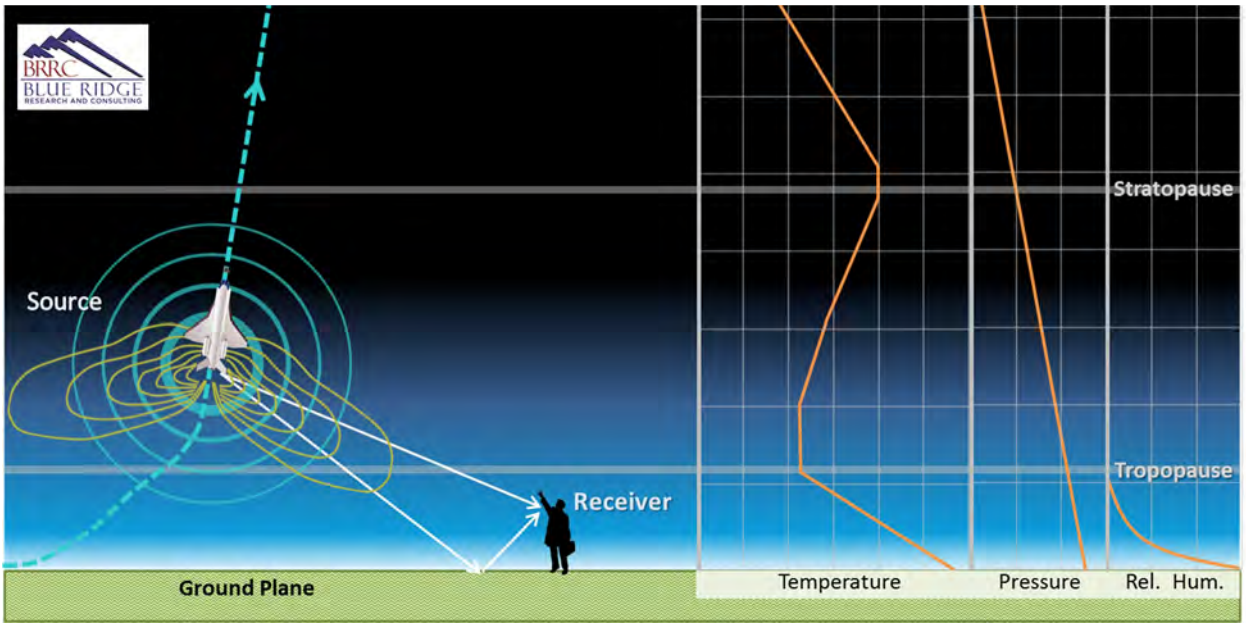

Figure 5. Conceptual overview of rocket noise prediction model methodology

4.1.1 Source

The rocket noise source definition considers the acoustic power of the rocket, forward flight effects, directivity, and the Doppler effect.

Acoustic Power

Eldred's Distributed Source Method 1 (DSM-1) [22] is utilized for the source characterization. The DSM-1 model determines the launch vehicle's total sound power based on its total thrust, exhaust-velocity, and the engine/motor's acoustic efficiency. BRRC's recent validation of the DSM-1 model showed very good agreement between full-scale rocket noise measurements and the empirical source curves [23]. The acoustic efficiency of the rocket engine/motor specifies the percentage of the mechanical power converted into acoustic power. The acoustic efficiency of the rocket engine/motor was modeled using Guest's variable acoustic efficiency [24]. Typical acoustic efficiency values range from 0.2% to 1.0% [22]. In the far-field, distributed sound sources are modeled as a single compact source located at the nozzle exit with an equivalent total sound power. Therefore, launch vehicle propulsion systems with multiple tightly clustered equivalent engines can be modeled as a single engine with an effective exit diameter and total thrust [22]. Additional boosters or cores (that are not considered to be tightly clustered) are handled by summing the noise contribution from each booster/core.

Forward Flight Effect

A rocket in forward flight radiates less noise than the same rocket in a static environment. A standard method to quantify this effect reduces overall sound levels as a function of the relative velocity between the jet plume and the outside airflow [25, 26, 27, 28]. This outside airflow travels in the same direction as the rocket exhaust. At the onset of a launch, the rocket exhaust travels at far greater speeds than the ambient airflow. As the differential between the forward flight velocity and exhaust velocity decreases, jet plume mixing is reduced, which reduces the corresponding noise emission. Notably, the maximum sound levels are normally generated before the vehicle reaches the speed of sound. Thus, the modeled noise reduction is capped at a forward flight velocity of Mach 1.

Directivity

Rocket noise is highly directive, meaning the acoustic power is concentrated in specific directions, and the observed sound pressure will depend on the angle from the source to the receiver. NASA's Constellation Program has made significant improvements in determining launch vehicle directivity of the reusable solid rocket motor (RSRM) [29]. The RSRM directivity indices (DI) incorporate a larger range of frequencies and angles then previously available data. Subsequently, improvements were made to the formulation of the RSRM DI [30] accounting for the spatial extent and downstream origin of the rocket noise source. These updated DI are used for this analysis.

Doppler Effect

The Doppler effect is the change in frequency of an emitted wave from a source moving relative to a receiver. The frequency at the receiver is related to the frequency generated by the moving sound source and by the speed of the source relative to the receiver. The received frequency is higher (compared to the emitted frequency) if the source is moving towards the receiver, it is identical at the instant of passing by,

and it is lower if the source is moving away from the receiver. During a rocket launch, an observer on the ground will hear a downward shift in the frequency of the sound as the distance from the source to receiver increases. The relative changes in frequency can be explained as follows: when the source of the waves is moving toward the observer, each successive wave crest is emitted from a position closer to the observer than the previous wave. Therefore, each wave takes slightly less time to reach the observer than the previous wave, and the time between the arrivals of successive wave crests at the observer is reduced, causing an increase in the frequency. While they are traveling, the distance between successive wave fronts is reduced such that the waves "bunch together." Conversely, if the source of waves is moving away from the observer, then each wave is emitted from a position farther from the observer than the previous wave; the arrival time between successive waves is increased, reducing the frequency. Likewise, the distance between successive wave fronts increases, so the waves "spread out." Figure 6 illustrates this spreading effect for an observer in a series of images, where a) the source is stationary, b) the source is moving less than the speed of sound, c) the source is moving at the speed of sound, and d) the source is moving faster than the speed of sound. As the frequency is shifted lower, the A-weighting filtering on the spectrum results in a decreased A-weighted sound level. For unweighted overall sound levels, the Doppler effect does not change the levels since all frequencies are accounted for equally.

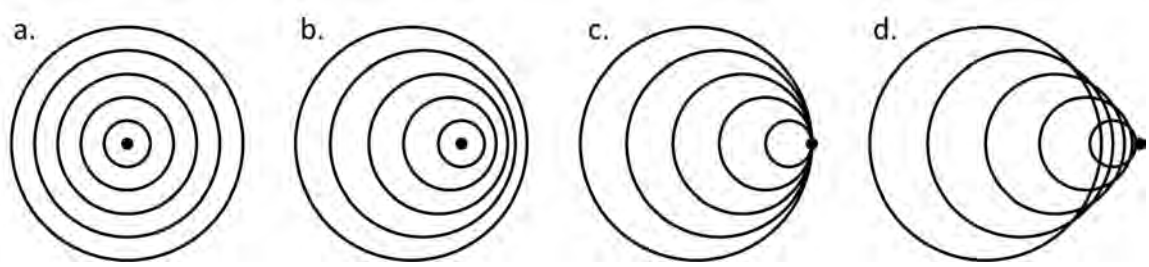

Figure 6. Effect of expanding wavefronts (decrease in frequency) that an observer would notice for higher relative speeds of the rocket relative to the observer for: a) stationary source b) source velocity < speed of sound c) source velocity = speed of sound d) source velocity > speed of sound

4.1.2 Propagation

The sound propagation from the source to receiver considers the ray path, atmospheric absorption, and ground interference.

Ray Path

The model assumes straight line propagation between the source and receiver to determine propagation effects. For straight rays, sound levels decrease as the sound wave propagates away from a source uniformly in all directions. The launch vehicle noise model components are calculated based on the specific geometry between source (launch vehicle trajectory point) to receiver (grid point). The position of the launch vehicle, described by the trajectory, is provided in latitude and longitude, defined relative to a reference system (e.g. World Geodetic System 1984) that approximates the Earth's surface by an ellipsoid. The receiver grid is also described in geodetic latitude and longitude, referenced to the same reference system as the trajectory data, ensuring greater accuracy than traditional flat earth models.

Atmospheric Absorption

Atmospheric absorption is a measure of the sound attenuation from the excitation of vibration modes of air molecules. Atmospheric absorption is a function of temperature, pressure and relative humidity of the air. The propulsion noise model utilizes an atmospheric profile, which describes the variation of temperature, pressure and relative humidity with respect to the altitude. Standard atmospheric data sources [31, 32, 33] were used to create a composite atmospheric profile for altitudes up to 66 miles. The atmospheric absorption is calculated using formulas found in ANSI Standard S1.26-1995 (R2004). The result is a sound-attenuation coefficient, which is a function of frequency, atmospheric conditions, and distance from the source. The amount of absorption depends on the parameters of the atmospheric layer and the distance that the sound travels through the layer. The total sound attenuation is the sum of the absorption experienced from each atmospheric layer.

Nonlinear propagation effects can result in distortions of high-amplitude sound waves [34] as they travel through the medium. These nonlinear effects are counter to the effect of atmospheric absorption [35, 36]. However, recent research shows that nonlinear propagation effects change the perception of the received sound [37, 38], but the standard acoustical metrics are not strongly influenced by nonlinear effects [39, 40]. The overall effects of nonlinear propagation on high-amplitude sound signatures and their perception is an on-going area of research, and it is not currently included in the propagation model.

Ground Interference

The calculated results of the sound propagation using DSM-1 provide a free-field sound level (i.e. no reflecting surface) at the receiver. However, sound propagation near the ground is most accurately modeled as the combination of a direct wave (source to receiver) and a reflected wave (source to ground to receiver) as shown in Figure 5. The ground will reflect sound energy back toward the receiver and interfere both constructively and destructively with the direct wave. Additionally, the ground may attenuate the sound energy causing the reflected wave to propagate a smaller portion of energy to the receiver. RUMBLE accounts for the attenuation of sound by the ground [41, 42] when estimating the received noise. The model assumes a five-foot receiver height and a homogeneous grass ground surface. However, it should be noted that noise levels may be 3 dB louder over water surfaces compared to the predicted levels over the homogeneous grass ground surfaces assumed in the modeling. To account for the random fluctuations of wind and temperature on the direct and reflected wave, the effect of atmospheric turbulence is also included [41, 43].

4.1.3 Receiver

The received noise is estimated by combining the source and propagation components. The basic received noise is modeled as overall and spectral level time histories. This approach enables a range of noise metrics relevant to environmental noise analysis to be calculated and prepared as output.

4.2 Sonic Booms

When a vehicle moves through the air, it pushes the air out of its way. At subsonic speeds, the displaced air forms a pressure wave that disperses rapidly. At supersonic speeds, the vehicle is moving too quickly for the wave to disperse, so it remains as a coherent wave. This wave is a sonic boom. When heard at ground level, a sonic boom consists of two shock waves (one associated with the forward part of the vehicle, the other with the rear part) of approximately equal strength and (for fighter aircraft) separated by 100 to 200 milliseconds. For launch vehicles, the separation can be extended because of the volume of the plume. Thus, their waveform durations can be as large as one second. When plotted, this pair of shock waves and the expanding flow between them has the appearance of a capital letter "N," so a sonic boom pressure wave is usually called an "N-wave." An N-wave has a characteristic "bang-bang" sound that can be startling. Figure 7 shows the generation and evolution of a sonic boom N-wave under the vehicle. Figure 8 shows the sonic boom pattern for a vehicle in steady, level supersonic flight. The boom forms a cone that is said to sweep out a "carpet" under the flight track. The boom levels vary along the lateral extent of the "carpet" with the highest levels directly underneath the flight track and decreasing as the lateral distance increases to the cut-off edge of the "carpet." When the vehicle is maneuvering, the sonic boom energy can be focused in highly localized areas on the ground.

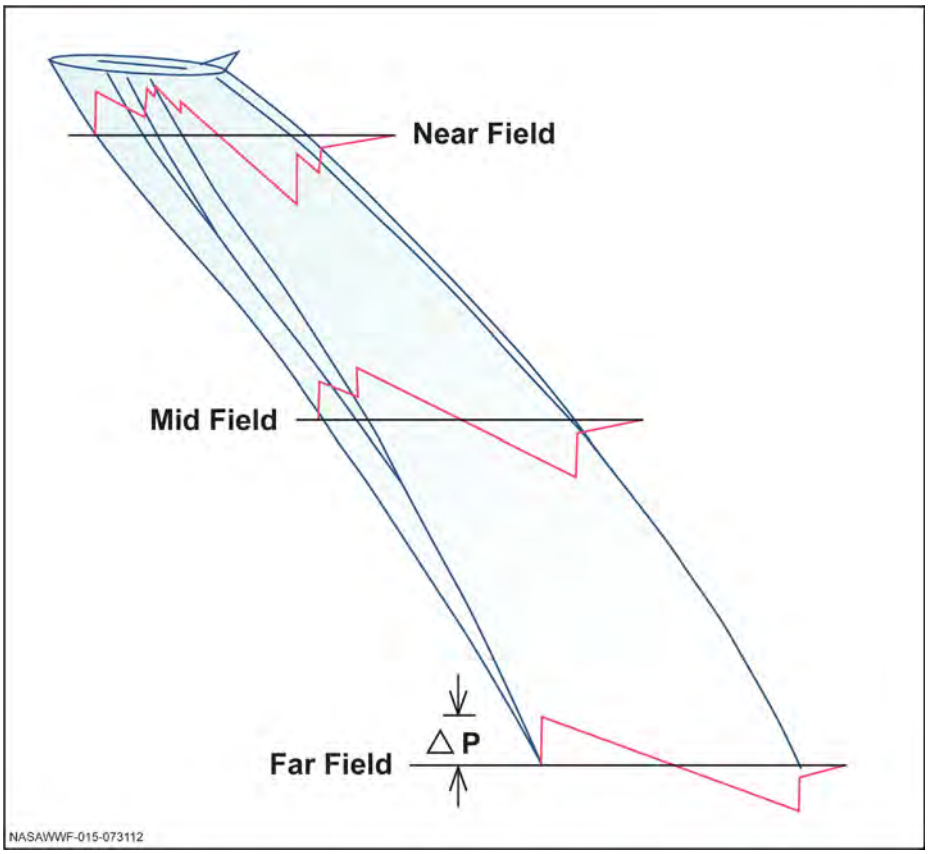

Figure 7. Sonic boom generation and evolution to N-wave [44]

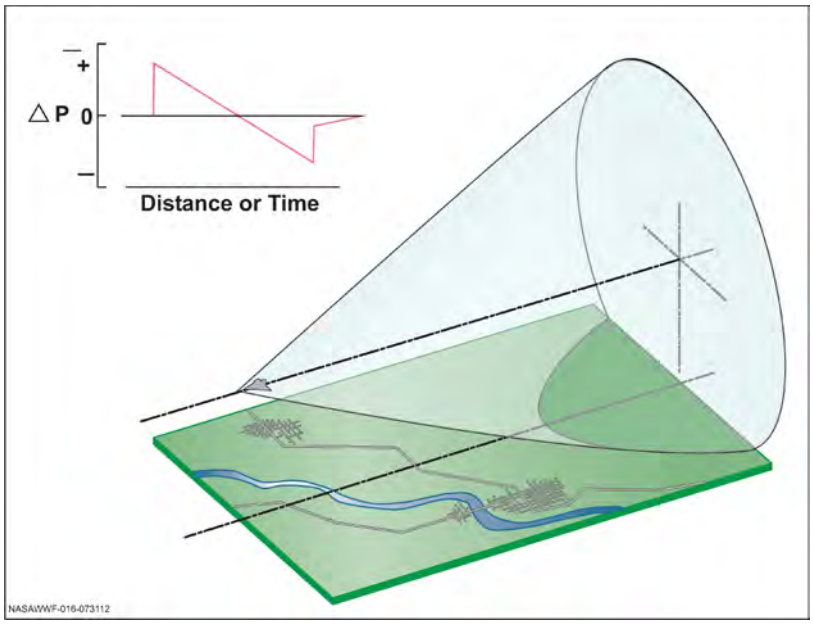

Figure 8. Sonic boom carpet for a vehicle in steady flight [45]

The complete ground pattern of a sonic boom depends on the size, weight, shape, speed, and trajectory of the vehicle. Since aircraft fly supersonically with relatively low horizontal angles, the boom is directed toward the ground. However, for rocket trajectories, the boom is directed laterally until the rocket rotates significantly away from vertical, as shown in Figure 9. This difference causes a sonic boom from a rocket to propagate much further downrange compared to aircraft sonic booms. This extended propagation usually results in relatively lower sonic boom levels from rocket launches. For aircraft, the front and rear shock are generally the same magnitude. However, for rockets, in addition to the two shock waves generated from the vehicle body, the plume itself acts as a large supersonic body, and it generates two additional shock waves (one associated with the forward part of the plume, the other with the rear part) and extends the waveform duration to as large as one second. The sonic boom generated by the plume is stronger since the plume volume is significantly larger than the rocket.

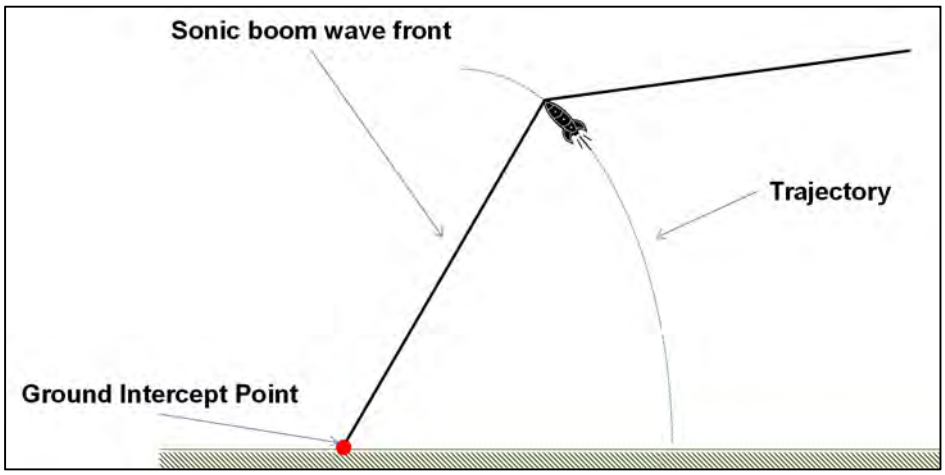

Figure 9. Sonic boom propagation for rocket launch

5 Results

The following sections present the results of the environmental propulsion noise and sonic boom impacts associated with the proposed Vulcan operations. Note, noise levels over water may be higher because of the acoustical hardness of the water surface. Single event and cumulative launch vehicle noise results are presented in Section 5.1 and Section 5.2 respectively, and Section 5.3 presents a discussion of the sonic boom impacts.

5.1 Single Event Results

Maximum A-weighted Sound Level ($L_{A,max}$)

The maximum A-weighted sound level ($L_{A,max}$) indicates the maximum sound level achieved over the duration of the event. An upper limit noise level of 115 dBA is used as a guideline to protect human hearing from long-term continuous daily exposures to high noise levels and to aid in the prevention of noise-induced hearing loss. A single Vulcan launch event may generate levels at or above an $L_{A,max}$ of 115 dBA within 0.7 miles of the launch pad, as shown by the orange contour in Figure 10. Note, the 115 dBA contour is entirely within the boundaries of CCAFS and NASA Kennedy Space Center (KSC).

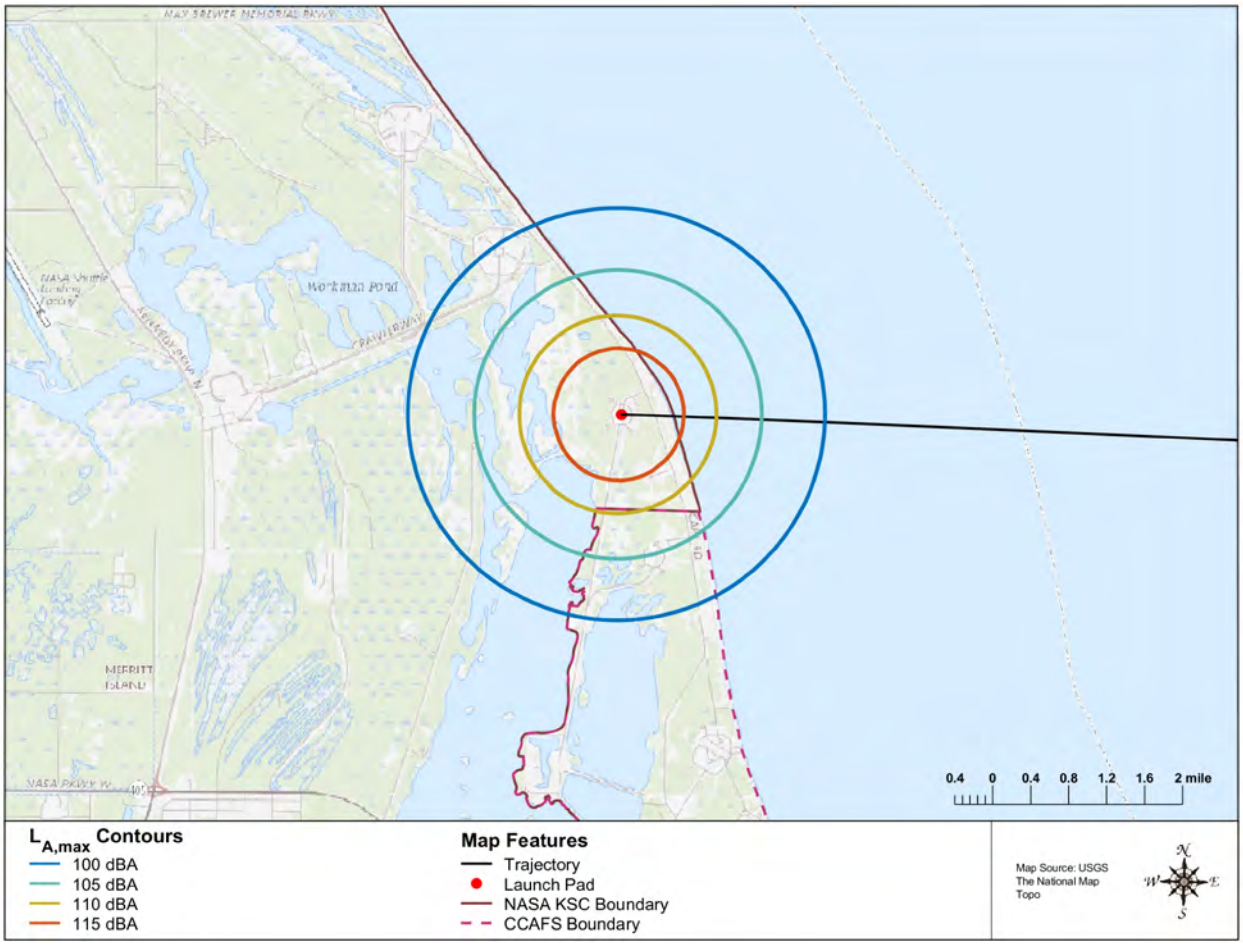

Figure 10. $L_{A,max}$ contours for a SLC-41 launch of the most powerful Vulcan configuration (composed of a single Vulcan core and six GEM-63XL strap-on SRB's)

Maximum Unweighted Sound Level (L_{max})

To assess the potential risk to structural damage claims, the 111 dB and 120 dB L_{max} contours generated by a Vulcan launch event are presented in Figure 11. The potential for structural damage claims is approximately one damage claim per 100 households exposed at 120 dB and one in 1,000 households at 111 dB [17]. For launch events, L_{max} in excess of 120 dB and 111 dB would be limited to a radius of 4.4 miles and 11.1 miles from the launch pad, respectively. Note, the 120 dB contour is entirely within the boundaries of CCAFS and NASA KSC. The 111 dB contour includes area outside the CCAFS/KSC boundaries to the west and southwest on the Indian River and Merritt Island.

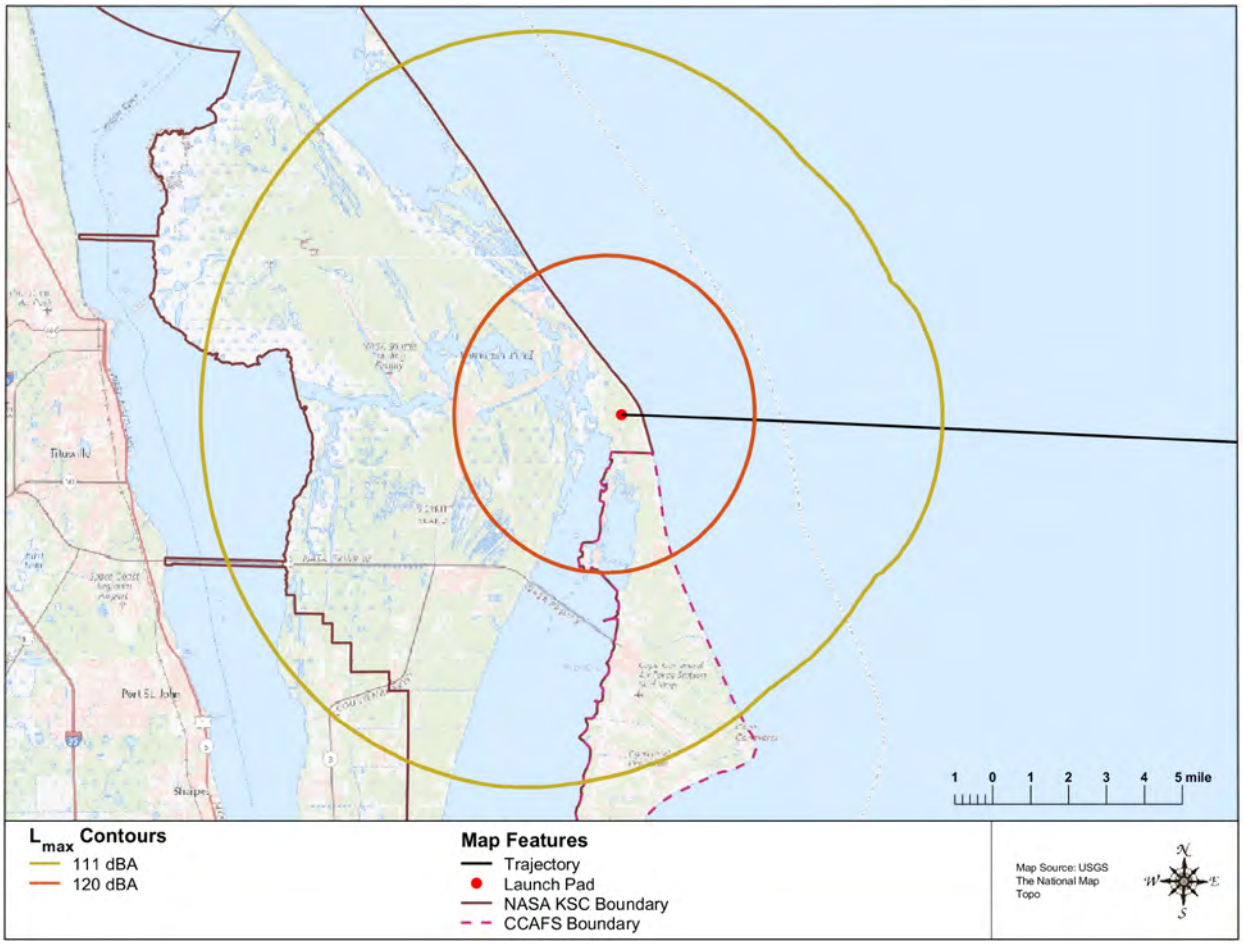

Figure 11. L_{max} contours for a SLC-41 launch of the most powerful Vulcan configuration (composed of a single Vulcan core and six GEM-63XL strap-on SRB's)

5.2 Cumulative Noise Results

DNL is used to estimate the potential long-term community annoyance to the proposed Vulcan launch operations. As DNL contours representing the no action alternative at CCAFS are unavailable, an alternative technique is used to identify the potential for significant noise impacts. The DNL 60 dBA contour is used to conservatively identify the potential for significant noise impacts, as 60 dBA is the smallest level that could "increase noise by DNL 1.5 dB[A] or more for a noise sensitive area that is exposed to noise at or above the DNL 65 dB[A] noise exposure level, or that will be exposed at or above this level due to the increase" [10]. The DNL contours from 60 dBA to 75 dBA are presented in Figure 12. The DNL 65 and 60 dBA contours extend approximately 1.2 and 1.8 miles from the launch pad, respectively. This area does not encompass land outside of the boundaries of CCAFS and NASA KSC, and thus no residences are impacted.

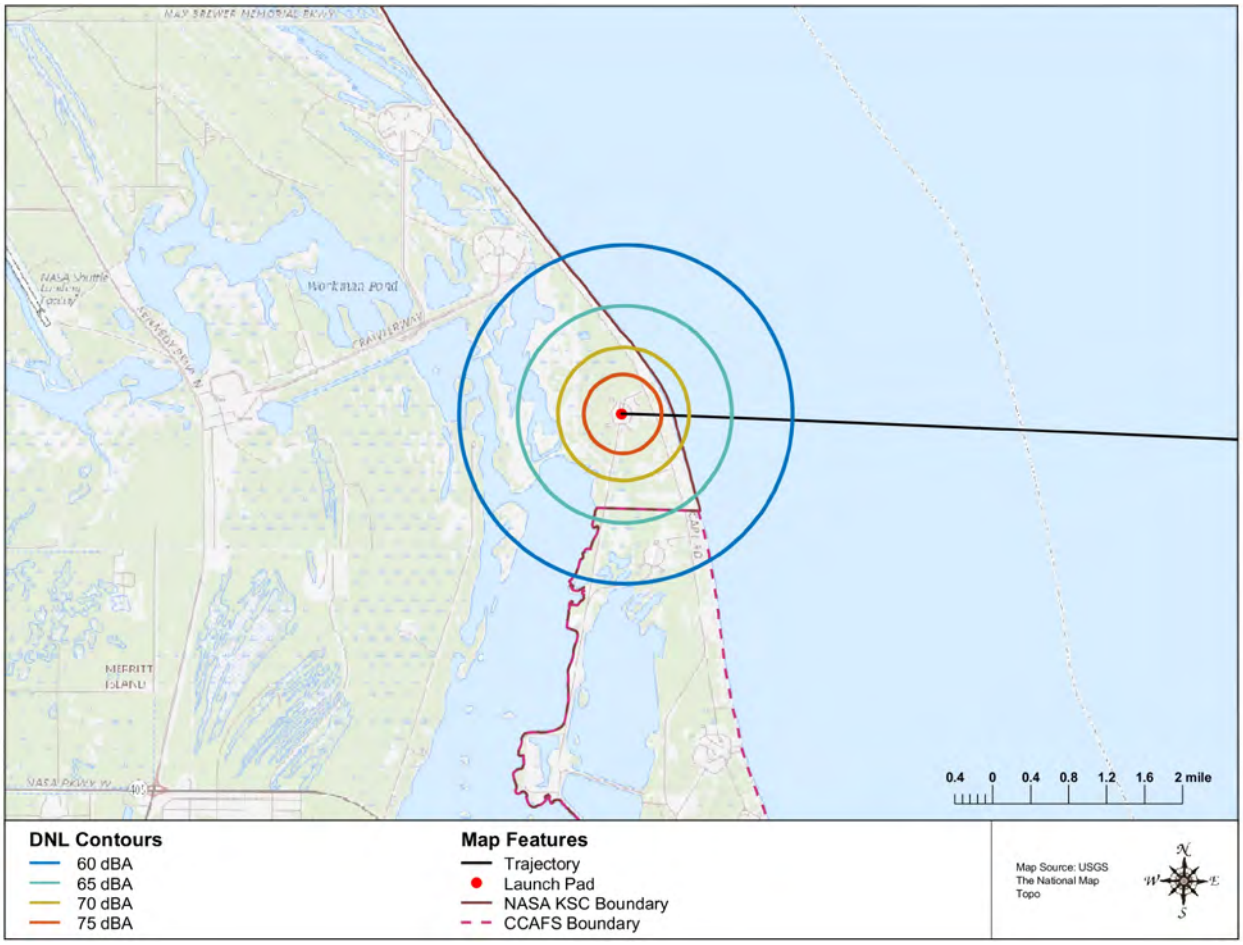

Figure 12. DNL contours for SLC-41 launches of the most powerful Vulcan configuration (composed of a single Vulcan core and six GEM-63XL strap-on SRB's)

5.3 Sonic Boom Discussion

The presence and/or location of sonic booms from Vulcan launches will be highly dependent on the vehicle configuration, trajectory, and atmospheric conditions at the time of flight. However, the sonic booms resulting from the Vulcan nominal launch trajectory would be directed easterly out over the Atlantic Ocean in the direction of the launch azimuth, making them inaudible on the mainland. Therefore, with respect to human annoyance, health and safety, or structural damage; noise impacts due to sonic booms for the launch trajectory are not expected. Thus, a quantitative analysis was not performed.

However, to provide more perspective, modeled and measured sonic boom levels of similar vehicles are discussed. Modeled sonic boom levels for a liquid-fueled medium class launch vehicle and liquid-fueled heavy class launch vehicle at other launch sites ranged from 3.0 and 5.25 psf [49], respectively. Additionally, a sonic boom due to the overflight of a Titan IV from Vandenberg AFB was measured at a number of locations in the Channel Islands, 30 to 40 miles from the launch pad [50]. The over pressures recorded at these locations were less than 2.4 psf, with the exception of one site which recorded an 8.4 psf focused sonic boom. As CCAFS and the adjacent KSC have previously launched heavy-class vehicles such as the Space Shuttle and Saturn V, the community is familiar with the sonic boom impacts generated by heavy-class vehicle launches at CCAFS. Additionally, CCAFS currently hosts launches of the Falcon 9, Falcon Heavy, Atlas V, and Delta IV; all of which also generate sonic booms.

6 Summary

This report documents the noise study performed as part of ULA's efforts on the EA for the proposed Vulcan operations from CCAFS. ULA plans to conduct launch operations of multiple Vulcan configurations from CCAFS SLC-41. The most powerful configuration, composed of a single Vulcan core and six GEM-63XL strap-on SRB's, will be modeled to determine the envelope of the potential noise impacts. Noise impacts were evaluated for a nominal launch trajectory for up to twenty annual launches per year. The potential for propulsion noise impacts was evaluated on a single-event and cumulative basis in relation to human annoyance, hearing conservation, and structural damage.

DNL was used to estimate the potential long-term community annoyance to the proposed Vulcan launch operations. The DNL 65 and 60 dBA contours extend approximately 1.2 and 1.8 miles from the launch pad, respectively. This area does not encompass land outside of the boundaries of CCAFS and KSC, and thus no residences are impacted. As defined by FAA Order 1050.1F, Vulcan launches would not result in a significant noise impact.

The single event launch vehicle noise results are related to hearing conservation and structural damage claims. Predicted noise levels are less than the 115 dBA upper noise limit guideline at distances greater than 0.7 mile from the launch pad. The potential for structural damage claims from launch vehicle noise is approximately one damage claim per 100 households exposed at 120 dB and one in 1,000 households at 111 dB [17]. L_{max} in excess of 120 dB would be limited to a radius of 4.4 miles from the launch pad, and L_{max} in excess of 111 dB would be limited to a radius of 11.1 miles from the launch pad. Note, the area encompassed by the 115 dBA and 120 dB is entirely within the boundaries of CCAFS and NASA KSC. The

111 dB contour includes area outside the CCAFS/KSC boundaries to the west and southwest on the Indian River and Merritt Island.

The potential for sonic boom impacts as a result of Vulcan launches was qualitatively assessed and discussed. The nominal Vulcan launch trajectory is in a primarily easterly direction, which is out over the water. The sonic booms generated would impact ground level over the Atlantic Ocean making them inaudible on the mainland. Therefore, with respect to human annoyance, health and safety, or structural damage, noise impacts due to sonic booms are not expected.

The proposed Vulcan launches are not expected to generate significant propulsion noise or sonic boom impacts in the community. Additionally, the community noise exposure will be less than that from previous launches from CCAFS and the adjacent KSC, including the Space Shuttle and Saturn V.

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APPENDIX C

Section 7 Endangered Species Act Informal Consultation

DEPARTMENT OF THE AIR FORCE
45TH SPACE WING (AFSPC)

6 February 2019

FWS Log No 2019-I-0544

The Service concurs with your effect determination(s) for resources protected by the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.). This finding fulfills the requirements of the Act.

Annie Dziegowski 4-3-19
FOR Jay B. Herrington Date
Field Supervisor

MEMORANDUM FOR UNITED STATES DE
U. S. FISH AND WIL
NORTH FLORIDA FI
7915 BAYMEADOW
JACKSONVILLE FL

FROM: 45 CES/CEIE
1224 Jupiter Street
Patrick AFB FL 32925-3343

SUBJECT: Informal Section 7 Consultation for United Launch Alliance Vulcan Centaur Operations and Launch Program, Cape Canaveral Air Force Station, Florida

1. The 45th Space Wing (45 SW) is requesting Informal Section 7 consultation on the United Launch Alliance (ULA) Vulcan Centaur Space Launch Program at Space Launch Complex (SLC) 41. ULA is developing the Vulcan Centaur to provide a more versatile and cost competitive space launch vehicle while maximizing the use of existing infrastructure and reducing reliance on the current Atlas V Launch Vehicle Russian-supplied RD-180 engines. This new configuration will contain a larger diameter booster tank than the Atlas V. The first stage will use new BE-4 booster engines that consume liquid oxygen (LO2) and liquefied natural gas (LNG). Multiple Solid Rocket Motor (SRM) configuration options can be specified depending on payload and performance requirements. The Vulcan first stage will integrate with the Centaur V upper stage, which is similar but larger than the current Centaur III stage flying on the Atlas V. ULA plans to launch the Vulcan from SLC 41, which is located on Kennedy Space Center (KSC) land that is leased to the Air Force. The 45 SW previously consulted with your office on the existing Expendable Evolved Launch Vehicle (EELV) Atlas V and Delta IV, currently being launched from SLC 41 and SLC 37, respectively, during preparation of an Environmental Impact Statement (EIS) during the mid-late 1990s. The only federally listed species proposed to be impacted at SLC 41 at the time were nesting sea turtles (exterior lighting) since all new construction was occurring on previously disturbed sites, which the exception of the Vertical Integration Facility, which impacted primarily wetlands. A Light Management Plan (LMP) was completed at the time and approved by your office.

2. As a result of the addition in vehicle configuration, some modifications at SLC 41 and adjacent facilities have occurred over the past couple of years. The first planned launch of the Vulcan Centaur is in mid-2020. Existing SLC 41 systems and infrastructure would be/have been modified for Vulcan Centaur but have remained substantially consistent with current launch operations. To date, all of these modifications have occurred within the fenceline on previously disturbed land; therefore, there have not been any impacts to federally listed species. A small amount of clearing (<2 acres) will occur outside the fence at SLC 41; however, the vegetation

consists primarily of Brazilian pepper located within an area identified as wetlands. The AF has determined that clearing of this vegetation will have no effect on listed species. Our office has reviewed all designs/work scopes to ensure there were no impacts to listed species that would warrant consultation with your office. Modifications to lighting have occurred and those have been forwarded to your office for approval as they have occurred. These have included construction of a Crew Access Tower and installation of an Emergency Escape System for astronauts. Our office has internally approved additional lighting modifications that consisted of a retrofit of low pressure sodium fixtures to amber LED, which overall reduced the number of pole-mounted fixtures significantly.

3. In addition to lighting, the Air Force believes the only other potential impact to federally listed species is noise, which has not been directly addressed in any other Section 7 consultations for SLC 41 to date. Noise was discussed in the EELV EIS, as well as the Environmental Assessment (EA) for the Vulcan Centaur, which identified launch as the major source of all operational noise.

4. The following federally listed species have been identified as occurring within the area that could be impacted by launch operations, either by noise or lighting:

- Loggerhead, Green, Leatherback, Kemp's Ridley and Hawksbill Sea Turtle
- Florida Scrub-Jay
- Southeastern Beach Mouse
- Eastern Indigo Snake
- Piping Plover
- Red Knot
- Wood Stork

5. Potential impacts to listed species during launch preparations would be minor. Other than a startle response, no impacts to listed species due to noise of daily operations are anticipated. Exterior lighting has the potential to impact sea turtles and hatchlings on the adjacent beaches. Currently, ULA has an approved LMP for SLC 41 and the majority of exterior lighting modifications associated with Vulcan have already occurred and have been approved either by your office or by our office internally. Although SLC 41 and associated facilities have been identified as causing disorientation on the adjacent beaches, it has not resulted in the Air Force exceeding their allowable 3% incidental take.

6. To date, no animal mortality has been observed that could be attributed to any vehicle launched or landed on CCAFS. Similar results are expected for the Vulcan Centaur launches. The above listed species are known to occur on or adjacent to SLC 41; however, post-launch monitoring conducted on previous launches, and previous environmental analysis concluded that launch impacts are minimal. The behavior of scrub-jays after previous Delta, Atlas and Titan launches has been normal, indicating no noise-reated effects. An anomaly on the pad could result in potential impacts to species from extreme heat and fire, percussive effects of the explosion and debris that might impact habitat. The explosion could injure or kill wildlife found

adjacent to the pad or within debris impact areas. Potential fires started from the anomaly could result in temporary loss of habitat and mortality of less mobile species. No current or past launch programs on CCAFS have been documented to cause any animal mortality or significantly impact habitat. Sonic booms occur well out over the Atlantic Ocean, therefore will have no effect on the above listed species.

7. Based on our office's review of past environmental documentation, previous consultations with your office, and direct observations of current and past launch operations, the Air Force has determined that the Vulcan Centaur may effect, but is not likely to adversely effect, federally listed species identified above.

8. Please review the proposed project in accordance with the Endangered Species Act and provide a response to this office at your earliest convenience. Our point of contact for this matter is Ms. Angy Chambers. She can be reached at 321-853-6822 or e-mail angy.chambers@us.af.mil.

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MICHAEL A. BLAYLOCK, GS-13, USAF
Chief, Environmental Conservation

APPENDIX D

Sections 106 and 110 National Historic Preservation Act of 1966 Consultation Documentation

FLORIDA DEPARTMENT of STATE

RICK SCOTT
Governor

KEN DETZNER
Secretary of State

Mr. Chris Stahl
Florida Department of Environmental Protection
Florida State Clearinghouse
2600 Blair Stone Road, MS 47
Tallahassee, FL 32399-2400

October 16, 2018

RE: DHR Project File No.: 2018-4805, Received by DHR: September 13, 2018
SAI# FL201809138415C
Project: *Draft Environmental Assessment for the Vulcan Centaur Program Operations and Launch on Cape Canaveral Air Force Station, Brevard County*

Ms. Stahl:

Our office reviewed the draft *Environmental Assessment for the Vulcan Centaur Program Operations and Launch on Cape Canaveral Air Force Station* in accordance with the National Environmental Policy Act of 1969 (NEPA) and implementing regulations. In addition to NEPA, the U.S. Air Force (USAF) will need to satisfy their responsibilities under Section 106 of the National Historic Preservation Act of 1966. The Section 106 process can be coordinated with NEPA environmental review pursuant to 36 CFR 800.8.

The current draft EA does not specifically address the undertaking's potential effects to historic properties. If the USAF intends to coordinate the NEPA and Section 106 process, the revised draft EA should identify historic properties within the area of potential effect, address possible effects to historic properties, and determine if the proposed undertaking will adversely affect historic properties. We are available to assist the USAF in coordinating the NEPA and Section 106 processes if necessary.

If you have any questions, please contact me by email at *Jason.Aldridge@dos.myflorida.com*, or by telephone at 850-245-6344.

Sincerely,

Jason Aldridge
Deputy State Historic Preservation Officer
for Compliance and Review

FLORIDA DEPARTMENT of STATE

RON DESANTIS
Governor

JENNIFER KENNEDY
Interim Secretary of State

Mr. Michael A. Blaylock
Chief, Environmental Conservation
45 CES/CEIE
1224 Jupiter Street, MS-9125
Patrick AFB, FL 32925-3343

January 31, 2019

RE: DHR Project File No.: 2018-4805-B, Received by DHR: January 7, 2019
Draft Environmental Assessment for the Vulcan Centaur Program Operations and Launch on Cape Canaveral Air Force Station
Cape Canaveral Air Force Station, Brevard County

Mr. Blaylock:

Our office received and reviewed the above referenced report in accordance with Section 106 and Section 110 of the *National Historic Preservation Act of 1966*, for possible impact to historic properties listed, or eligible for listing, in the *National Register of Historic Places*.

We reviewed Sections 3.4 and 4.4, which deal with Cultural Resources of the above referenced environmental assessment. Based on the information provided and the conditions outlined in the document, it is the opinion of this office that the Department of the Air Force has adequately addressed cultural resources. Therefore, it is the opinion of this office that the proposed undertaking will have no effect on historic properties.

If you have any questions, please contact Scott Edwards, Historic Preservationist, by electronic mail *scott.edwards@dos.myflorida.com*, or at 850.245.6333 or 800.847.7278.

Sincerely,

Jason Aldridge
For

Timothy A. Parsons, Ph.D.,
Director, Division of Historical Resources
and State Historic Preservation Officer